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GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE

KEITH CREAGH
DIRECTOR

May 25, 2016

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. Jason Roughton
RJ Industrial Recycling
5061 Energy Drive
Flint, MI 48505

Kotz Sangster Wysocki P.C
Mr. George F. Curran, III
400 Renaissance Center, Suite 3400
Detroit, MI 48243-1618

SRN: N7885, Genesee County

Dear Mr. Roughton and Mr. Curran:

VIOLATION NOTICE

On May 24, 2016, the Department of Environmental Quality (DEQ), Air Quality Division (AQD) conducted visible emission (VE) readings of your facility located at G5167 North Dort Highway, Flint. The purpose of this inspection was to determine compliance with the requirements of the federal Clean Air Act; Part 55, Air Pollution Control, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451); and Administrative Consent Order EPA number 5-15-113(a)-MI-02.

As a result of the evaluation on May 24, 2016, the following air pollution violations were identified:

Process Description	Rule/Permit Condition Violated	Comments
Torch cutting of scrap metal	Rule 301	Smoke from torch cutting operations exceeded 20% opacity
Torch cutting of scrap metal	Administrative Consent Order EPA 5-15-113(a)-MI-02, paragraph 23	Opacity exceedances show lack of or insufficient training of employees
Torch cutting of scrap metal	Administrative Consent Order EPA 5-15-113(a)-MI-02, Appendix A paragraph 8	Operators torching materials giving high emissions
Torch cutting of scrap metal	Administrative Consent Order EPA 5-15-113(a)-MI-02, Appendix A paragraph 10	SPARCS unit was not being used or was not operating, or was not effective
Torch cutting of scrap metal	Administrative Consent Order EPA 5-15-113(a)-MI-02, Appendix A paragraph 19	SPARCS unit was not being used or was not operating, or was not effective

During this inspection it was noted that your company's torch cutting processes were emitting opacity in excess of emissions allowed by Act 451, Rule 301.

Enclosed are copies of the instantaneous and six minute average readings taken on May 24, 2016, from 9:08 am to 9:53 am. It should be noted that this timeframe is not the only times in which opacity was witnessed on this date, but rather the times it was read and documented using Method 9 analysis.

In addition, opacity was observed on the dates of May 17, 18, and 19, 2016, by DEQ, AQD staff. Though Method 9 readings were not conducted during these days, it is the professional judgement of the AQD staff that the visible emissions observed were in excess of Rule 301.

The cited is enforceable per DEQ, AQD Rule 301 (R336.1301) and Administrative Consent Order EPA 5-15-113(a)-MI-02 paragraph 23, Appendix A paragraphs 8, 10, and 19 in the following manner:

Rule 301(1)(a) states: a person shall not cause or permit to be discharged into the outer air from a process or process equipment a visible emission of a density greater than the most stringent of the following: (a) A 6-minute average of 20% opacity, except for 1 6-minute average per hour of not more than 27% opacity. During the visible emissions readings, the maximum six minute opacity reading was 51.0%.

Paragraph 23 of the consent order requires "a training program and shall require all of its employees who conduct torch cutting, in addition to the appropriate supervisors and managers, to complete training on all aspects of the best management practices for torch cutting as described in Appendix A". Based on my observations, the individuals conducting torch cutting operations are not properly trained, or they are ignoring the training content and the site manager is not enforcing the standards.

Appendix A paragraph 8 states: "RJ shall ensure that its employees are aware of what materials are likely to produce higher VEs when torch cut and shall develop protocols to manage VEs when cutting those materials." Based on my observations, awareness of materials that produce higher VEs was either ignored or unknown to the torch operator.

Appendix A paragraph 10 states: "RJ shall utilize the SPARCS units, which are designed to reduce opacity from torch-cutting operations." Observations of the torch cutting operations were made without the use of the SPARCS equipment.

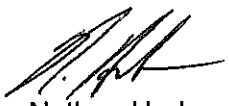
Appendix A paragraph 19 states: "RJ shall conduct torch cutting in a SPARCS unit at any time when, due to the scraps metallurgical properties and size, emissions are expected to exceed the VE limit in R336.1301(1)(a) of the Michigan SIP. Observations of torch cutting operations were made without the use of SPARCS.

Please initiate actions necessary to correct the cited violations and submit a written response to this Violation Notice by June 15, 2016. The written response should include: the dates the violations occurred; an explanation of the causes and duration of the violations; whether the violations are ongoing; a summary of the actions that have been taken and are proposed to be taken to correct the violations and the dates by which these actions will take place; and what steps are being taken to prevent a reoccurrence.

If RJ Industrial Recycling believes the above observations or statements are inaccurate or do not constitute violations of the applicable legal requirements cited, please provide appropriate factual information to explain your position.

Thank you for your attention to resolving the violations cited above. If you have any questions regarding the violations or the actions necessary to bring this facility into compliance, please contact me at the telephone number listed below.

Sincerely,



Nathan Hude
Environmental Quality Analyst
Air Quality Division
517-284-6779

NNH:TG

Enclosures

cc/via e-mail: Ms. Sarah Marshall, EPA
Mr. Raymond Cullen, EPA
Ms. Lynn Fiedler, DEQ
Ms. Teresa Seidel, DEQ
Ms. Heidi Hollenbach, DEQ
Mr. Thomas Hess, DEQ
Mr. Brad Myott, DEQ

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Unanticipated potential cancer risk near metal recycling facilities

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ABSTRACT

Metal recycling is an important growing industry. Prior to this study, area sources consisting of metal recycling facilities fell in a category of limited regulatory scrutiny because of assumed low levels of annual emissions. Initiating with community complaints of nuisance from smoke, dust and odor, the Houston Department of Health and Human Services (HDHHS) began a monitoring program outside metal recycler facilities and found metal particulates in outdoor ambient air at levels which could pose a carcinogenic human health risk. In a study of five similar metal recycler facilities which used a torch cutting process, air downwind and outside the facility was sampled for eight hours between 6 and 10 times each over 18 months using a mobile laboratory. Ten background locations were also sampled. Iron, manganese, copper, chromium, nickel, lead, cobalt, cadmium and mercury were detected downwind of the metal recyclers at frequencies ranging from 100% of the time for iron to 2% of the time for mercury. Of these metals, chromium, nickel, lead, cobalt, cadmium and mercury were not detected in any sample in the background. Two pairs of samples were analyzed for total chromium and hexavalent chromium to establish a ratio of the fraction of hexavalent chromium in total chromium. This fraction was used to estimate hexavalent chromium at all locations. The carcinogenic risk posed to a residential receptor from metal particulate matter concentrations in the ambient air attributed to the metal recyclers was estimated from each of the five facilities in an effort to rank the importance of this source and inform the need for further investigation. The total risk from these area sources ranged from an increased cancer risk of 1 in 1,000,000 to 6 in 10,000 using the 95th upper confidence limit of the mean of the carcinogenic metal particulate matter concentration, assuming the point of the exposure is the sample location for a residential receptor after accounting for wind direction and the number of shifts that could operate a year. Further study is warranted to better understand the metal air pollution levels in the community and if necessary, to evaluate the feasibility of emission controls and identify operational improvements and best management practices for this industry.
This research adds two new aspects to the literature: identification of types and magnitude of metal particulate matter air pollutants associated with a previously unrecognized area source, metal recyclers and their potential risk to health.

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1. Introduction

The aim of this study was to investigate metal particulate matter concentrations at an area source concerning air pollution previously not considered significant and use carcinogenic risk assessment to rank the severity of the human health threat. The particular area source category we investigate, metal recyclers, was first recognized as a possible hazard by the residents of nearby neighborhoods. Communities in Houston, Texas, the fourth largest city in the United States, complained to the Houston Department of Health and Human Services (HDHHS) repeatedly between 2004 and 2012 regarding odor, smoke, and dust from metal recycler facilities in their neighborhood. Motivated by public health concerns, and not just by violation of any state or federal regulation, the City of Houston responded to the community complaints with initiation of air monitoring off-site of local metal recycler facilities. What the communities recognized as a smoke, dust and odor

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nuisance has ultimately been found to pose a potential health concern due to the chemical composition of the emissions.

Metal particulate matter emissions are generated from cutting metal to be recycled on an industrial scale. The term metal cutting encompasses a broad range of metal recycler destruction from shredding to torch cutting. Torch cutting is the destruction process of most concern because the process generates fine particulate matter air pollution. Evidence that short term exposure to particulate matter air pollution is associated with morbidity and mortality is increasingly found in the literature, especially with respect to fine particulate matter of aerodynamic diameter smaller than 2.5 μm (PM2.5) (Pope and Dockery, 2006). There is growing evidence that the chemical composition of particulate matter is another important consideration when studying the health impact (De Hartog et al., 2009; Franklin et al., 2008). Though not previously specifically studied, the particulate matter from metal recyclers is likely composed of metals often seen in surface coatings (e.g., arsenic, cadmium, chromium, mercury, lead and selenium), and the alloys themselves which are being recycled (e.g., iron, chromium, copper, cobalt, manganese and nickel), some of which are toxic.

Section 112 of the United States Clean Air Act addresses emissions of hazardous air pollutants (HAPs). This section divides stationary sources, or groups of stationary sources, into two categories: major sources and area sources. A major source is defined as a stationary source that either emits or has the potential to emit 10 tons per year (tpy) of a HAP or 25 tpy or more of a combination of HAPs. An area source is defined as any stationary source that is not a major source, thus emits less than 10 tpy of a single HAP and less than 25 tpy of a combination of HAPs. The metal recyclers in Houston analyzed in this study fall in the area source category. Metal HAP emissions, from certain types of area sources including metal recyclers are not required to be controlled, measured, inventoried or modeled, while other types of area sources are required to be controlled and measured. As a result there is large uncertainty in regulatory estimates of emissions from area sources generally, and especially from the area sources without effective control requirements, like metal recyclers.

2. Materials and methods

2.1. Facility selection

The U.S. Census Bureau statistics of U.S. Businesses (Census.gov) indicates that there are over 100 metal recycler facilities in Houston. We conducted particulate matter ambient air monitoring using a mobile ambient air monitoring laboratory for a collective total of 48 days at five of the medium sized metal recyclers in four different communities. While we did not measure the emissions, the concentrations in the ambient air reflect emissions from the facilities because continuous weather data (wind direction and speed) were recorded during the sampling period. Only days when air monitoring data were collected entirely downwind of the facility, according to weather monitoring and back trajectory analysis, were included in this analysis.

These metal recycler facilities are similar in size, processing an estimated 200 to 500 tons per day of steel and various other recyclable metals, use metal torch cutting, have similar regulatory authorizations and are located in mixed industrial-residential areas. Each metal torch cutting facility is authorized under Title 30 of the Texas Administrative Code (30 TAC) §106.265 Handheld and Manually Operated Equipment, which provides no limitations regarding management practices, distances to offsite receptors or emissions from the metal torch cutting operations, provided the total emissions do not exceed Title V Air permit threshold limits per (30 TAC) §106.4.

An often used rationale for inaction regarding smaller industrial type area emission sources is that the potential risk is mitigated because of an assumed lack of human receptors. This is not a valid assumption for this particular type of area source, especially in Houston where a lack of zoning restrictions results in residences and industry frequently being located in close proximity with each other, and in some cases, sharing a fence line. The metal recyclers studied are in populated communities with a diversity of ethnicity, income and education. Table 1 lists the community name, the metal recyclers in that community and a description of the community (FILES: Census, 2010 Summary File 1; FILES: 2006–2010 American Community Survey).

Within one mile of each of the facilities studied are numerous neighborhood features which serve as indicators that these area sources are not located in predominantly industrial areas (Table 2).

For control and comparison purposes, we also sampled at ten other locations across the city to assess background metal particulate matter concentrations. All locations where background sampling was conducted were upwind of any nearby metal recyclers during sampling. The ten comparison locations consisted of industrial facilities as well as parks and neighborhood centers. The locations of the known metal recyclers in Houston, the five facilities studied, and the comparison/control points are shown in Fig. 1. Filter blank samples were also collected for quality assurance. The number of blank samples equal 20% of the total samples collected.

2.2. Sampling and analysis

Total suspended particulate matter (TSP) samples were collected downwind from these facilities using high volume samplers operating at a flow rate of 85 l/m for a collective total of 48 days at locations 50 to 100 ft outside the facility fence. The high volume sample model, HiQ Hi-Vol Model #: CF-1002BRL-DGTL, was purchased from Hi-Q Environmental Products located in California. While future research will consider particulate matter broken down by size fraction, in this study, we restrict analysis to TSP because the City of Houston sampling and analysis capacity was more limited with other size fractions.

The sample durations lasted approximately 8 h per deployment. The location of the mobile lab outside of the facility was selected based on wind direction to ensure that the concentrations in the ambient air were downwind of the facility.

Each facility was sampled several times over a span of 18 months (6 to 13 times). Samples were collected on 47 mm binderless quartz fiber filters. The metals in the particulate matter samples were analyzed by inductively coupled plasma using the United States Environmental Protection Agency (EPA) method 6010 (EPA, 2007) at the City of Houston laboratory. The laboratory is accredited through the National Environmental Laboratory Accreditation Program for all the metals analyzed in this study.

In addition to the high volume samplers, HAZ-DUST EPAM-5000 samplers were used to collect TSP and PM10 data for hexavalent chromium (CrVI) speciation. The HAZ-DUST EPAM-5000 was purchased

Table 1
Characteristics of the communities in vicinity of metal recyclers studied.

Community	Metal recycler	Dominant ethnicity	Population density (per sq. mile)	Dominant age	Median household income	% less than high school degree
Washington Ave.	Facility 1	White	3979	25–34	$61,910	16
Magnolia Park/Harrisburg	Facility 2/Facility 3	Hispanic	4188	25–34	$28,257	57
South Park	Facility 4	African American	4545	34–54	$32,635	46
Sunnyside	Facility 5	African American	937	25–34	$48,694	10

Table 2
Neighborhood features within a mile from metal recycling facility.

	Parks/trails	Schools	Fire stations	Churches	Community Centers	Hospitals
Facility 1	5	9	1	7	2	3
Facility 2	3	16	1	11	1	–
Facility 3	5	9	2	10	1	–
Facility 4	–	8	1	–	–	–
Facility 5	1	4	–	16	1	–

from Environmental Devices Corporation. The unit uses an infra red detector to estimate particle concentrations μg/m^3, has a calibrated flow of 4.0 lpm and collects samples on a 47 mm filter for laboratory analysis. The HAZ-DUST EPAM-5000 was used because the flow rate is lower (4 lpm) than the high volume rate and the currently acceptable methodologies (National Institute for Occupational Safety and Health et al., 1985) all require a lower flow rate and smaller sample volume than the TSP method to prevent sample loss or conversion of CrVI. The samples for CrVI were prepared and analyzed by ion chromatography as referenced in OSHA ID 215 and our sample collection was consistent with the method (Occupational Safety and Health Administration, 1998).

3. Results

3.1. Ambient air metal particulate matter results

TSP samples were collected for 48 days at the metal recycler locations and 10 days at the comparison (background) locations. All TSP samples were analyzed for silver (Ag), cadmium (Cd), total chromium (Cr), copper (Cu), manganese (Mn), nickel (Ni), lead (Pb), zinc (Zn), iron (Fe), cobalt (Co) and mercury (Hg). At the five study locations, Ag was not detected and Hg was detected once at one location. Zn was detected in all samples including significant concentrations in the blank filter samples and at the ten comparison and control locations used for background; therefore, the Zn results are not considered accurate. Hg, Ag and Zn were eliminated from further assessment.

The number of sample days, arithmetic mean, standard deviation, percent of sample days with concentrations above the detection limit, the assumed distributional shape and 95th upper confidence limit of the mean based on the assumed distribution shape (Singh and Singh, 2003; Singh et al., 2006) are summarized for each metal by facility in Table 3. Calculations were performed in SAS and ProUCL statistical software (SAS, 2010; ProUCL, 2011).

The statistical assessment indicates that the most commonly detected metals across the five locations were Fe, Mn, Cu, and Cr, with an average detection rate of 100%, 98%, 96% and 92% respectively. In contrast, Cd was detected at only one location and in only 31% of the samples at that location and Co was detected at only two of the locations, in 14 and 75% of the samples at those locations (Table 3). The distributions of the Fe, Mn, Cu, and Cr across the five sites were found to be variable with the largest difference in relative range associated with Cr (Fig. 2 a,b,c,d).

In comparison, only three metals, Fe, Mn and Cu, were detected at the locations used to represent background (Table 4). The background concentrations of the detected metals were significantly lower than the concentrations at the metal recyclers (Table 3 and Fig. 2).

As expected, the time series of certain metal concentrations at the five study locations were found to be linearly correlated according to Pearson correlation coefficients. For example, Fe and Mn were linearly correlated at four of the five locations: facility 1 0.96, facility 2 0.92, facility 4 0.86 and facility 5 0.64. Each facility had at least two pairs of metals with statistically significant correlations greater than 0.80.

While Cr (total) was routinely collected with the other metals, as noted above, two CrVI samples were collected simultaneously with Cr total, one TSP and one PM10. The results of the simultaneous sampling were used to develop a ratio of total Cr that is CrVI, which could be used to estimate the CrVI fraction when only Cr total was measured. Note, EPA assumes 34% of the reported chromium is CrVI when other data are not available (EPA, 2010). Our results indicate the percentage of total Cr that is CrVI in ambient air downwind from metal recyclers to

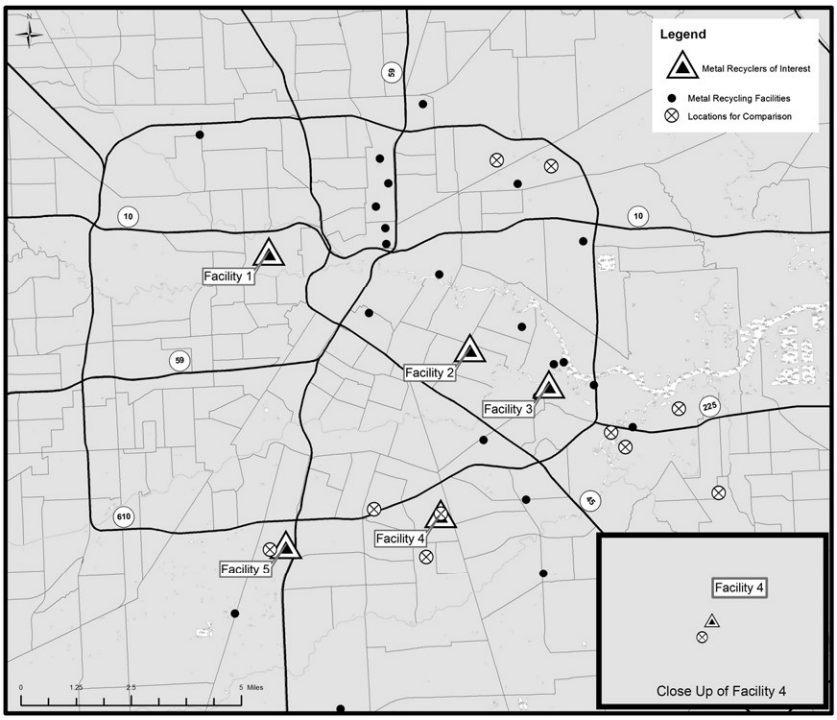

Fig. 1. Metal recycler facilities in Houston, facilities in study, and comparison/control locations.

Table 3
Descriptive statistics of metal concentrations.

Metal	Statistic	Facility 1	Facility 2	Facility 3	Facility 4	Facility 5	Background
		n = 10	n = 6	n = 7	n = 12	n = 13	n = 10
		μg/m^3					
Cd	Mean (SD)	NA	NA	NA	NA	0.026 (0.022)	NA
	% detected	0	0	0	0	31	0
	Distribution	NA	NA	NA	NA	None discernible	NA
	95th UCL	NA	NA	NA	NA	0.0532	NA
Co	Mean (SD)	NA	NA	0.016 (0.002)	0.048 (0.072)	NA	NA
	% detected	0	0	14	75	0	0
	Distribution	NA	NA	None discernible	None discernible	NA	NA
	95th UCL	NA	NA	0.0169	0.138	NA	NA
Cu	Mean (SD)	0.11 (0.08)	1.317 (0.718)	0.139 (0.057)	0.471 (0.523)	0.296 (0.186)	0.0341 (0.0386)
	% detected	90	100	100	92	100	71
	Distribution	Normal	Normal	Normal	Gamma	Normal	None discernible
	95th UCL	0.156	1.907	0.181	0.911	0.388	0.079
Cr	Mean (SD)	0.036 (0.015)	0.095 (0.109)	0.751 (0.665)	0.312 (0.28)	0.129 (0.121)	NA
	% detected	60	100	100	100	100	0
	Distribution	Normal	Gamma	Normal	Gamma	Gamma	NA
	95th UCL	0.044	0.288	1.239	0.532	0.208	NA
Fe	Mean (SD)	12.47 (9.45)	4.3 (1.748)	8.377 (5.64)	14.28 (8.857)	18.21 (16.94)	1.731 (1.419)
	% detected	100	100	100	100	100	100
	Distribution	Normal	Normal	Normal	Normal	Gamma	Gamma
	95th UCL	17.95	5.738	12.52	18.87	31.59	2.595
Pb	Mean (SD)	0.21 (0.282)	0.44 (0.313)	0.93 (0.04)	0.096 (0.05)	0.249 (0.242)	NA
	% detected	40	100	14	100	92	0
	Distribution	Gamma	Normal	None discernible	None discernible	Gamma	NA
	95th UCL	0.383	0.697	0.123	0.121	0.385	NA
Mn	Mean (SD)	0.147 (0.103)	0.096 (0.056)	0.21 (0.079)	0.24 (0.132)	0.22 (0.129)	0.0344 (0.0285)
	% detected	90	100	100	100	100	64
	Distribution	Normal	Normal	Normal	Normal	Gamma	Gamma
	95th UCL	0.206	0.142	0.269	0.309	0.313	0.049
Ni	Mean (SD)	0.064 (0.32)	0.149 (0.142)	0.423 (0.18)	0.766 (0.618)	0.157 (0.129)	NA
	% detected	30	50	100	100	85	0
	Distribution	None discernible	Gamma	Normal	Normal	Gamma	NA
	95th UCL	0.082	0.382	0.555	1.087	0.243	NA

SD, standard deviation. 95th UCL refers to the 95th upper confidence limit of the mean based on the distributional shape. If there was no discernible distribution, the 95th upper confidence limit of the mean for the t distribution was used.

be approximately 10% (0.042 μg/m^3/0.396 μg/m^3). This same percentage of total Cr that is CrVI found in the TSP sample was also found in the simultaneously collected PM10 sample.

3.2. Ambient air metal particulate matter risk

Of the metals detected in the ambient air downwind of the metal recyclers, Ni, Cd, CrVI, and Co are carcinogenic. None of these metals were detected in the ambient air at the background locations. In order to determine if the metal concentrations detected in the ambient air offsite of the metal recyclers were potentially posing an increased cancer risk above acceptable levels, the concentrations were first compared with screening level concentrations. The screening levels were calculated using EPA methodology for assessing inhalation human health risk (EPA, 2009), assuming a residential exposure, a risk of one in a million as the acceptable risk level, and toxicity values obtained from EPA's Integrated Risk Information System (IRIS) with the exception of cobalt (IRIS, 2012a,b). The toxicity value for cobalt is from the Provisional Peer Reviewed Toxicity Values for Superfund (EPA, 2003).

The residential carcinogenic screening level (SL) is calculated as follows:

$$SL = (TR \times AT)/(EF \times ED \times ET \times IUR)$$

TR	Target risk (1×10^{-6});
AT	Average time (70 years lifetime × 365 days/year × 24 h/day);
EF	Exposure frequency (350 days/year);
ED	Exposure duration (30 years);
ET	Exposure time (24 h/day);
IUR	Inhalation unit risk ($(\mu g/m^3)^{-1}$)

The metal concentrations measured 50 to 100 ft downwind of the site fence line represent the concentration detected in an 8 hour period. This concentration reflects emissions resulting directly from the industrial operations because the monitoring sites were selected based on current and forecasted wind direction data. In order to approximate an annual concentration, the 8 hour concentration was adjusted for the hours and days a facility operates in a year.

Facilities may operate continuously or fewer shifts a day (i.e., one, two or three 8 hour shifts a day). Most facilities are closed on Sundays. For a facility working three 8 hour shifts a day and closed on Sunday, a reasonable approximation of the annual potential exposure concentration would be the 95th upper confidence limit of the mean of the measured 8 hour concentration adjusted for zero emissions on Sunday (i.e., 8 hour concentrations multiplied by 6/7). If the facility worked less than three 8 hour shifts a day while operating, the concentration is adjusted down accordingly. For example, the annual concentration is derived as follows:

$$C_{Annual} = C(8\ h) \times (6/7) \times n/3$$

C_{Annual}	Annual concentration, $\mu g/m^3$
C_{8h}	95th upper confidence limit of measured 8 hour mean concentration, $\mu g/m^3$
n	Number of 8 hour shifts per day.

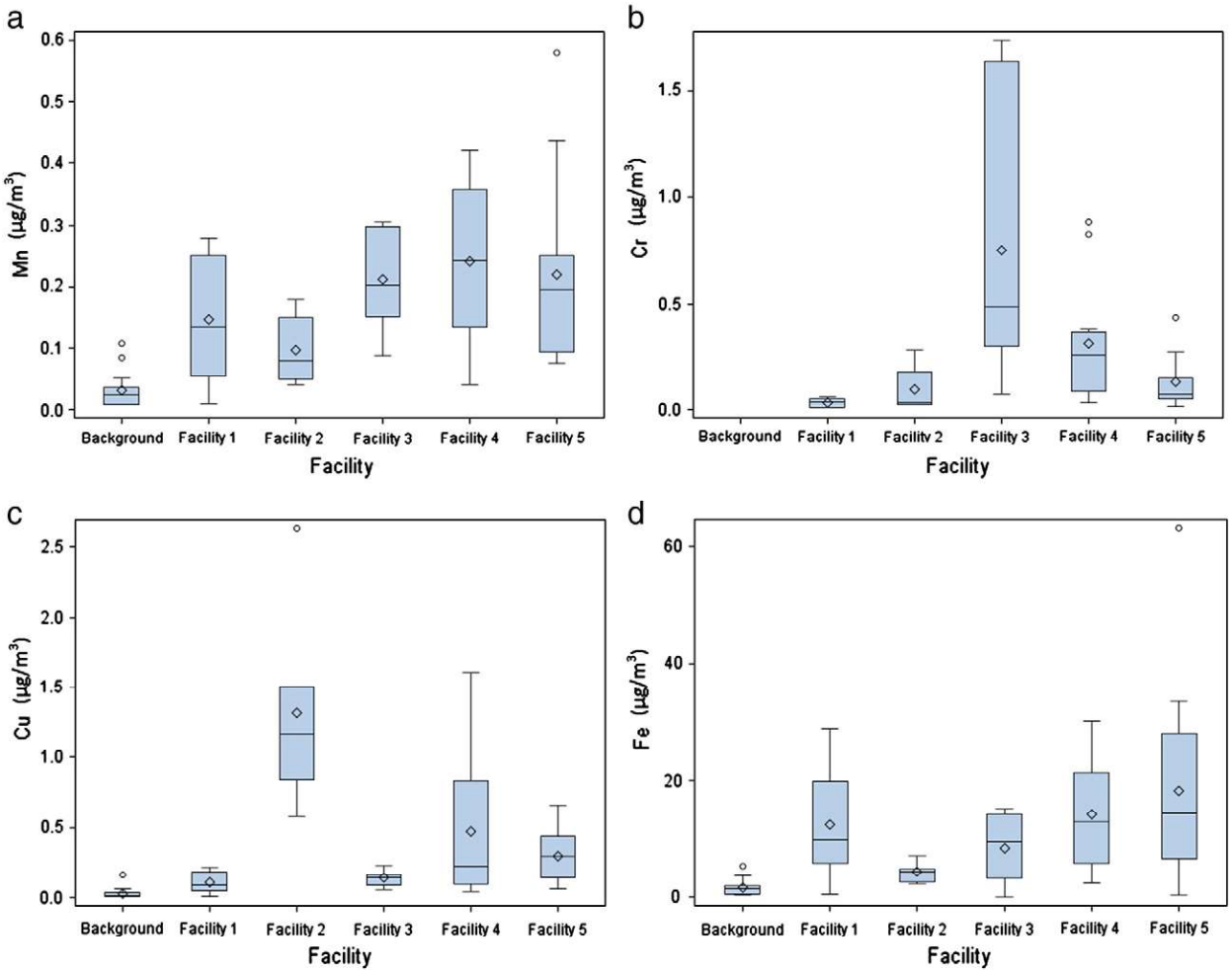

Fig. 2. Distribution plots of most commonly detected metals by location µg/m^3. a) Upper left: Mn b) upper right: Cr c) lower left: Cu d) lower right: Fe.
Circle are outliers defined as 1.5x interquartile range below the 25th percentile and above the 75th percentile.
The length of the box represents the interquartile range (the distance between the 25th and 75th percentiles).
The symbol (diamond) in the box interior represents the group mean.
The horizontal line in the box interior represents the group median.
The vertical lines (whiskers) issuing from the box extend to the group minimum and maximum values that are not outliers.

Table 5 lists each carcinogenic metal found at the facility and not in the background, the inhalation unit risk toxicity value, (IRIS, 2012a,b) the 95th upper confidence limit of the 8 hour mean metal concentrations measured during sampling and the estimate of the annual concentration adjusted based on a range of number of facility operating shifts per workday. The table also lists the corresponding residential inhalation carcinogenic screening level per metal. The number of checks in the table indicates the number of shift schedule weighted concentrations which exceed the screening level (e.g., three checks indicate that the concentration exceeded the screening level for the three shift scenarios presented). Every facility in the study with detectable metals exceeded the screening level for at least one metal over all shift scenarios.

Table 4
Average frequency of detection of metals downwind of metal recycler area sources and background.

Metal	Metal recycler	Background areas
Fe	100	100
Mn	98	64
Cu	96	71
Cr	92	0
Ni	73	0
Pb	69	0
Co	18	0
Cd	6	0
Hg	2	0
Ag	0	0

As a second step, the total risk from the carcinogenic metals emitted at each facility was calculated by summing over the risk each metal at a facility poses (Table 6). This risk value provides a measure of the potential magnitude resulting from exposure to more than one metal, for populations near metal recyclers in Houston.

The risk was calculated as follows:

$$Risk = C_{Annual} \times (EF \times ED \times ET \times IUR)/AT.$$

The concentrations used to calculate the risks above assume a constant wind direction throughout the year. Because wind direction is not constant and the concentrations of these metals were not detected in the background, the actual annual concentrations will be lower when the concentrations from the metal recyclers are averaged with the background. While future research should address longer term monitoring

Table 5
Facility concentrations compared with residential carcinogenic screening levels.

Facility	Metal	Inhalation unit risk (per μg/m^3)	Measured concentration (μg/m^3)	Annual concentration (μg/m^3)[a]			Residential carcinogenic screening level (μg/m^3)	Exceeded
			8 h[b]	1 shift/day	2 shifts/day	3 shifts/day		
1	CrVI[b]	1.20E−02	4.44E−03	1.27E−03	2.54E−03	3.81E−03	2.03E−04	√√√
	Ni	2.40E−04	8.22E−02	2.35E−02	4.70E−02	7.05E−02	1.01E−02	√√√
2	CrVI[b]	1.20E−02	2.88E−02	8.23E−03	1.65E−02	2.47E−02	2.03E−04	√√√
	Ni	2.40E−04	3.82E−01	1.09E−01	2.18E−01	3.27E−01	1.01E−02	√√√
3	CrVI[b]	1.20E−02	1.24E−01	3.54E−02	7.09E−02	1.06E−01	2.03E−04	√√√
	Ni	2.40E−04	5.55E−01	1.59E−01	3.17E−01	4.76E−01	1.01E−02	√√√
	Co	9.00E−03	1.69E−02	4.83E−03	9.66E−03	1.45E−02	2.70E−04	√√√
4	CrVI[b]	1.20E−02	5.23E−02	1.49E−02	2.99E−02	4.48E−02	2.03E−04	√√√
	Ni	2.40E−04	1.09E+00	3.11E−01	6.23E−01	9.34E−01	1.01E−02	√√√
	Co	9.00E−03	1.38E−01	3.94E−02	7.89E−02	1.18E−01	2.70E−04	√√√
5	CrVI[b]	1.20E−02	2.08E−02	5.94E−03	1.19E−02	1.78E−02	2.03E−04	√√√
	Ni	2.40E−04	2.43E−01	6.94E−02	1.39E−01	2.08E−01	1.01E−02	√√√
	Cd	1.80E−03	5.32E−02	1.52E−02	3.04E−02	4.56E−02	1.35E−03	√√√

[a] Assume 6 day work week.
[b] Concentration estimated from CrVI/Cr total ratio.

to better estimate the annual concentration, in the absence of more precise information a simplistic approach is used.

The wind direction history indicates that the prevailing wind direction in Houston is southeasterly, with southeasterly winds occurring approximately 12% of the time (TCEQ, 2012). To approximate the long term metal concentration northwest of a metal recycler, we assumed that the measured metal concentrations downwind from a metal recycling operation occurs 12% of the time and that the background concentrations (0 metal concentration) occurs the remaining 88% of the time. Taking 12% of total risk in Table 7 provides a range spanning risk posed from constant downwind to 12% of the year downwind.

These risk estimates, are used to frame the potential risk to residents, and do not represent personal exposure. While there are limitations to this comparison, the results provide a means of informing regulators regarding the relative rank of potential health threat of sources in the city. The estimated increased cancer risks range from 1 case in 1,000,000 to 8 cases in 10,000 depending upon the facility, the operating schedule and the wind direction.

4. Discussion and conclusions

In response to community complaints regarding smoke and dust nuisance, we detected metals in ambient air off-site of metal recyclers at concentration levels of potential concern for increased carcinogenic risk. These metals were not detected at background locations. After accounting for wind direction and the number of shifts that could operate a year, the total risk from these area sources ranged from an increased cancer risk 1 case in 1,000,000 to 8 cases in 10,000 depending upon the facility.

Table 6
Human health risk for residential exposure to facility concentrations.

	Metal	Carcinogenic risk from metal concentrations		
		1 shift/day	2 shifts/day	3 shifts/day
Facility 1	CrVI[a]	6.25E−06	1.25E−05	1.87E−05
	Ni	2.33E−06	4.65E−06	6.98E−06
	Total	8.57E−06	1.71E−05	2.57E−05
Facility 2	CrVI[a]	4.05E−05	8.11E−05	1.22E−04
	Ni	1.08E−05	2.16E−05	3.24E−05
	Total	5.13E−05	1.03E−04	1.54E−04
Facility 3	CrVI[a]	1.75E−04	3.49E−04	5.24E−04
	Ni	1.57E−05	3.14E−05	4.71E−05
	Co	1.79E−05	3.58E−05	5.37E−05
	Total	2.08E−04	4.16E−04	6.24E−04
Facility 4	CrVI[a]	7.49E−05	1.50E−04	2.25E−04
	Ni	3.08E−05	6.17E−05	9.25E−05
	Co	1.46E−04	2.92E−04	4.38E−04
	Total	2.52E−04	5.03E−04	7.55E−04
Facility 5	CrVI[a]	2.93E−05	5.86E−05	8.78E−05
	Ni	6.87E−06	1.37E−05	2.06E−05
	Cd	1.13E−05	2.25E−05	3.38E−05
	Total	4.74E−05	9.48E−05	1.42E−04

[a] Concentration estimated from CrVI/Cr total ratio.

4.1. National Air Toxic Assessment

The EPA uses the National Air Toxic Assessment (NATA) (Technology Transfer Network, 2012a) as a screening tool that state, local, and tribal agencies may use to prioritize pollutants, identify areas of concern, and develop a better understanding of the risks posed from air pollution to residents at the census tract level (Pechan and Associates Inc., 2006; Technology Transfer Network, 2012b). NATA is developed using the National Emission Inventory (NEI). Area source emissions like metal recyclers that are not reported for the NEI at the source level are referred to in NEI and NATA as non-point sources. A review of the non-point source categories used by NATA and the NEI indicates that metal recycler emissions were not included in the NEI and therefore not reflected in NATA.

4.2. Plausibility of findings

Are these findings plausible given the physical process? *Yes*. Little information on emissions from torch metal cutting exists in the literature but emissions from metal welding have been well studied. The processes are physically similar enough to glean some understanding of what types of emissions may be expected from metal cutting from what is known about metal welding. Generally, gas welding torches have two tubes of oxygen and fuel and cutting torches have three tubes of oxygen, fuel, and another oxygen tube controlled by a blast

Table 7
Total risk ranges by facility for prevailing downwind locations.

Shifts/day	Facility 1	Facility 2	Facility 3	Facility 4	Facility 5
1	8.57E−06 to 1.03E−06	5.13E−05 to 6.16E−06	2.08E−04 to 2.50E−05	2.52E−04 to 3.02E−05	4.74E−05 to 5.69E−06
2	1.71E−05 to 2.06E−06	1.03E−04 to 1.23E−05	4.16E−04 to 4.99E−05	5.03E−04 to 6.04E−05	9.48E−05 to 1.14E−05
3	2.57E−05 to 3.09E−06	1.54E−04 to 1.85E−05	6.24E−04 to 7.49E−05	7.55E−04 to 9.06E−05	1.42E−04 to 1.71E-05

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trigger. The oxygen blast trigger is used to increase the torch flame to cut through thick metals (Finch, 2007). The body of the torch and the nozzle direction is at an obtuse angle for welding and a 90° angle for cutting. The former is designed for precision and the latter for power.

From research on emissions from welding, we can expect torch metal cutting to generate particulate matter of Cr, CrVI, Mn, Ni and Pb in at least two size modes (Serageldin and Reeves, 2009). Our study detected these metals in addition to Co.

A strong time series correlation between two air contaminants indicates there is a common source. The strong time series correlations for Fe and Mn concentrations were expected because we expect the metal recyclers to conduct a significant amount of torch cutting of steel. We know that the primary constituent of steel is Fe, while Mn is one of the more common constituents found in steel alloys.

Of special interest is information regarding CrVI because it is highly toxic, reflects the highest risk in our preliminary findings and limited concentration information exists compared with other metals (EPA, 1994), perhaps because it requires special sampling and analysis techniques. Depending upon the welding method, the ratio of CrVI/Cr generated in air varies: 55% for shielded metal arc welding, 5% for gas metal arc welding, 10% for flux core arc welding and 0.05% for submerged arc welding (In The Chromium File, 2002). Our preliminary findings indicate the percentage of Cr that is CrVI in ambient air is 10% (0.042 $\mu g/m^3$/0.396 $\mu g/m^3$). The ratios we are seeing from metal cutting are consistent with those found in arc welding.

Although not previously studied, given the similarity in the welding and torch metal cutting processes and what is known about emissions from welding, the concentrations we are seeing from metal recyclers are quite plausible.

4.3. Implications

This is the first evidence that an important and growing industry necessary for sustainable development, metal recyclers, may pose a significant human health risk. Citizen complaints about smoke and dust from metal recycling facilities led to a monitoring study by the City of Houston. Carcinogenic metal concentrations downwind of these facilities proved to be at levels which may potentially impact the health of the local community. Further study is warranted to better understand the metal air pollution levels in the community and if necessary, to evaluate the feasibility of emission controls and identify operational improvements and best management practices for this industry. As is likely true in other big cities with industrial operations, the local government focus in Houston has been largely committed to monitoring control of major source emissions and, although not within the local government jurisdiction, mobile source emissions are continually tracked because together mobile and major source emissions account for the vast majority of ambient air contamination in the city. In light of this study, while we continue to acknowledge that the majority of emissions stem from major and mobile sources, we now better recognize the need to examine area sources posing a neighborhood level, but significant risk.

4.4. Limitations

The data used in this study collected by the City of Houston in response to citizen complaints of smoke and dust are not the product of funded research. Consequently, the data collection and sampling analysis were limited to the City's capabilities. The data were limited to TSP samples collected outside the fence at one physical location per facility for 8 hour duration at between 6 and 13 different sampling periods per facility. Future research should include sampling at more locations throughout the neighborhood, more frequently throughout the year, for longer durations and smaller particulate matter size fractions. In addition, CrVI should be collected at each facility.

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World Health Organization
REGIONAL OFFICE FOR Europe

HEALTH EFFECTS OF PARTICULATE MATTER

Policy implications for countries in eastern Europe, Caucasus and central Asia

R 007484

Abstract

This paper summarizes the evidence about the health effects of air pollution from particulate matter and their implications for policy-makers, with the aim of stimulating the development of more effective strategies to reduce air pollution and its health effects in the countries of eastern Europe, the Caucasus and central Asia.

Keywords
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POLICY MAKING

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Convention on Long-Range Transboundary Air Pollution

Abbreviations

AQG	air quality guidelines
EECCA	eastern Europe, the Caucasus and central Asia
PAH	polycyclic aromatic hydrocarbon
PM	particulate matter
UNECE	United Nations Economic Commission for Europe

Introduction and context

In most countries in the region covered by the United Nations Economic Commission for Europe (UNECE), ambient air quality has improved considerably in the last few decades. This has been achieved by a range of measures to reduce harmful air emissions, including those stipulated by the various protocols under the Convention on Long-range Transboundary Air Pollution *(1)*. There is, however, convincing evidence that current levels of air pollution still pose a considerable risk to the environment and to human health.

Recently, the Executive Body of the Convention has adopted amendments to the Convention's 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone. Following years of negotiations, the approved revised text of the Protocol now specifies national emission reduction commitments for main air pollutants to be achieved by the UNECE Parties by 2020 and beyond. The revised Protocol includes, for the first time, commitments to reduce the emission of fine particulate matter ($PM_{2.5}$). Furthermore, black carbon or soot is now included in the revision as an important component of $PM_{2.5}$. Black carbon is an air pollutant which both affects health and contributes to climate change *(2)*.

What is particulate matter?

PM is a widespread air pollutant, consisting of a mixture of solid and liquid particles suspended in the air.

Commonly used indicators describing PM that are relevant to health refer to the mass concentration of particles with a diameter of less than 10 µm (PM_{10}) and of particles with a diameter of less than 2.5 µm ($PM_{2.5}$). $PM_{2.5}$, often called fine PM, also comprises ultrafine particles having a diameter of less than 0.1 µm. In most locations in Europe, $PM_{2.5}$ constitutes 50–70% of PM_{10}.

PM between 0.1 µm and 1 µm in diameter can remain in the atmosphere for days or weeks and thus be subject to long-range transboundary transport in the air.

PM is a mixture with physical and chemical characteristics varying by location. Common chemical constituents of PM include sulfates, nitrates, ammonium, other inorganic ions such as ions of sodium, potassium, calcium, magnesium and chloride, organic and elemental carbon, crustal material, particle-bound water, metals (including cadmium, copper, nickel, vanadium and zinc) and polycyclic aromatic hydrocarbons (PAH). In addition, biological components such as allergens and microbial compounds are found in PM.

Where does PM come from?

Particles can either be directly emitted into the air (primary PM) or be formed in the atmosphere from gaseous precursors such as sulfur dioxide, oxides of nitrogen, ammonia and non-methane volatile organic compounds (secondary particles).

Primary PM and the precursor gases can have both man-made (anthropogenic) and natural (non-anthropogenic) sources.

Anthropogenic sources include combustion engines (both diesel and petrol), solid-fuel (coal, lignite, heavy oil and biomass) combustion for energy production in households and industry, other industrial activities (building, mining, manufacture of cement, ceramic and bricks, and smelting), and erosion of the pavement by road traffic and abrasion of brakes and tyres. Agriculture is the main source of ammonium.

Secondary particles are formed in the air through chemical reactions of gaseous pollutants. They are products of atmospheric transformation of nitrogen oxides (mainly emitted by traffic and some industrial processes) and sulfur dioxide resulting from the combustion of sulfur-containing fuels. Secondary particles are mostly found in fine PM.

Soil and dust re-suspension is also a contributing source of PM, particularly in arid areas or during episodes of long-range transport of dust, for example from the Sahara to southern Europe.

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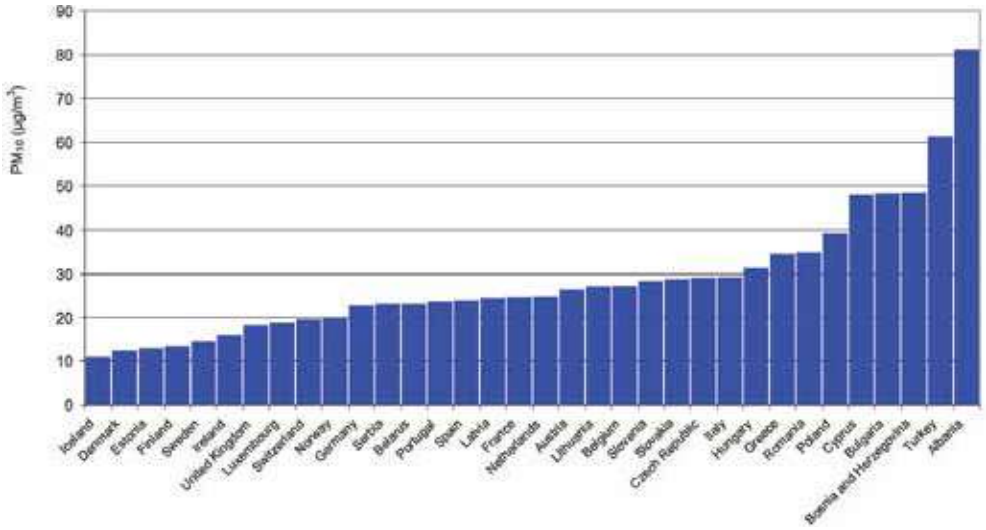
What are the levels of and trends in PM in the WHO European Region[1] ?

The WHO Environment and Health Information System (ENHIS), which is based to a large extent on data submitted by European Union (EU) member states to the European Environment Agency AirBase *(3)*, includes PM_{10} monitoring data from urban and suburban background locations. Fig. 1 presents the population exposure, expressed as annual mean concentration of PM_{10}, weighted by the population in cities with data, in 403 cities in 34 WHO European Member States for 2010. In only 9 of these 34 Member States, PM_{10} levels in at least some cities are below the annual WHO air quality guideline (AQG) level of 20 $\mu g/m^3$. Almost 83% of the population of the cities for which PM data exist is exposed to, PM_{10} levels exceeding the AQG levels. Although this proportion remains high, it is an improvement compared to previous years, with average PM_{10} levels slowly decreasing in most countries in the last decade.

Fig. 1.
Population-weighted annual mean PM_{10} in cities by WHO European Member State, 2010



Source: WHO Regional Office for Europe *(4)*.

On the other hand, monitoring of PM_{10} and $PM_{2.5}$ is very limited in countries in eastern Europe, the Caucasus and central Asia (EECCA), with only a small number of monitoring

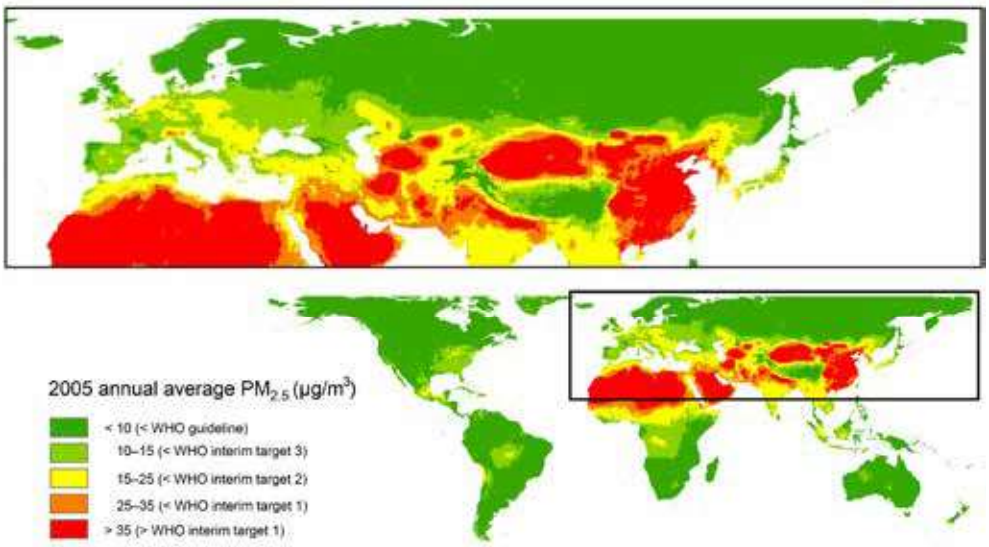
1 The WHO European Region includes 53 countries stretching from the Atlantic Ocean to the Pacific Ocean, with a population of almost 900 million people.

stations in Belarus, the Russian Federation (Moscow) and Uzbekistan (one in Tashkent and one in Nukus). Initial data from the two Uzbek cities indicate that PM_{10} and $PM_{2.5}$ levels are high in comparison with most of the other cities with PM monitoring in the Region. While the levels in Nukus may be affected by dust storms (which are frequent in that area), various combustion sources may be predominant in Tashkent.

The proper assessment of levels of and trends in PM in EECCA countries requires PM_{10} and/or $PM_{2.5}$ monitoring in more locations in those countries. The assessment of PM concentrations requires continuous monitoring conducted for 24 hours daily for 365 days a year, with standardized methods or methods equivalent to the standard. Quantitative knowledge about sources and levels of and trends in emissions of primary particles and precursor gases plays an important role in finding the best control strategy for reducing risks.

In view of the scarcity of ground-level data for PM, remote (satellite) sensing combined with modelling and existing surface measurements has recently been used for the assessment of population exposure at country level. Recent estimates have been published for $PM_{2.5}$ concentrations using this technology as part of the Global Burden of Diseases, Injuries and Risk Factors Project *(5)* (see Fig. 2). Further development of these methods and their precision depends to a large extent on the availability of surface measurements in all regions of the world.

Fig. 2.
Estimated 2005 annual average $PM_{2.5}$ concentrations (µg/m^3), presented according to the WHO AQG and interim target values



Source: Michael Brauer, personal communication based on *(5)*.

What are the health effects of PM?

PM_{10} and $PM_{2.5}$ include inhalable particles that are small enough to penetrate the thoracic region of the respiratory system. The health effects of inhalable PM are well documented. They are due to exposure over both the short term (hours, days) and long term (months, years) and include:

- respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms and an increase in hospital admissions;
- mortality from cardiovascular and respiratory diseases and from lung cancer.

There is good evidence of the effects of short-term exposure to PM_{10} on respiratory health, but for mortality, and especially as a consequence of long-term exposure, $PM_{2.5}$ is a stronger risk factor than the coarse part of PM_{10} (particles in the 2.5–10 µm range). All-cause daily mortality is estimated to increase by 0.2–0.6% per 10 µg/m^3 of PM_{10} *(6,7)*. Long-term exposure to $PM_{2.5}$ is associated with an increase in the long-term risk of cardiopulmonary mortality by 6–13% per 10 µg/m^3 of $PM_{2.5}$ *(8–10)*.

Susceptible groups with pre-existing lung or heart disease, as well as elderly people and children, are particularly vulnerable. For example, exposure to PM affects lung development in children, including reversible deficits in lung function as well as chronically reduced lung growth rate and a deficit in long-term lung function *(4)*. There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur. The exposure is ubiquitous and involuntary, increasing the significance of this determinant of health.

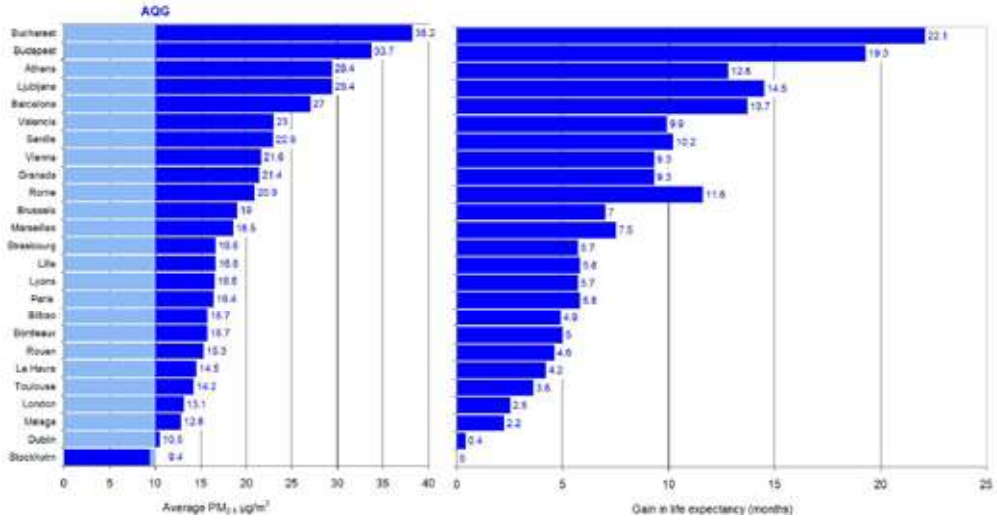
At present, at the population level, there is not enough evidence to identify differences in the effects of particles with different chemical compositions or emanating from various sources *(11)*. It should be noted, however, that the evidence for the hazardous nature of combustion-related PM (from both mobile and stationary sources) is more consistent than that for PM from other sources *(12)*. The black carbon part of $PM_{2.5}$, which results from incomplete combustion, has attracted the attention of the air quality community owing to the evidence for its contribution to detrimental effects on health as well as on climate. Many components of PM attached to black carbon are currently seen as responsible for health effects, for instance organics such as PAHs that are known carcinogens and directly toxic to the cells, as well as metals and inorganic salts. Recently, the exhaust from diesel engines (consisting mostly of particles) was classified by the International Agency for Research on Cancer as carcinogenic (Group 1) to humans *(13)*. This list also includes some PAHs and related exposures, as well as the household use of solid fuels *(14,15)*.

What is the burden of disease related to exposure to PM?

It is estimated that approximately 3% of cardiopulmonary and 5% of lung cancer deaths are attributable to PM globally. In the European Region, this proportion is 1–3% and 2–5%, respectively, in various subregions *(16)*. Results emerging from a recent study indicate that the burden of disease related to ambient air pollution may be even higher. This study estimates that in 2010, ambient air pollution, as annual $PM_{2.5}$, accounted for 3.1 million deaths and around 3.1% of global disability-adjusted life years *(17)*.

Exposure to $PM_{2.5}$ reduces the life expectancy of the population of the Region by about 8.6 months on average. Results from the scientific project Improving Knowledge and Communication for Decision-making on Air Pollution and Health in Europe (Aphekom), which uses traditional health impact assessment methods, indicate that average life expectancy in the most polluted cities could be increased by approximately 20 months if the long-term $PM_{2.5}$ concentration was reduced to the WHO (AQG) annual level (Fig. 3).

Fig. 3.
Predicted average gain in life expectancy (months) for people aged 30 years for a reduction in average annual levels of $PM_{2.5}$ down to the WHO AQG annual mean level of 10µg/m^3 in 25 European cities participating in the Aphekom project



Source: based on Medina *(18)*.

WHO AQGs

WHO last revised its AQG values for PM in 2005, as follows:

- for $PM_{2.5}$: 10 µg/m^3 for the annual average and 25 µg/m^3 for the 24-hour mean (not to be exceeded for more than 3 days/year);
- for PM_{10}: 20 µg/m^3 for the annual average and 50 µg/m^3 for the 24-hour mean.

In addition to these guideline values, the AQGs provide interim targets for each air pollutant, aimed at promoting a gradual shift to lower concentrations in highly polluted locations. If these targets were to be achieved, significant reductions in risks for acute and chronic health effects from air pollution could be expected. Progress towards the guideline values should, however, be the ultimate objective. As no threshold for PM has been identified below which no damage to health is observed, the recommended values should be regarded as representing acceptable and achievable objectives to minimize health effects in the context of local constraints, capabilities and public health priorities.

WHO is currently developing indoor air guidelines for household combustion of fuels for cooking, heating and lighting. These will provide recommendations for household fuels and technologies that will enable progress towards the AQGs.

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Evidence on effects of air quality improvements

There is consistent evidence that lower air pollution levels following a sustained, long-term intervention result in health benefits for the population, with improvements in population health occurring soon (a few years) after the reduction in pollution. Several successful interventions and accountability studies have been evaluated *(19,20)*. A few examples are summarized below.

Follow-up to the Harvard Six Cities Study, United States

A group of adults living in six cities in the United States was followed from 1974 to 2009 in order to estimate the effects of air pollution on mortality. Overall, $PM_{2.5}$ concentrations had decreased to below 15 µg/m^3 by 2000 (except in one city where levels were below 18 µg/m^3). The main finding was that a 2.5 µg/m^3 decrease in the annual average level of $PM_{2.5}$ was associated with a 3.5% reduction in all-cause mortality *(21–23)*. Results show associations between chronic exposure to $PM_{2.5}$ and all-cause, cardiovascular and lung cancer mortality, with health effects seen at any PM concentration. Results suggest that the critical period of exposure to $PM_{2.5}$ for the associated health effects is one year for all-cause mortality, implying that health improvements can be expected to start almost immediately after a reduction in air pollution. In a related study, but using different data, it was demonstrated that the reduction in fine particulate air pollution in the United States in the 1980s and 1990s accounted for as much as 15% of the 2.7-year overall increase in life expectancy that had occurred in that period *(24)*.

Short-term decrease in industrial emissions, United States

A copper smelter strike in 1967–1968 in four states, and the closure and reopening of a steel mill in Utah Valley in 1986–1987, are two examples of unplanned events which had a positive impact on health by decreasing air pollution concentrations in specific areas. The copper smelter strike led to a 60% drop in regional sulfur dioxide concentrations over eight months and was associated with a 2.5% decrease in mortality *(25)*. In the Utah Valley, the closure of the steel mill, which was the primary source of PM_{10} in the area, lasted for 13 months and led to a decrease in PM_{10} levels of approximately 50% during the closure in winter compared to the previous winter when the mill was operating. Hospital admissions for children were approximately three times lower and bronchitis and asthma admissions were halved when the mill was closed *(26)*. Furthermore, the reported 3.2% drop in daily numbers of deaths was associated with a simultaneous fall in PM_{10} levels of approximately 15 µg/m^3 while the steel mill was closed, the strongest association being with respiratory deaths *(27)*.

Respiratory health studies and air pollution abatement measures, Switzerland

The Swiss Study on Air Pollution and Lung Diseases in Adults assessed lung diseases in adults from eight Swiss communities in 1991 and again in 2002. Overall exposure to outdoor PM_{10} estimated at each individual's residence fell by an average of 6.2 µg/m^3 over the study period, to reach a range of approximately 5 µg/m^3 to 35 µg/m^3 in 2002, depending on the community. This reduction in particle levels was associated with attenuated age-related annual declines in various lung function parameters. The falling PM_{10} levels were also associated with fewer reports of respiratory symptoms such as regular cough, chronic cough or phlegm, and wheezing and breathlessness *(28,29)*. As part of a separate investigation, children from nine Swiss communities were followed between 1992 and 2001 as part of the Swiss Study on Childhood Allergy and Respiratory Symptoms with respect to Air Pollution, Climate and Pollen. Falling levels of regional PM_{10} were associated with a declining prevalence of various respiratory symptoms, including chronic cough, bronchitis, common cold, nocturnal dry cough and conjunctivitis symptoms *(30)*. These findings suggest that modest as well as drastic improvements in ambient air quality are beneficial for respiratory health in both children and adults.

These examples of successful interventions show that decreased levels of particulate air pollution can substantially diminish total, respiratory and cardiovascular death rates. Benefits can be expected at almost any reduction in levels of air pollution, which suggests that further policy efforts that reduce fine PM air pollution are likely to have continuing favourable effects on public health.

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Air quality management and policy

Up to 80% of particulate air pollution in EECCA countries can be reduced with currently available technologies *(31)*. The reduction of outdoor air pollutants in general, and PM in particular, requires concerted action by public authorities, industry and individuals at national, regional and even international levels. Responsible authorities with a vested interest in air pollution management include the environment, transport, land planning, public health, housing and energy sectors. Since the burden of air pollution on health is significant at even relatively low concentrations, the effective management of air quality is necessary to reduce health risks to a minimum.

The development and exchange of information on policies, strategies and technical measures to reduce emissions are part of the fundamental principles of the Convention on Long-range Transboundary Air Pollution. The Working Group on Strategies and Reviews of the Convention, and in particular its Expert Group on Techno-economic Issues *(32)*, maintains the database of information on control technologies for air pollution abatement and their costs. An example of its work is provided by the Group's 2010 report summarizing progress in work to reduce dust emissions from small combustion installations *(33)*.

There are co-benefits to addressing particulate air pollution that go beyond just the positive impact on health. For example, reductions in black carbon emissions from the strategic mitigation of combustion sources will also simultaneously reduce global warming *(34)*.

Finally, integrated policies on urban planning and transport can encourage the use of cleaner modes of transport and lead to changes in individual behaviour by promoting walking, cycling and increased commuting by public transport. These policies contribute to cleaner air while promoting physical activity and largely benefiting public health.

Conclusions

PM is a widespread air pollutant, present wherever people live.

The health effects of PM_{10} and $PM_{2.5}$ are well documented. There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur.

Since even at relatively low concentrations the burden of air pollution on health is significant, effective management of air quality aiming to achieve WHO AQG levels is necessary to reduce health risks to a minimum.

Monitoring of PM_{10} and/or $PM_{2.5}$ needs to be improved in many countries to assess population exposure and to assist local authorities in establishing plans for improving air quality.

There is evidence that decreased levels of particulate air pollution following a sustained intervention result in health benefits for the population assessed. These benefits can be seen with almost any decrease in level of PM. The health and economic impacts of inaction should be assessed.

Particulate air pollution can be reduced using current technologies.

Interventions resulting in a reduction in the health effects of air pollution range from regulatory measures (stricter air quality standards, limits for emissions from various sources), structural changes (such as reducing energy consumption, especially that based on combustion sources, changing modes of transport, land use planning) as well as behavioural changes by individuals by, for example, using cleaner modes of transport or household energy sources.

There are important potential co-benefits of integrating climate change and air pollution management strategies, as evidenced by the importance of the PM indicator and climate change contributor black carbon.

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R 007503

METAL RECYCLING INDUSTRY PROJECT

New York State Department of Health
Center for Environmental Health
Bureau of Occupational Health

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PREVENTING LEAD EXPOSURE DURING METAL RECYCLING

New York State Department of Health
Bureau of Occupational Health

The New York State Department of Health (NYSDOH), Bureau of Occupational Health (BOH) completed a Metal Recycling Industry Project (MRIP) in June 2006. During this project, information was collected on metal recycling operations and processes from 101 metal recyclers throughout New York State. This project included measuring worker lead exposures during routine tasks, such as sorting, shearing, and torch cutting a variety of materials. Findings from this project include:

- Significant lead exposure occurred when torch cutting not only painted metals, but also unpainted metals and new steel;
- Lead contamination was found in bathrooms and lunchrooms, and on workers' hands prior to eating;
- Metal recycling companies did not recognize potential sources of lead exposure (such as new steel) and underestimated the degree of exposure; and
- Metal recycling companies that we visited made substantial improvements to their lead protection programs after receiving information and technical guidance.

Recommendations

- Institute a blood-lead monitoring program for all employees potentially exposed to lead;
- Implement engineering controls, such as replacing torch cutting with shearing, to reduce workers' lead exposures;
- Implement employee lead training programs;
- Conduct personal air monitoring to assess airborne lead exposures and the adequacy of respiratory protection;
- Provide respiratory protection to all workers who perform torch cutting, radiator disassembly or other tasks associated with high airborne lead exposures;
- Require employees to clean the interior and exterior surfaces of their respirators daily;
- Provide hygiene facilities, such as a clean lunch room, a locker room with separate "clean" and "dirty" lockers, and a shower facility;
- Prohibit eating, drinking, and smoking in any area where lead contamination may occur; and
- Perform routine housekeeping to reduce surface lead dust accumulation throughout the facility.

If you would like more information about these recommendations, contact the NYSDOH, Bureau of Occupational Health at 1-866-807-2130.

METAL RECYCLING INDUSTRY PROJECT

New York State Department of Health
Center for Environmental Health
Bureau of Occupational Health

547 River Street, Room 230
Troy, NY 12180

June 2007

EXECUTIVE SUMMARY

Significant Findings

- Significant lead exposure occurred when torch cutting not only painted metals, but also unpainted metals and new steel;
- Lead contamination was found in bathrooms and lunchrooms, and on workers' hands prior to eating;
- Metal recycling companies did not recognize potential sources of lead exposure (such as new steel) and underestimated the degree of exposure; and
- Metal recycling companies that we visited made substantial improvements to their lead protection programs after receiving information and technical guidance.

Background and Methods

Metal recycling workers can be exposed to lead, a known industrial hazard, while performing typical metal recycling tasks. The New York State Department of Health's (NYSDOH) Bureau of Occupational Health (BOH) launched a Metal Recycling Industry Project (MRIP) in June 2000. The goals of the project were to 1) collect information on metal recycling operations and processes from a representative survey population, 2) identify and evaluate metal recycling workers' exposures to lead and other hazardous metals and 3) propose feasible and effective measures to reduce the exposures if needed. The information collected and the preventive measures formulated during the survey are currently being used to develop worker educational and training materials that will be disseminated to the industry and to other stakeholders.

The project had two components: a mail survey and on-site industrial hygiene (IH) evaluations. The mail survey portion was completed at the end of September 2000 and the on-site evaluations completed in February 2001. We additionally conducted a telephone survey in 2005 to collect updated information from the companies that received our on-site evaluations. The follow-up telephone survey was completed in June 2005.

During the mail survey, questionnaires were sent to 224 metal recycling facilities in New York State and 101 (45%) completed responses were received. BOH industrial hygienists conducted on-site industrial hygiene (IH) evaluations at eight facilities that responded to the mail survey and indicated an interest in the evaluation. Each on-site evaluation included a walk-through

survey, safety and health program review, personal air monitoring and collection of surface dust samples. A written evaluation report was provided to each facility. Seven of the eight facilities that received the IH evaluations completed the telephone follow-up survey in 2005 (one company was no longer in business).

Results and Discussion

At the time of our survey, companies reported recycling assorted metals such as aluminum, iron, copper, brass, steel, stainless steel, and tin. Workers reportedly performed tasks included sorting, shearing, baling, saw cutting and torch cutting of metal. Among the surveyed companies, 60 (59%) reported performing torch cutting, an operation expected to generate excessive quantities of airborne lead particulates that pose a high health risk to the workers. Despite this, when the companies were asked to assess the likelihood of employee lead exposures at their facilities, 72 (71%) stated that their employees were unlikely or definitely not exposed to lead at work.

Two of the eight companies that received an on-site evaluation required workers to use respiratory protection only when cutting galvanized or painted metals. The companies' decisions were based on the assumption that lead only existed in painted or galvanized steels. However, our personal air monitoring results demonstrated otherwise: workers may be exposed to sufficiently high concentrations of lead when cutting unpainted metal, steel without galvanized coating and even new steel. Three of the six personal air samples that were collected from the workers who performed torch cutting had average lead concentrations over sample time exceeding the Occupational Safety and Health Administration (OSHA)'s Permissible Exposure Limit (PEL) for lead. Two samples were obtained when the workers were torch cutting unpainted steel. In fact, one of the workers was cutting new steel from a local fabrication shop.

Lead is one of the elemental metals that are commonly used as an additive in the steel making process to improve the machinability of the steel. Although the quantity of lead contained in these steels is small - typically ranging from 0.15 to 0.35%, torch cutting can release substantial amount of lead fume as demonstrated by our air monitoring results.

We also found personal air lead levels during sample time in excess of the OSHA PEL during auto radiator disassembly at one facility.

Only 10% of the 101 companies that responded to the survey reported performing personal air monitoring to assess employee lead exposures. Of the 101 companies, forty-five (45%) companies did not provide their workers with any respiratory protection; twenty-eight (28%) provided only disposable dust masks. Of the 60 companies that performed torch cutting, twenty-four (40%) companies provided their workers with half-face or full-face air purifying respirators (APR). Sixty percent (60%) of the companies that had torch cutting operations did not provide workers with any respiratory protection or provided only disposable dust masks.

Fifteen (15%) companies reported that they provided blood lead testing for their employees at least once. This was slightly higher (18%) among the companies that reported torch cutting.

With regard to frequency of biological monitoring, four (4%) of the companies reported that they offered blood lead testing annually, six (6%) semiannually, and two (2%) quarterly.

More than 70% of the wipe samples collected in lunchrooms and bathrooms at the eight metal recycling sites had lead dust concentrations exceeding the Environmental Protection Agency (EPA) clearance threshold for homes following lead remediation projects. Lead was also found in wipe samples collected from the hands of workers who held different job titles, including a yard supervisor, a torch cutter, a driver, a sorter, and a laborer in a facility's new steel shop. These samples were collected after the workers washed their hands to eat lunch.

The telephone follow up survey found that the facilities have made improvements in providing workers with personal protective equipment (PPE) and hygiene facilities. The survey also found that owners of metal recycling companies did not understand the prevalence of occupational lead exposures associated with metal recycling activities.

Recommendations

We recommend that the governmental agencies, metal recycling trade organizations, safety and health professionals, workers' compensation carriers and other stakeholders work together to educate employers of the metal recycling industry and raise their awareness of occupational lead exposure in the trade.

We also encourage employers within the metal recycling industry to adopt the following to reduce workers' lead exposures:

- Institute a biological monitoring program for all employees potentially exposed to lead;
- Implement engineering controls such as replacing torch cutting with shearing to reduce workers' lead exposures;
- Implement employee lead training programs;
- Conduct personal air monitoring to assess workers' airborne lead exposures and the adequacy of respiratory protection;
- Provide appropriate respiratory protection to all workers who perform torch cutting, radiator disassembly or other tasks associated with high airborne lead exposures;
- Require employees to thoroughly clean their respirators daily;
- Provide hygiene facilities, such as a clean lunch room, a locker room with separate "clean" and "dirty" lockers and a shower facility;
- Prohibit eating, drinking, and smoking in work areas where lead contamination may occur; and
- Perform routine housekeeping to reduce surface lead dust accumulation throughout the facility.

METAL RECYCLING INDUSTRY PROJECT

New York State Department of Health
Center for Environmental Health
Bureau of Occupational Health

547 River Street, Room 230
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INTRODUCTION

A typical metal recycling facility recycles a variety of materials, including ferrous and nonferrous scrap metals, vehicles and parts, communication cables, radiators, and batteries. The recycling process includes receiving, sorting, processing, packaging, storing and shipping the materials or metals to other facilities where they can be reused or reprocessed. Sorting is either done manually or by machines such as shaker beds, cranes, or magnets. Large scrap metal parts are cut with shears or torches into smaller pieces. The scrap metal is then compressed and packaged, commonly by balers for storage and transportation.

Lead is a ubiquitous metal, and a known environmental and industrial hazard *(1)*. Many of the materials being recycled, such as batteries, radiators, and metals contain lead. It may be in the coatings on the scrap metal (lead-based paint or galvanized coatings) *(2)*. It may also be present in the metal as an additive, alloy element or contaminant *(3, 4, 5, 6)*. When metal recycling workers cut, shear, bale or sort scrap metals, they can be exposed to lead dust and fume.

Lead can be absorbed into the body by inhalation (breathing) and ingestion (eating) *(7)*. Once lead gets into the body, it travels in the blood to the "soft tissues" such as the liver, kidneys, lungs, brain, spleen, muscles, and heart before it moves to the bones and teeth where it may stay for decades *(8)*. Elevated blood lead levels in adults can damage the cardiovascular, central nervous, reproductive, hematologic, and renal systems *(7)*. The mean blood lead level (BLL) of adults in the United States is less than three micrograms of lead per deciliter of whole blood (µg/dL) *(9)*. The U.S. Department of Health and Human Services recommends that BLLs among all adults be less than 25 µg/dL *(9)*. According to the U.S. Occupational Safety and Health Administration's (OSHA) lead standard for general industry, a worker must be removed from further lead exposure when the worker's BLL is at or above 60 µg/dL[1] or the average of the worker's last three BLLs is at or above 50 µg/dL[1] *(7)*. The worker cannot return to work unless his or her BLL is reduced to below 40 µg/dL[1].

[1] OSHA used the unit of micrograms of lead per 100 grams of blood (µg/ 100 g) for blood lead level in its lead standard for general industry (29CFR1910.1025). According to OSHA, the units of µg/dL and µg/ 100 g are essentially the same (see 29CFR1910.1025: Appendix A, II, B, (3)).

The Bureau of Occupational Health (BOH) of the New York State Department of Health (NYSDOH) maintains a Heavy Metals Registry (HMR) to identify adults who have elevated biological indicators (blood or urine) of lead and other heavy metals. BOH staff work with the individuals reported to the HMR to determine the source of exposure and to prevent or reduce further intake of the metals. If the source of exposure is work related or in a work environment, the BOH industrial hygienists may work with the employers to develop and implement controls to reduce the workers' occupational exposures.

According to Census data, there were approximately 6,300 workers in the metal recycling industry in New York State in 2000. From 1990 to 2000, the HMR received reports of elevated BLLs for 65 individuals working in metal recycling companies. Of those reported, 25 had blood lead levels above 40 μg/dL, and three had blood lead levels above 100 μg/dL. Given the reports of elevated BLLs in metal recycling workers and these reports likely underrepresented the extent of the problem (since many scrap metal workers may not be tested), a Metal Recycling Industry Project (MRIP) was initiated in June 2000.

The goals of the project were to collect information on metal recycling operations and processes from a representative survey population, to identify and evaluate workers' exposures to lead and selected other hazardous metals during metal recycling processes and to propose feasible and effective measures to reduce the exposures. BOH staff worked with the Institute of Scrap Recycling Industries, Inc. (ISRI), a metal recycling industry trade association in Washington DC, in developing the project. The project had two components: a mail survey and on-site industrial hygiene (IH) evaluations. The mail survey portion was completed at the end of September 2000 and the on-site evaluations were completed in February 2001. Additionally, we conducted a telephone survey in June 2005 to collect updated information on the companies that received our IH on-site evaluations.

METHODS

Mail Survey

A survey questionnaire was designed to gather information on company operations, potential employee lead exposures, biological monitoring programs, control measures e.g. engineering controls, personal protective equipment (PPE), employee training, and housekeeping. ISRI provided valuable input in formulating the questionnaire. In an effort to maximize the response rate, we kept the survey brief, limiting it to 19 multiple choice or short answer questions.

The yellow pages provided by several internet websites were used to compile a list of potential survey participants, including all listings from the following categories: "Scrap Metals", "Process & Recycle", "Scrap Metals & Iron (wholesale)", and "Steel-used". A total of 355 companies were identified. A cover letter explaining the nature and objectives of the survey was sent with the questionnaire to each of the 355 companies in June 2000. Companies that did not respond within three weeks after the initial mailing were contacted via telephone to attempt to complete the survey. Of the 355 companies, 131 were removed from the survey for one or more of the following reasons: (1) not having a valid mailing address or phone number; (2) not in business; or (3) not in the metal recycling business. The final survey population was thus

reduced to 224 companies that were active and in the metal recycling business. A total of 101 companies completed the survey either by mail or by phone, resulting in a response rate of 45%. The remaining (123) declined to participate.

On-site Industrial Hygiene Evaluations

Ten (10%) of the facilities that answered the mail survey also requested on-site evaluations from the BOH industrial hygiene group. One of these companies only agreed to a preliminary walk-through; another was in the electronics recycling business (not a typical metal recycling operation). The results of the on-site IH evaluations of the eight remaining facilities are presented in this report.

During each on-site evaluation, BOH industrial hygienists conducted a walk-through survey to observe recycling processes and employees' work activities, reviewed company lead safety programs, performed personal air monitoring, and collected surface dust samples. We also performed a thorough review of the eight companies' biological monitoring activities and their blood lead monitoring data that had been reported to the HMR. The focus of these site visits was to identify and evaluate occupational exposure to lead and other metals. Other safety and health hazards were not within the scope of the site visits. Therefore, the on-site assessments should not be viewed as a complete hazard evaluation for a specific facility or for the industry.

Personal breathing zone (PBZ) air samples were collected to measure employees' exposures to lead and other selected metals, such as cadmium, cobalt and nickel. These samples were collected during the performance of the various job tasks, such as sorting metal, driving forklifts, operating shears and balers, torch-cutting metal, and crushing cars. Sampling was task-specific (collected only during the performance of a single task) and generally lasted the duration of the task. For tasks performed all day, sample duration was limited to half of the shift.

The sampling train consisted of a personal sampling pump (Ametek Model 2500 Constant Flow Sampler), Tygon tubing and a close-faced 37 millimeter (mm) filter cassette containing a 0.8 micron (m) mixed cellulose ester filter (MCEF) with a backup pad. The cassette was clipped onto a worker's lapel. If a worker wore a face shield, the MCEF cassette was placed outside the face shield. The pump was calibrated before and after sampling with a primary flow meter (Gilibrator) at a flow rate of two liters per minute (LPM). Pump start and stop times were recorded to the nearest minute. One to two field blanks were submitted for each batch of PBZ air samples.

Surface dust samples were also collected to assess the extent of surface contamination by lead dust in non-production areas throughout each facility. Areas sampled included surfaces in lunchrooms, bathrooms, and locker rooms. The samples were collected by wiping an area of 100 square centimeters (cm^2) with an individual "baby wipe". At one facility, we collected wipes from workers' hands. This was done by thoroughly wiping the palm and fingers of one hand with an individual "baby wipe".

All of the personal air samples and wipe samples were analyzed by the Wadsworth Laboratory of the NYSDOH. National Institute for Occupational Safety and Health (NIOSH) Method 7082, flame atomic absorption spectrophotometry (FAAS) *(10)*, was used for analyzing all lead

samples. NIOSH Method 7300, Inductively Coupled Argon Plasma-Atomic Emission Spectroscopy (ICP-AES) *(10)*, was used to analyze samples for other metals.

An individualized report including a survey summary and recommendations on reducing and controlling workers' lead exposures was sent to each of the eight facilities that received site visits.

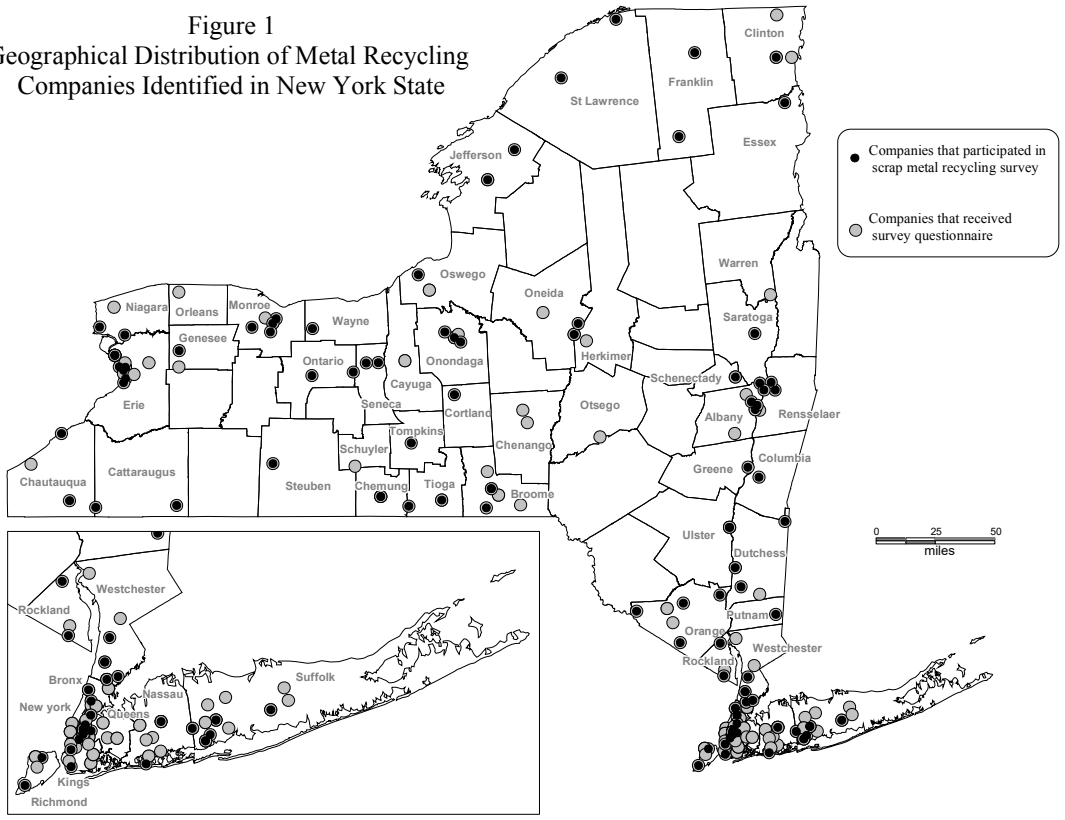
In May 2005, five years after completion of the IH on-site evaluations, BOH conducted a follow-up telephone survey to collect updated information from the eight facilities. The questionnaire was designed to collect information on current company production status and preventive measures adopted by the companies to control and reduce workers lead exposures. One company was no longer in business; the remaining seven facilities completed the telephone survey.

RESULTS

Mail Survey

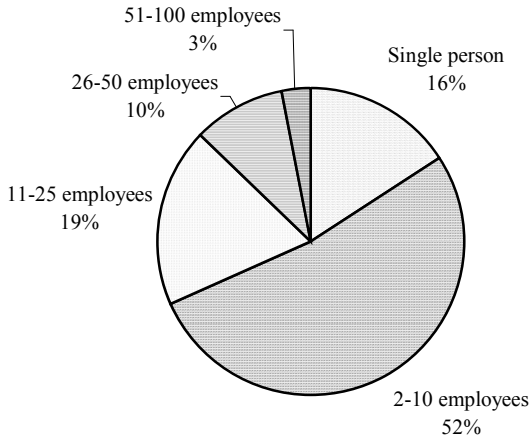
The geographical distribution of the metal recycling companies identified in New York State by the survey is illustrated in Figure 1. The companies that received survey questionnaires and those that participated in the survey are indicated with different symbols in the figure. The participation rate was not consistent throughout the state. While the overall participation rate was 45%, the rate downstate (New York City plus Long Island) was only 26%, and the rate for the rest of state was 57%.

Figure 1
Geographical Distribution of Metal Recycling Companies Identified in New York State



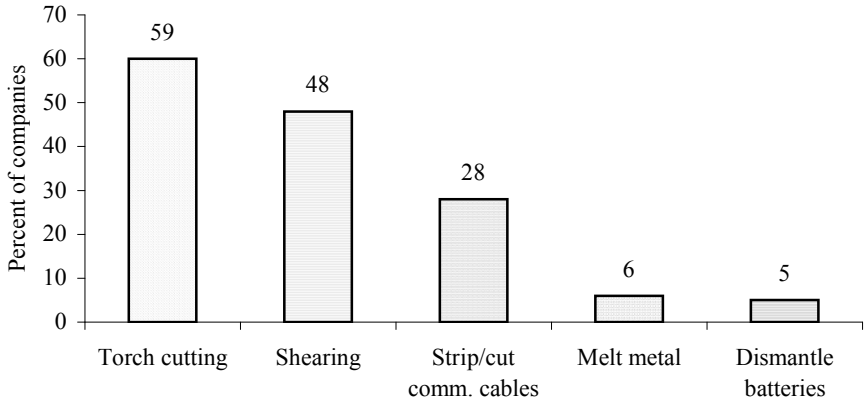
Among the 101 companies that responded to the survey, most were small facilities; 16 (16%) reported that they were a single person operation and 53 (52%) reported that they had 2-10 employees (see Figure 2). Only 3 (3%) had more than 50 employees. The surveyed companies reported that they recycled aluminum, iron, copper, brass, steel, stainless steel, and tin.

Figure 2. Number of employees in participating companies



Forty-eight (48%) companies belonged to one or more statewide or national trade associations, such as ISRI, New York Recyclers, Empire Metal Merchants or Auto Recyclers' Association of New York.

Figure 3. Metal recycling operations performed by the participating companies



Sixty (59%) survey respondents reported performing torch cutting, a task that has the potential for significant lead dust or fume exposure (Figure 3) *(11)*. The companies also reported shearing metal, stripping or cutting communication cables, melting metal and dismantling batteries. These tasks are also likely to carry a potential for lead exposure. When asked to assess the likelihood of employee lead exposures at their facility, however, 72 (71%) of the companies responded that their employees were unlikely or definitely not exposed to lead at work (Figure 4).

Figure 4. Employers' self-reported likelihood of employee lead exposure at their facilities

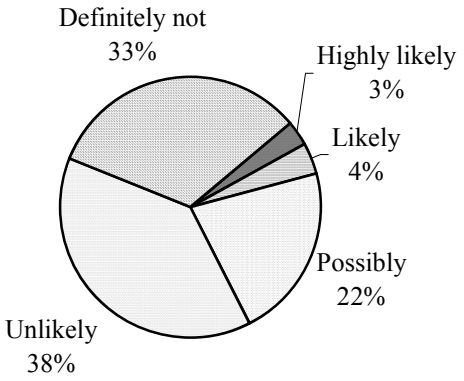


Table 1 presents the lead hazard awareness level (likelihood of employee lead exposures as reported by the company owner) in relation to the percentage of these companies that reportedly

conducted personal air monitoring. Only 10% of the surveyed companies reported performing personal air monitoring to assess employee lead exposures. Of the 60 companies that performed torch cutting, only eight (13%) reported conducting personal air monitoring. Of the 72 companies that considered the likelihood of their employee lead exposure as "unlikely" or "definitely not", only one company reported performing personal air monitoring.

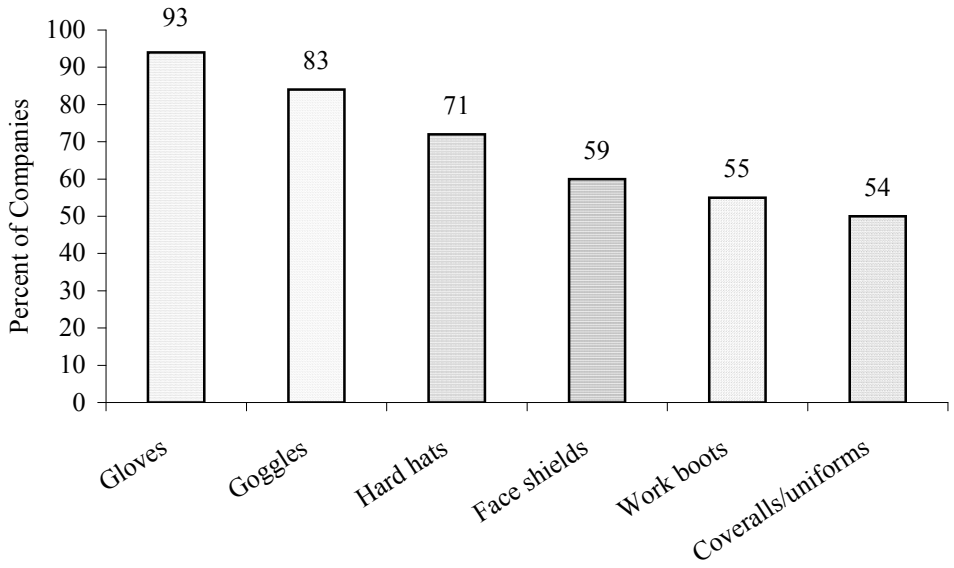
Table 1. Number of companies that reported conducting personal air monitoring in relation to their lead hazard awareness levels

Reported likelihood of employee lead exposure	Number of companies	Number of companies reporting conducting personal air monitoring	Percentage (%)
Highly likely	3	3	100
Likely	4	2	50
Possible	22	4	18
Unlikely	39	0	0
Definitely not	33	1	3

Of the 101 companies that responded to the survey, forty-five (45%) companies did not provide their workers with any respiratory protection and twenty-eight (28%) provided only disposable dust masks. Of the 60 companies that performed torch cutting, twenty-four (40%) companies provided their workers with half-face or full-face air purifying respirators (APR). Sixty percent (60%) of the companies that had torch cutting operations did not provide workers with any respiratory protection or provided only disposable dust masks.

With regard to other personal protective equipment, 94 (93%) of the 101 survey respondents provided their employees with gloves, 84 (83%) provided goggles, 72 (71%) hard hats, 60 (59%) face shields, 55 (54%) work shoes/boots, and 50 (50%) uniforms (Figure 5).

Figure 5. Personal protective equipment provided by the surveyed companies



With regard to hygiene facilities, 68 (67%) of the 101 survey respondents reported that they had lunchrooms, 81 (80%) had wash stations, 21 (21%) had showers, and 49 (49%) had lockers available.

We inquired about whether the companies had a biomonitoring program for lead. Of the 101 respondents, 15 (15%) reported that they provided blood lead testing for their employees at least once (Table 2). Eleven (18%) of the sixty companies that performed torch cutting reported having provided workers with blood lead monitoring at least once. With regard to frequency of biomonitoring, four (4%) of the companies reported that they offered blood lead testing annually, six (6%) semiannually, and 2 (2%) quarterly. The likelihood of having a biological monitoring program in place increased with the self-reported likelihood of employee lead exposure (Table 3).

Table 2. Biological monitoring reported by participating companies

	Total Number	Companies Offered Biomonitoring	Percentage (%)
Total survey population	101	15	15
Companies that torch cut	60	11	18

Table 3. Number of companies that reported providing biological monitoring in relation to their self-reported likelihood of lead exposure

Reported Likelihood of Lead Exposure	Number of companies	Reported providing biomonitoring
Highly likely	3	3 (100%)
Likely	4	2 (50%)
Possibly	22	5 (23%)
Unlikely	39	4 (10%)
Definitely not	33	1 (3%)

On-Site Industrial Hygiene Evaluations

Of the eight facilities that received IH on-site evaluations, employment ranged from four to sixty workers. Seven facilities belonged to trade associations. Six were ISRI members and one was a member of the Automotive Recyclers' Association of New York.

Two facilities recycled automobiles in addition to other scrap metals. Seven sites had torch cutting operations, seven sheared metal, four stripped communication cables, and one disassembled radiators. Overall, the eight facilities appeared representative of the mail surveyed population in terms of the types of metal recycling tasks performed by the workers.

Table 4 summarizes the employers' assessment of the likelihood of lead exposure in the workplace, whether torch cutting was conducted, and the availability of the key elements of a lead safety program at each facility. All but two companies reported that occupational lead exposures were at least possible while recycling scrap metals. Seven facilities reported performing torch cutting either weekly or monthly. One of the seven companies did not provide any respiratory protection to the torch cutters, three provided only disposable dust masks, and the remaining three provided half-face or full-face air purifying respirators (APR) with P100 (high efficiency particulate air-HEPA) filters to the workers. Two of the three companies that provided APR also provided qualitative respirator fit testing for the employees.

Table 4. Summary of employers' assessment of the likelihood of occupational lead exposures, torch cutting activity and the availability of key elements of a lead safety program

Facility	Reported Likelihood of Lead Exposure	Perform Torch Cutting	Respirator Protection	Respirator fit testing	Bio-monitoring	Showers	Require Change Clothing
G	Highly likely	No	No[1]		Yes	Yes	Yes
C	Likely	Yes	Dust mask	No	No	No	No
D	Likely	Yes	½ APR + P100, dust mask	Yes	Yes	Yes	No
A	Possibly	Yes	No		No	No	No
B	Possibly	Yes	Full APR + P100	Yes	Yes	No	Yes
E	Possibly	Yes	½ APR + P100, sup. air	No	Yes	No	No
F	Unlikely	Yes	Dust mask	No	No	No	No
H	Unlikely	Yes	Dust mask	No	No	No	Yes

[1] *Respiratory protection was not needed at site G based on the personal air monitoring results.*

Of the eight facilities visited, two (D and G) had showers available. Three (B, G and H) required their employees to change into their work clothes before the beginning of the work shift and to change back to their street clothes after work.

Air Sampling Results

A total of 27 personal air samples were collected during the eight industrial hygiene site visits. Eighteen samples were analyzed for lead only, eight were analyzed for cadmium and lead and one sample was analyzed for cadmium, cobalt, lead and nickel. The monitoring was done to evaluate workers' exposures as they performed typical metal recycling tasks. Neither cadmium nor cobalt was detected in the samples. Nickel was detected in Sample No. 5 when the worker was cutting new plate steel and the concentration during sample time was 8.1 micrograms of nickel per cubic meter of air ($\mu g/m^3$). This level is well below the OSHA's Permissible Exposure Limit (PEL) of 1000 $\mu g/m^3$, that is based on an 8-hour time weighted average (TWA) exposure *(12)*. NIOSH recommends that workers' 8-hour TWA exposure to nickel should not exceed 15 $\mu g/m^3$ *(13)*. The American Conference of Governmental Industrial Hygienists (ACGIH) has established a TWA threshold limit value (TLV) for nickel as 1500 $\mu g/m^3$ *(14)*.

The results of the personal air monitoring for lead are presented in Table 5. OSHA requires an employer to comply with the General Industry Lead Standard (29CFR1910.1025). The OSHA action level (AL) is defined as an airborne concentration of lead of 30 $\mu g/m^3$ averaged over an 8-hour period. If the OSHA AL is exceeded, employee personal air monitoring, medical surveillance and employee training are mandated. OSHA also established a PEL of 50 $\mu g/m^3$ based on an 8-hour TWA exposure. Employers are required by OSHA to keep workers' airborne

lead exposures below the PEL through implementing engineering controls and providing personal protective equipment. Both NIOSH and ACGIH have recommended 50 $\mu g/m^3$ as a TWA lead exposure limit *(13, 14)*.

Personal air samples were collected on six torch cutters (Samples 1-6) at five facilities. Five of the six torch cutters used oxy-propane torches and one used an oxy-acetylene torch. The materials that were cut during the monitoring included painted machine parts, unpainted highway guard rails, unpainted new plate steel, aluminum and copper. Sample times ranged from 89 to 172 minutes. The time-weighted average of lead concentrations during the sample time (Sample Time TWA) ranged from below the laboratory's limit of detection (LOD) to 320 $\mu g/m^3$. If these workers performed essentially the same tasks as being monitored during their entire eight-hour work shift, the Sample Time TWA would be equivalent to the workers' 8-hour TWA exposures and would be compared with the OSHA PEL.

The lead concentrations for the torch cutters (Samples 4 and 5) at facility B and H were the highest: 250 $\mu g/m^3$ and 320 $\mu g/m^3$ respectively. Both workers' exposures during their sample time (166 minutes and 124 minutes respectively) exceeded the OSHA PEL. If these workers had no additional lead exposure during the duration of their 8-hour shift, the 8-hour TWAs for the torch cutters at facility B and facility H would be 86 $\mu g/m^3$ and 83 $\mu g/m^3$, respectively. At facility H, the workers were reported to perform torch cutting usually up to six hours a day; the 8-hour TWA for such a worker with the sampled concentration would be 240 $\mu g/m^3$ or 4.8 times the OSHA PEL.

Table 5. Personal air sampling results

Sample ID Number	Site ID	Job Description	Materials being Cut	Sample Time (min.)	Lead [1] Concentration ($\mu g/m^3$)	Respiratory Protection	Compare TWA exposure in sample time with PEL
1	F	Torch cutting	Unpainted new plate metal	133	2	No	<PEL
2	D	Torch cutting	Assorted scrap metal	145	29	No	<PEL
3	**A**	**Torch cutting**	**Scrap metal**	**89**	**110**	**No**	**Exceeds PEL**
4	**B**	**Torch cutting**	**Unpainted highway guard rails**	**166**	**250**	**Yes**	**Exceeds PEL**
5	**H**	**Torch cutting**	**Unpainted new plate steel**	**124**	**320**	**No**	**Exceeds PEL**
6	D	Torch cutting	Nonferrous metal	172	<11 [2]	No	<PEL
7	C	Operating a baler		192	16	No	<PEL
8	D	Operating a baler		191	<11 [2]	No	<PEL
9	B	Operating a crane		169	<1 [2]	No	<PEL
10	F	Operating a crane		135	<1 [2]	No	<PEL
11	D	Operating a forklift		167	<11 [2]	No	<PEL
12	**H**	**Disassembling radiators**		**119**	**67**	**No**	**Exceeds PEL**
13	**H**	**Disassembling radiators**		**32**	**210**	**No**	**Exceeds PEL**
14	H	Sorting copper		164	13	No	<PEL
15	H	Sorting brass		146	<1 [2]	No	<PEL
16	C	Operating a shear		203	13	No	<PEL
17	C	Operating a shear		202	18	No	<PEL
18	E	Manual sorting scrap		150	3	No	<PEL
19	F	Sorting in warehouse		141	3	No	<PEL
20	G	Sorting in yard		121	5	No	<PEL
21	G	Sorting in yard		121	6	No	<PEL
22	A	Sorting nonferrous		136	7	No	<PEL
23	D	Sorting scrap		192	<11 [2]	No	<PEL
24	E	Welding		250	4.9	No	<PEL
25	**E**	**Abrasive blasting**		**41**	**578**	**Yes**	**Exceeds PEL**
26	C	Dumping wheel weights		22	<20 [2]	No	<PEL
27	C	Repairing a saw		56	<9 [2]	No	<PEL

[1] For each set of personal air samples, a minimum of one blank field blank samples was collected and all lead concentrations reported were blank corrected.

[2] The concentration of lead in this sample was below the laboratory's limit of detection (LOD).

Although six facilities indicated that the workers were provided with some kind of respiratory device (see Table 4), only one (Facility B) provided its torch cutter with respiratory protection (a full-face APR with dual P100 HEPA cartridges) at the time of the monitoring. The other torch cutters, including the one at Facility H whose exposure exceeded the OSHA PEL, were not wearing any respiratory protection during sample time.

Table 5 also presents the personal air sample results collected from 21 workers who performed metal recycling tasks other than torch cutting. While the lead concentrations measured during most of the tasks were low or even below the LOD, two samples taken during radiator disassembly and the one obtained during sandblasting exceeded the OSHA PEL during the sample time.

At facility H, two workers (Samples 12 and 13) were monitored while they disassembled auto radiators. Their tasks involved separating steel support pieces from the radiators using a hatchet and a pneumatic chisel. The air lead concentrations for the two workers were 67 $\mu g/m^3$ (worker 012) and 210 $\mu g/m^3$ (worker 013) during the sampling periods of 119 minutes and 32 minutes respectively. Neither of the workers wore respiratory protection.

Facility E had a maintenance/welding shop where workers repaired and refinished vehicles and equipment. The abrasive blaster was reported sandblasting an average of four to six hours a day. Based on the air monitoring results, the blaster's 8-hour TWA would be 289 $\mu g/m^3$ if he blasted four hours a day, assuming that he had no additional lead exposure during the other four hours of his shift. The blaster wore a supplied air blasting hood with continuous flow while he was being monitored.

Wipe Sampling Results

A total of 40 wipe samples were collected to evaluate surface contamination in non-production areas at the eight facilities. The sample results for lunchrooms, bathrooms and miscellaneous surfaces are reported in Tables 6, 7 and 8 respectively.

Sixteen wipe samples taken from lunchrooms in six metal recycling facilities had lead dust concentrations ranging from below the LOD (<45 $\mu g/ft^2$) up to 1,710 micrograms of lead per square foot ($\mu g/ft^2$) (see Table 6). The mean lead dust concentration on the surfaces in lunchrooms was 221 $\mu g/ft^2$ and the median was 89.1 $\mu g/ft^2$.

Table 6. Lunchroom surface sample results for lead

Sample ID	Site ID	Surfaces	Concentration[1] (µg/ft^2)
1	D	Coffee counter	88.2
2	F	Coffee pot	108
3	H	Locker	<45[2]
4	B	Lunch table	<45[2]
5	D	Lunch table	162
6	E	Lunch table	810
7	F	Lunch table	1710
8	G	Lunch table	<45[2]
9	F	Microwave oven	135
10	G	Microwave oven	<45[2]
11	D	Microwave oven dial	189
12	B	Microwave oven front panel	<45[2]
13	H	Microwave oven top	189
14	D	Refrigerator handle	56.7
15	B	Table	90
16	G	Window ledge	<45[2]

[1] *For each set of wipe samples collected at a facility, a minimum of one blank field blank samples was collected and all lead concentrations reported were blank corrected.*
[2] *The concentration of lead in this sample was below the laboratory's limit of detection (LOD).*

The lead dust concentrations of the fourteen wipe samples from bathrooms in six facilities ranged from below LOD to 2070 µg/ft^2 on a paper towel dispenser (Table 7). The mean concentration was 465 µg/ft^2 and median 189 µg/ft^2.

Table 7. Bathroom surfaces' sample results for lead

Sample ID	Site ID	Surfaces	Concentration (µg/ft^2)[1]
17	F	First aid kit box	162
18	E	Paper towel dispenser front	<45[2]
19	B	Paper towel dispenser, handle	71
20	F	Shelf	324
21	A	Sink	216
22	E	Sink	351
23	A	Storage shelf	162
24	C	Toilet tank	1260
25	F	Toilet tank	<45[2]
26	H	Toilet top	45.9
27	H	Towel dispenser (in non ferrous area)	153
28	H	Towel dispenser (in ferrous area)	2070
29	E	Urinal top	990
30	E	Washing machine	702

[1] *For each set of wipe samples collected at a facility, a minimum of one blank field blank samples was collected and all lead concentrations reported were blank corrected.*
[2] *The concentration of lead in this sample was below the laboratory's limit of detection (LOD).*

Table 8 presents the results of the ten wipe samples collected from surfaces in a variety of locations other than bathrooms and lunchrooms. The highest level found was 23,400 µg/ft^2 on a microwave oven in an aluminum room where workers processed scrap aluminum and stored and ate their lunches.

Table 8. Miscellaneous surface sample results for lead

Sample ID	Site ID	Surfaces	Location	Concentration[1] (µg/ft^2)
31	H	Microwave oven	Aluminum room	23400
32	D	Locker door	Clean locker room	126
33	D	Locker top	Clean locker room	4500
34	D	Cubby	Locker room	135
35	H	Microwave oven	Locker room	<45[2]
36	G	Refrigerator top	Locker room	144
37	C	Desk	Office	1080
38	C	Locker	Office	<45[2]
39	A	Vending machine	Outdoor	243
40	G	Shelf	Shower room	216

[1] For each set of wipe samples collected at a facility, a minimum of one blank field blank samples was collected and all lead concentrations reported were blank corrected.
[2] The concentration of lead in this sample was below the laboratory's limit of detection (LOD).

During one of the site visits (Site B), we also collected wipe samples from workers' hands. Five wipe samples were collected after the workers washed their hands just before their lunch break. These workers performed different job duties with varied airborne lead exposures. The results are reported as micrograms of lead per hand (µg/hand) in Table 9. Lead was positively identified from all five workers' hands. The hand wipe samples were to demonstrate that workers may be exposed to lead through hand to mouth contamination regardless of their assigned jobs and the extent of airborne lead exposures, and they could ingest lead if they did not wash their hands well.

Table 9. Hand wipe results collected at site B for lead

Sample ID	Job title	Lead Concentration[1] (µg/ hand)
W1	Yard supervisor	12
W2	Crane operator	15
W3	Torch cutter	140
W4	Sorting, non-ferrous metal shop	34
W5	Worker, new steel shop	19

[1] For each set of wipe samples collected at a facility, a minimum of one blank field blank samples was collected and all lead concentrations reported were blank corrected.

Workers' Blood Lead Monitoring Data

At the time of our site visits, there were approximately 100 workers at the eight sites sorting, shearing, baling and cutting scrap metals. HMR data indicated that 20 (20%) of these workers received a total of 55 blood lead tests in 2000. Some of the tests were administered by workers'

private physicians rather than through company biological monitoring programs. Table 10 summarizes the eight facilities' biological monitoring status at the time of our site visits. Four sites A, C, F and H did not provide workers with blood lead tests. According to our personal air monitoring results, the torch cutters of companies A and H were exposed to airborne lead fume and dust exceeding the OSHA PEL during sample time.

Table 10. Summary of blood lead monitoring status in 2000 of the eight companies for the metal recycling yard workers

Site ID	Number of yard workers	Number of workers tested	Job titles of workers tested	Number of tests	BLL range (µg/dL)	BLL Mean (µg/dL)	BLL Median (µg/dL)	Frequency of testing
A	7	0	NA[1]	0	NA	NA	NA	NA
B	15	2	Torch cutter	12	27-161	64	49	Followed doctor's recommendations
C	7	0	NA	0	NA	NA	NA	NA
D	23	13	Torch cutter, ferrous and nonferrous yard labor	29	10-41	16	14	Baseline and semi-annual testing
E	12	1	Maintenance mechanic	1	17	17	17	No company set frequency
F	5	0	NA	0	NA	NA	NA	NA
G	4	4	Metal recycling labor	13	18-40	29	28	Semi-annual testing
H	27	0	NA	0	NA	NA		NA

[1] *Not applicable.*

Four facilities (B, D, E and G) provided blood lead monitoring for some of their yard workers during the year of 2000. Company B had two torch cutters and one of them became ill after cutting bridge steel for a few months. The worker went to see his personal physician who tested the worker's blood lead level. His initial BLL was 121 µg/dL, which is severely elevated. The company had neither performed personal air monitoring to assess the worker's airborne lead exposure, nor provided any lead awareness training to the torch cutters prior to assigning them the torch cutting job. The worker had been provided with a full-face air-purifying respirator with P100 cartridges, although he was not fit tested and the respirator did not fit well. After consulting with the BOH industrial hygiene staff, Company B began providing blood lead testing

for its two torch cutters in 2000. A total of 12 tests were provided that year; the torch cutters' BLL ranged from 27 to 161 μg/dL and the mean BLL was 64 μg/dL.

In responding to a torch cutter's elevated blood lead level of 41 μg/dL, Site D offered its thirteen yard workers with baseline and semiannual blood lead tests in 2000. A total of 29 blood lead tests were administered and the mean BLL was 16 μg/dL.

Facility G did not have a torch cutting operation; four workers sorted, sheared, and baled scrap metals. The facility did not have a biological monitoring program until 1996 when two workers found out that their children had elevated blood lead levels. Of the workers' children, a 23 month-old had a BLL of 25 μg/dL and a 13 month-old had a BLL of 27 μg/dL. The Centers for Disease Control and Prevention (CDC) defines an elevated BLL as 10 μg/dL for children younger than six years-old *(15)*. The two workers subsequently requested blood lead tests through their personal physicians; their initial blood lead levels were 26 μg/dL and 53 μg/dL, respectively. Based on the information gathered through the employee interviews and from the company, the BOH determined that the likely cause of the children's elevated blood lead was take-home lead from the fathers' metal recycling work. Following BOH's recommendations, Facility G started providing routine blood lead monitoring for all four employees in 1997.

At Facility G, the workers' main routes of lead intake was ingestion according to the results of the personal air monitoring. To reduce workers' exposures to lead dust through hand to mouth contamination, the BOH industrial hygiene staff recommended that the facility provide workers with a locker room with separate "dirty" and "clean" lockers, a lunchroom that was separated from the work area, and a shower room. Facility G completed the construction and the workers started using the hygiene facilities in April 2000. The workers changed into work clothes at the beginning of their work shift, showered at the end of a workday and changed into their street clothes before leaving for home. During their lunch break, the workers removed the outer layer of their work uniforms and boots, put on clean slippers, washed their hands and then entered the lunchroom for lunch in their under shirts and pants. These measures effectively reduced the employees' lead exposures as reflected in the reduction of the workers' blood lead levels. One worker whose blood lead level had been above 40 μg/dL since 1997 had a BLL below 30 μg/dL for the first time in 2000. The workers' mean BLL in 1997 was 42 μg/dL; it declined to 29 μg/dL in 2000. The workers' mean BLL was 25 μg/dL in 2005.

During the five years (from 2001 to 2005) after our site visits, facilities B, D and G continued monitoring their yard workers blood lead levels. The number of workers being monitored, and the number of tests administered at each facility varied every year, and the testing frequencies at each facility were not consistent over the time. Among the three facilities, the number of people being tested every year ranged from one to six and the number of annual tests administered ranged from two to sixteen. There were no clear statistical trends demonstrated by the BLL data among the three facilities.

Although both Sites E and F had on-going torch cutting operations, neither provided regular blood lead testing to the workers who had lead exposures. Site E had one worker tested twice while Site F provided three workers with a total of five blood lead tests during the five years following our site visits.

Follow-up Telephone Survey

The follow-up survey found that the seven facilities still recycled the same types of materials and metals as reported during the initial survey. However, three of the seven companies reported that they increased shearing operations as a substitute for torch cutting to reduce workers' lead exposures.

Two facility representatives stated that they provided torch cutters with better respiratory protection. One of the two companies upgraded the torch cutters' respirators from half-face APR to full-face APR with P100 filters. The other facility replaced the torch cutter's disposable dust mask with a half-face APR with P100 filters and provided respirator fit testing.

According to the follow-up telephone survey, the surveyed facilities reported across the board improvements in providing employees with personal protective equipment and hygiene facilities such as lunchrooms, lockers and showers. The number of facilities that provided employee lunchrooms increased from two to four. Two more companies provided workers with lockers and showers. The reported improvement could not be verified since no on-site evaluations were conducted.

When asked whether workers would be exposed to lead while cutting new steel, six facility representatives answered no. When asked whether workers would be exposed to lead while cutting unpainted scrap, four company representatives answered no.

DISCUSSION

Employee Airborne Lead Exposures

It is important to recognize when reviewing the personal air sample results that monitoring occurred on only one day at each facility. The work conditions and contaminant concentrations could vary significantly from day-to-day or even during a work shift. Some factors that can influence workers' airborne lead exposures in the various scrap yard operations include: the types of metal (composition and coating) being processed, the amounts of those metals, the condition of the equipment and the machinery involved, the skills and techniques of the persons who conducted the tasks, and the weather. The air sampling results are representative only to the extent that the conditions on the day of monitoring were "typical" of that job.

For workers who do more than one job during a typical 8-hour shift, one needs to monitor the exposure they receive while performing each task to determine their total exposure for the work shift. The formula for calculating an 8-hour TWA that involves different tasks with varied exposures is "$C_1T_1+C_2T_2+C_3T_3+\ldots)/480$" *(12)*. "$C_1$" represents the lead concentration for the first task performed, "C_2" the concentration for the second task, etc. "T_1" represents the time (in minutes) that the first task is performed, "T_2" is the time for the second task, etc.

Among all the typical metal recycling tasks, torch cutting showed the greatest potential for serious lead exposure (see Table 5). When asked to assess lead hazards associated with torch cutting different scrap metals during the survey, the majority of the companies considered that unpainted metal presented less lead hazards and new steel presented none. The survey found that some companies only require workers to use respirators when cutting galvanized steel (lead is a common impurity in zinc that is used for galvanizing steel) or painted metals (lead-based paint). The companies' decision was based on the assumption that lead only existed in painted or galvanized coatings.

However, lead is one of the elemental metals that are commonly used as an additive by steelmakers to enhance the steel's machinability *(16)*. For example, Grade 12L14, a free-machining steel widely used throughout the world, contains up to 0.35 percent (%) lead by weight *(4,5,16)*. Lead is used in the manufacturing of other ferrous and non-ferrous metals or alloys for its unique characteristics *(5)*. Torch cutting these metals can release substantial amounts of lead fume and dust as demonstrated by our air monitoring results. Two of the samples (ID #004 and #005) had sufficiently high lead concentrations that, even if the workers were exposed to no lead for the remainder of their work shift, their 8-hour TWA would still exceed the OSHA PEL. Both workers were cutting unpainted steel; the worker (#005) at facility H was cutting new steel from a local fabrication shop.

Scrap comes to recycling facilities from a variety of sources and the exact content or composition of the materials being processed by metal recycling workers are usually unknown. Given the difficulty in predicting the specific and precise lead and other toxic metal contents in any metal, a good industrial hygiene practice is for workers to wear respiratory protection during torch cutting of any scrap metal.

Besides torch cutting, radiator disassembly is also a relatively high-risk operation and workers can be potentially exposed to lead levels exceeding the OSHA PEL.

The workers who performed sorting, shearing, baling and moving metal with vehicles were exposed to relatively low airborne concentrations (from below LOD up to 18 $\mu g/m^3$). Although the air lead concentrations during these operations may be influenced by the factors that were discussed in the first paragraph of the Discussion section, the monitoring results in this study did not exceed the OSHA action level (AL) of 30 $\mu g/m^3$ for general industry *(7)*. For the workers who performed these operations, the employers should focus on minimizing ingestion of lead through hand to mouth contamination.

Surface Lead Contamination and Workers Exposures Through Ingestion

During metal recycling processes, lead dust can be generated and dispersed through the air, eventually settling on surfaces both inside and outside the work area, and on workers' exposed hair, skin, clothes and shoes. Lead can accumulate on surfaces over time if the facility is not kept clean of lead dust. When surfaces have lead dust on them, a worker may touch those surfaces, and then may pick up food, a cigarette, or touch his mouth with his hand. This can result in the accidental ingestion (eating) of lead, which is then absorbed into the body.

The OSHA General Industry Lead Standard *(7)* contains housekeeping provisions that address the issue of surface contamination, but there are currently no threshold levels of surface contamination included in the OSHA standards. The United States Environmental Protection Agency (EPA) has defined dangerous levels of lead dust in deteriorated paint, settled dust on floors and window sills, and soil *(17)*. Although the EPA standard is often used as a reference when evaluating surface dust accumulation and the effectiveness of housekeeping, it should be noted that the EPA levels are principally intended to protect young children in the home, and may not be directly applicable to an industrial setting. Under the EPA's recent (2000) standard, the threshold concentration for floors is 40 $\mu g/ft^2$, for interior window sills is 250 $\mu g/ft^2$ and for window troughs is 400 $\mu g/ft^2$.

Many of the wipe samples that were collected on lunchroom surfaces during the site visits had measurable levels of lead dust. Given that food and beverages are consumed in those areas, this represents a risk of lead ingestion. Some of the samples obtained in the restrooms indicate similar concern. For example, finding a concentration of 2070 $\mu g/ft^2$ on a towel dispenser is problematic, given that a worker may touch his mouth or face after obtaining a towel.

In one of the facilities, some workers took their lunch break in the "aluminum room", where aluminum was sorted, sheared and baled. A microwave oven placed in the aluminum room was used by the workers to heat their lunches. The lead dust concentration on top of the microwave was very elevated at 23,400 $\mu g/ft^2$. It was recommended to the company that eating, drinking, and smoking in that area (and other lead work areas) be prohibited.

It is critical that workers wash their hands thoroughly before eating, drinking or smoking in order to minimize their risk of ingesting lead. Practicing good personal hygiene requires involvement of both management and workers. At the facility where the hand wipes were collected, certain work areas were considered by both management and employees as "clean" and "lead free", such as the "new steel" shop where only new steel was processed and handled. Hand washing was not required by management for the workers who worked in those areas or who did not perform torch cutting. All the hand wipe samples were collected after workers washed their hands and were ready to eat their lunches. The highest lead dust accumulation (140 μg) was found on a torch cutter's hand. The worker in the "new steel" shop had 19 μg of lead dust on his hand. The supervisor who did not do yard work had 12 μg of lead dust on his hand. The hand wipe sample results demonstrated that there was no such area as "clean" and "lead free" in a metal recycling facility, and that all metal recycling tasks present a potential hazard for lead ingestion. Practicing correct hand washing technique is one way to reduce ingestion of lead.

The lead dust that settled on workers' clothes and shoes can also pose a hazard. Even if a lunchroom is completely separate from all production areas, workers can track lead into the room if they don't clean the lead dust off their work clothes before entering the lunchroom. The dust should be removed with a high efficiency particulate air (HEPA) vacuum (not with compressed air) to avoid dispersing lead dust into the air.

In addition to regular cleaning, one facility (Site G) required all of its employees to remove the outer layer of their work uniforms and boots, put on clean slippers, wash their hands and then enter the lunchroom to eat in their under shirts and pants. By doing that, they were able to keep

the concentration of lead dust on their lunchroom surfaces below the analytical detection limit (Table 6).

Workers can also inadvertently bring lead dust home on their clothes and in their hair, potentially exposing family members to lead. Most vulnerable are young children less than two years of age. Such take-home exposures can and should be minimized. A shower facility with separate "clean" and "dirty" lockers can help prevent cross contamination between the workplace and workers' homes. With this system, a worker leaves the production area, enters the "dirty" locker room, removes his clothes, showers, and goes directly into the "clean" locker room before donning clean clothes, getting into his vehicle and traveling home after work.

Biological Monitoring for Lead

Our mail survey found that 85% of the metal recycling companies did not provide workers with biological monitoring for lead. Since the survey question did not differentiate between routine, on-going biological monitoring for lead that was part of a company lead safety program and sporadic or one-time blood lead testing, the percentage of the companies without regular biological monitoring for lead could be even higher.

Among the companies that provided blood lead testing, few initiated the biological monitoring for lead proactively. Some companies provided minimum testing in responding to OSHA citations, while others only started monitoring their workers' blood lead levels after a worker or workers' family members (including children) were diagnosed with lead poisoning by the workers' private physicians.

Most companies that offered blood lead testing only had their torch cutters tested. Very few companies provided blood lead testing to the workers who performed metal recycling tasks other than torch cutting such as sorting, baling and shearing. The HMR data showed that workers could have lead poisoning through ingestion while handling scrap metals by hand. Workers can also inadvertently bring lead dust home and poison their family members, including children who are more susceptible to lead poisoning (as it happened at Facility G).

The BLL data of Facilities B, D and E that mainly monitored torch cutters' blood lead levels did not demonstrate clear statistical trends during the five years following the BOH on-site consultations. This may be due to the limited numbers of workers being tested, limited number of tests administered on each worker annually and inconsistent testing frequencies. Overall, the metal recycling industry as a whole has not integrated biological monitoring for lead into its routine safety and health programs.

Air monitoring can only determine workers' airborne lead exposures. Biological monitoring can assess workers' exposures to lead through both inhalation and ingestion. Symptoms of lead poisoning may be subtle and non-specific at early stages of lead poisoning; timely blood lead monitoring can offer early detection. Workers elevated blood lead levels may indicate problems in engineering controls, personal protective equipment, personal hygiene or housekeeping. Early detection of workers' elevated blood lead levels can lead to prompt industrial hygiene

intervention that can prevent further exposures and protect workers from suffering irreversible health effects.

Worker Exposures to Other Metals

In addition to lead, metal recycling workers may be exposed to other metals. A NIOSH study found that besides lead, torch cutters were also exposed to elevated levels of arsenic, cadmium, copper, iron and nickel fumes and dusts *(18)*. Our personal air samples did not find significant airborne exposures to cobalt and cadmium. One worker was exposed to nickel at a concentration of 8.1 $\mu g/m^3$ while torch cutting new steel that came from a local fabricating shop. Although this level is well below the OSHA PEL of 1000 $\mu g/m^3$ and ACGIH TWA of 1500 $\mu g/m^3$, it is more than half of the Threshold Limit Value (TLV) of 15 $\mu g/m^3$ recommended by NIOSH. Nickel is often combined with other metals to form alloys. The U.S. Department of Health and Human Services (DHHS) has determined that nickel metal may reasonably be anticipated to be a carcinogen *(19)*. The general control measures for occupational lead exposures discussed above would also be used to control exposures to nickel and other metals during metal recycling processes.

Employer Awareness of Workplace Lead Exposures

Our survey found that the greater the employer's awareness of workplace lead exposures, the greater the likelihood that the employer will conduct personal air monitoring (Table 1) and implement a biological monitoring program (Table 3).

Based on our survey results, metal recycling workers are exposed to lead on a daily bases from both inhalation and ingestion. However, of the 101 companies that completed our survey, 72 (71%) of them considered that occupational lead exposure was unlikely to or definitely did not occur at their facilities. These survey results demonstrate that efforts should be made to increase the awareness on the part of scrap yard owners as to the prevalence, extent and magnitude of occupational lead exposures in the metal recycling trade.

CONCLUSIONS

Metal recycling workers can be exposed to lead through both inhalation and ingestion while performing typical metal recycling tasks. Torch cutting and radiator disassembly may generate lead dust and fume concentrations exceeding the OSHA PEL. New or unpainted steel is not "clean" or "lead free". Torch cutters' airborne lead exposures can exceed the OSHA PEL even while cutting steel that may mistakenly be assumed to be lead-free.

Ingestion is a significant potential route of lead exposure for all workers at a metal recycling facility. It is prudent to assume that all of the scrap metal handling areas and adjacent support areas, such as lunchrooms, bathrooms, and offices have lead surface contamination. Workers' hands can be contaminated with lead dust even when they work in so called "non-lead" areas, such as a new steel shop. Personal air monitoring cannot assess the extent of the workers' lead

exposure through ingestion. The only method that can assess exposure in this situation is biological monitoring (conducting regular blood lead testing).

Owners of metal recycling companies did not understand the widespread nature of occupational lead exposures in their facilities and the importance of biological monitoring. The majority of the metal recycling companies in New York State are either single person operations or have less than 10 employees (see Figure 2). Educating this population presents a special challenge, since these small companies may have limited occupational safety and health resources.

RECOMMENDATIONS

1. **Occupational health and safety professionals and other stakeholders should raise employers' awareness of occupational lead exposures in metal recycling operations.**

Governmental agencies, metal recycling industry trade organizations, safety and health professionals, workers' compensation carriers and other stakeholders should work together to help educate the employers of the metal recycling industry and raise their awareness of occupational lead exposure in the trade. The effort should be focused on developing effective educational materials and intervention strategies, disseminating the materials to the target population, and evaluating the effectiveness of the education materials through follow up surveys.

2. **Employers should implement engineering controls to reduce workers' lead exposures in metal recycling operations.**

The first and best strategy is to control the hazard at its source, and engineering controls are generally recommended to achieve that goal *(20)*. Employers should eliminate workplace hazards or reduce exposure to hazards by implementing engineering controls to the extent feasible. The following engineering controls may be adopted to reduce workers' exposures to metals while performing typical metal recycling tasks:

- Replace torch cutting with other cutting methods that generate less lead fume and dust, such as shearing; and
- Provide local exhaust ventilation to the workers who disassemble radiators. Employers may want to refer to the ACGIH Industrial Ventilation manual for examples of local exhaust hood designs *(21)*.

3. **Employers should implement employee lead training programs.**

Employers should provide employees with lead training on a regular basis, preferably annually. Workers should be informed of the hazards of lead exposure, correct methods for using respiratory protection, good personal hygiene, the benefits of biological monitoring, and the dangers of contaminating their homes with lead from work. The workers should also learn the proper techniques and practices to minimize lead exposure for each job assignment.

4. Employers should institute a biological monitoring program to assess employee exposures to lead.

Employers should institute a biological monitoring program for all employees potentially exposed to lead. The metal recycling companies are encouraged to follow the guidelines developed by the New York State Occupational Health Clinic Network (OHCN) *(22)*. These guidelines, originally developed for the construction industry exceed OSHA biological monitoring requirement for the general industry and offer an early detection of blood lead poisoning:

- Initial blood lead test before beginning work involving lead;
- Blood lead test every month in the following circumstances:
  - For the first three months of work; or
  - If the previous blood lead level was greater than 25 µg/dL ; or
  - If the previous blood lead level was at least 50 µg/dL (*a follow-up test within two weeks and medical removal is strongly recommended);* or
  - If an increase of at least 10 µg/dL from the previous test is observed;
- Blood lead test every two months in the following circumstances:
  - When the blood lead level remains below 25 µg/dL for three months; and
  - If an increase less than 10 µg/dL from the previous test is observed;
- Blood lead test every six months in the following circumstances:
  - When the blood lead levels remain below 25 µg/dL for six months; and
  - If an increase less than 10 µg/dL from the previous test is observed.

The employee blood lead test results may be charted and recorded in a graph or a spreadsheet format that is easily understood and can offer a historical perspective to the worker and the company. The companies could utilize the spreadsheet to look for trends and to perform hazard evaluation for specific jobs.

5. Employers should provide respiratory protection to all workers who perform torch cutting, radiator disassembly and other tasks with high airborne lead exposures.

Engineering controls should be implemented first to reduce workers' airborne lead exposures to the lowest feasible. Torch cutters should be wearing respirators whenever they cut, since their exposures vary significantly.

Each facility should develop and implement a written respiratory protection program. The employees who perform torch cutting, radiator disassembly, and any other tasks that could subject them to significant lead exposures should be placed in the program. The workers should wear at least half-face respirators with dual P100 (HEPA) cartridges whenever they torch cut, or disassemble radiators. An employee who is required to use a respirator should receive a medical evaluation, a respirator fit test, and training on respirator usage and maintenance, as per the OSHA Respirator Standard (29CFR1910.134) and OSHA lead standard (29CFR1910.1025)

6. Employers should require employees to clean the respirators and other personal protective equipment daily.

The interior and exterior surfaces of workers' respirators and other personal protective equipment should be cleaned daily to prevent lead dust contamination and subsequent lead ingestion by the workers who use the PPE. A sink with cleaning supplies should be available for this purpose.

7. Employers should provide hygiene facilities.

Employers should provide clean lunchrooms separate from the production areas. Workers should store food and drink in the lunchrooms. A locker room with separate "clean" and "dirty" areas should be available to allow workers to store their work and street clothes and shoes separately to avoid cross contamination. Showers should be available for the workers who perform tasks that emit high levels of lead dust and fume. Workers should shower and change to their clean clothing and shoes after their work shift to prevent "take-home" lead.

8. Employers should prohibit eating, drinking, and smoking in lead contaminated areas and employees should practice good personal hygiene.

Workers should not eat, drink, or smoke in any work area where there is potential contamination with lead dust. Signs clearly prohibiting such activities should be posted prominently in those areas. Employees should clean the dust off their clothes with a HEPA vacuum (and ideally remove their outer clothing) before taking a lunch break. All the production employees should be instructed to wash their faces and hands before eating, drinking, smoking, or taking breaks.

Employers should provide a brush and hand soap for hand washing. Workers should learn and practice good hand washing techniques, such as rubbing and scrubbing with a brush vigorously, and rinsing with a copious quantity of water.

Employees who perform certain tasks with significant lead exposures, such as torch cutting and radiator disassembling, should shower at the end of their shift. All employees with lead exposures should change into work clothes and shoes at the beginning of their work shift and back into street clothes and shoes afterwards to avoid exposing their family members to "take home" lead. Work clothes should be stored and laundered separately to avoid cross contamination.

9. Employers should develop an effective housekeeping program to reduce surface lead dust accumulation.

The lunchrooms and bathrooms should be cleaned daily to reduce lead dust accumulation. A HEPA filter vacuum should be used to clean floors. Wet methods can prevent surface dusts from becoming airborne. Dry sweeping should be prohibited. Cleaning should be done with detergent and water.

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Exhibit 6.

R 007537

RECEIVED
JUN 20 1994
STATE OF ILLINOIS
POLLUTION CONTROL BOARD

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
CATEGORIES OF INSIGNIFICANT ACTIVITIES OR EMISSION LEVELS AT A CAAPP SOURCE, AMENDMENTS TO 35 ILL. ADM. CODE PARTS 201 AND 211.	)	R94-14 (Rulemaking)

Testimony of Christopher Romaine
Illinois Environmental Protection Agency

June 1994

I. INTRODUCTION

My name is Christopher Romaine. I am testifying for the Illinois Environmental Protection Agency ("Agency"). I am employed as Manager of the New Source Review Unit of the Permit Section in the Division of Air Pollution Control.

I have a Bachelor of Science Degree in Engineering from Brown University and have completed course work toward a Masters Degree in Environmental Engineering from Southern Illinois University. I am a Professional Engineer. I have worked for the Agency since June 1976.

As manager of the New Source Review Unit, I have programmatic responsibility for permitting activities related to certain federal or federally derived rules for new or modified sources. These rules include New Source Performance Standards (40 CFR Part 60), Prevention of Significant Deterioration of Air Quality (40 CFR 52.21), and Major Stationary Sources Construction and Modification (35 Ill. Adm. Code Part 203). I assist permit analysts in the Division of Air Pollution Control in their review of permit applications and examine their work. I am also responsible for coordination of Permit Section activities with respect to these programs with the United States Environmental Protection Agency ("USEPA") and the Agency's program development.

As part of my duties at the Agency, I assist in certain aspects of program development for the Division of Air Pollution Control. One of these is the development of regulations. I have been the Agency's technical expert in Board proceedings regarding New Source Review rules: R81-16, R85-20, and R92-21. I have also

participated in numerous regulatory proceedings dealing with the control of Volatile Organic Material emissions, including R86-18, R91-8, and R93-9.

I was a member of the Agency workgroup chaired by Donald Sutton, Manager of the Air Permit Section, that developed this proposal. My testimony provides the technical support for the Agency's proposal. The purpose of this rulemaking is to amend Parts 201 and 211 to define insignificant activities or emission levels for purposes of Illinois' Clean Air Act Permit Program. The testimony includes an overview of the Clean Air Act Permit Program, an explanation of the Agency's proposed approach to insignificant activities and emission levels, and a detailed discussion of the proposed amendments.

II. OVERVIEW

A. Historical Background

Section 502(d) of the Clean Air Act, as amended in 1990, required Illinois to develop and submit to USEPA a permit program that meets the requirements of Title V of the Clean Air Act and the federal regulations promulgated thereunder (40 CFR Part 70). Illinois adopted new Section 39.5 of the Environmental Protection Act ("Act") establishing Illinois' program known as the Clean Air Act Permit Program or "CAAPP." This program is intended to meet all federal requirements. Draft application forms and other necessary documentation and supporting procedures have also been generally developed by the Agency. On November 15, 1993, the Agency submitted Illinois' CAAPP program to USEPA for approval. Implementation of the CAAPP by the Agency will begin when the program is approved by USEPA. All

CAAPP applications for existing major sources are to be submitted in the year following approval of the program by USEPA. The Agency is to complete issuance of permits for these sources within three years of program approval by USEPA.

Although the federal regulations allow for States to designate insignificant activities and emission levels for State Title V programs, States are not required to do so. The CAAPP currently submitted to USEPA does not specifically identify such activities or emission levels. However, the Agency is required, pursuant to Section 39.5(5)(w) of the Act, to propose regulations to the Board defining insignificant activities or emission levels for purposes of CAAPP permitting. These regulations must be consistent with the federal regulations for Title V permit programs. The federal regulations provide that 1) the Administrator may approve as part of a State program a list of insignificant activities and emission levels which need not be included in permit applications, 2) for insignificant activities which are exempted because of size or production rate, a list of such insignificant activities must be included in the permit, and 3) an application may not omit information needed to determine the applicability of, or to impose, any applicable requirement (See 40 CFR 70.5(c)).

The Agency has submitted the proposed amendments to 35 Ill. Adm. Code Part 201 to the Pollution Control Board to comply with the mandate of Section 39.5(5)(w) of the Act. The Agency is also proposing amendments to 35 Ill. Adm. Code Part 211 to add definitions for certain terms used in the proposed amendments to Part 201. Upon adoption by the Board, the Agency will be submitting these amendments to Parts 201 and 211 to USEPA for review as an additional aspect of Illinois' CAAPP.

Accordingly, the scope of insignificant activities and emission levels is a potential concern for all sources required to have CAAPP permits. These sources include any "major source" as defined in Section 39.5(2)(c) of the Act.

The proposed amendments to Part 201, Subpart F, would establish insignificant activities and emission levels at a CAAPP source. Classification of an activity or emission level as insignificant is relevant primarily for purposes of preparing a CAAPP application. It is also relevant for the subsequent content of the CAAPP permit. It is also important for the ongoing operation of a source because it is expected that an owner or operator of a CAAPP source will not be required to address insignificant activities in anywhere near the same level of detail as other activities at the CAAPP source.

The classification of an activity as insignificant, so that detailed emission data would not have to be provided, would also effectively exclude the activity from consideration for purposes of fees. This impact should be minimal, for both sources and the Agency, if insignificant activities and emission levels are established appropriately. Moreover, the Clean Air Act requires the CAAPP to be self-sustaining, irrespective of the treatment of insignificant activities and emission levels.

It must be stressed that classification of activities as insignificant cannot be relied upon for purposes of applicability, that is, to show that a source is not a major source. For purposes of applicability, insignificant activities can count, and a source cannot rely on them as the difference between being a major and non-major source. In this respect, a source that is required to submit a CAAPP application, but is seeking

a Federally Enforceable State Operating Permit ("FESOP"), may have to provide additional information about insignificant activities. This additional information will have to show that the restrictions in a FESOP will ensure that the source is not a major source, even after accounting for all emissions from insignificant activities.

D. Coordination with Current State Operating Permit Program

35 Ill. Adm. Code Part 201 contains Illinois' regulations requiring state operating permits for sources of air pollution. In addition to addressing insignificant activities and emission levels for CAAPP permitting, proposed Subpart F also provides that the existing state operating permit requirement and associated permitting procedures do not apply for purpose of the CAAPP. This is intended to avoid confusion between the existing state operating permit program and the new federal CAAPP operating permit program.

III. EXPLANATION OF AGENCY PROPOSAL FOR INSIGNIFICANT ACTIVITIES

The Agency's proposal represents a multi-layered approach to insignificant activities, with four layers or classes of insignificant activities. The first layer identifies various "non-traditional" activities at sources, such as cafeterias, office equipment, groundskeeping, vehicle maintenance, building maintenance, etc., that are considered insignificant. These activities are not routinely permitted now and the Agency proposes to formalize this practice for purposes of the CAAPP. In conjunction with these provisions, the proposal also clarifies that certain emission units, such as leaking components, should be addressed as a group rather than individually in a CAAPP application. The second layer identifies a number of specific categories of equipment

and operations, such as "small" boilers, "small" tanks and "small" printing operations, below certain sizes or activity levels that can be considered insignificant. In the third layer, the proposal establishes emission levels that are considered insignificant. These levels are set for those regulated air pollutants that are not listed as hazardous air pollutants. The proposed insignificant emission levels for these pollutants are 0.1 pound/hour and 0.44 ton/year, expressed as emissions prior to any control device. The final layer of the Agency's approach to insignificant activities is a case-to-case process whereby a source may propose that an activity with emissions of up to 1.0 pound/hour be considered insignificant, subject to acceptance or rejection by the Agency.

The four classes of activities proposed by the Agency to be insignificant are further differentiated based on whether an activity must be individually listed in an application. All of the "non-traditional" activities and some of the specific "traditional" activities need not be individually listed in the application. These activities do not include size or throughput restrictions and these activities are expected to be present at most if not all sources. (See proposed 35 Ill. Adm. Code 201.210(b)). All of the other insignificant activities, including the other traditional emission units, the emissions criteria activities, and the case-by-case activities must be individually listed. (See proposed 35 Ill. Adm. Code 201.210(a)). Based on the list of insignificant activities submitted in a CAAPP application, the Agency or USEPA may find during the course of permitting that an activity should not qualify as insignificant. Such a finding might be based on the amount of emissions from an emission unit or applicable air

pollution control requirements. In such circumstances, the owner or operator of a source would be required to supplement the application to address the activity and allow the Agency to prepare a CAAPP permit which appropriately addresses such activity. During a field inspection, Agency personnel may also verify whether the activities listed in an application were properly identified as insignificant by the owner or operator of the CAAPP source.

This multi-layered approach to insignificant activities was developed to provide simplicity and certainty for CAAPP permitting generally, while still allowing flexibility on a case-by-case basis. It is intended to assure that the environmental goals of Title V of the Clean Air Act are achieved, while minimizing the procedural and administrative burden on CAAPP applicants and the Agency.

The first class of insignificant activities, the "nontraditional" activities, is the one that I find most interesting. In day to day practice, the current state air pollution control permit program has been focused on individual equipment and operations, using what I can only describe as administrative common sense. The Agency has not required permits for cafeterias where cooking may release smoke and volatile organic material or maintenance of buildings which may involve painting, blasting, or welding. For purposes of the CAAPP, which is Illinois' version of the federal Title V permit program, it is appropriate to better define the activities of routine interest at a stationary source. It is apparent that there are a variety of activities at stationary sources that will not fit into a CAAPP permit, at least on an individual basis, because of limited impact on the environment, transitory nature, uncertainty of emissions,

unpredictability of occurrence, or coincidental relationship to the source. To avoid any uncertainty in CAAPP permitting, the Agency is proposing to identify such activities as "insignificant".

In this respect, it is important to note that there may be requirements and obligations with respect to air pollution control that exist outside the CAAPP permit. For example, it is wholly inappropriate to address in a CAAPP permit individual asbestos removal activities, each use of architectural coating, each application of fertilizer to lawns, smoking by employees, or each job performed by refrigeration repair workers. The owner or operator of CAAPP sources will still be required to comply with control requirements for such activities, if such control requirements apply to the owner or operator of a source.

The Agency has also realized that even for equipment that is of interest for air pollution control, the Agency has used administrative common sense in implementing the State permit programs. The Agency has focused on stationary equipment and assemblages of components, termed "emission sources" under the existing State permit programs. The Agency also proposes to use the provisions for insignificant activities to formally continue this practice. The Agency is proposing to identify certain activities individually to be insignificant, e.g., an individual valve or pipeline flange in a chemical process or a particular engine being run on an engine test stand. In the absence of this clarification, these activities might inappropriately be treated as individual emission units. These activities, which will be referred to as emission points, are, however, to be addressed in the aggregate, as the group of components

The insignificant activities addressed in this subsection are required to t individually listed in a CAAPP application and generally contain eligibility criteria terms of emissions, capacity, size, materials being handled, and so forth. The listin of an activity in an application provides general notice to the Agency, USEPA, and th public that specific activities that are deemed insignificant are occurring at a source

i. Section 201.210(a)(1)

This subsection makes reference to the case-by-case process fo insignificant activities in proposed Section 201.211, which allows an emissio unit with up to 1.0 pound/hour emissions to be considered insignificant.

ii. Section 201.210(a)(2) and (a)(3)

These subsections establish the emission levels at and below which unit's emission of regulated pollutants other than hazardous air pollutants, e.g. particulate matter and volatile organic material, may be considered insignificant These cut-offs are 0.1 pound/hour or less and 0.44 ton/year, in the absence o air pollution control equipment.

iii. Section 201.210(a)(4) through (a)(18)

These subsections identify specific activities, that is, categories o equipment, which are proposed to be insignificant and for which individua listing in an application would be required. This portion of the Agency's proposal is generally self-explanatory and one should refer to the proposed rule for the specific equipment that the Agency is proposing for this treatment.

b. Section 201.210(b)(1) through (b)(29)

The insignificant activities proposed in this subsection are both traditional and nontraditional activities that the Agency would propose to not have individually listed in a CAAPP application. Rather, the applicant would denote in its CAAPP application whether any of the listed activities are present at the source. The Agency intends to provide a space on the CAAPP application form for insignificant activities whereby the applicant can indicate whether one or more of these activities are present.

Many of these provisions are self explanatory, and one is again referred to the Agency's proposal. A discussion of selected provisions follows, for which additional explanation is provided.

i. Section 201.210(b)(9)

This subsection addresses housekeeping activities, but does not include the use of cleaning materials that contain organic solvent. This Section is intended to address both portable vacuum cleaning equipment and centrally located vacuum cleaning systems used to collect dust as part of housekeeping activity. As such, it would not extend to continuously operated aspiration systems to control dust emissions. This section has also been written to accommodate immediate cleanup of solids or liquids following a spill or accidental release. In certain situations, reporting requirements or liability may apply to such a cleanup, pursuant to provisions for emergency releases. However, it is not appropriate to address or delay the remedial cleanup activity by CAAPP permitting.

ii. Section 201.210(b)(10)

criteria is specified at 68°F, (0.1 psi, measured at 68°F) as solvent vapor pressure data may be more readily available for a temperature of 68°F.

vi. Section 201.210(b)(20)

This subsection addresses a variety of manually operated equipment used for buffing, polishing, carving, cutting, drilling, machining, routing, sanding, sawing, scarfing, surface grinding, or turning. This subsection is supported by a proposed definition of "manually operated equipment" in Section 211.3620. The term manually operated equipment does not extend to central dust collection systems serving more than one machine or tool. The emissions from such central dust collection systems will be affected by the number and type of manually operated equipment being served, and therefore, it is not appropriate to extend this category to include such systems.

vii. Section 201.210(b)(21)

This subsection addresses the use of consumer products where the product is used at a source in a manner similar to the use the general public would make of a product. This use of consumer products extends to hazardous substances used in the same manner as normal consumer use.

viii. Section 201.210(b)(23)

This subsection addresses firefighting and firefighting training activities; provided, however, as specifically stated in a note, that state open burning permits may be required for certain firefighting training activity pursuant to 35 Ill. Adm. Code Part 237.

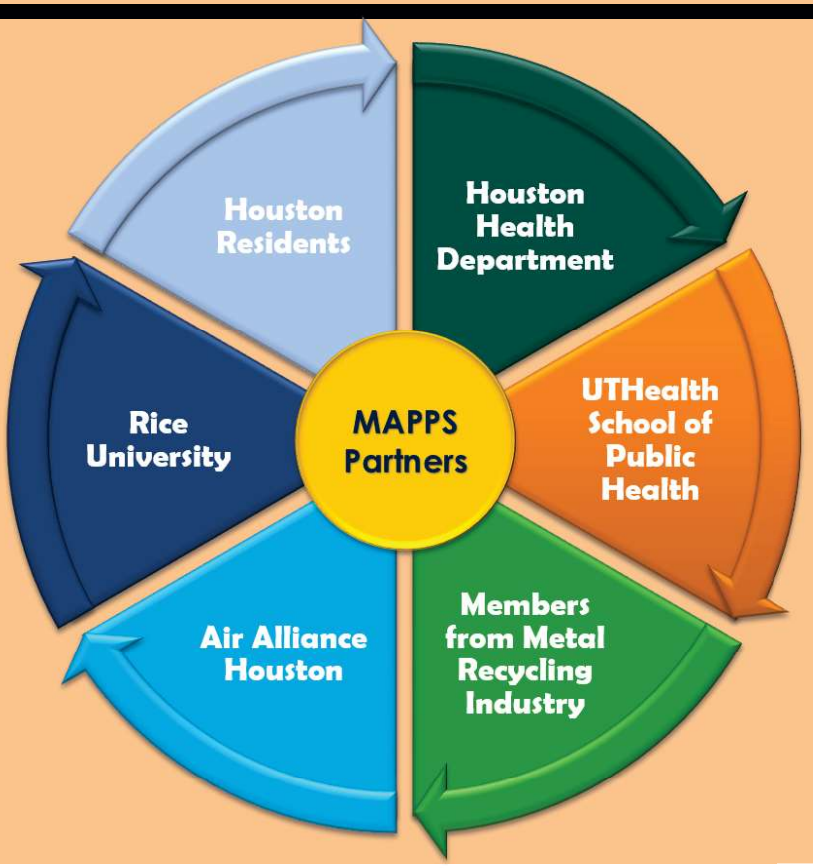
MAPPS: Metal Air Pollution Partnership Solutions

Clean Air and Healthy Communities

UTHealth
The University of Texas
Health Science Center at Houston
School of Public Health
Southwest Center for Occupational and Environmental Health

2018 MAPPS REPORT
South Park near Allied Alloys

MAPPS is a research-to-action project, with multiple partners, to find ways to improve environmental health in your community.

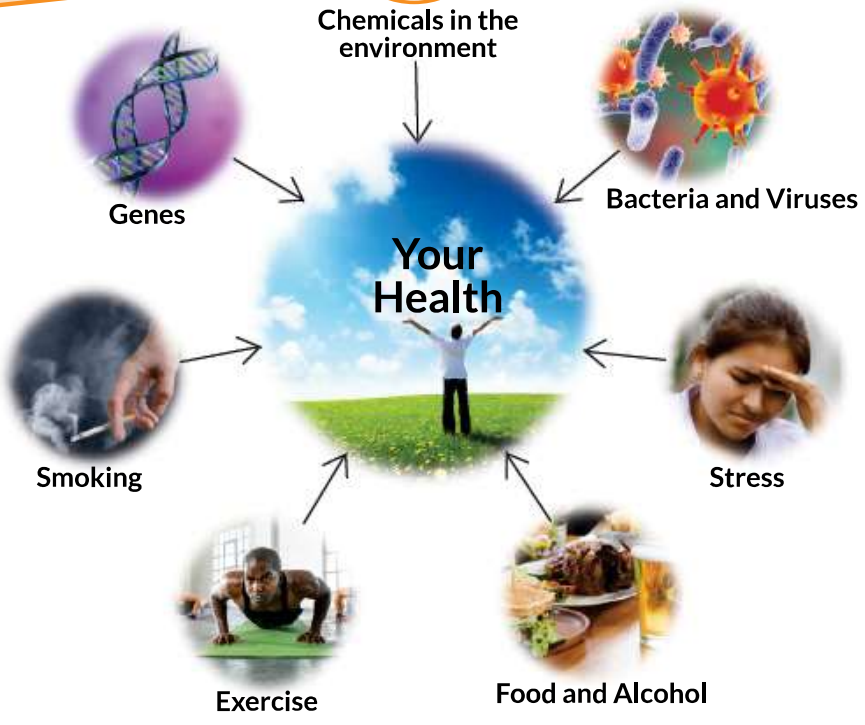


Metal air pollution from Allied Alloys

Chemicals in the environment

Many factors impact health such as chemicals in the air, water and soil. These chemicals include metals that come from traffic emissions and industries like scrap metal recyclers.

In response to 311 complaints about various metal recyclers, we launched the MAPPS project to learn more about possible health impacts due to metal air pollution from metal recyclers in Houston communities.



OUR GOALS

We are working together to improve the air quality and health of Houston communities near metal recycling facilities by:

1. minimizing metal air pollution from metal recycling facilities
2. developing partnerships between residents and metal recyclers
3. increasing community awareness about environmental health

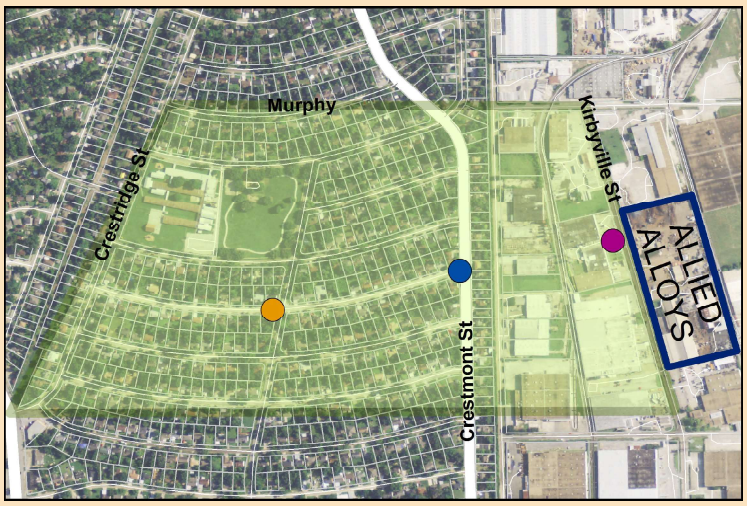
OUR WORK IN YOUR COMMUNITY

- We measured metals in the air at three sampling locations.
- We used the metal air measurements to estimate the increased lifetime risk for cancer and other diseases.

- We conducted a door-to-door survey to learn more about residents' views on industries and air quality.

- We used our risk assessment and survey findings to develop a plan of action.
- We are working with metal recyclers and residents to improve environmental health in your community.

The map shows our air sampling locations and survey area



- Allied Alloys
- The area where we conducted the door-to-door survey

Three sampling locations:

- Closest to Allied Alloys
- 925 ft. away from Allied Alloys
- 1905 ft. away from Allied Alloys

MAPPS RISK ASSESSMENT

1. The purpose of our risk assessment was to provide a basis for developing an action plan to improve community health.

2. We estimated the increased risk for cancer and other diseases over a 70-year lifetime from breathing metals in the air from Allied Alloys for 30 years.

3. We assumed that metal emissions from Allied Alloys will stay the same over 30 years.

4. Our assessment did not consider other sources of metals in the air or other ways to come in contact with metals.

5. Although not evaluated in our study, the health risks are likely to be greater for children, pregnant women, the elderly and the sick.

6. The results cannot be used to say that a person's illness was caused by breathing metal air pollution in the past or that breathing metal air pollution now will cause an illness in the future.

Estimated Risks for Diseases other than Cancer

What diseases may be a concern?

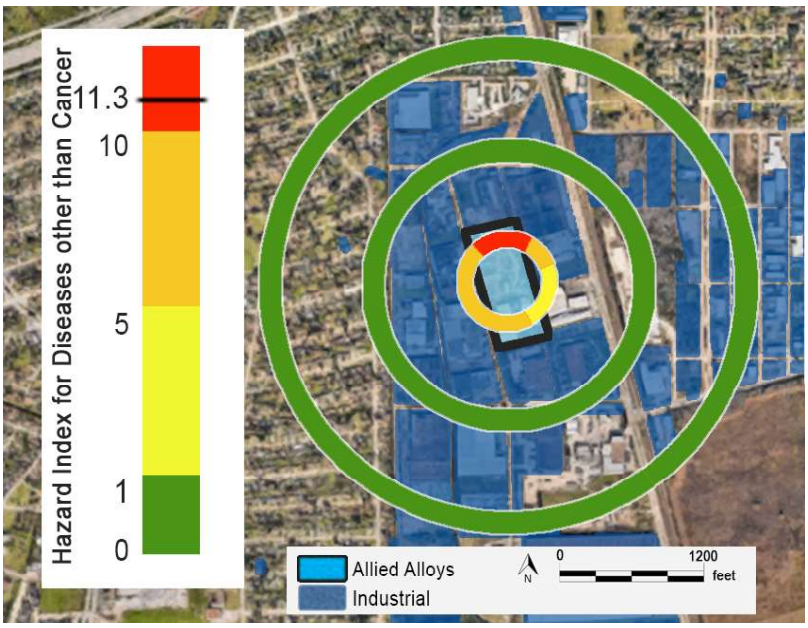
People who breathe toxic metals in the air can develop diseases in their skin, nose/sinuses and lungs such as **skin irritation, nasal irritation, bronchitis and lung inflammation.**

What is Hazard Index (HI)?

The risk of developing other diseases is presented as **a Hazard Index (HI) by organ in the human body such as nose/sinuses and lungs**.

What are our key findings?

- The Hazard Index (HI) was **highest at the location closest to Allied Alloys** and decreased with distance away from the facility. There are currently no residents living at the location closest to the facility.
- **The HI for developing** nasal irritation and upper respiratory distress ranged from 0.3 to 11.3.
- **The HI for developing** bronchitis, lung inflammation and difficulty breathing ranged from 0.3 to 11.2.
- The risks for diseases other than cancer would decrease if metal air pollution decreases; the risks would increase if metal air pollution increases.



How does the Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ) interpret a Hazard Index (HI) in their regulatory programs?

An HI greater than 1 does not mean that diseases other than cancer will occur. The EPA recommends considering other reasons that may make people sick when deciding whether the risk is acceptable.

Increasing risk for diseases other than cancer

HI = 1

HI = 10

The EPA considers an HI equal to or below 1 as "acceptable."

The TCEQ uses HI = 10 as an action level in their regulatory program.

Estimated Risks for Cancer

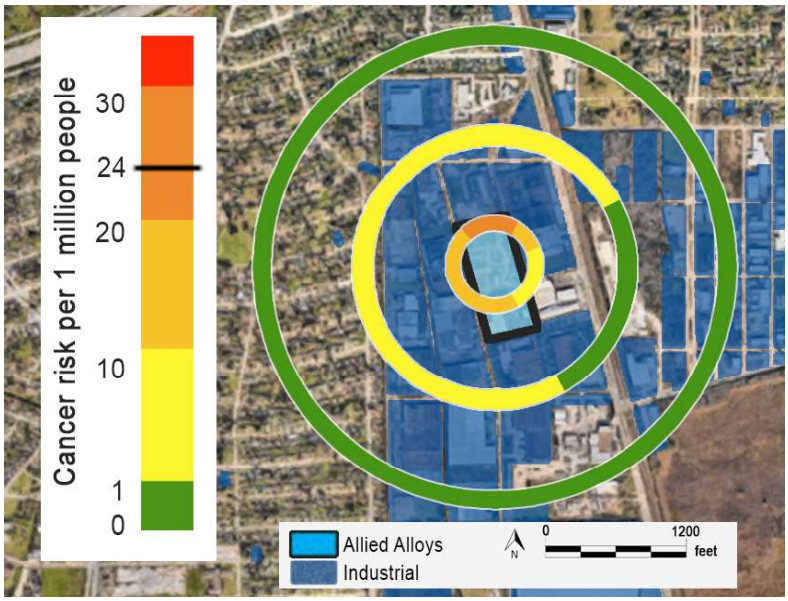
What is cancer risk?

Cancer risk is presented in terms of the number of extra cancer cases out of 1 million people that may occur due to pollution.

1 cancer case in 1 million means that if 1 million people were breathing air pollution for 30 years at a specific level, there may be 1 additional person who gets cancer over a 70-year lifetime.

What are our key findings?

- Chances of developing cancer were **highest at the location closest to Allied Alloys** and decreased with distance away from the facility. There are currently no residents living at the location closest to the facility.
- Cancer risks ranged from less than 1 case to 24 cases in 1 million people.
- The risks for cancer would decrease if metal air pollution decreases; the risks would increase if metal air pollution increases.



How does the Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ) interpret levels of cancer risk in their regulatory programs?

The TCEQ uses a range between 10 cancer cases and 100 cancer cases in 1 million people to trigger potential action in their regulatory program.

1 cancer case in 1 million | 10 cancer cases in 1 million | 100 cancer cases in 1 million

The EPA set a risk level no higher than 100 cancer cases in 1 million people for individuals living near an industrial facility and an individual lifetime risk level to be no higher than 1 cancer case in 1 million people to protect the greatest number of people possible.

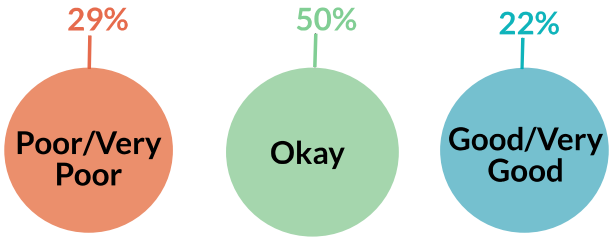
SURVEY RESULTS

Who answered our questions?

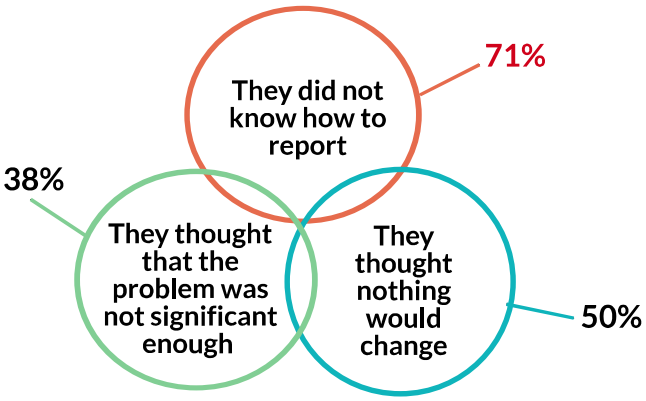
- 105 residents completed the survey.
- 67% lived in the neighborhood for over 5 years.
- 60% were female, 40% were male.
- 60% were Black, 37% were Hispanic.

44% of participants said that they know about Allied Alloys

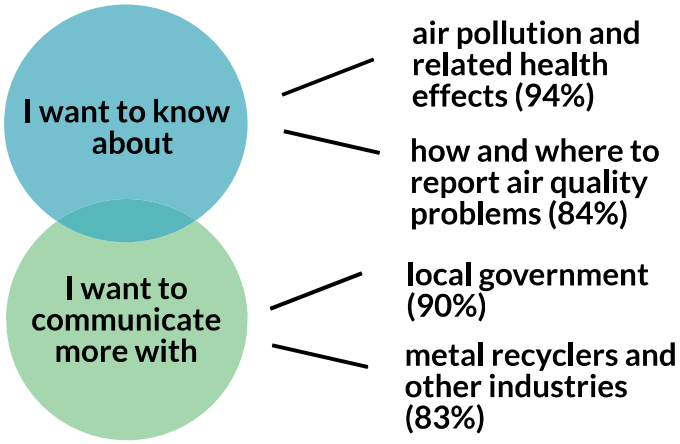
I think the air quality in my neighborhood is:



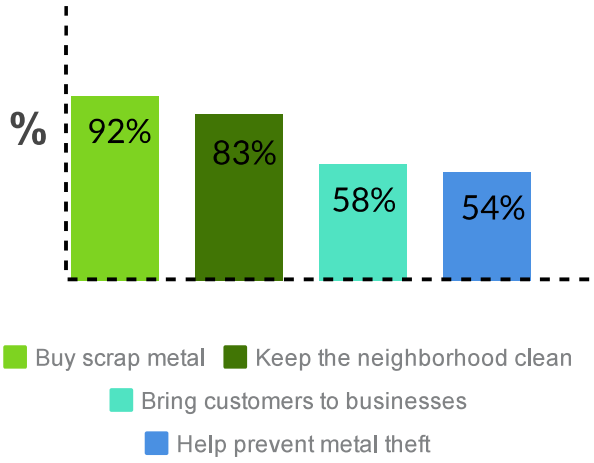
People who had a problem with air quality, did not report it because:



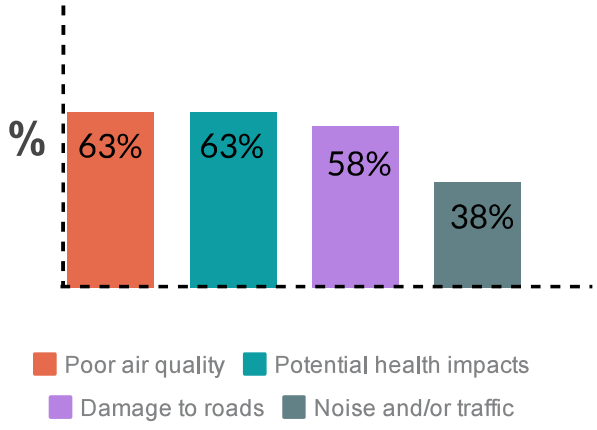
To improve air quality and health in my neighborhood:



The top four benefits of having metal recyclers in my neighborhood are that they:



The top four concerns of having metal recyclers in my neighborhood are:



Do I have similar concerns about other industries?

WHAT WE ARE DOING BASED ON OUR FINDINGS

Minimizing metal emissions from metal recycling facilities.

Allied Alloys has voluntarily and collaboratively:

- Increased fence height to 20 feet.
- Added additional processing equipment to reduce torch cutting.
- Outsourced majority of torch cutting while evaluating other technology to further reduce metal emissions.

Improving communication and collaboration between MAPPS partners and residents.

- Hold community forum to introduce MAPPS partners and inform the community about the findings and action plan.
- Participate in existing community events.
- Provide information on how to communicate environmental health concerns to Allied Alloys and Houston's 311 Call system.
- Track complaints.

Improving neighborhood capacity to address possible environmental health concerns.

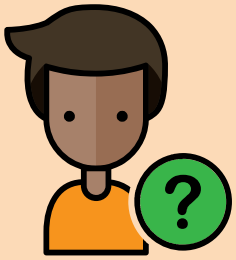
- Provide training to residents to become environmental health leaders in your neighborhood.
- Support trainee-initiated outreach activities in the neighborhood.

WHAT YOU CAN DO

Learn how to contact Allied Alloys or 311 about environmental concerns

Attend MAPPS environmental health leadership training

Invite MAPPS partners to neighborhood meetings



Contact us with questions

GET IN TOUCH WITH US

Elaine Symanski, PhD, PI
713.500.9238

https://go.uth.edu/MAPPS

MAPPS@uth.tmc.edu

The MAPPS project is funded by National Institute of Environmental Health Science (NIEHS), grant no. 5R01ES023563.
The UTHealth CPHS has reviewed and approved. October 2018.

Ohio Environmental Protection Agency
John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

Certified Mail

5/7/2012

No	TOXIC REVIEW
No	PSD
No	SYNTHETIC MINOR TO AVOID MAJOR NSR
No	CEMS
No	MACT/GACT
No	NSPS
No	NESHAPS
No	NETTING
No	MAJOR NON-ATTAINMENT
No	MODELING SUBMITTED
No	SYNTHETIC MINOR TO AVOID TITLE V
No	FEDERALLY ENFORCABLE PTIO (FEPTIO)
No	SYNTHETIC MINOR TO AVOID MAJOR GHG

Dennis Stropko
Reserve, FTL, LLC, DBA Reserve Iron Ohio
1831 East Highland Road
Twinsburg, OH 44087

RE: FINALAIR POLLUTION PERMIT-TO-INSTALL AND OPERATE
Facility ID: 1576055014
Permit Number: P0107117
Permit Type: Initial Installation
County: Stark

Dear Permit Holder:

Enclosed please find a final Air Pollution Permit-to-Install and Operate (PTIO) which will allow you to install, modify, and/or operate the described emissions unit(s) in the manner indicated in the permit. Because this permit contains conditions and restrictions, please read it very carefully. Please complete a survey at www.epa.ohio.gov/dapc/permitsurvey.aspx and give us feedback on your permitting experience. We value your opinion.

The issuance of this PTI is a final action of the Director and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the Director's action. The appeal must be accompanied by a filing fee of $70.00, made payable to "Ohio Treasurer Josh Mandel," which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the Director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
309 South Fourth Street, Room 222
Columbus, OH 43215

If you have any questions, please contact Canton City Health Department at (330)489-3385or the Office of Compliance Assistance and Pollution Prevention at (614) 644-3469. This permit can be accessed electronically on the DAPCWeb page,www.epa.ohio.gov/dapc, by clicking the "Issued Air Pollution Control Permits" link.

Sincerely,

Michael W. Ahern

Michael W. Ahern, Manager
Permit Issuance and Data Management Section, DAPC

Cc: Canton

Ohio Environmental Protection Agency

FINAL

Division of Air Pollution Control
Permit-to-Install and Operate
for
Reserve, FTL, LLC, DBA Reserve Iron Ohio

Facility ID:	1576055014
Permit Number:	P0107117
Permit Type:	Initial Installation
Issued:	5/7/2012
Effective:	5/7/2012
Expiration:	5/7/2022

Ohio Environmental Protection Agency

Division of Air Pollution Control
Permit-to-Install and Operate
for
Reserve, FTL, LLC, DBA Reserve Iron Ohio

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Authorization

Facility ID: 1576055014
Application Number(s): A0039857
Permit Number: P0107117
Permit Description: Installation permit for scrap metal torch cutting operations that was initially installed in March 2008, with the addition of a fugitive particulate emission capture and control system in December 2010.
Permit Type: Initial Installation
Permit Fee: $1,250.00
Issue Date: 5/7/2012
Effective Date: 5/7/2012
Expiration Date: 5/7/2022
Permit Evaluation Report (PER) Annual Date: Jan 1 - Dec 31, Due Feb 15

This document constitutes issuance to:

Reserve, FTL, LLC, DBA Reserve Iron Ohio
1451 Trump Avenue NE
Canton, OH 44730

of a Permit-to-Install and Operate for the emissions unit(s) identified on the following page.

Ohio EPA District Office or local air agency responsible for processing and administering your permit:

Canton City Health Department
420 Market Avenue
Canton, OH 44702-1544
(330)489-3385

The above named entity is hereby granted this Permit-to-Install and Operate for the air contaminant source(s) (emissions unit(s))listed in this section pursuant to Chapter 3745-31 of the Ohio Administrative Code. Issuance of this permit does not constitute expressed or implied approval or agreement that, if constructed or modified in accordance with the plans included in the application, the described emissions unit(s) will operate in compliance with applicable State and federal laws and regulations.

This permit is granted subject to the conditions attached hereto.

Ohio Environmental Protection Agency

Scott J. Nally
Director

Authorization (continued)

Permit Number: P0107117
Permit Description: Installation permit for scrap metal torch cutting operations that was initially installed in March 2008, with the addition of a fugitive particulate emission capture and control system in December 2010.

Permits for the following Emissions Unit(s) or groups of Emissions Units are in this document as indicated below:

Emissions Unit ID:	**P901**
Company Equipment ID:	Torch Area
Superseded Permit Number:	
General Permit Category and Type:	Not Applicable

A. Standard Terms and Conditions

1. What does this permit-to-install and operate ("PTIO") allow me to do?

This permit allows you to install and operate the emissions unit(s) identified in this PTIO. You must install and operate the unit(s) in accordance with the application you submitted and all the terms and conditions contained in this PTIO, including emission limits and those terms that ensure compliance with the emission limits (for example, operating, recordkeeping and monitoring requirements).

2. Who is responsible for complying with this permit?

The person identified on the "Authorization" page, above, is responsible for complying with this permit until the permit is revoked, terminated, or transferred. "Person" means a person, firm, corporation, association, or partnership. The words "you," "your," or "permittee" refer to the "person" identified on the "Authorization" page above.

The permit applies only to the emissions unit(s) identified in the permit. If you install or modify any other equipment that requires an air permit, you must apply for an additional PTIO(s) for these sources.

3. What records must I keep under this permit?

You must keep all records required by this permit, including monitoring data, test results, strip-chart recordings, calibration data, maintenance records, and any other record required by this permit for five years from the date the record was created. You can keep these records electronically, provided they can be made available to Ohio EPA during an inspection at the facility. Failure to make requested records available to Ohio EPA upon request is a violation of this permit requirement.

4. What are my permit fees and when do I pay them?

There are two fees associated with permitted air contaminant sources in Ohio:

- PTIO fee. This one-time fee is based on a fee schedule in accordance with Ohio Revised Code (ORC) section 3745.11, or based on a time and materials charge for permit application review and permit processing if required by the Director.

  You will be sent an invoice for this fee after you receive this PTIO and payment is due within 30 days of the invoice date. You are required to pay the fee for this PTIO even if you do not install or modify your operations as authorized by this permit.

- Annual emissions fee. Ohio EPA will assess a separate fee based on the total annual emissions from your facility. You self-report your emissions in accordance with Ohio Administrative Code (OAC) Chapter 3745-78. This fee assessed is based on a fee schedule in ORC section 3745.11 and funds Ohio EPA's permit compliance oversight activities. Unless otherwise specified, facilities subject to one or more synthetic minor restrictions must use Ohio EPA's "Air Services" to submit annual emissions associated with this permit requirement.Ohio EPA will notify you when it is time to report your emissions and to pay your annual emission fees.

5. When does my PTIO expire, and when do I need to submit my renewal application?

This permit expires on the date identified at the beginning of this permit document (see "Authorization" page above) and you must submit a renewal application to renew the permit. Ohio EPA will send a renewal notice to you approximately six months prior to the expiration date of this permit. However, it is

very important that you submit a complete renewal permit application (postmarked prior to expiration of this permit) even if you do not receive the renewal notice.

If a complete renewal application is submitted before the expiration date, Ohio EPA considers this a timely application for purposes of ORC section 119.06, and you are authorized to continue operating the emissions unit(s) covered by this permit beyond the expiration date of this permit until final action is takenby Ohio EPA on the renewal application.

6. What happens to this permit if my project is delayed or I do not install or modify my source?

This PTIO expires 18 months after the issue date identified on the "Authorization" page above unless otherwise specified if you have not (1) started constructing the new or modified emission sources identified in this permit, or (2) entered into a binding contract to undertake such construction. This deadline can be extended by up to 12 months, provided you apply to Ohio EPA for this extension within a reasonable time before the 18-month period has ended and you can show good cause for any such extension.

7. What reports must I submit under this permit?

An annual permit evaluation report (PER) is required in addition to any malfunction reporting required by OAC rule 3745-15-06 or other specific rule-based reporting requirement identified in this permit. Your PER due date is identified in the Authorization section of this permit.

8. If I am required to obtain a Title V operating permit in the future, what happens to the operating provisions and PER obligations under this permit?

If you are required to obtain a Title V permit under OAC Chapter 3745-77 in the future, the permit-to-operate portion of this permit will be superseded by the issued Title V permit. From the effective date of the Title V permit forward, this PTIO will effectively become a PTI (permit-to-install) in accordance with OAC rule 3745-31-02(B). The following terms and conditions will no longer be applicable after issuance of the Title V permit: Section B, Term 1.b) and Section C, for each emissions unit, Term a)(2).

The PER requirements in this permit remain effective until the date the Title V permit is issued and is effective, and cease to apply after the effective date of the Title V permit. The final PER obligation will cover operations up to the effective date of the Title V permit and must be submitted on or before the submission deadline identified in this permit on the last day prior to the effective date of the Title V permit.

9. What are my obligations when I perform scheduled maintenance on air pollution control equipment?

You must perform scheduled maintenance of air pollution control equipment in accordance with OAC rule 3745-15-06(A). If scheduled maintenance requires shutting down or bypassing any air pollution control equipment, you must also shut down the emissions unit(s) served by the air pollution control equipment during maintenance, unless the conditions of OAC rule 3745-15-06(A)(3) are met. Any emissions that exceed permitted amount(s) under this permit (unless specifically exempted by rule) must be reported as deviations in the annual permit evaluation report (PER), including nonexempt excess emissions that occur during approved scheduled maintenance.

10. Do I have to report malfunctions of emissions units or air pollution control equipment? If so, how must I report?

If you have a reportable malfunction of any emissions unit(s) or any associated air pollution control system, you must report this to the Canton City Health Department in accordance with OAC rule 3745-15-06(B). Malfunctions that must be reported are those that result in emissions that exceed permitted emission levels. It is your responsibility to evaluate control equipment breakdowns and operational upsets to determine if a reportable malfunction has occurred.

If you have a malfunction, but determine that it is not a reportable malfunction under OAC rule 3745-15-06(B), it is recommended that you maintain records associated with control equipment breakdown or process upsets. Although it is not a requirement of this permit, Ohio EPA recommends that you maintain records for non-reportable malfunctions.

11. Can Ohio EPA or my local air agency inspect the facility where the emission unit(s) is/are located?

Yes. Under Ohio law, the Director or his authorized representative may inspect the facility, conduct tests, examine records or reports to determine compliance with air pollution laws and regulations and the terms and conditions of this permit. You must provide, within a reasonable time, any information Ohio EPA requests either verbally or in writing.

12. What happens if one or more emissions units operated under this permit is/are shut down permanently?

Ohio EPA can terminate the permit terms associated with any permanently shut down emissions unit. "Shut down" means the emissions unit has been physically removed from service or has been altered in such a way that it can no longer operate without a subsequent "modification" or "installation" as defined in OAC Chapter 3745-31.

You should notify Ohio EPA of any emissions unit that is permanently shut down by submitting[1] a certification that identifies the date on which the emissions unit was permanently shut down. The certification must be submitted by an authorized official from the facility. You cannot continue to operate an emissions unit once the certification has been submitted to Ohio EPA by the authorized official.

You must comply with all recordkeeping and reporting for any permanently shut down emissions unit in accordance with the provisions of the permit, regulations or laws that were enforceable during the period of operation, such as the requirement to submit a PER, air fee emission report, or malfunction report. You must also keep all records relating to any permanently shutdown emissions unit, generated while the emissions unit was in operation, for at least five years from the date the record was generated.

Again, you cannot resume operation of any emissions unit certified by the authorized official as being permanently shut down without first applying for and obtaining a permit pursuant to OAC Chapter 3745-31.

[1] Permittees that use Ohio EPA's "Air Services" can mark the affected emissions unit(s) as "permanently shutdown" in the facility profile along with the date the emissions unit(s) was permanently removed and/or disabled. Submitting the facility profile update will constitute notifying of the permanent shutdown of the affected emissions unit(s).

13. Can I transfer this permit to a new owner or operator?

You can transfer this permit to a new owner or operator. If you transfer the permit, you must follow the procedures in OAC Chapter 3745-31, including notifying Ohio EPA or the local air agency of the change in ownership or operator. Any transferee of this permit must assume the responsibilities of the transferor permit holder.

14. Does compliance with this permit constitute compliance with OAC rule 3745-15-07, "air pollution nuisance"?

This permit and OAC rule 3745-15-07 prohibit operation of the air contaminant source(s) regulated under this permit in a manner that causes a nuisance. Ohio EPA can require additional controls or modification of the requirements of this permit through enforcement orders or judicial enforcement action if, upon investigation, Ohio EPA determines existing operations are causing a nuisance.

15. What happens if a portion of this permit is determined to be invalid?

If a portion of this permit is determined to be invalid, the remainder of the terms and conditions remain valid and enforceable. The exception is where the enforceability of terms and conditions are dependent on the term or condition that was declared invalid.

B. Facility-Wide Terms and Conditions

1. This permit document constitutes a permit-to-install issued in accordance with ORC 3704.03(F) and a permit-to-operate issued in accordance with ORC 3704.03(G).

   a) For the purpose of a permit-to-install document, the facility-wide terms and conditions identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

      (1) None.

   b) For the purpose of a permit-to-operate document, the facility-wide terms and conditions identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

      (1) None.

C. Emissions Unit Terms and Conditions

1. P901, Torch Area

Operations, Property and/or Equipment Description:

Torch Cutting Operations: 3 Jet Torches, Propane/Oxygen, Victor HC1500C, used to cut large ferrous scrap metal pieces (tundish and skulls). Emissions controlled by a 3-sided enclosure with a roof vented to a baghouse.

a) This permit document constitutes a permit-to-install issued in accordance with ORC 3704.03(F) and a permit-to-operate issued in accordance with ORC 3704.03(G).

(1) For the purpose of a permit-to-install document, the emissions unit terms and conditions identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

a. None.

(2) For the purpose of a permit-to-operate document, the emissions unit terms and conditions identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

a. None.

b) Applicable Emissions Limitations and/or Control Requirements

(1) The specific operation(s), property, and/or equipment that constitute each emissions unit along with the applicable rules and/or requirements and with the applicable emissions limitations and/or control measures are identified below. Emissions from each unit shall not exceed the listed limitations, and the listed control measures shall be specified in narrative form following the table.

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
a.	OAC rule 3745-31-05(A)(3), as effective 11/30/2001 [Best Available Technology (BAT)]	Stack Emissions from the baghouse shall not exceed 0.15 pounds per hour and 0.66 tons per year of particulate matter less than 10 microns in diameter (PM_{10}). Fugitive (uncaptured) Emissions shall not exceed 1.68 pounds per hour and 7.36 tons per year of particulate emissions (PE). Compliance with this rule also includes compliance with OAC rule 3745-17-07(B) and 3745-17-08(B)(3) below. See b)(2)a, b)(2)c, b(2)e, and c)(1).

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
b.	OAC rule 3745-31-05(A)(3), as effective 12/01/2006 [Less than 10 tpy BAT exemption]	See b)(2)f.
c.	Director's Final Findings and Orders issued September 27, 2011, sections IV.14, IV.16, and IV.19.	See b)(2)b and c)(1).
d.	OAC rule 3745-17-07(A)	The emission limitation specified by this rule is less stringent than the emission limitation established pursuant to OAC rule 3745-17-08(B)(3).
e.	OAC rule 3745-17-07(B)	The fugitive (uncaptured) visible particulate emissions shall not exceed 20% opacity as a 3-minute average.
f.	OAC rule 3745-17-08(B)(3)	See b)(2)d, c)(1), and c(2).
g.	OAC rule 3745-17-11(B)	The emission limitation specified by this rule is less stringent than the emission limitation established pursuant to OAC rule 3745-17-08(B)(3).

(2) Additional Terms and Conditions

a. For the purposes of this permit, all particulate emissions (PE) are assumed to be particulate matter less than 10 microns in diameter (PM_{10}).

b. In accordance with the Director's Final Findings and Orders issued September 27, 2011, the permittee shall install and operate a capture and control system consisting of a 3-sided enclosure with a roof vented to a baghouse for the control of particulate matter emissions generated from the torch cutting operations.

c. The Best Available Technology (BAT) control requirements for this emissions unit have been determined to be the use of the capture and control system specified in b)(2)b. above, and compliance with the terms and conditions of this permit.

d. The permittee shall employ reasonably available control measures (RACM) to minimize or eliminate visible particulate emission of fugitive dust. These control measures shall include, but not be limited to, the following:

i. The installation and use of hoods, fans, and/or other equipment to adequately enclose, contain, capture, vent, and control fugitive dust from this emissions unit and shall meet the following requirements:

(a) the collection efficiency shall be sufficient to minimize or eliminate visible emissions of fugitive dust at the point(s) of capture to the extent possible with good engineering design; and

(b) the control equipment for this emissions unit shall achieve an outlet emission rate of not greater than 0.030 grain of particulate emissions per dry standard cubic foot of exhaust gases or there shall be no visible particulate emissions (whichever is less stringent) from the exhaust stack of this emissions unit.

The capture and control system described in paragraph b)(2)b. above satisfies these control measures.

ii. Employing good operating practices to minimize accidental fires. Such practices shall include, but not be limited to, the following items: cutting metal that is clean of any oils(s) or other combustible fluids, the minimization of flame impingement with the ground, and the use of appropriately sized cutting torches.

Implementation of the control measures mentioned above is appropriate and sufficient to satisfy the requirements of OAC 3745-17-08. Nothing in this paragraph shall prohibit the permittee from employing other control measures to ensure compliance.

e. With the emissions limits and control measures mentioned in term b)(1)a. above, the permittee has satisfied the Best Available Technology (BAT) requirements pursuant to Ohio Administrative Code (OAC) rule 3745-31-05(A)(3), as effective November 30, 2001. On December 1, 2006, paragraph (A)(3) of OAC rule 3745-31-05 was revised to conform to the Ohio Revised Code (ORC) changes effective August 3, 2006 (Senate Bill 265 changes), such that BAT is no longer required by State regulations for sources having potential to emit, taking into account controls, less than ten tons per year of emissions of a National Ambient Air Quality Standards (NAAQS) pollutant or precursor. However, that rule revision has not yet been approved by U.S. EPA as a revision to Ohio's State Implementation Plan (SIP). Therefore, until the SIP revision occurs and the U.S. EPA approves the revisions to OAC rule 3745-31-05, the requirement to satisfy BAT still exists as part of the federally-approved SIP for Ohio. Once U.S. EPA approves the December 1, 2006 version of OAC rule 3745-31-05, then the emission limitations and control measures listed in b)(1)a. no longer apply. See next section, b)(2)e.

f. This term only applies once U.S. EPA approves the December 1, 2006 version of OAC rule 3745-31-05 as part of the State Implementation Plan. In that case only, the following Terms and Conditions will apply instead of those listed under b)(1)a.:

i. The Best Available Technology (BAT) requirements under OAC rule 3745-31-05(A)(3) do not apply to the PE and PM_{10} emissions from this air contaminant source since the potential to emit for PE and PM_{10} are less than 10 tons/yr, taking into account air pollution controls.

ii. The control measure described in b)(2)b. above and the operational restriction in c)(1) below shall be utilized, not under a BAT requirement,

but rather pursuant to the Director's Final Findings and Orders issued September 27, 2011 and RACM per OAC rule 3745-17-08(B).

c) Operational Restrictions

(1) All torch cutting operations shall be performed within the enclosure and the baghouse shall be operating at all times during torch cutting operations.

(2) The permittee shall have fire extinguishers of the appropriate type located near the torch cutting operations and they shall be employed promptly to extinguish any accidental fires caused by the torch cutting operations.

(3) In accordance with OAC rule 3745-19-03, any open burning of solid waste (including combustible fluids) at this facility/location is prohibited.

d) Monitoring and/or Recordkeeping Requirements

(1) The permittee shall maintain daily records that document any time periods when the baghouse was not operating during torch cutting operations.

(2) The permittee shall perform daily checks, when the emissions unit is in operation and when the weather conditions allow, for (a) any visible particulate emissions from the baghouse stack serving this emissions unit and (b) fugitive visible particulate emissions from non-stack egress points of this emissions unit (i.e. open side of the enclosure, roof openings, etc). The presence or absence of any visible emissions shall be noted in an operations log. If visible emissions are observed, the permittee shall also note the following in the operations log:

a. for visible particulate emissions from the baghouse stack:

i. the color of the emissions;

ii. the total duration of any visible emissions incident; and

iii. any corrective actions taken to eliminate the visible emissions.

b. for fugitive visible particulate emissions not captured:

i. the color and location of the emissions;

ii. whether the emissions are representative of normal operations;

iii. if emissions are not representative of normal operations, the cause of the abnormal emissions;

iv. the total duration of any visible emissions incident; and

v. any corrective actions taken to eliminate the visible emissions.

For d)(2)b, if visible emissions are present, a visible emissions incident has occurred. The observer does not have to document the exact start and end times for the visible

emissions incident under item (iv) above or continue the check until the incident has ended. The observer may indicate that the visible emissions incident was continuous during the observation period (or, if known, continuous during operation of the emissions unit). With respect to the documentation of corrective actions, the observer may indicate that no corrective actions were taken if the visible emissions were representative of normal operations, or specify the minor corrective actions that were taken to ensure that the emissions unit continued to operate under normal conditions, or specify the corrective actions that were taken to eliminate abnormal visible emissions

(3) The permittee may, upon receipt of written approval from the Canton City Health Department, Air Pollution Control Division, modify the above-mentioned frequencies for performing the visible emissions checks if operating experience indicates that less frequent visible emission checks would be sufficient to ensure compliance with the above-mentioned applicable requirements.

e) Reporting Requirements

(1) The reports required by this permit may be submitted through the Ohio EPA's eBusiness Center: Air Services online web portal, or they may be mailed as a hard copy to the Canton City Health Department, Air Pollution Control Division (CCHD, APCD).

(2) The permittee shall report any and all accidental fires that may be caused by the torch cutting operations. A written report shall be submitted to the CCHD, APCD no later than 15 days following the incident.

(3) The permittee shall submit an annual Permit Evaluation Report (PER) to the CCHD, APCD by the due date identified in the Authorization section of this permit. The PER shall cover a reporting period of no more than twelve-months for each air contaminant source identified in this permit. PER forms will be mailed to the permittee at the end of the reporting period specified in the Authorization section of this permit. It is recommended that the PER is submitted electronically through the Ohio EPA's "e-Business Center: Air Services" although PERs can be submitted via U.S. postal service or can be hand delivered.

(4) The permittee shall identify the following information in the PER in accordance with the monitoring requirements in term d)(1) above:

a. all days and time periods during which the baghouse was not operating during torch cutting operations.

(5) The permittee shall identify the following information in the PER in accordance with the monitoring requirements for visible emissions in term d)(2) above:

a. all days during which any visible particulate emissions were observed from the baghouse stack serving this emissions unit;

b. all days during which any abnormal fugitive visible particulate emissions were observed from the non-stack egress points (i.e., open side of the enclosure, roof openings, etc.) serving this emissions unit; and

c. any corrective actions taken to eliminate the visible particulate emissions listed in "a" and abnormal fugitive visible particulate emissions listed in "b".

(6) The information in (4) and (5) above shall be provided within the "Additional Information and Corrections" section of the PER.

f) Testing Requirements

(1) Compliance with the emission limitations in b)(1) shall be determined in accordance with the following method(s):

a. Emission Limitation:

Stack Emissions from the baghouse shall not exceed 0.15 pounds per hour and 0.66 tons per year of particulate matter less than 10 microns in diameter (PM_{10}).

Applicable Compliance Method:

The hourly and annual emission limits were established by setting them equal to the maximum potential to emit of this emission unit. The maximum potential to emit was calculated as follows:

Emissions are generated from two sources: the cutting of the metal and from the torch fuel burning. Each were calculated separately and then combined to get the total, as shown below.

Metal Cutting Emissions:

Per the application, the raw pieces of ferrous metal weigh in the range of 5 to 25 gross tons each. It takes a minimum of 30 minutes per torch to complete all the necessary cutting to get the ferrous metal pieces into saleable size. The maximum throughput is calculated as follows:

$$\frac{3 \text{ torches}}{} \left| \frac{1 \text{ piece}}{30 \text{ minutes per torch}} \right| \frac{60 \text{ minutes}}{1 \text{ hour}} = 6 \text{ pieces/hour}$$

$$\frac{6 \text{ pieces}}{\text{hour}} \left| \frac{25 \text{ gross tons maximum metal cut}}{\text{piece}} \right| \frac{2240 \text{ lbs}}{\text{Gross ton}} \left| \frac{1 \text{ ton}}{2000 \text{ lbs}} \right. = 168 \text{ tons metal cut/hour}$$

Emissions were calculated using the best approximation emission factor for torch cutting operations which is the same emission factor used for other torch operations throughout the State. The emission factor is 0.10 lb PE per ton metal processed for machine scarfing from AP-42, section 12.5, table 12.5-1 (10/86).

Uncontrolled metal cutting emissions were calculated as shown below:

$$\frac{168 \text{ tons metal cut}}{\text{hour}} \left| \frac{0.10 \text{ lb PE}}{\text{ton metal processed}} \right| = 16.8 \text{ lbs PE/hour}$$

$$\frac{16.8 \text{ lbs PE}}{\text{hour}} \left| \frac{24 \text{ hours}}{\text{day}} \right| \frac{365 \text{ days}}{\text{year}} \left| \frac{1 \text{ ton}}{2000 \text{ lbs}} \right| = 73.6 \text{ tons PE/year}$$

Fuel Burning Emissions:

Per the application, the torches use propane as fuel and oxygen as an oxidizer for additional metal cutting power. For a 6 hour/day operation, 100 gallons of liquid propane and 43,600 cubic feet of oxygen are used. The maximum throughput of propane is calculated as follows:

$$\frac{100 \text{ gallons propane}}{6 \text{ hours}} \left| = 16.67 \text{ gallons propane per hour} \right.$$

The oxygen does not generate emissions, so the only emissions are from the propane burning. However, since oxygen is used, a more efficient combustion of the propane is achieved. Emissions were calculated using the best available emission factors for propane burning, which are from AP-42, section 1.5, table 1.5-1 (07/08) for liquefied petroleum gas combustion for boilers. Emissions of pollutants NO_x, CO, and SO_2 are negligible so they are not addressed in this permit. The particulate emissions for propane burning were calculated as follows:

$$\frac{16.67 \text{ gallons propane}}{\text{hour}} \left| \frac{0.7 \text{ lb PE total}}{1000 \text{ gallons propane}} \right| = 0.012 \text{ lb PE per hour}$$

$$\frac{0.012 \text{ lb PE}}{\text{hour}} \left| \frac{24 \text{ hours}}{\text{day}} \right| \frac{365 \text{ days}}{\text{year}} \left| \frac{1 \text{ ton}}{2000 \text{ lbs}} \right| \approx 0.05 \text{ tons PE per year}$$

Total Particulate Emissions:

The total particulate emissions from this emission unit is the sum of the metal cutting emissions and propane fuel burning emissions, which is demonstrated below:

16.8 lbs PE/hr + 0.012 lb PE/hr = 16.812 lbs PE/hr uncontrolled

73.6 tons PE/yr + 0.05 tons PE/yr = 73.65 tons PE/yr uncontrolled

Particulate emissions are controlled by a 3-sided enclosure with a roof venting to a baghouse. The permit application provided a design capture efficiency of 90-95% and a baghouse control efficiency of 99.0-99.9%. As the most conservative approach, the permit writer used 90% capture efficiency with 99% baghouse control efficiency to get an overall control efficiency of 89.1% (0.90 x 0.99 = 0.891).

Controlled emissions were calculated as shown below:

Stack PE = (16.812 lbs PE/hour) x (0.90) x (1 - 0.99) = 0.15 lbs PE/hour controlled

$$\text{Stack PE} = \frac{0.15 \text{ lbs PE}}{\text{hour}} \times \frac{24 \text{ hours}}{\text{day}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2000 \text{ lbs}} = 0.66 \text{ tons PE/year controlled}$$

Only PM_{10} or smaller is emitted from a fabric filter/baghouse stack, so the PE is set equal to PM_{10}.

0.15 lbs PE/hour controlled = 0.15 lbs PM_{10}/hour controlled
0.66 tons PE/year controlled = 0.66 tons PM_{10}/year controlled

Compliance with the hourly and annual emissions limitations can be demonstrated by using actual production and operating hours data within the calculation methodology described above to calculate the actual emissions from this emission unit.

If required, the permittee shall demonstrate compliance with the hourly limitation by testing in accordance with Methods 201/201A of 40 CFR Part 51, Appendix M. Alternative U.S. EPA approved test methods may be used with prior approval from the CCHD, APCD.

b. Emission Limitation:

Fugitive (uncaptured) Emissions shall not exceed 1.68 pounds per hour and 7.36 tons per year of particulate emissions (PE).

Applicable Compliance Method:

The hourly and annual emission limits were established by setting them equal to the maximum potential to emit of this emission unit. The uncontrolled maximum potential to emit was calculated as shown above in f)(1)a. To get the controlled fugitive (uncaptured) particulate emission limits, the following calculations were used:

Fugitive PE = (16.812 lbs PE/hour uncontrolled) x (1 - 0.90) = 1.68 lbs PE/hour controlled

$$\text{Fugitive PE} = \frac{1.68 \text{ lbs PE}}{\text{hour}} \times \frac{24 \text{ hours}}{\text{day}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2000 \text{ lbs}} = 7.36 \text{ tons PE/year controlled}$$

Compliance with the hourly and annual emissions limitations can be demonstrated by using actual production and operating hours data within the calculation methodology described above to calculate the actual emissions from this emission unit.

c. Emission Limitation:

Fugitive (uncaptured) visible PE shall not exceed 20% opacity as a 3-minute average

Applicable Compliance Method:

If required, compliance with the visible emission limitation listed above shall be determined in accordance with Method 9 as set forth in "Appendix on Test Methods" in 40 CFR, Part 60, and the modifications listed in paragraphs (B)(3)(a) and (B)(3)(b) of OAC rule 3745-17-03.

d. Emission Limitation:

The controlled emissions from the baghouse stack shall achieve an outlet emission rate of not greater than 0.030 grain of particulate emissions per dry standard cubic foot of exhaust gases or there shall be no visible emissions from the exhaust stack.

Applicable Compliance Method:

Compliance with the requirement for no visible particulate emissions from the exhaust stack, identified in this permit, shall be determined in accordance with U.S. EPA Method 22. If opting to comply with the outlet particulate emissions rate, compliance with the 0.030 grain of particulate emissions per dry standard cubic foot of exhaust gases from the stack shall be determined in accordance with U.S. EPA Methods 1 through 5, as appropriate.

g) Miscellaneous Requirements

(1) The permittee shall submit the appropriate permit to install and operate (PTIO) application to the CCHD, APCD, prior to the installation of any additional jet torches at this facility.

Fire crews were called to General Iron Industries in the 1900 north block of Clifton Avenue Monday after a "major explosion," Ald. Brian Hopkins (2nd) said on Ma
2020.

COLIN BOYLE/BLOCK CLUB CHICAGO

LINCOLN PARK, OLD TOWN

Major Explosion At General Iron Scrap Plant Rocks Neighborhood, Company Suggests 'Potential Sabotage'

"It shook our whole place, the whole building shook," a nearby resident said. "We could see some smoke coming up immediately."

MAY 18, 2020 9:33AM CDT

Hannah Alani

Colin Boyle

LINCOLN PARK — An explosion rocked a controversial metal shredding plant on the banks of the Chicago River's North Branch Monday morning, sending a plume of smoke into the air and hazardous material response teams to the scene.

No one was hurt in the 9:10 a.m. blast at the General Iron scrap plant at 1909 N. Clifton Ave., officials said.

Chicago Fire Department spokesperson Larry Merritt confirmed the explosion took place on the shredder's conveyor system. Upon arrival, he said, firefighters tested the air quality and found "no apparent immediate health risk." The Chicago Department of Public Health performed further testing and evaluation, Merritt said.

"Should any environmental violation be determined, the city will issue citations immediately," he said. "Work at the site has stopped as a result of the incident and will not resume until the city has determined the cause of the explosion. The health and safety of Chicago's residents remain a top priority, and we will continue to provide more information as details are gathered."

Witnesses on the scene and blocks away reported two loud blasts in succession. Although there were initial reports of an ensuing fire, a spokesman for the company denied that.

What caused the blast wasn't immediately clear, although the company spokesman raised the idea of "sabotage."

"Shredding operations have ceased for the present time," General Iron spokesman Randall Samborn said in a statement. "We are thoroughly investigating all possible causes, including potential sabotage. We are fully cooperating with city officials."

He declined to elaborate on the sabotage suggestion, saying, "We have no further information to provide at this time and we're not going to speculate. Suffice to say what happened this morning was not normal. We will conduct a thorough investigation that looks at all possibilities."

Pieces of burnt and bent metal lay on the ground as fire crews were called to General Iron Industries in the 1900 north block of Clifton Avenue Monday after a Òmajor explosion,Ó Ald. Brian Hopkins (2nd) said on May 18, 2020. | Colin Boyle/Block Club Chicago

COLIN BOYLE/BLOCK CLUB CHICAGO

The blast happened within the metal shredding process, he said

Ald. Brian Hopkins (2nd) described it as "major explosion and fire" that led to a "sudden increase" in pollution readings. Pollution from the plant has long been protested by Lincoln Park neighbors.

General Iron is already slated to leave the neighborhood for the Far South Side's East Side neighborhood. Hopkins said he want it shut down now.

"Permanent and immediate closure of this hazardous facility is no longer a discussion point, it must happen NOW, by executive order," Hopkins tweeted.

Fire crews were called to General Iron Monday after a "major explosion," Ald. Brian Hopkins (2nd) said.

IAN WHITAKER

Ald. Michele Smith (43rd) said she spoke with Mayor Lori Lightfoot's staff and will receive details on what happened later in the day.

Alderman Hopkins
@AldermanHopkins

major explosion and fire at General Iron this morning. sudden increase in pollution readings detected in surrounding residential neighborhood. Permanent and immediate closure of this hazardous facility is no longer a discussion point, it must happen NOW, by executive order.

94 10:58 AM - May 18, 2020

48 people are talking about this

Ald. Michele Smith
@AldermanSmith43

I have been on the phone with the Chief of Staff to @chicagosmayor regarding this morning's events at the General Iron, and will receive a briefing later today with full details.

18 11:23 AM - May 18, 2020

See Ald. Michele Smith's other Tweets

Albert Muniz, an employee of General Iron, told a Block Club reporter the explosions were simultaneous."It felt like we were getting bombed," Muniz said.

An employee of General Iron who asked not to be named told a Block Club reporter on the scene he heard two explosions, back to back.

"We might be unemployed now," he said.

Pieces of burnt and bent metal lay on the ground as fire crews were called to General Iron Industries in the 1900 north block of Clifton Avenue Monday after a Òmajor explosion,Ó Ald. Brian Hopkins (2nd) said on May 18, 2020. | Colin Boyle/Block Club Chicago

COLIN BOYLE/BLOCK CLUB CHICAGO

In Lincoln Park, it felt like an "earthquake" inside the home of Jillian Dixon. The shaking feeling was followed by two "loud booms," she said.

"It shook our whole place, the whole building shook," she said. "We could see some smoke coming up immediately."

Dixon quickly saw two to three fire trucks, a "handful" of police cars and ambulance arrive on the scene.

15 people are talking about this

From across the river in Bucktown, workers at Local Foods, 1427 W. Willow St., heard and saw what appeared to be a fiery explosion, said Jamie Phelps Proctor.

"We all heard the loud explosion from inside the Local Food store. It shook the building and the windows," he said. "We could see smoke starting to rise across the river. We went outside and saw the gray smoke rising from one of the buildings. … The smoke kept rising and started to smell. There were lots of sirens audible within less than a minute of the explosion."

Fire crews were called to General Iron Industries in the 1900 north block of Clifton Avenue Monday after a Òmajor explosion,Ó Ald. Brian Hopkins (2nd) said on May 18, 2020. | Colin Boyle/Block Club Chicago

COLIN BOYLE/BLOCK CLUB CHICAGO

Iain Whitaker, another neighbor, said he also witnessed an "explosion" that "shook the houses" nearby.

"I ran out to investigate and it appears that one of the buildings at the site collapsed due to the incident," he said. "This is just another reason General Iron needs to be closed down immediately. They are not only poisoning the air we breathe but putting the neighborhood in danger."

By 9:30 a.m. the smoke dissipated, Phelps Proctor said.

Dixon, in Lincoln Park, hoped the incident would propel Lightfoot to shut down the metal shredder during the coronavirus pandemic — a move neighbors have been pleading the mayor to consider for months.

"This is just another example of why it's important to get it shut down," she said. "It feels like an egregious use of resources right now, to send out emergency personnel … [increase their] exposure."

Gov. JB Pritzker said at an unrelated news conference Monday that the Illinois Environmental Protection Agency also is looking into the explosion.

"We're actually, as you can imagine, paying very close attention, want to make sure people are kept safe," Pritzker said.

Fire crews were called to General Iron Industries in the 1900 north block of Clifton Avenue Monday after a Òmajor explosion,Ó Ald. Brian Hopkins (2nd) said on May 18, 2020. | Colin Boyle/Block Club Chicago

COLIN BOYLE/BLOCK CLUB CHICAGO

General Iron plans to relocate to 11600 S. Burley Ave. by the end of the year. The Illinois Environmental Protection Agency must first issue an "air pollution control construction permit," which neighbors protested in a public meeting last week.

Last fall, General Iron promised Lightfoot and Hopkins to leave the North Side.

That agreement followed a 2015 fire, a 2016 city-ordered shutdown, a 2017 harassment lawsuit and a 2018 citation for excessive air emissions.

Lincoln Park neighbors have long complained about the health risks associated with fluff, a substance that routinely coats the neighborhood's sidewalks, roads, porches and playgrounds.

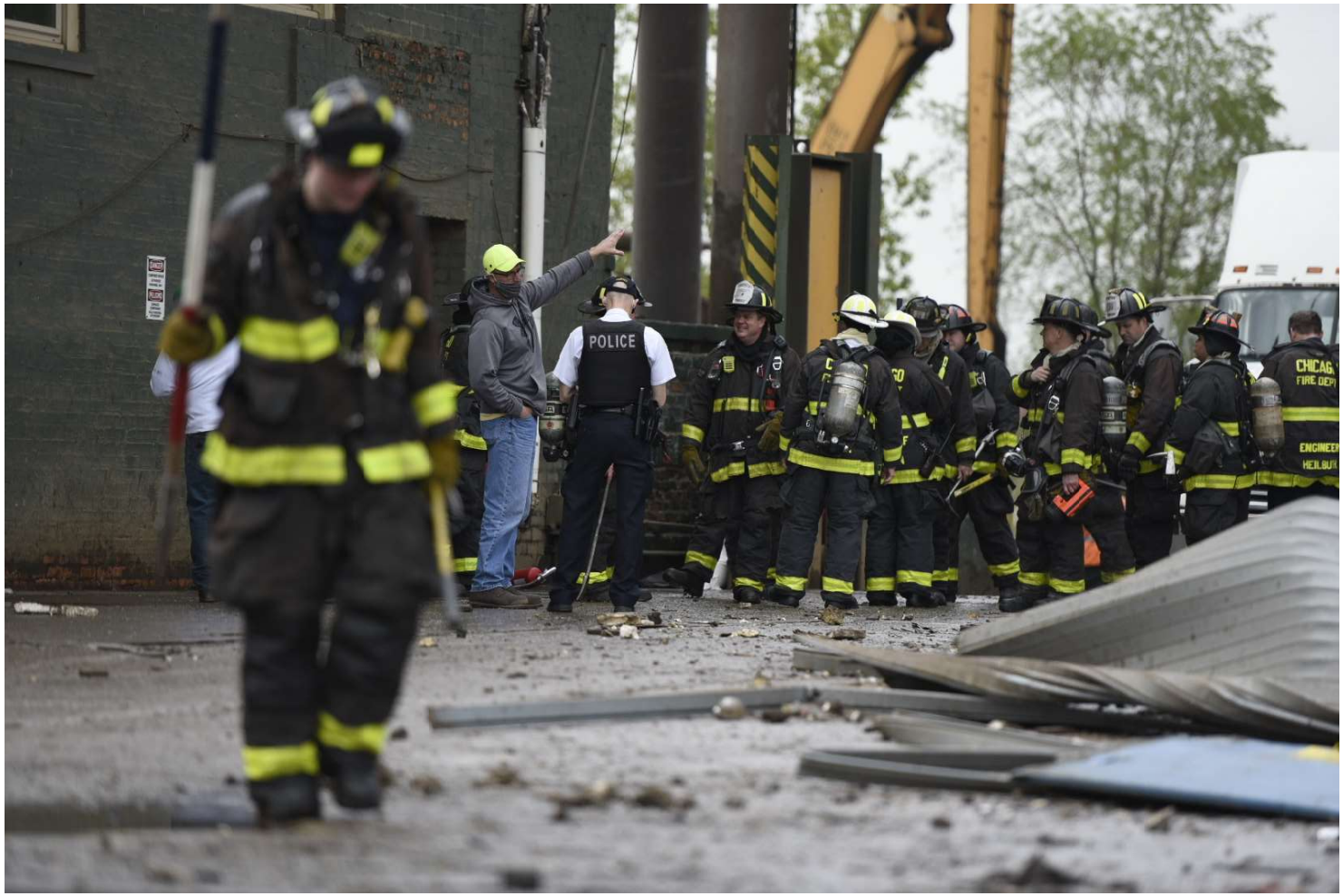
The Environmental Protection Agency defines fluff as "fugitive dust."

An air quality monitoring device is currently being used by Hopkins and neighbors to monitor the PM2.5 in the air near General Iron. You can see the ratings here.

IAIN WHITAKER

Fire crews were called to General Iron Monday after a "major explosion," Ald. Brian Hopkins (2nd) said.

COLIN BOYLE/ BLOCK CLUB CHICAGO

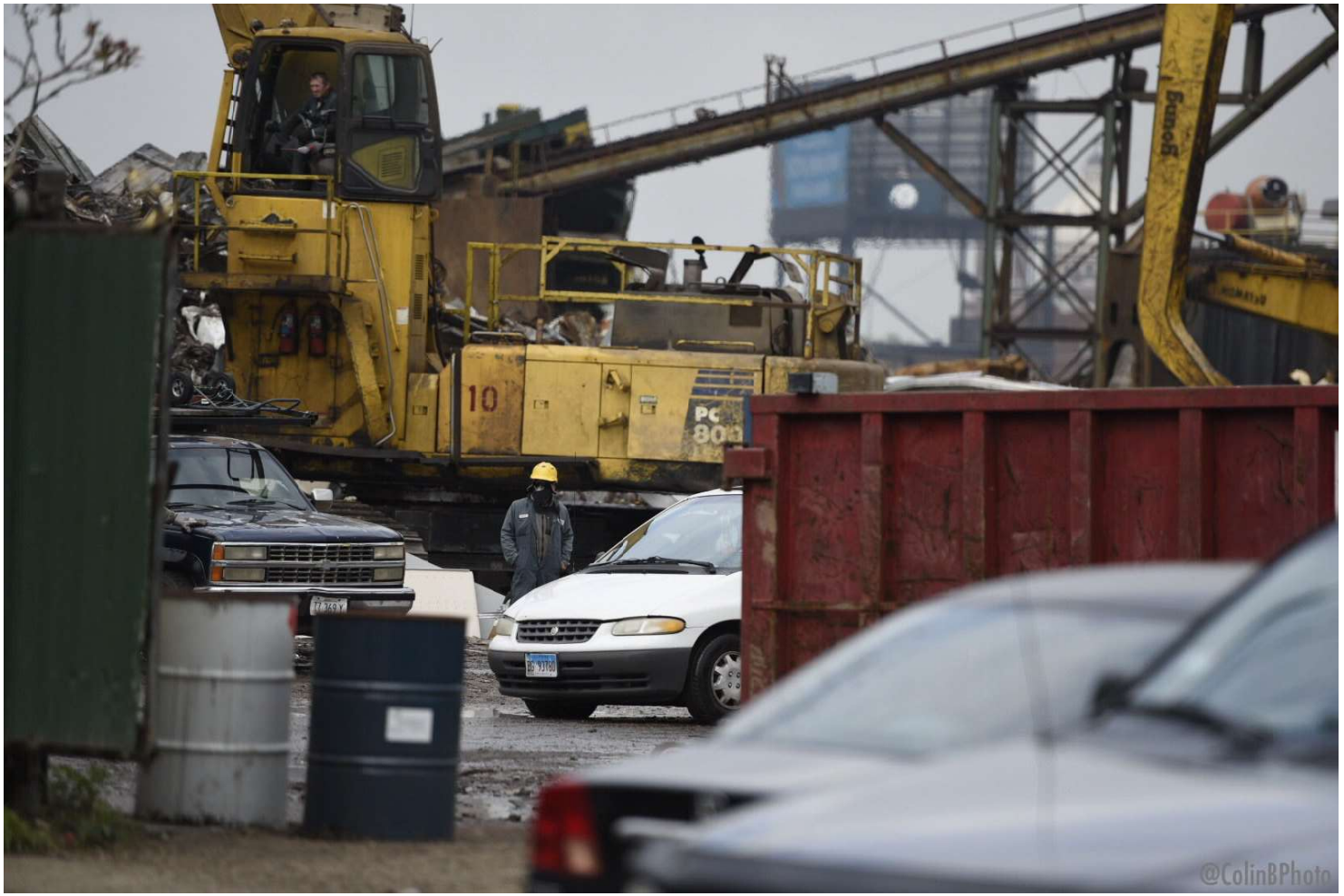


Fire crews were called to General Iron Monday after a "major explosion," Ald. Brian Hopkins (2nd) said.

COLIN BOYLE/ BLOCK CLUB CHICAGO

Fire crews were called to General Iron Monday after a "major explosion," Ald. Brian Hopkins (2nd) said.

COLIN BOYLE/ BLOCK CLUB CHICAGO



Fire crews were called to General Iron Monday after a "major explosion," Ald. Brian Hopkins (2nd) said.

COLIN BOYLE/ BLOCK CLUB CHICAGO

Fire crews were called to General Iron Monday after a "major explosion," Ald. Brian Hopkins (2nd) said.

COLIN BOYLE/ BLOCK CLUB CHICAGO

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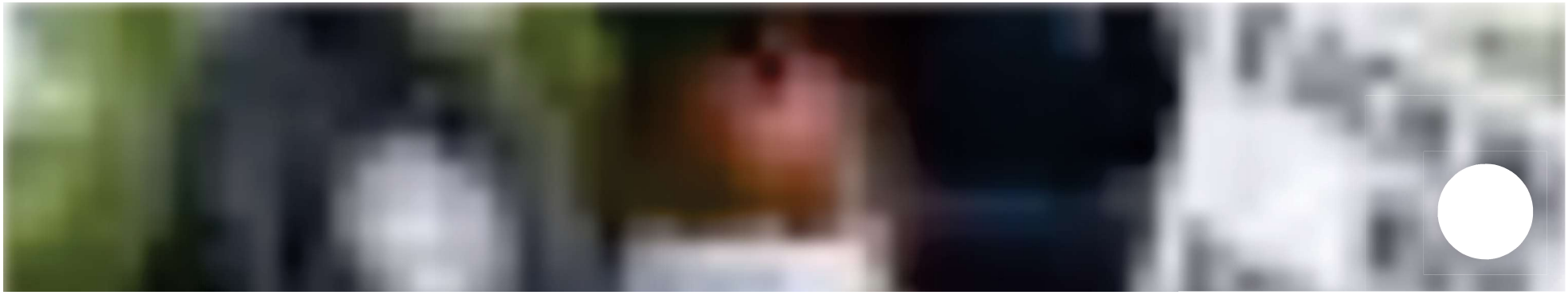
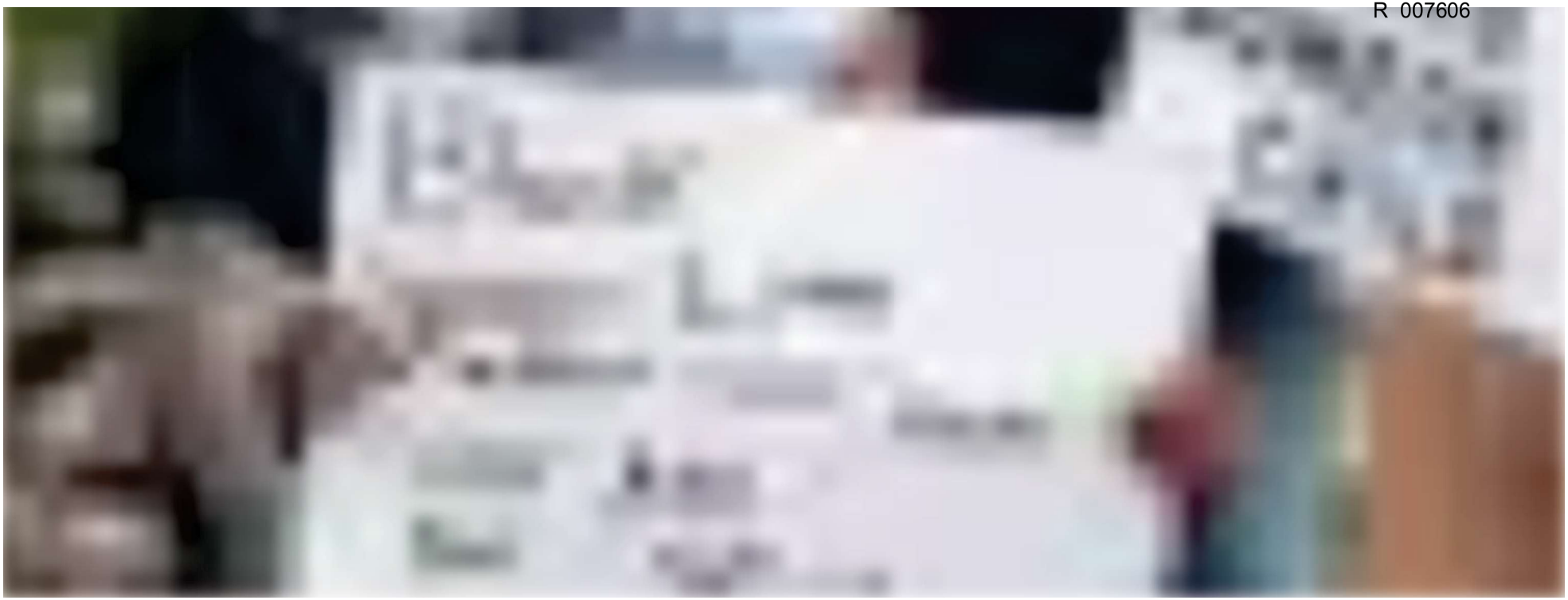




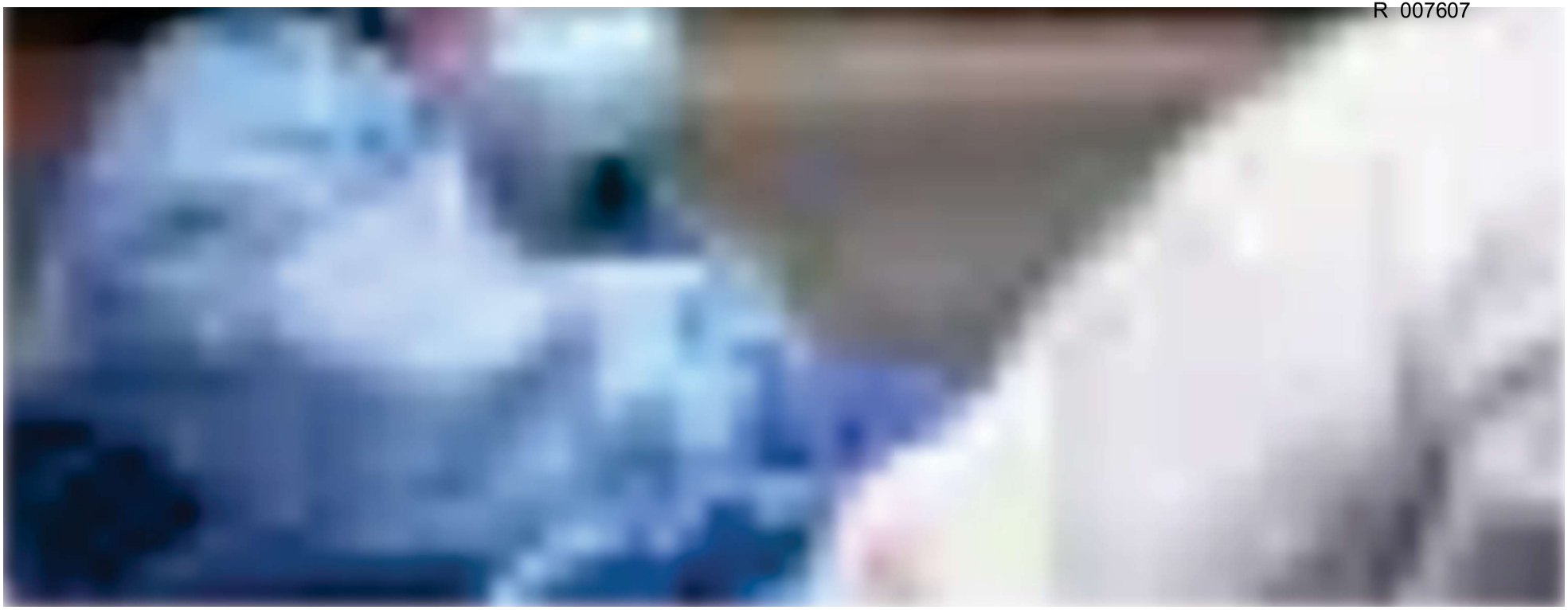
BRONZEVILLE, NEAR SOUTH SIDE

At Kids March Against Racism On South Side, Young Protesters Share Messages Of Hope

"We are tired, but when I look upon all of the youth here today, my hope is not lost."

Colin Boyle

JUN 13, 2020 5:52PM CDT



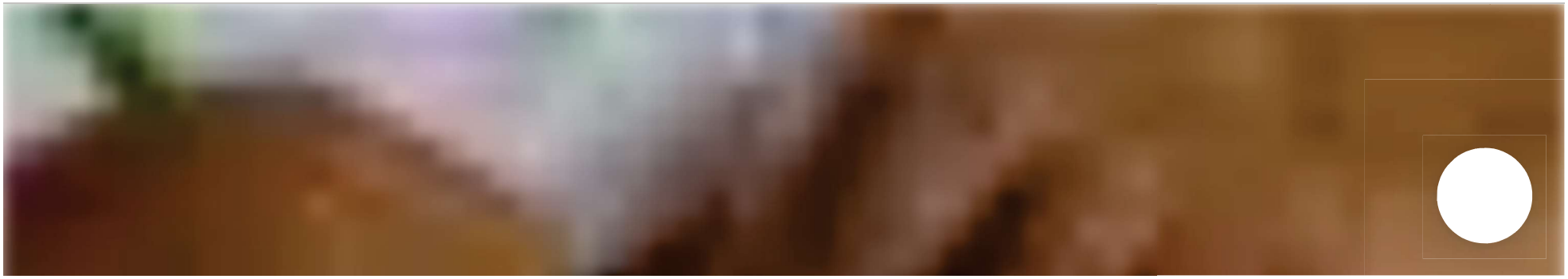
DOWNTOWN

29 More People Die From Coronavirus In Illinois And Another 673 Test Positive

Of the dead Saturday, 12 people were from Cook County and all but one victim was over the age of 60.

Block Club Chicago Staff

JUN 13, 2020 5:02PM CDT



DOWNTOWN

Expect Masks, Temperature Checks: Chicago Schools Chief Offers New Details About Fall

Chicago remains "committed" to its start date of Sept. 8, the day after Labor Day, Chicago schools chief Janice Jackson wrote.

Cb **Cassie Walker Burke, Chalkbeat Chicago**

JUN 13, 2020 10:55AM CDT

[redacted]

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LINCOLN PARK & OLD TOWN (//WWW.DNAINFO.COM/CHICAGO/LINCOLN-PARK-OLD-TOWN)

Crime & Mayhem (//www.dnainfo.com/chicago/topics/crime-mayhem)

After Explosions at Extra-Alarm Scrap Yard Fire, Ald. Calls for Its Closure

By Alex Nitkin (//www.dnainfo.com/about-us/our-team/editorial-team/alex-nitkin) and Alisa Hauser (//www.dnainfo.com/chicago/about-us/our-team/editorial-team/alisa-hauser) | December 6, 2015 10:07am | *Updated on December 6, 2015 6:49pm*

Ald. Hopkins and Smith are calling for the closure of General Irons Industries after a Hazmat Level 1 fire broke out Sunday morning.

▲View Full Caption DNAinfo/Zac Schiffman

LINCOLN PARK — An investigation is underway after a fire at the General Iron scrap yard in Lincoln Park caused loud explosions and threw large plumes of dark smoke into the air Sunday morning, and two aldermen are calling for the closure of the facility.

According to a statement from Ald. Brian Hopkins (2nd), the fire department responded to a "powerful explosion and extra alarm fire" at 8:45 a.m. Sunday at General Iron Industries in the 1900 block of North Clifton.

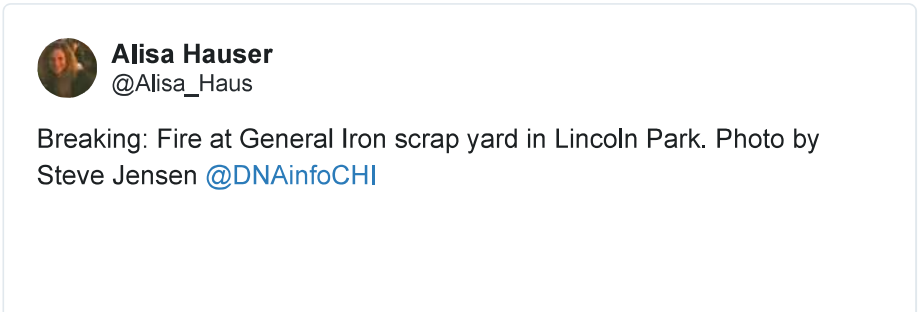
"Fire officials immediately declared a Level 1 hazmat situation after detecting the presence of toxic and corrosive chemicals," Hopkins wrote. Level 1 is the lowest level for a hazardous materials situation.

As firefighters battled the blaze, which did not cause any injuries, Hopkins advised residents to steer clear of the area, noting he was "on site" and would provide updates on his Twitter account (http://www.twitter.com/hopkinschicago).

North Siders reported hearing explosions and seeing dark smoke drift across the neighborhoods. North/northeast winds pushed the haze and an unpleasant smell up Clybourn Avenue.

Hopkins said in a statement, "This site lacks a sufficient drainage system, so thousands of gallons of water that was used to douse a 70 ft. high pile of combustible material is draining into the North Branch of the Chicago River, carrying with it a plume of contaminates of an unknown nature. I have contacted officials from the Metropolitan Water Reclamation District to arrange for testing of water samples."

General Iron was the site of another major explosion last July, according to Hopkins. Though the investigation will take time, Hopkins and Ald. Michele Smith (43rd) are calling General Iron a health hazard and are calling for the "immediate closure of this facility."



1 12:21 PM - Dec 6, 2015 · Chicago, IL

See Alisa Hauser's other Tweets

> Huge fire somewhere on the north side! View from Old Town. pic.twitter.com/nekwk3zGUt (https://t.co/nekwk3zGUt)
>
> — Ali Ferrell (@hiimali1) December 6, 2015 (https://twitter.com/hiimali1/status/673528888396554240)

Alex Nitkin
@AlexNitkin

Hazmat fire at a scrap yard at Marcey & Cortland, near 2000 N Clybourn. CFD attacking from above & below.

12:14 PM - Dec 6, 2015 · Chicago, IL

See Alex Nitkin's other Tweets

Chicago Fire Media
@CFDMedia

S & B Marcey & Cortland. Large pile of scrap burning. Multiple large diameter lines surrounding fire.

11 11:53 AM - Dec 6, 2015

22 people are talking about this

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(https://www.dnainfo.com/chicago/20161220/old-town/gofundme-

WEST LOOP » (HTTPS://WWW.DNAINFO.COM/CHICAGO/WEST-LOOP-NEAR-WEST-SIDE-PILSEN)

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(https://www.dnainfo.com/chicago/20170927/west-loop/sterling

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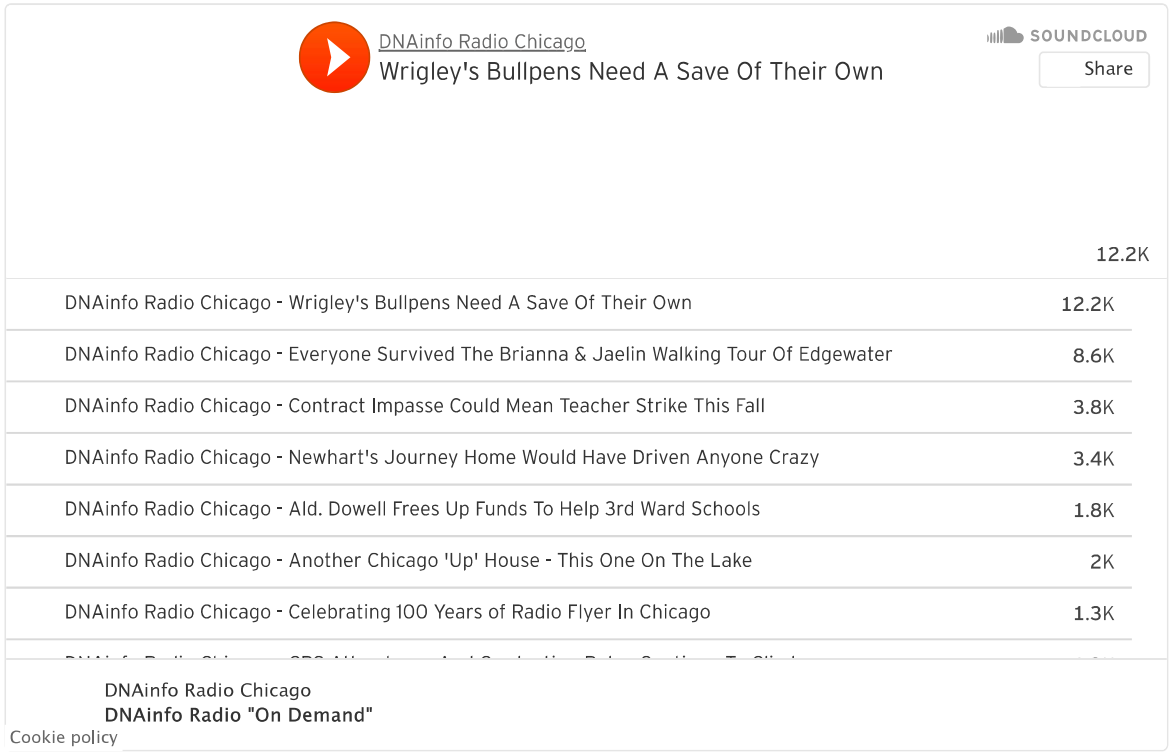


MINNEAPOLIS

North Minneapolis residents welcome shutdown of metal shredder

But residents also want legal consequences for Northern Metal Recycling.

By Marissa Evans (https://www.startribune.com/marissa-evans/508696281/) Star Tribune

SEPTEMBER 30, 2019 — 11:38AM

North Minneapolis residents are breathing easier for the first time in a decade after a metal shredder linked to years of air pollution ceased operation last week.

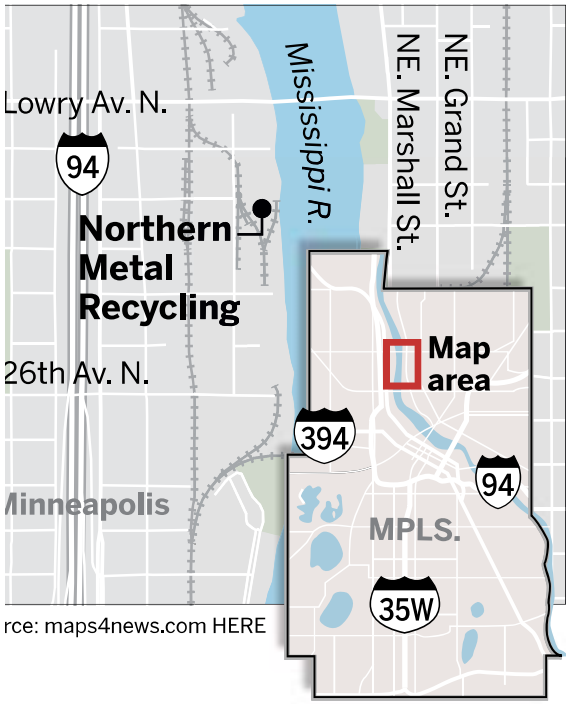
Scrap metal and car parts are still piled high at the Northern Metal Recycling facility in north Minneapolis, where the company is allowed to run a junkyard. But the company shut down its shredder Monday as part of a legal settlement in which it also admitted altering and improperly recording the performance of its pollution filters.

While neighbors cheered the end of their long struggle to close down the shredder, they questioned whether the company will face any more consequences for its long record of pollution violations. Residents and at least two lawmakers support a criminal investigation.

Channy Leaneagh, a north Minneapolis resident, said her daughter spent two weeks at home with asthma problems because of dirty air. She said it's been like this for the past five years, making it "treacherous" to walk through heavy pollutants to find green space where her two kids can play.

"It's been really frustrating for the community, because people that live around here know the scent of shredded metal," said Leaneagh, the lead singer of the popular band Poliça. "Anyone that lives with it on a daily basis knows it's a heavy, putrid smell."

JERRY HOLT - STAR TRIBUNE



The Northern Metals Recycling facility, located on the Mississippi River just south of the Lowry Avenue Bridge in Minneapolis. Families in north

After years of pollution violations and neighborhood pressure, Northern Metal was slated to close the shredder by Aug. 1. A Ramsey County judge gave the company a reprieve while it finished its new facility in Becker, Minn.

Altered pollution records

Then a whistleblower who worked for Northern Metal came forward in August and revealed the altered pollution records. With last week's settlement, the company agreed to additional monitors and reports for its pollution control equipment when it opens in Becker. The company must also pay $200,000 to the Minnesota Pollution Control Agency.

In a statement, Scott Helberg, chief operating officer of Northern Metal, said the Becker facility will employ 85 people and "set the benchmark for sustainability and environmental protection for the recycling industry in the state and the nation." The company declined to comment on Minneapolis residents' criticisms.

The facility's shredding ending is a victory for community members who rallied for years with petitions, door-knocking and demanding accountability from Northern Metal and public officials. But it's also about marginalized communities forcing businesses and lawmakers to reckon with the intersections of racism and environmental problems, said Roxxanne O'Brien, a community organizer with the Environmental Justice Coordinating Council who lives in north Minneapolis.

She said Northern Metal was "definitely another eye-opener" about how companies use loopholes to avoid accountability.

"That has to do with how a lot of corporations tell the story, like trying to sell us jobs," O'Brien said. "Fresh air should come first. You can't work a job if you don't have fresh air."

Investigation encouraged

State Sens. Kari Dziedzic and Bobby Joe Champion, DFLers who represent northeast and north Minneapolis, are encouraging local and federal authorities to continue investigating. They said in a statement that the neighborhoods "deserve to have their voices heard and compensation for damages."

Dziedzic said in an interview they were expecting to meet with Attorney General Keith Ellison's office to learn if they would forward information to the Hennepin County attorney or Minneapolis city attorney for potential charges.

"As I read the settlement agreement ... there might be some instances where they criminally violated the law," Dziedzic said. "Reading all that, I think that should at least be discussed, and I think the public has the right to know — especially if it is, for whatever reason, not sent over."

The Attorney General's Office has not made a decision yet, according to a spokesman.

Northern Metal shut down the shredder on its own terms, not the community's, said Philip Harder, a resident in northeast Minneapolis. He said he's frustrated there may be no more consequences for the company, and he's concerned about the unknown health effects that await the community.

"It's just an example of that kind of corporate pollution crime and stalling techniques that they use," Harder said. "You read about it a lot, but it's really bizarre and frightening to see it right there in our neighborhood and be amazed at what a company like that can get away with."

For now, Leaneagh said that while it's important to find ways to recycle metal, she's hoping people in Becker know the potential harm, particularly when it comes to lead poisoning.

"I hate to hear that they're moving to another community," Leaneagh said. "I just hope that they're far away from children and vulnerable people."

In his statement, Helberg said, "We are working closely with government officials, business leaders and local community groups to expand economic, educational and cultural opportunities in the Becker community."

Correction: Previous versions of this story misstated the name of Philip Harder.

Marissa Evans writes about social issues for the Star Tribune.

marissa.evans@startribune.com 612-673-4280 marissaaevans

Air district takes action against smelly Paramount metal plant

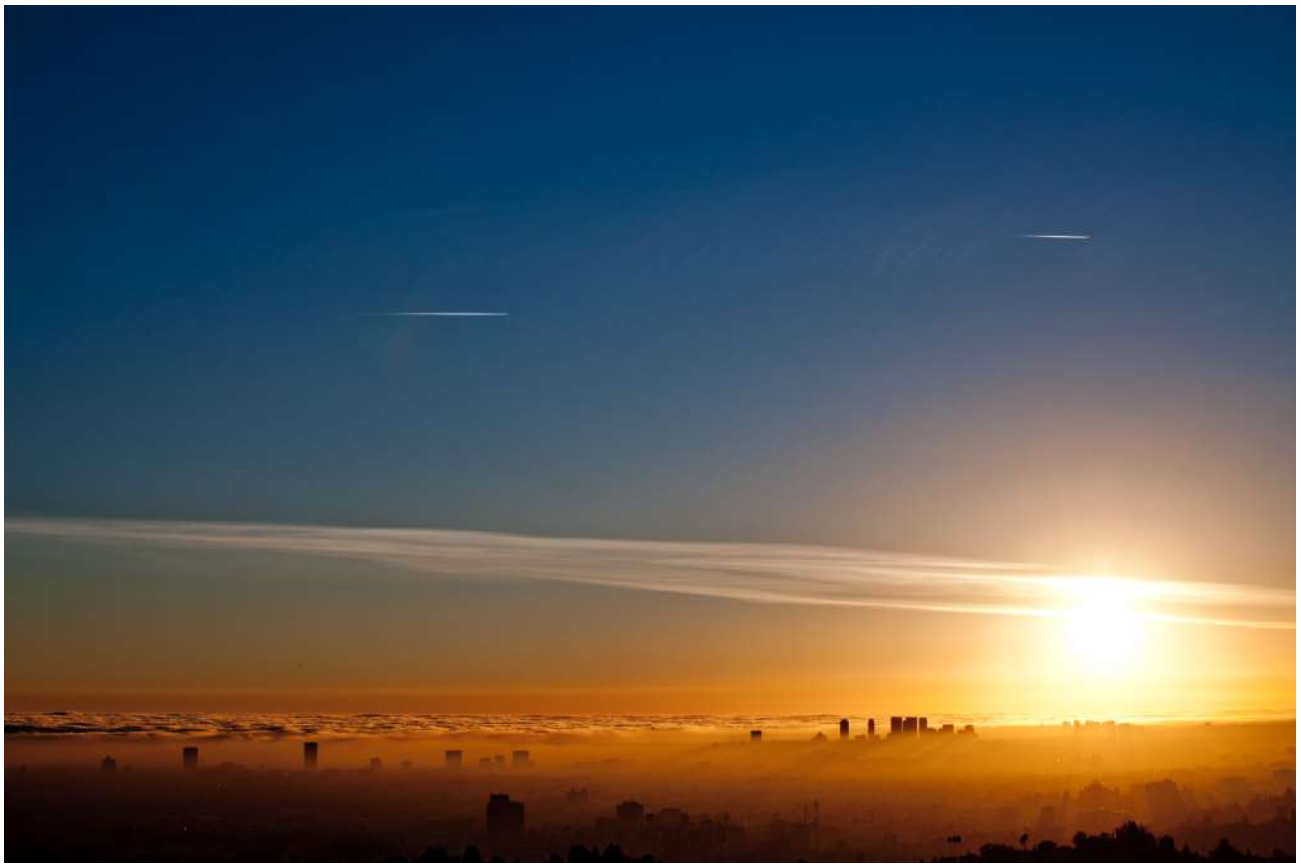


Photo by Ray Smith/Ray_from_LA via Flickr Creative Commons

Rebecca Plevin | June 14, 2017

R 007627

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The South Coast Air Quality Management District is cracking down on a Paramount metal manufacturing company that has received 17 violation notices since December for allegedly emitting odors.

The district on Tuesday filed a petition for an administrative order that would require Carlton Forge Works to reduce the odors. The agency's independent Hearing Board will hold a hearing regarding the petition on July 13.

District inspectors have traced the odors to the South L.A. facility's grinding room and an area near two gates.

Carlton Forge general manager Luis Liu says the AQMD's allegation is "without merit."

The company is "disappointed that SCAQMD has chosen to pursue the Petition as CFW has acted in good faith, cooperated with SCAQMD, and taken measures to minimize potential odors," he says in a statement.

Jo Arias, who lives across the street from the facility, welcomes the action. She attended a town hall meeting on Tuesday night hosted by the air district.

"They're like a burning, metallic, rubber odor," she says. "They burn your eyes, your mouth, your throat."

Arias says she smells the odor every day or every other day and gets frequent nosebleeds and headaches.

Jo Kay Ghosh, the AQMD's health effects officer, acknowledges that odors can cause immediate health problems.

"When the odor goes away, the health effects usually go away as well," she says. "So the health effects tend to be short-lived or as long-lived as the odors are."

Ghosh says in some cases, odors can come along with toxic emissions but "at this point, we have not associated the odor with any specific toxics of concern."

The air district says Carlton Forge has attempted to reduce the odors by stopping outdoor grinding, sealing its grinding building and installing high-efficiency filters on the grinding building exhaust. But since the odors have persisted, the district is asking the Hearing Board to require the facility to take additional steps, including developing a comprehensive odor plan.

The agency reports it has received more than 190 odor complaints regarding odors allegedly emanating from Carlton Forge. Some of those complaints have come from people at Lincoln Elementary School, located a few blocks from the facility.

In response to complaints about metallic odors in Paramount, the district began conducting ambient monitoring of toxic metal emissions in 2013. The monitoring showed elevated levels of nickel and hexavalent chromium, a carcinogen.

In 2014 and 2015, AQMD worked with Carlton Forge to reduce metal particulate emissions from its grinding operation. The company implemented a number of voluntary measures that substantially reduced nickel levels in the neighborhood.

Those measures did not decrease hexavalent chromium levels in the community, so AQMD also deployed several air monitors. The agency identified two Paramount metal processors that it said were contributing to those levels; they agreed to plans to lower their emissions of hexavalent chromium, also known as chromium 6.

AQMD is also investigating elevated chromium 6 levels in southern Paramount, near the facilities of Mattco Forge, Press Forge and Weber Metals. The agency is conducting sampling and source testing at the facilities to determine if they're contributing to the heightened emissions.

Meanwhile, the agency says the facilities are voluntarily implementing interim measures to control metal grinding emissions and are expediting installation of new pollution controls.

This story has been updated to include Carlton Forge's statement.

AEP 7012
AEP 7012

106th ST

Todd Cloud

Summary

Years of Experience

20+

Industries

- Pulp & Paper
- Wood Products
- Oil and Gas
- Upstream/Midstream
- Onshore

Types of Facilities

- Production Facilities
- Terminal
- Refineries

Areas of Expertise

- Federal/major New Source Review (NSR), state/minor NSR
- Prevention of Significant Deterioration (PSD)
- Reasonably Available Control Technology (RACT)
- Best Available Control Technology (BACT)
- Lowest Achievable Emission Rate (LAER) determinations
- Air dispersion modeling (ISCST3, AERMOD, CALPUFF)
- Auditing and compliance program development
- Notice of Violation (NOV) response and mitigation
- Expert witness and litigation support

Education

Bachelor, Chemical Engineering, Georgia Tech

Juris Doctorate, University of Georgia School of Law

Recent Project Experience

Sun Bio Materials (U.S.) Company
Arkadelphia, AR

Secured the Prevention of Significant Deterioration (PSD) pre-construction authorizations for $2,000,000,000 softwood pulp mill and linerboard manufacturing facility in Arkadelphia, AR. Supported pre-engineering and design efforts needed to secure air permit. Completed all federal Class II National Ambient Air Quality Standards (NAAQS) and PSD Increment air dispersion modeling demonstrations. Completed all federal Class I PSD Increment and Air Quality Related Values (AQRV) modeling demonstrations for Federal Land Manager (FLM) review and approval for three Class I areas. Negotiated Best Available Control Technology (BACT) emission limits as well as draft permit conditions. Supported Sun Bio through contentious public hearing process.

Harbor Island Crude Oil Terminal
Corpus Christi, TX

Secured the Prevention of Significant Deterioration (PSD) pre-construction authorizations for $1,400,000,000 crude oil storage terminal (200,000,000 bbl) and marine loading (160,000 bph) facility in Corpus Christi, TX. Supported pre-engineering and design efforts needed to secure air permit. Completed all federal Class II National Ambient Air Quality Standards (NAAQS) and PSD Increment air dispersion modeling demonstrations. Completed the state-only Effects Screening Level (ESL) air dispersion modeling risk assessments. Assessed best achievable control technologies (BACT) for all new or modified emission units.

Colombo Energy
Greenwood, SC

Reviewed, revised, and revamped all previously secured state-only pre-construction authorizations for a $140,000,000 wood pellet manufacturing facility (500,000 metric ton/year) located in Greenwood , South Carolina. Affirmed Prevention of Significant

Todd Cloud

Recent Project Experience (continued)

Deterioration (PSD) minor source status of facility pursuant to a concurrent enforcement action and plant divestiture. Completed all state Class II National Ambient Air Quality Standards (NAAQS air dispersion modeling demonstrations. Supported engineering and design efforts for additional air pollution controls on the pellet cooler operations. Completed the state-only air dispersion modeling air toxic risk assessments.

Sunoco Logistics Partners
Nederland, TX

Secured Texas minor New Source Review (NSR) pre-construction authorizations to modify the existing Nederland, TX marine terminal operations to accommodate 500,000 bpd ethane receiving, compression, storage and transport facility. Supported pre-engineering and design efforts needed to secure air permit Assessed best achievable control technologies (BACT) for all new or modified emission units. Completed all federal Class II National Ambient Air Quality Standards (NAAQS) and PSD Increment air dispersion modeling demonstrations. Completed Effects Screening Level (ESL) dispersion modeling risk assessments.

Fram Renewable Fuels
Various Locations, GA

Supported all aspects of Clean Air Act compliance for the combined 1,000,000 metric ton/year Fram Renewable Fuels operations in Baxley, GA (Appling County Pellets), Hazlehurst, GA (Hazlehurst Wood Pellets), Nahunta, GA (Archer Forest Products), and Telfair, GA (Telfair Forest Products) including (but not limited to) pellet certification compliance, construction permits, semiannual and annual Title V reporting, Tier 2 submittals, Toxic Release Inventory (TRI) reports, internal auditing and compliance program improvement, emission fees, emission inventories, Notice of Violation (NOV) response and mitigation, greenhouse gas (GHG) life-cycle and emissions reporting, etc.

Koch Pipeline Company
LP Clearbrook, MN

Secured all Minnesota Pollution Control Agency (MPCA) pre-construction authorizations pursuant to Minn. R. 7007.0750 to construct four (4) additional 300,000 barrel external floating roof tanks to an existing crude oil terminal in Clearbrook, MN. The existing volatile organic compound (VOC) emission calculation infrastructure was employed to estimate a revised facility VOC potential to emit (PTE) with four (4) additional tanks at the current terminal maximum throughput of 430,200 bbl/day.

Northern Tier Energy/Flint Hills Resources
Wausau, WI

Assisted client in determining what regulatory gaps existed upon purchase and restart of the gasoline storage tanks and loading rack at a mothballed gasoline terminal in Wausau, WI. The gap assessments concluded that, upon terminal restart, the site would likely lose its exemption from 40 Code of Federal Regulations (CFR) Part 60, Subpart XX Standards of Performance for Bulk Gasoline Terminals but would likely retain its exemption from 40 CFR Part 60, Subpart Kb Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels). With the gap assessments complete, the air permit application materials necessary to obtain Wisconsin Department of Environmental Resources (DENR) authorization to restart the terminal under the terms of Wisconsin's FESOP program codified at NR407 of the Wisconsin Administrative Code.

Todd Cloud

Professional Bio

Mr. Cloud has 20 years of consulting experience in interpreting and implementing the 1970 Clean Air Act (CAA) and subsequent amendments. Mr. Cloud's areas of expertise include (but are not limited to): federal/major New Source Review (NSR), state/minor NSR, non-attainment NSR, Prevention of Significant Deterioration (PSD), Reasonably Available Control Technology (RACT), Best Available Control Technology (BACT), and Lowest Achievable Emission Rate (LAER) determinations, air dispersion modeling (ISCST3, AERMOD, CALPUFF), auditing and compliance program development, Notice of Violation (NOV) response and mitigation, expert witness, and litigation support. Mr. Cloud also completes risk based analyses in the context of compliance and due diligence audits, identifies areas of CAA concern, prioritizes potential liabilities, and provides CAA risk management recommendations.

Professional History

- Wood Environment & Infrastructure Solutions, Associate Scientist, Atlanta, Georgia + Houston, Texas
- Sage Environmental Consulting, Senior Project Manager, Atlanta, Georgia, 2010–2014
- ERM, Project Manager, Atlanta, Georgia, 2006–2010
- SECOR International, Senior Consultant, Atlanta, Georgia, 2003–2006
- Trinity Consultants, Consultant, Atlanta, Georgia, 1998–2003

Publications / Presentations

- Todd Cloud and David Wilsford, "Under Construction, Round II: U.S.-Japanese Negotiations to Open Japan's Construction Markets to American Firms, 1988-92," Pew Case Studies, Georgetown University (1990)
- Todd Cloud, "Exploring the NSPS and PSD "Alternative Fuels" Exemption," Air Issues Review (June 2001)
- Todd Cloud, "NSR Reform – Where We Stand Today, Air Issues Review" (December 2001)
- Todd Cloud, "NSR Reform Update," Air Issues Review (May 2002)
- Todd Cloud, "PAL Permits: Friends for Life?," presented at the Air and Waste Management Association Southern Section Annual Meeting and Technical Conference, Nashville, Tennessee (August 2005)
- Todd Cloud, "Clean Air Act Regulatory Update," presented at the Georgia Environmental Conference, Savannah, Georgia (August 2012)
- Todd Cloud, "Requirements and Considerations in Designing Initial Performance Tests for Multi-Fuel Boilers – Panel Discussion, presented at the NCASI Southern Regional Meeting, Savannah, Georgia (June 2014).

An official website of the United States government.

Close

We've made some changes to EPA.gov. If the information you are looking for is not here, you may be able to find it on the EPA Web Archive or the January 19, 2017 Web Snapshot.

KCBX Fenceline Air Monitoring Data

On this page:

- Summary Data
  - Daily 24-hour averages of hourly PM_{10} measurements
  - Hourly PM_{10} data
  - Filter metals analysis
- Raw Data
  - Fenceline Air Monitor Calibration Records
    - Calibration Records for BAM-1020 Particulate Matter Monitor
    - Calibration Records for Partisol Particulate Matter Sampler
  - Fenceline Air Monitor Checklists - QAQC
  - Fenceline Air Monitor Site Log
  - Lab Analyses of Fenceline PM_{10} Air Filters
  - Fenceline Air Monitor PM_{10} 24-Hour Average Raw Data
  - Fenceline Air Monitor PM_{10} and Meteorological Hourly Raw Data

Summary Data

Monitoring at North Terminal Has Ceased

In a letter dated December 23, 2015, EPA approved KCBX's request to cease ambient air monitoring at the North Terminal. Petcoke has been removed from the KCBX North Terminal since summer 2015. Ambient air monitoring data for the North Terminal ended January 4, 2016.

EPA Monitoring at South Terminal Has Ceased

In a letter dated February 13, 2017, EPA approved KCBX's request to terminate the monitoring requirements at the South Terminal. Ambient air monitoring continues at the South Terminal under the City of Chicago Regulation.

Monitoring Requirements Altered for SouthTerminal

In a letter dated March 23, 2016, EPA conditionally approved KCBX's request to alter the monitoring requirements at the South Terminal. Ambient air monitoring continues at the South Terminal.

These spreadsheets present a summary of the KCBX fenceline air monitoring data. View the raw data.

- **Daily 24-hour averages of hourly PM_{10} measurements**

  KCBX fenceline monitor data Daily 24-Hour Average PM10 (1 pg, 78 K, through Jan. 31, 2017)
- **Hourly PM_{10} data**

  KCBX fenceline monitor data hourly PM10 (2 pp, 2 MB, through Jan. 31, 2017) These are the values used to calculate daily 24-hour averages. (South Terminal and North Terminal are on separate spreadsheet tabs.)
- **Filter metals analysis**

  KCBX fenceline monitor data: filter metals (2 pp, 38 K, through Feb. 27, 2016) (South Terminal and North Terminal are on separate spreadsheet tabs.)

Raw Data

These documents present the raw data for KCBX fenceline air monitoring. Newest files are on top.

Fenceline Air Monitor Calibration Records

Routine calibrations occur on the air monitoring equipment operated at the KCBX facility. These are copies of the calibration summaries.

- Calibration Records for BAM-1020 Particulate Matter Monitor
- Calibration Records for Partisol Particulate Matter Sampler

Fenceline Air Monitor Checklists - QAQC

Qualitative checks are performed on the air monitoring equipment operated at the KCBX facility. These are copies of the completed checklists.

- KCBX Fenceline Air Monitor Checklists

Fenceline Air Monitor Site Log

KCBX maintains this log for activities performed on the air monitoring equipment.

- KCBX Air Monitor Site Log (9 pp, 351 K, through Jan. 31, 2016) This file is an Excel spreadsheet (XLS).

Lab Analyses of Fenceline PM_{10} Air Filters

This is the raw data from lab analysis of air monitoring filters. It is used to produce the Filter Metals Analysis reports above.

- Lab Analyses of Fenceline PM10 Air Filters

Fenceline Air Monitor PM_{10} 24-Hour Average Raw Data

This is the raw PM_{10} air monitoring data provided by KCBX. It is presented as a summary at the top of this page.
The following files are Excel spreadsheets (XLSX).

January 2017

KCBX 24-Hour Data January 1-31, 2017 (1 pg, 10 K)

December 2017

KCBX 24-Hour Data December 1-31, 2016 (1 pg, 12 K)

November 2016

KCBX 24-Hour Data November 1-30, 2016 (1 pg, 10 K)

October 2016

KCBX 24-Hour Data October 1-31, 2016 (10 pp, 10 K)

September 2016

KCBX 24-Hour Data September 1-30, 2016 (6 pp, 10 K)

August 2016

KCBX 24-Hour Data August 1-31, 2016 (6 pp, 10 K)

July 2016

KCBX 24-Hour Data July 1-31, 2016 (6 pp, 10 K)

June 2016

KCBX 24-Hour Data June 2016 (1 pg, 10 K)

May 2016

KCBX 24-Hour Data May 1-31, 2016 (1 pg, 10 K)

April 2016

KCBX 24-Hour Data April 2-30, 2016 (1 pg, 10 K)

March 2016

- KCBX 24-Hour Data March 27 - April 2, 2016 (6 pp, 19 K)
- KCBX 24-Hour Data March 20-26, 2016 (6 pp, 19 K)

- KCBX 24-Hour Data March 13-19, 2016 (6 pp, 19 K)
- KCBX 24-Hour Data March 6-12, 2016 (6 pp, 19 K)
- KCBX 24-Hour Data Feb. 28 - March 5, 2016 (6 pp, 19 K)

February 2016

- KCBX 24-Hour Data Feb. 21-27, 2016 (6 pp, 20 K)
- KCBX 24-Hour Data Feb. 14-20, 2016 (6 pp, 19 K)
- KCBX 24-Hour Data Feb. 7 -13, 2016 (6 pp, 19 K)
- KCBX 24-Hour Data Jan. 31 - Feb. 6, 2016 (6 pp, 19 K)

January 2016

- KCBX 24-Hour Data Jan. 24-30, 2016 (6 pp, 19 K)
- KCBX 24-Hour Data Jan. 17-23, 2016 (6 pp, 19 K)
- KCBX 24-Hour Data Jan. 10-16, 2016 (6 pp, 19 K)
- KCBX 24-Hour Data Jan. 3-9, 2016 (10 pp, 25 K)
- KCBX 24-Hour Data Dec. 27, 2015 - Jan. 2, 2016 (10 pp, 25 K)

December 2015

- KCBX 24-Hour Data Dec. 20-26, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Dec. 13-19, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Dec. 6-12, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Nov. 29 - Dec. 5, 2015 (10 pp, 25 K)

November 2015

- KCBX 24-Hour Data Nov. 22-28, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Nov. 15-21, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Nov. 8-14, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Nov. 1-7, 2015 (10 pp, 25 K)

October 2015

- KCBX 24-Hour Data Oct. 25-31, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Oct. 18-24, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Oct. 11-17, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Oct. 4-10, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Sept. 27-Oct. 3, 2015 (10 pp, 25 K)

September 2015

- KCBX 24-Hour Data Sept. 20-26, 2015 (10 pp, 25 K)

- KCBX 24-Hour Data Sept. 13-19, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Sept. 6-12, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Aug. 30- Sept. 5, 2015 (10 pp, 25 K)

August 2015

- KCBX 24-Hour Data Aug. 23-29, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Aug. 16-22, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Aug. 9-15, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data Aug. 2-8, 2015 (10 pp, 25 K)

July 2015

- KCBX 24-Hour Data July 26-Aug. 6, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data July 19-25, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data July 12-18, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data June 28- July 4, 2015 (10 pp, 25 K)

June 2015

- KCBX 24-Hour Data June 21-26, 2015 (10 pp, 25 K)
- KCBX 24-Hour data June 14-20, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data June 7-13, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data May 31-June 6, 2015 (10 pp, 25 K)

May 2015

- KCBX 24-Hour Data May 24-30, 2015 (10 pp, 25 K)
- KCBX 24-hour Data May 17-23, 2015 (10 pp, 25 K)
- KCBX 24-hour Data May 10-16, 2015 (10 pp, 25 K)
- KCBX 24-hour Data May 3-9, 2015 (10 pp, 25 K)

April 2015

- KCBX 24-Hour Data - April 26, 2015 to May 2, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data - April 19-25, 2015 (10 pp, 25 K)
- KCBX 24-hour Data April 12-18, 2015 (10 pp, 25 K)
- KCBX 24-hour Data - April 5-11, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data - March 29 - April 4, 2015 (10 pp, 24 K)

March 2015

- KCBX 24-hour Data - March 22-28, 2015 (10 pp, 25 K)
- KCBX 24-hour Data - March 15-21, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data - March 8-14, 2015 (10 pp, 25 K)

- KCBX 24-hour Data - March 1-7, 2015 (10 pp, 25 K)

February 2015

- KCBX 24-Hour Data - Feb. 22-28, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data - Feb. 15-21, 2015 (10 pp, 25 K)
- KCBX 24-hour Data - Feb. 8-14, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data - Feb. 1-7, 2015 (10 pp, 25 K)

January 2015

- KCBX 24-hour Data - Jan. 25-31, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data - Jan. 18-24, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data - Jan. 11-17, 2015 (10 pp, 25 K)
- KCBX 24-Hour Data - Jan. 4-10, 2015 (10 pp, 26 K)
- KCBX 24-Hour Data - Dec. 28 - Jan. 3, 2015 (10 pp, 21 K)

December 2014

- KCBX 24-Hour Data - Dec. 21-27, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data - Dec. 14-20, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data - Dec. 7-13, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data - Nov. 30- Dec. 6, 2014 (10 pp, 21 K)

November 2014

- KCBX 24-Hour Data - Nov. 23-29, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data - Nov. 16-22, 2014 (10 pp, 21 K)
- KCBX 24-hour Data - Nov 9-15, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data - Nov. 2-8, 2014 (10 pp, 21 K)

October 2014

- KCBX 24-Hour Data Oct. 26-Nov. 1, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data Oct. 19-25, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data Oct. 12-18, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data Oct. 5-11, 2014 (10 pp, 21 K)

September 2014

- KCBX 24-Hour Data Sept. 28-Oct. 4, 2014 (10 pp, 21 K)
- KCBX 24-Hour Data Sept. 21-27, 2014 (10 pp, 16 K)
- KCBX 24-hour Data Sept. 14-20, 2014 (10 pp, 21 K)
- 24 Hour Data Sept. 7-13, 2014 (10 pp, 21 K)
- 24 Hour Data Aug. 31 - Sept. 6, 2014 (10 pp, 21 K)

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August 2014

- 24 Hour Data Aug 24 - Aug 30, 2014 (10 pp, 19 K)
- 24 Hour Data Aug, 17-23, 2014 (10 pp, 19 K)
- 24 Hour Data Aug, 10-16, 2014 (10 pp, 19 K)
- 24 Hour Data Aug 3-9, 2014 (10 pp, 19 K)
- 24 Hour Data July 27 - Aug, 2, 2014 (10 pp, 19 K)

July 2014

- 24 Hour Data July 20-26, 2014 (17 pp, 19 K)
- 24 Hour Data July 13-19, 2014 (17 pp, 19 K)
- 24 Hour Data July 6-12, 2014 (17 pp, 19 K)
- 24 Hour Data June 29-July 7, 2014 (10 pp, 19 K)

June 2014

- 24 Hour Data June 22-28, 2014 (10 pp, 19 K)
- 24 Hour Data June 15-21, 2014 (10 pp, 19 K)
- 24 Hour Data June 8-14, 2014 (10 pp, 19 K)
- 24 Hour Data June 1-7, 2014 (10 pp, 19 K)

May 2014

- 24 Hour Data May 25-31, 2014 (10 pp, 19 K)
- 24 Hour Data May 18-24, 2014 (10 pp, 19 K)
- 24 Hour Data May 11-17, 2014 (10 pp, 19 K)
- 24 Hour Data May 4-10, 2014 (10 pp, 19 K)

April 2014

- 24 Hour Data April 27-May 3, 2014 (10 pp, 19 K)
- 24 Hour Data April 20-26, 2014 (10 pp, 19 K)
- 24 Hour Data April 1-19, 2014 (10 pp, 21 K)

March 2014

- 24 Hour Data March 1-31, 2014 (17 pp, 29 K)

February 2014

- 24 Hour Data Feb. 18-28, 2014 (10 pp, 20 K)

Fenceline Air Monitor PM_{10} and Meteorological Hourly Raw Data

This is the raw PM_{10} hourly fenceline air monitoring data provided by KCBX. It is presented as a summary at the top of this page.
The spreadsheets also include the raw meteorological data on an hourly basis.
The following files are Excel spreadsheets (XLSX).

January 2017

KCBX PM10 and Meteorological Hourly Raw Data January 1-31, 2017 (3 pp, 91 K)

December 2016

KCBX PM10 and Meteorological Hourly Raw Data December 1-31, 2016 (3 pp, 94 K)

November 2016

KCBX PM10 and Meteorological Hourly Raw Data November 1-30, 2016 (3 pp, 91 K)

October 2016

KCBX PM10 and Meteorological Hourly Raw Data October 1-31, 2016 (11 pp, 81 K)

September 2016

KCBX PM10 and Meteorological Hourly Raw Data September 1-30, 2016 (7 pp, 10 K)

August 2016

KCBX PM10 and Meteorological Hourly Raw Data August 1-31, 2016 (7 pp, 91 K)

July 2016

KCBX PM10 and Meteorological Hourly Raw Data July 1-31, 2016 (7 pp, 91 K)

June 2016

KCBX PM10 and Meteorological Hourly Raw Data June 2016 (2 pp, 90 K)

May 2016

KCBX PM10 and Meteorological Hourly Raw Data May 1-31, 2016 (3 pp, 141 K)

April 2016

KCBX PM10 and Meteorological Hourly Raw Data April 2-30, 2016 (3 pp, 128 K)

March 2016

- KCBX PM10 and Meteorological Hourly Raw Data March 27 - April 2, 2016 (7 pp, 58 K)
- KCBX PM10 and Meteorological Hourly Raw Data March 20-26, 2016 (7 pp, 58 K)
- KCBX PM10 and Meteorological Hourly Raw Data March 13-19, 2016 (7 pp, 58 K)

- KCBX PM10 and Meteorological Hourly Raw Data March 6-12, 2016 (7 pp, 58 K)
- KCBX PM10 and Meteorological Hourly Raw Data Feb. 28 - March 5, 2016 (7 pp, 58 K)

February 2016

- KCBX PM10 and Meteorological Hourly Raw Data Feb. 21-27, 2016 (7 pp, 62 K)
- KCBX PM10 and Meteorological Hourly Raw Data Feb. 14-20, 2016 (7 pp, 58 K)
- KCBX PM10 and Meteorological Hourly Raw Data Feb. 7-13, 2016 (7 pp, 58 K)
- KCBX PM10 and Meteorological Hourly Raw Data Jan. 31 - Feb. 6, 2016 (7 pp, 58 K)

January 2016

- KCBX PM10 and Meteorological Hourly Raw Data Jan. 24-30, 2016 (7 pp, 57 K)
- KCBX PM10 and Meteorological Hourly Raw Data Jan. 17-23, 2016 (7 pp, 58 K)
- KCBX PM10 and Meteorological Hourly Raw Data Jan. 10-16, 2016 (7 pp, 57 K)
- KCBX PM10 and Meteorological Hourly Raw Data Jan. 3-9, 2016 (11 pp, 85 K)
- KCBX PM10 and Meteorological Hourly Raw Data Dec. 27, 2015 - Jan. 2, 2016 (11 pp, 96 K)

December 2015

- KCBX PM10 and Meteorological Hourly Raw Data Dec. 20-26, 2015 (11 pp, 96 K)
- KCBX PM10 and Meteorological Hourly Raw Data Dec. 13-19, 2015 (11 pp, 96 K)
- KCBX PM10 and Meteorological Hourly Raw Data Dec. 6-12, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data Nov. 29 - Dec. 5, 2015 (11 pp, 96 K)

November 2015

- KCBX PM10 and Meteorological Hourly Raw Data Nov. 22-28, 2015 (11 pp, 93 K)
- KCBX PM10 and Meteorological Hourly Raw Data Nov. 15-21, 2015 (11 pp, 95 K)
- KCBX PM10 and Meteorological Hourly Raw Data Nov. 8-14, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data Nov. 1-7, 2015 (11 pp, 83 K)

October 2015

- KCBX PM10 and Meteorological Hourly Raw Data Oct. 25-31, 2015 (11 pp, 96 K)
- KCBX PM10 and Meteorological Hourly Raw Data Oct. 18-24, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data Oct. 11-17, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data Oct. 4-10, 2015 (11 pp, 96 K)
- KCBX PM10 and Meteorological Hourly Raw Data Sept. 27-Oct. 3, 2015 (11 pp, 97 K)

September 2015

- KCBX PM10 and Meteorological Hourly Raw Data Sept. 20-26, 2015 (10 pp, 96 K)
- KCBX PM10 and Meteorological Hourly Raw Data Sept. 13-19, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data Sept. 6-12, 2015 (11 pp, 97 K)

- KCBX PM10 and Meteorological Hourly Raw Data Aug. 30-Sept. 5, 2015 (11 pp, 97 K)

August 2015

- KCBX PM10 and Meteorological Hourly Raw Data Aug. 23-29, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data Aug. 16-22, 2015 (11 pp, 72 K)
- KCBX PM10 and Meteorological Hourly Raw Data Aug. 9-15, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data Aug. 2-8, 2015 (11 pp, 97 K)

July 2015

- KCBX PM10 and Meteorological Hourly Raw Data July 26-Aug. 1, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data July 19-25, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data July 12-18, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data June 28 - July 4, 2015 (11 pp, 97 K)

June 2015

- KCBX PM10 and Meteorological Hourly Raw Data June 21-26, 2015 (11 pp, 97 K)
- KCBX PM10 and Meteorological Hourly Raw Data June 14-20, 2015 (11 pp, 97 K) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data June 7-12, 2015 (11 pp, 97 K) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data - May 31-June 6, 2015 (11 pp, 98 K, July 21, 2015) This data file was updated to correct wind direction data.

May 2015

- KCBX PM10 and Meteorological Hourly Raw Data - May 24-30, 2015 (11 pp, 98 K, July 21, 2015) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data - May 17-23, 2015 (11 pp, 98 K, July 21, 2015) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data - May 10-16, 2015 (11 pp, 98 K, July 21, 2015) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data - May 3-9, 2015 (11 pp, 98 K, July 21, 2015) This data file was updated to correct wind direction data.

April 2015

- KCBX PM10 and Meteorological Hourly Raw Data - April 26, 2015 - May 2, 2015 (11 pp, 98 K, July 21, 2015) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data - April 19-25, 2015 (11 pp, 98 K, July 21, 2015) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data - April 12-18, 2015 (11 pp, 98 K, July 21, 2015) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data - April 5-11, 2015 (11 pp, 99 K, July 21, 2015) This data file was updated to correct wind direction data.
- KCBX PM10 and Meteorological Hourly Raw Data - March 29-April 4, 2015 (11 pp, 951 K)

March 2015

- KCBX PM10 and Meteorological Hourly Raw Data - March 22-28, 2015 (11 pp, 100 K)
- KCBX PM10 and Meteorological Hourly Raw Data - March 15-21, 2015 (11 pp, 100 K)
- KCBX PM10 and Meteorological Hourly Raw Data - March 8-14, 2015 (11 pp, 100 K)
- KCBX PM10 and Meteorological Hourly Raw Data - March 1-7, 2015 (11 pp, 100 K)

February 2015

- KCBX PM10 and Meteorological Hourly Raw Data - Feb. 22-28, 2015 (11 pp, 100 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Feb. 15-21, 2015 (11 pp, 100 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Feb. 8-14, 2015 (11 pp, 100 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Feb. 1-7, 2015 (11 pp, 100 K)

January 2015

- KCBX PM10 and Meteorological Hourly Raw Data - Jan. 25-31, 2015 (11 pp, 94 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Jan. 18-24, 2015 (11 pp, 94 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Jan. 11-17, 2015 (11 pp, 98 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Jan. 5-10, 2015 (11 pp, 99 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Dec. 28 - Jan. 3, 2015 (11 pp, 77 K)

December 2014

- KCBX PM10 and Meteorological Hourly Raw Data - Dec. 21-27, 2014 (11 pp, 76 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Dec. 14-20, 2014 (11 pp, 70 K)
- KCBX PM10 and Meteorological Hourly Raw Data - Dec. 7-13, 2014 (11 pp, 70 K)
- KCBX PM10 and Meteorological Hourly Raw Data Nov. 30-Dec. 6, 2014 (11 pp, 71 K)

November 2014

- KCBX PM10 and Meteorological Hourly Raw Data Nov. 23-29, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Nov. 16-22, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Nov. 9-15, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Nov. 2-8, 2014 (11 pp, 67 K)

October 2014

- KCBX PM10 and Meteorological Hourly Raw Data Oct. 26-Nov. 1, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Oct. 19-25, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Oct. 12-18, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Oct. 5-11, 2014 (11 pp, 71 K)

September 2014

- KCBX PM10 and Meteorological Hourly Raw Data Sept. 28-Oct. 4, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Sept. 21-27, 2014 (11 pp, 56 K)
- KCBX PM10 and Meteorological Hourly Raw Data Sept. 14-20, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Sept. 7-13, 2014.xlsx (11 pp, 69 K)
- KCBX PM10 and Meteorological Hourly Raw Data Aug 31 - Sept 6, 2014 (11 pp, 66 K)

August 2014

- KCBX PM10 and Meteorological Hourly Raw Data Aug. 24 - Aug. 30, 2014 (11 pp, 66 K)
- KCBX PM10 and Meteorological Hourly Raw Data Aug. 17-23, 2014 (11 pp, 71 K)
- KCBX PM10 and Meteorological Hourly Raw Data Aug 10-16, 2014 (11 pp, 71 K)
  this is an updated data file
- KCBX PM10 and Meteorological Hourly Raw Data Aug 3-9, 2014 (11 pp, 70 K)
  this is an updated data file
- KCBX PM10 and Meteorological Hourly Raw Data July 27- Aug. 2, 2014 (11 pp, 71 K)
  this is an updated data file

July 2014

- KCBX PM10 and Meteorological Hourly Raw Data July 20-26, 2014 (11 pp, 66 K)
  this is an updated data file
- KCBX PM10 and Meteorological Hourly Raw Data July 13-19, 2014 (11 pp, 71 K)
  this is an updated data file
- KCBX PM10 and Meteorological Hourly Raw Data July 6-12, 2014 (11 pp, 67 K)
  this is an updated data file
- KCBX PM10 and Meteorological Hourly Raw Data June 29-July 5, 2014 (11 pp, 66 K)
  this is an updated data file

June 2014

- KCBX PM10 and Meteorological Hourly Raw Data June 22-28, 2014 (XLSX) (11 pp, 66 K)
  this is an updated data file
- KCBX PM10 and Meteorological Hourly Raw Data June 15-21, 2014 (11 pp, 66 K)
- KCBX PM10 and Meteorological Hourly Raw Data June 8-14, 2014 (11 pp, 66 K)
- KCBX PM10 and Meteorological Hourly Raw Data June 1-7, 2014 (11 pp, 66 K)

May 2014

- KCBX PM10 and Meteorological Hourly Raw Data May 25-31, 2014 (11 pp, 66 K)
- KCBX PM10 and Meteorological Hourly Raw Data May 18-24, 2014 (11 pp, 67 K)
- KCBX PM10 and Meteorological Hourly Raw Data May 11-17, 2014 (11 pp, 67 K)
- KCBX PM10 and Meteorological Hourly Raw Data May 4-10, 2014 (11 pp, 66 K)

April 2014

- KCBX PM10 and Meteorological Hourly Raw Data April 27-May 3, 2014 (11 pp, 66 K)
- KCBX PM10 and Meteorological Hourly Raw Data April 20-26, 2014 (11 pp, 65 K)

- KCBX PM10 and Meteorological Hourly Raw Data April 1-19, 2014 (11 pp, 145 K)

March 2014

- KCBX PM10 and Meteorological Hourly Raw Data March 2014 Summary (11 pp, 197 K)

February 2014

- KCBX PM10 and Meteorological Hourly Raw Data Feb. 18-28, 2014 (11 pp, 90 K)

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S.H. Bell Chicago Air Monitoring Data

EPA has required environmental air monitoring of the S.H. Bell Company facility in Chicago, Ill.

- Air monitor locations
- Air monitor data

Monitor Locations

Monitoring Site ID	Approximate Location		Monitoring Equipment
	Northing	Easting	
S1	41.708239	-87.544058	BAM-1020 monitor for PM10 (Continuous FEM)
S2	41.710553	-87.539204	BAM-1020 monitor for PM10 (Continuous FEM)
S3	41.710552	-87.542043	BAM-1020 monitor for PM10 (Continuous FEM) Agilaire 8872 Datalogger
S4	41.711541	-87.539607	BAM-1020 monitor for PM10 (Continuous FEM) Two (2) Tisch Environmental HiVol 6070 DVBL Filter-Based FRM PM10 Monitors
EMS (Existing Monitoring Station)	41.709841	-87.540376	Meteorological monitors (Climatronics: Wind Speed, Wind Direction, Temperature, Barometric Pressure, Data Logger)

Placement of the monitors is illustrated in the map below. Click on the map to view a larger image.

Air Monitor Data

EPA has developed various pollution and wind roses with the March 1, 2017, through June 30, 2017, air monitoring data.
View the S.H. Bell Chicago Pollution Roses.

- A **wind rose** is a diagram that shows the distribution of wind direction over a period of time.
- A **pollution rose** is a graphical display of wind direction frequency for winds having certain amounts of a particulates.
- Additional information on wind and pollution roses. (*Air Pollution Control Orientation Course Unit 3 Air Pollution Meteorology*, p. 48)

Air monitor data from S.H. Bell facility in Chicago, Ill.

Month	**Continuous Hourly PM10 Data From the FEM PM10 Monitors**			
	S1	**S2**	**S3**	**S4**
March 2017 - April 2020	FEM Continuous Hourly PM10 Data - April 2020 (10 MB)			

Month	**Filter-based Monitor (S4) Data From the FRM Monitor**
March 2017 - April 2020	Filter-based Monitor (S4) Data From the FRM Monitor (241 K)

Meteorological data from S.H. Bell facility in Chicago, Ill.

Date	Meteorological Data (EMS)
March 2017	Meteorological data - March 2017 (csv) (1 pg, 50 K)
April 2017	SH Bell Chicago April 2017 MET Data (xls) (5 pp, 58 K, June 5, 2017)
May 2017	S.H. Bell Chicago May 2017 MET Data (XLSX) (1 pg, 59 K)
June 2017	S.H. Bell Chicago June 2017 MET Data (XLSX) (1 pg, 58 K)
July 2017	S.H. Bell Chicago July 2017 MET Data (1 pg, 60 K)
August 2017	S.H. Bell August 2017 MET data (5 pp, 60 K)
September 2017	S.H. Bell September 2017 MET data (3 pp, 58 K)
October 2017	Meteorological Data (EMS) October 2017 (5 pp, 59 K)
November 2017	Meteorological Data (EMS) November 2017 (5 pp, 58 K)
December 2017	Meteorological Data (EMS) December 2017 (5 pp, 59 K)
January 2018	Meteorological Data (EMS) January 2018 (5 pp, 59 K)
February 2018	Meteorological Data (EMS) February 2018 (5 pp, 55 K)
March 2018	Meteorological Data (EMS) March 2018 (5 pp, 59 K)
April 2018	Meteorological Data (EMS) April 2018 (5 pp, 58 K)
May 2018	Meteorological Data (EMS) May 2018 (5 pp, 60 K)
June 2018	Meteorological Data (EMS) June 2018 (5 pp, 58 K)
July 2018	Meteorological Data (EMS) July 2018 (5 pp, 59 K)
August 2018	Meteorological Data (EMS) August 2018 (64 K)

September 2018	Meteorological Data (EMS) September 2018 (56 K)
October 2018	Meteorological Data (EMS) October 2018 (59 K)
November 2018	Meteorological Data (EMS) November 2018 (56 K)
December 2018	Meteorological Data (EMS) December 2018 (58 K)
January 2019	Meteorological Data (EMS) January 2019 (58 K)
February 2019	Meteorological Data (EMS) February 2019 (54 K)
March 2019	Meteorological Data (EMS) March 2019 (58 K)
April 2019	Meteorological Data (EMS) April 2019 (57 K)
May 2019	Meteorological Data (EMS) May 2019 (59 K)
June 2019	Meteorological Data (EMS) June 2019 (57 K)
July 2019	Meteorological Data (EMS) July 2019 (59 K)
August 2019	Meteorological Data (EMS) August 2019 (59 K)
September 2019	Meteorological Data (EMS) September 2019 (57 K)
October 2019	Meteorological Data (EMS) October 2019 (58 K)
November 2019	Meteorological Data (EMS) November 2019 (57 K)
December 2019	Meteorological Data (EMS) December 2019 (58 K)
January 2020	Meteorological Data (EMS) January 2020 (58 K)
February 2020	Meteorological Data (EMS) February 2020 (55 K)
March 2020	Meteorological Data (EMS) March 2020 (58 K)

April 2020	Meteorological Data (EMS) April 2020 (57 K)

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Watco Terminal and Port Services

Versión en español: Terminal y servicios portuarios de Watco

On this page:

- Soil Sampling Update
- Air Monitoring Update
- Air monitor locations
- Air monitor data
- Documents

Watco Terminal and Port Services (Watco) is a bulk solid material handler located at 2926 East 126th Street, Chicago, Illinois 60633. Watco stores and handles bulk solid materials, including manganese-bearing alloys. U.S. EPA has been studying air in Chicago's Southeast side since 2013 in response to residents' concerns about the area's long industrial history. U.S. EPA has inspected Watco several times since June 2014.

U.S. EPA is committed to investigating sources of pollution, fugitive dust, and toxic metals in Southeast Chicago, including conducting inspections, issuing Section 114 Information Requests, and taking appropriate enforcement action. (Learn about EPA enforcement in The Clean Air Act in a Nutshell: How It Works).

Update-June 2020

Environmental Issues in Southeast Chicago

Contact Information

For soil sampling access agreements:
Heriberto León
(leon.heriberto@epa.gov)
Community Involvement Coordinator
312-886-6163

Collecting soil samples near the Watco Terminal and Port Services facility in Southeast Chicago.

Soil Sampling

U.S. Environmental Protection Agency is sampling the Babe Ruth Field on the southwest corner of East 126th Place and South Carondolet Avenue in Chicago's Hegewisch neighborhood in response to a request in February 2020 from the City of Chicago Department of Public Health (CDPH). EPA personnel and contractors adhere to protective measures including social distancing, increased sanitation, and the use of personal protective equipment as needed. These special measures, among others, are documented in the site-specific Health and Safety Plan. The Agency expects to have validated sampling results later in the summer.

Background

U.S. EPA collected soil samples at residential properties near the Watco Terminal and Port Services facility in Southeast Chicago in the summer of 2019 to analyze them for manganese and other metals. This would help the Agency determine whether these elements in the soil posed an unacceptable health risk to residents and whether any follow-up action would be required. The targeted sampling area covered roughly between East 126th Place to the north and East 127th and 128th streets to the south, South Torrence and South Muskegon avenues to the west and South Carondolet Avenue to the east. (See map below)

For soil sampling technical questions:
Kristina Miller
(miller.kristina@epa.gov)
On-Scene Coordinator
312-353-1057

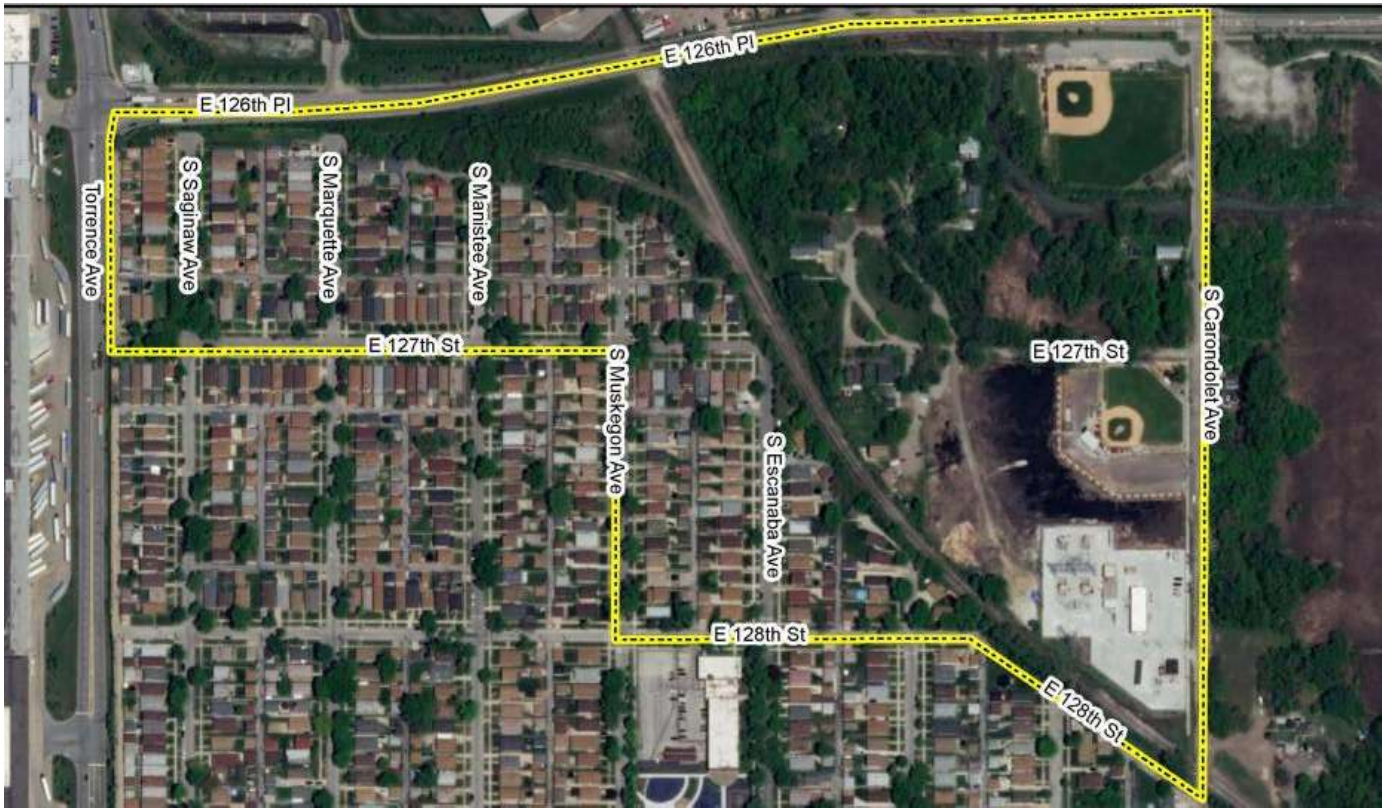
For air monitoring questions:
Patrick Miller
(miller.patrick@epa.gov)
Environmental Engineer
312-886-4044 or 800-621-8431, ext. 64044

The residential property sample results showed that manganese, lead, and arsenic were not present in soil at concentrations that exceeded the U.S. EPA removal management levels (RMLs). EPA sets regional management levels (RMLs) for many contaminants that are considered to be protective of humans (including sensitive groups) over a lifetime. Of this data, the highest level of manganese detected was 2,200 parts per million (ppm), which is below the RML of 5,500 ppm. The highest level of lead detected was 268 ppm, which is below the RML of 400 ppm. U.S. EPA notified owners the results of the 2019 soil sampling on their properties.

U.S. EPA also collected soil samples in the right of ways adjacent to the Virgil Grissom Elementary School, which is a Chicago Public School. These sample results were also below the RMLs for lead, arsenic, and manganese.

U.S. EPA also conducted sampling at the Hegewisch Little League Field located at 127th Street and Carondolet Avenue. More information on the results of this sampling and future U.S. EPA actions can be found on the 127th Street Soil Site webpage.

View documents for this site.



Map of area for collecting soil samples near the Watco Terminal and Port Services.

Update-November 2019

Air Monitoring

Aerial image showing location of MET and FRM monitors in relation to Watco Terminal and Port Services

On Nov. 7, 2019, U.S. EPA finalized an administrative consent order requiring Watco to limit handling, storing and shipping of bulk manganese-containing materials to and from its Chicago facility by Jan. 31, 2020. Bulk manganese-containing materials are those materials which are open to the air, non-packaged and able to escape as fugitive emissions.

EPA's order requires Watco to remove all bulk materials containing 2% or more of manganese. The order also requires the company to continue air monitoring for small particles including manganese for six months after all loose manganese-containing materials are removed. Monitoring can end after six months if average manganese concentrations are below the conservative risk level set by the federal Agency for Toxic Substances and Disease Registry.

On May 15, 2018, U.S. EPA issued an information request to Watco that requires the installation and operation of a Federal Reference Method (FRM) monitor to measure concentrations of particulate matter less than 10 microns (PM_{10}) and several types of heavy metals and a meteorological station to measure wind speed and wind direction. Watco previously installed a meteorological station in August 2017. The FRM monitor was installed and began operating on September 14, 2018. EPA inspected the facility on September 25, 2018 Clean Air Act Inspection Report to verify the installation of the monitor.

Monitoring Locations

Monitor	Approximate Location (UTM NAD83)		Monitoring Equipment
	Northing	Easting	
Filter-based Monitor	4613090.99	453944.31	Met One Inc. Model E-SEQ-FRM
Meteorological Station	4613152.66	453754.62	Met One Inc. Model 034B

Air Monitor Data

Monitor	Timeframe	Data

Monitor	Timeframe	Data
Filter-based Monitor	September 2018 – April 2020	Filter-based Monitor: September 2018 – April 2020 (307 K)
Meteorological Station	September 2018 – April 2020	Meteorological Station: September 2018 – April 2020 (9 MB)

The average manganese concentration for the month of April 2020 is 0.086 µg/m^3. The 12-month rolling average manganese concentration is 0.052 µg/m^3.

Exposure to a level above the MRL does not mean that adverse health effects will occur. ATSDR sets MRLs below levels that might cause adverse health effects in the people most sensitive to such substance-induced effects based on current information. Learn more about MRLs.

EPA will continue to evaluate Watco's operations and all monitoring data as it is submitted. EPA is committed to sharing the air monitoring data even when the data is preliminary with the community and other government agencies and to take action needed to protect public health. EPA has been in communication with Watco and Watco is committed to investigating its operations and manganese emissions.

Documents

Information request and inspection report documents

- EPA Fact Sheet – U.S. EPA to Conduct Soil Tests in Southeast Chicago (PDF) (2 pp, 493 K, About PDF)
- WATCO Terminal Site - Sampling Area Map (PDF) (1 pg, 1.13 MB, About PDF)

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SO BUILDHGT RTO             18.29    18.29    18.29    18.29    18.29    18.29
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SO BUILDHGT RTO              0.00     0.00     0.00    18.29    18.29    18.29
SO BUILDHGT RTO             18.29    18.29    18.29    18.29    18.29    18.29
SO BUILDWID RTO             39.01    39.78    39.35     0.00     0.00     0.00
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SO BUILDWID RTO             29.68    28.31    26.07    29.85    33.96    37.05
SO BUILDWID RTO             39.01    39.78    39.35     0.00     0.00     0.00
SO BUILDWID RTO              0.00     0.00     0.00    36.02    34.83    32.58
SO BUILDWID RTO             29.68    28.31    26.07    29.85    33.96    37.05
SO BUILDLEN RTO             36.02    34.83    32.58     0.00     0.00     0.00
SO BUILDLEN RTO              0.00     0.00     0.00    39.01    39.78    39.35
SO BUILDLEN RTO             37.72    34.94    31.11    33.05    35.12    36.12
SO BUILDLEN RTO             36.02    34.83    32.58     0.00     0.00     0.00
SO BUILDLEN RTO              0.00     0.00     0.00    39.01    39.78    39.35
SO BUILDLEN RTO             37.72    34.94    31.11    33.05    35.12    36.12
SO XBADJ    RTO              6.90     3.87     0.73     0.00     0.00     0.00
SO XBADJ    RTO              0.00     0.00     0.00   -40.62   -44.68   -47.38
SO XBADJ    RTO            -48.63   -48.42   -46.73   -47.44   -47.36   -45.83
SO XBADJ    RTO            -42.92   -38.70   -33.30     0.00     0.00     0.00
SO XBADJ    RTO              0.00     0.00     0.00     1.61     4.89     8.03
SO XBADJ    RTO             10.92    13.47    15.62    14.39    12.24     9.72
SO YBADJ    RTO             21.11    24.78    27.70     0.00     0.00     0.00
SO YBADJ    RTO              0.00     0.00     0.00    24.91    21.29    17.01
SO YBADJ    RTO             12.05     5.52    -1.19    -6.80   -11.98   -16.80
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SO YBADJ    RTO            -12.05    -5.52     1.19     6.80    11.98    16.80
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SO BUILDHGT DC1             13.72    13.72    13.72    13.72    13.72    13.72
SO BUILDHGT DC1             13.72    13.72    13.72    13.72    13.72    13.72
SO BUILDWID DC1             66.64    68.61    68.49    66.29    62.07    55.97
SO BUILDWID DC1             60.44    65.23    68.04    68.78    67.44    64.04
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SO BUILDLEN DC1             68.78    67.44    64.04    58.70    51.57    42.88
SO BUILDLEN DC1             49.14    56.76    62.65    66.64    68.61    68.49
SO BUILDLEN DC1             66.29    62.07    55.97    60.44    65.23    68.04
SO BUILDLEN DC1             68.78    67.44    64.04    58.70    51.57    42.88
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SO YBADJ    DC1             24.20    23.83    22.73    20.95    18.52    15.53
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SO EMISFACT V5 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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SO EMISFACT V9 HRDOW 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 1 1 1 1 1 1 1 1
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0.0195 1 1 1 1 1
SO EMISFACT V9 HRDOW 1 1 1 1 1 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195
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0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195
**
SO LOCATION V10 VOLUME 454173.38 4614858.04 178.19
SO SRCPARAM V10 0.0304 0.9144 1.41768576 0.85060536
SO EMISFACT V10 HRDOW 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1.7456 1.7456 1.7456 1.7456 0 0 0 0
0 0 0 0 0 0 0 0 1 1 1 1 1
SO EMISFACT V10 HRDOW 1 1 1 1.7456 1.7456 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
**
SO LOCATION V11 VOLUME 454170.92 4614872.75 178.19
SO SRCPARAM V11 0.0251 5.334 8.5060536 4.96186968
SO EMISFACT V11 HRDOW 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650 1 1 1 1 1 1 1 1
2.1636 2.1636 2.1636 2.1636 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650
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SO EMISFACT V11 HRDOW 1 1 1 2.1636 2.1636 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650
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0.2650
**
SO LOCATION V12 VOLUME 454179.64 4614840.61 178.19
SO SRCPARAM V12 0.0251 5.334 8.5060536 4.96186968
SO EMISFACT V12 HRDOW 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650 1 1 1 1 1 1 1 1
2.1636 2.1636 2.1636 2.1636 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650
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SO EMISFACT V12 HRDOW 1 1 1 2.1636 2.1636 0.2650 0.2650 0.2650 0.2650 0.2650 0.2650
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0.2650
**
SO LOCATION V13 VOLUME 454094.65 4614815.89 177.72
SO SRCPARAM V13 0.0715 0.9144 1.41768576 0.85060536
SO EMISFACT V13 HRDOW 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1
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SO EMISFACT V13 HRDOW 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0
**
SO LOCATION VN1 VOLUME 454294.913 4614781.55 178.19
SO SRCPARAM VN1 2.962210172E-07 6.096 7.08836784 5.67071256
SO EMISFACT VN1 HRDOW 0.000103 0.000103 0.000103 0.000103 0.000103 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 1 1 1 1 1 1 1
SO EMISFACT VN1 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0.000103 0.000103 0.000103 0.000103
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0.000103 0.000103 0.000103
**
SO LOCATION VN2 VOLUME 454328.547 4614797.57 178.19
SO SRCPARAM VN2 8.225141643E-08 6.096 7.08836784 5.67071256
SO EMISFACT VN2 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 1 1 1 1
1 1 1
SO EMISFACT VN2 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0
**
SO LOCATION VN3 VOLUME 454345.365 4614834.4 178.19
SO SRCPARAM VN3 1.684591663E-07 3.81 7.08836784 3.54418392
SO EMISFACT VN3 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 1 1 1 1
1 1 1
SO EMISFACT VN3 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0
**
SO LOCATION VN4 VOLUME 454300.519 4614814.38 178.19
SO SRCPARAM VN4 7.25747792E-09 3.81 7.08836784 3.54418392
SO EMISFACT VN4 HRDOW 0.0567 0.0567 0.0567 0.0567 0.0567 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 1 1 1 1 1 1 1
SO EMISFACT VN4 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567
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**
SO LOCATION VN5 VOLUME 454338.158 4614842.41 178.19
SO SRCPARAM VN5 4.775319673E-09 3.81 7.08836784 3.54418392
SO EMISFACT VN5 HRDOW 0.1438 0.1438 0.1438 0.1438 0.1438 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 1 1 1 1 1 1 1
SO EMISFACT VN5 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438
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0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438
**
SO LOCATION VN6 VOLUME 454383.003 4614853.62 178.19
SO SRCPARAM VN6 6.716947012E-08 3.81 2.83534104 3.54418392
SO EMISFACT VN6 HRDOW 0.0095 0.0095 0.0095 0.0095 0.0095 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 1 1 1 1 1 1 1
SO EMISFACT VN6 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095
0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095
0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095
**
SO LOCATION AB_0001 VOLUME 454569.7 4615033.84 178.19
SO SRCPARAM AB_0001 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0001 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1
1 1 1 1 1
SO EMISFACT AB_0001 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
**
SO LOCATION AB_0002 VOLUME 454557.7 4615033.84 178.19
SO SRCPARAM AB_0002 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0002 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1
1 1 1 1 1
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SO EMISFACT AB_0002 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**
SO LOCATION AB_0003 VOLUME 454545.7 4615033.84 178.19
SO SRCPARAM AB_0003 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0003 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1
SO EMISFACT AB_0003 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**
SO LOCATION AB_0004 VOLUME 454533.7 4615033.84 178.19
SO SRCPARAM AB_0004 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0004 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1
SO EMISFACT AB_0004 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**
SO LOCATION AB_0005 VOLUME 454521.7 4615033.84 178.19
SO SRCPARAM AB_0005 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0005 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1
SO EMISFACT AB_0005 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**&
SO LOCATION AB_0006 VOLUME 454509.7 4615033.84 178.19
SO SRCPARAM AB_0006 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0006 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1
SO EMISFACT AB_0006 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**
SO LOCATION AB_0007 VOLUME 454497.7 4615033.84 178.19
SO SRCPARAM AB_0007 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0007 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1
SO EMISFACT AB_0007 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**
SO LOCATION AB_0008 VOLUME 454485.7 4615033.84 178.19
SO SRCPARAM AB_0008 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0008 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1
SO EMISFACT AB_0008 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**
SO LOCATION AB_0009 VOLUME 454473.7 4615033.84 178.19
SO SRCPARAM AB_0009 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0009 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1
SO EMISFACT AB_0009 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**
SO LOCATION AB_0010 VOLUME 454461.7 4615033.84 178.19
SO SRCPARAM AB_0010 2.127930E-02 2.59 5.58 2.41
SO EMISFACT AB_0010 HRDOW 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1
SO EMISFACT AB_0010 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
**
SO LOCATION CDE_0001 VOLUME 454449.996 4615030.05 178.19
SO SRCPARAM CDE_0001 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0002 VOLUME 454440.148 4615023.19 178.19
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SO SRCPARAM CDE_0002 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0003 VOLUME 454430.299 4615016.34 178.19
SO SRCPARAM CDE_0003 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0004 VOLUME 454420.675 4615009.19 178.19
SO SRCPARAM CDE_0004 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0005 VOLUME 454411.484 4615001.47 178.19
SO SRCPARAM CDE_0005 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0006 VOLUME 454402.292 4614993.76 178.19
SO SRCPARAM CDE_0006 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0007 VOLUME 454394.404 4614984.73 178.19
SO SRCPARAM CDE_0007 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0008 VOLUME 454386.594 4614975.62 178.19
SO SRCPARAM CDE_0008 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0009 VOLUME 454380.888 4614965.12 178.19
SO SRCPARAM CDE_0009 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0010 VOLUME 454375.67 4614954.32 178.19
SO SRCPARAM CDE_0010 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0011 VOLUME 454370.542 4614943.47 178.19
SO SRCPARAM CDE_0011 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0012 VOLUME 454366.572 4614932.28 178.19
SO SRCPARAM CDE_0012 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0013 VOLUME 454364.926 4614920.39 178.19
SO SRCPARAM CDE_0013 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0014 VOLUME 454361.686 4614909.6 178.19
SO SRCPARAM CDE_0014 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0015 VOLUME 454351.165 4614903.83 178.19
SO SRCPARAM CDE_0015 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0016 VOLUME 454340.644 4614898.06 178.19
SO SRCPARAM CDE_0016 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0017 VOLUME 454330.123 4614892.29 178.19
SO SRCPARAM CDE_0017 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0018 VOLUME 454319.602 4614886.52 178.19
SO SRCPARAM CDE_0018 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0019 VOLUME 454309.08 4614880.75 178.19
SO SRCPARAM CDE_0019 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0020 VOLUME 454298.559 4614874.97 178.19
SO SRCPARAM CDE_0020 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0021 VOLUME 454288.038 4614869.2 178.19
SO SRCPARAM CDE_0021 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0022 VOLUME 454277.517 4614863.43 178.19
SO SRCPARAM CDE_0022 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0023 VOLUME 454266.996 4614857.66 178.19
SO SRCPARAM CDE_0023 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0024 VOLUME 454256.475 4614851.89 178.19
SO SRCPARAM CDE_0024 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0025 VOLUME 454245.953 4614846.12 178.19
SO SRCPARAM CDE_0025 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0026 VOLUME 454235.432 4614840.35 178.19
SO SRCPARAM CDE_0026 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0027 VOLUME 454224.911 4614834.58 178.19
SO SRCPARAM CDE_0027 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0028 VOLUME 454214.39 4614828.81 178.19
SO SRCPARAM CDE_0028 4.107428E-03 2.59 5.58 2.41
SO LOCATION CDE_0029 VOLUME 454203.869 4614823.03 178.19
SO SRCPARAM CDE_0029 4.107428E-03 2.59 5.58 2.41
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SO LOCATION I_0001 VOLUME 454452.749 4615028.45 178.19
SO SRCPARAM I_0001 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0002 VOLUME 454447.62 4615017.6 178.19
SO SRCPARAM I_0002 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0003 VOLUME 454442.491 4615006.75 178.19
SO SRCPARAM I_0003 9.654306E-04 2.59 5.58 2.41
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SO LOCATION I_0004 VOLUME 454437.363 4614995.9 178.19
SO SRCPARAM I_0004 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0005 VOLUME 454432.234 4614985.05 178.19
SO SRCPARAM I_0005 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0006 VOLUME 454427.105 4614974.21 178.19
SO SRCPARAM I_0006 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0007 VOLUME 454421.976 4614963.36 178.19
SO SRCPARAM I_0007 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0008 VOLUME 454416.847 4614952.51 178.19
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SO LOCATION I_0009 VOLUME 454411.718 4614941.66 178.19
SO SRCPARAM I_0009 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0010 VOLUME 454406.589 4614930.81 178.19
SO SRCPARAM I_0010 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0011 VOLUME 454401.46 4614919.96 178.19
SO SRCPARAM I_0011 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0012 VOLUME 454396.332 4614909.11 178.19
SO SRCPARAM I_0012 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0013 VOLUME 454391.203 4614898.26 178.19
SO SRCPARAM I_0013 9.654306E-04 2.59 5.58 2.41
SO LOCATION I_0014 VOLUME 454386.074 4614887.42 178.19
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SO LOCATION I_0016 VOLUME 454375.816 4614865.72 178.19
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SO LOCATION I_0017 VOLUME 454370.687 4614854.87 178.19
SO SRCPARAM I_0017 9.654306E-04 2.59 5.58 2.41
SO LOCATION H_0001 VOLUME 454569.74 4615048.61 178.19
SO SRCPARAM H_0001 6.209647E-03 2.59 5.58 2.41
SO LOCATION H_0002 VOLUME 454557.74 4615048.58 178.19
SO SRCPARAM H_0002 6.209647E-03 2.59 5.58 2.41
SO LOCATION H_0003 VOLUME 454545.74 4615048.55 178.19
SO SRCPARAM H_0003 6.209647E-03 2.59 5.58 2.41
SO LOCATION H_0004 VOLUME 454533.74 4615048.51 178.19
SO SRCPARAM H_0004 6.209647E-03 2.59 5.58 2.41
SO LOCATION H_0005 VOLUME 454521.74 4615048.48 178.19
SO SRCPARAM H_0005 6.209647E-03 2.59 5.58 2.41
SO LOCATION H_0006 VOLUME 454509.74 4615048.45 178.19
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SO LOCATION H_0007 VOLUME 454497.74 4615048.41 178.19
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SO LOCATION H_0008 VOLUME 454485.74 4615048.38 178.19
SO SRCPARAM H_0008 6.209647E-03 2.59 5.58 2.41
SO LOCATION H_0009 VOLUME 454473.826 4615049.52 178.19
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SO LOCATION H_0010 VOLUME 454462.408 4615052.96 178.19
SO SRCPARAM H_0010 6.209647E-03 2.59 5.58 2.41
SO LOCATION FG_0001 VOLUME 454450.378 4615031.43 178.19
SO SRCPARAM FG_0001 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0002 VOLUME 454439.841 4615025.69 178.19
SO SRCPARAM FG_0002 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0003 VOLUME 454429.304 4615019.95 178.19
SO SRCPARAM FG_0003 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0004 VOLUME 454418.767 4615014.21 178.19
SO SRCPARAM FG_0004 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0005 VOLUME 454408.23 4615008.46 178.19
SO SRCPARAM FG_0005 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0006 VOLUME 454397.693 4615002.72 178.19
SO SRCPARAM FG_0006 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0007 VOLUME 454387.156 4614996.98 178.19
SO SRCPARAM FG_0007 3.993313E-03 2.59 5.58 2.41
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SO LOCATION FG_0008 VOLUME 454376.619 4614991.24 178.19
SO SRCPARAM FG_0008 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0009 VOLUME 454366.082 4614985.5 178.19
SO SRCPARAM FG_0009 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0010 VOLUME 454355.545 4614979.75 178.19
SO SRCPARAM FG_0010 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0011 VOLUME 454345.008 4614974.01 178.19
SO SRCPARAM FG_0011 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0012 VOLUME 454334.471 4614968.27 178.19
SO SRCPARAM FG_0012 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0013 VOLUME 454323.934 4614962.53 178.19
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SO LOCATION FG_0014 VOLUME 454313.397 4614956.79 178.19
SO SRCPARAM FG_0014 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0015 VOLUME 454301.708 4614955.36 178.19
SO SRCPARAM FG_0015 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0016 VOLUME 454289.711 4614955.09 178.19
SO SRCPARAM FG_0016 3.993313E-03 2.59 5.58 2.41
SO LOCATION FG_0017 VOLUME 454277.714 4614954.82 178.19
SO SRCPARAM FG_0017 3.993313E-03 2.59 5.58 2.41
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SO SRCPARAM FG_0018 3.993313E-03 2.59 5.58 2.41
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SO SRCGROUP ALL
SO FINISHED

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ME PROFFILE E:\CONSULTING\GEN_IRON.PFL
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ME UAIRDATA 94982 2012
ME PROFBASE 175 METERS
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OU PLOTFILE  24  ALL SIXTH "E:\CONSULTING\PM10_NAQ_24.GRF"
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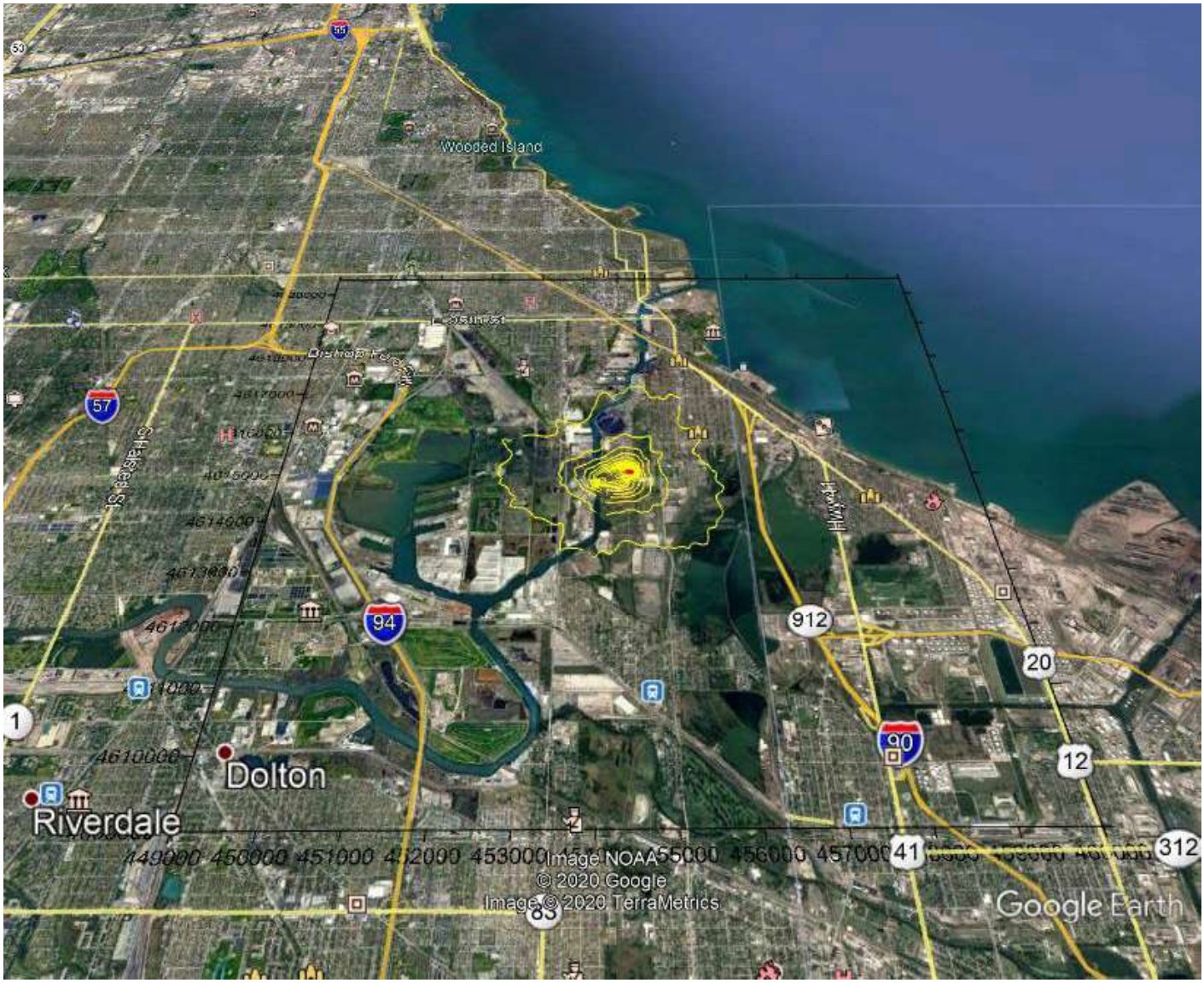
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Dolton
Riverdale
Image NOAA
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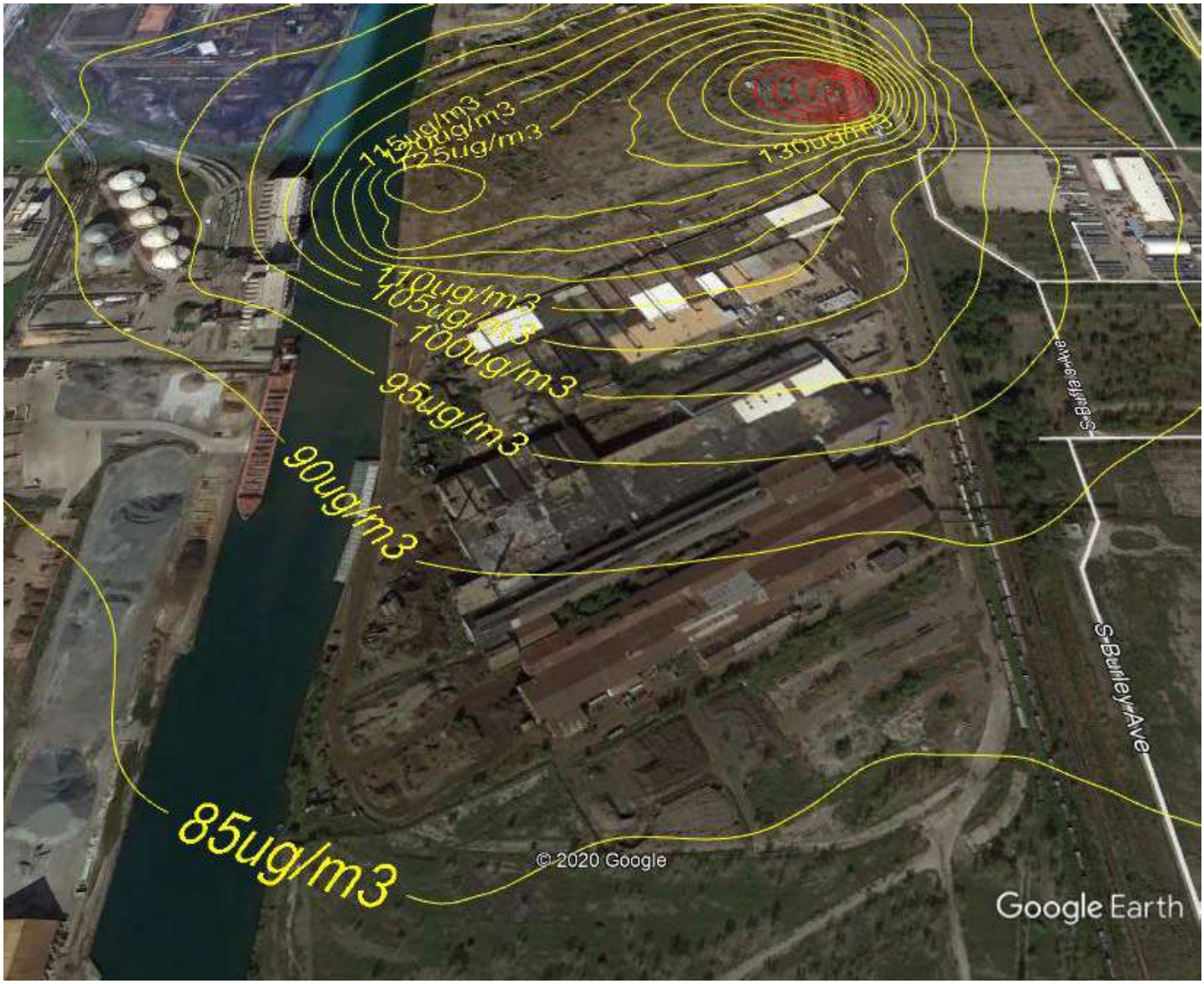
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125ug/m3
130ug/m3
110ug/m3
105ug/m3
100ug/m3
95ug/m3
90ug/m3
85ug/m3
S Burley Ave
S Burley Ave
© 2020 Google
Google Earth

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NO ECHO


  *** Message Summary For AERMOD Model Setup ***

  --------- Summary of Total Messages --------

 A Total of            0 Fatal Error Message(s)
 A Total of            2 Warning Message(s)
 A Total of            0 Informational Message(s)


    ******** FATAL ERROR MESSAGES ********
               ***  NONE  ***


    ********   WARNING MESSAGES   ********
 ME W186    3535       MEOPEN: THRESH_1MIN 1-min ASOS wind speed threshold used
0.50
 ME W187    3535       MEOPEN: ADJ_U* Option for Stable Low Winds used in AERMET

 **********************************
 *** SETUP Finishes Successfully ***
 **********************************
```

```
 *** AERMOD - VERSION  19191 ***   *** PM10 Modeling
***        06/15/20
 *** AERMET - VERSION  18081 ***   ***
***        08:21:15

PAGE   1
 *** MODELOPTs:    RegDFAULT  CONC  ELEV  NODRYDPLT  NOWETDPLT  RURAL  ADJ_U*

                                          ***     MODEL SETUP OPTIONS SUMMARY
***
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - -

 **Model Is Setup For Calculation of Average CONCentration Values.

   --  DEPOSITION LOGIC  --
 **NO GAS DEPOSITION Data Provided.
 **NO PARTICLE DEPOSITION Data Provided.
 **Model Uses NO DRY DEPLETION.  DRYDPLT  =  F
 **Model Uses NO WET DEPLETION.  WETDPLT  =  F

 **Model Uses RURAL Dispersion Only.

 **Model Uses Regulatory DEFAULT Options:
        1. Stack-tip Downwash.
        2. Model Accounts for ELEVated Terrain Effects.
        3. Use Calms Processing Routine.
        4. Use Missing Data Processing Routine.
        5. No Exponential Decay.

 **Other Options Specified:
        ADJ_U*   - Use ADJ_U* option for SBL in AERMET
        CCVR_Sub - Meteorological data includes CCVR substitutions
        TEMP_Sub - Meteorological data includes TEMP substitutions

 **Model Assumes No FLAGPOLE Receptor Heights.

 **The User Specified a Pollutant Type of:  PM10

 **Model Calculates  1 Short Term Average(s) of:  24-HR

 **This Run Includes:    112 Source(s);       1 Source Group(s); and    2966
Receptor(s)

                with:      2 POINT(s), including
                           0 POINTCAP(s) and      0 POINTHOR(s)
                 and:    110 VOLUME source(s)
                 and:      0 AREA type source(s)
                 and:      0 LINE source(s)
                 and:      0 RLINE/RLINEXT source(s)
                 and:      0 OPENPIT source(s)
                 and:      0 BUOYANT LINE source(s) with      0 line(s)


 **Model Set To Continue RUNning After the Setup Testing.

 **The AERMET Input Meteorological Data Version Date:  18081

 **Output Options Selected:
          Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE
Keyword)
          Model Outputs External File(s) of High Values for Plotting (PLOTFILE Keyword)
```

```
 **NOTE:  The Following Flags May Appear Following CONC Values:  c for Calm Hours
                                                                 m for Missing Hours
                                                                 b for Both Calm and
Missing Hours

 **Misc. Inputs:  Base Elev. for Pot. Temp. Profile (m MSL) =   175.00 ;  Decay Coef. =
0.000     ;  Rot. Angle =     0.0
                  Emission Units = GRAMS/SEC                                ;  Emission
Rate Unit Factor =   0.10000E+07
                  Output Units   = MICROGRAMS/M**3

 **Approximate Storage Requirements of Model =      4.3 MB of RAM.

 **Input Runstream File:          aermod.inp
 **Output Print File:             aermod.out
```

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER EMISSION RATE CATS.	URBAN PART.	CAP/ EMIS RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BLDG EXISTS	HOR VARY BY
RTO	0	0.59220E+00		454280.6	4614874.6	178.2	12.50	314.26	12.91	1.83	YES	NO	NO	HRDOW
DC1	0	0.51430E+00		454378.4	4614823.0	178.2	14.33	295.37	19.40	0.61	YES	NO	NO	

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** VOLUME SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	INIT. SY (METERS)	INIT. SZ (METERS)	URBAN SOURCE	EMISSION RATE SCALAR VARY BY
V1	0	0.14300E+00	454297.7	4614928.0	178.2	0.61	0.71	0.57	NO	HRDOW
V2	0	0.17600E-01	454259.7	4614907.5	178.2	9.14	5.95	8.51	NO	HRDOW
V3	0	0.17600E-01	454235.9	4614892.4	178.2	0.61	0.43	0.57	NO	HRDOW
V4	0	0.15000E-02	454227.0	4614887.1	178.2	3.81	3.54	3.54	NO	HRDOW
V5	0	0.23700E-01	454218.1	4614878.5	178.2	3.81	1.42	3.54	NO	HRDOW
V6	0	0.26300E-01	454225.9	4614867.5	178.2	5.33	4.25	4.96	NO	HRDOW
V7	0	0.18400E-01	454197.1	4614871.1	178.2	4.57	1.42	4.25	NO	HRDOW
V8	0	0.31000E-02	454193.5	4614874.6	178.2	4.57	1.42	4.25	NO	HRDOW
V9	0	0.52000E-02	454213.5	4614885.7	178.2	3.81	1.77	3.54	NO	HRDOW
V10	0	0.30400E-01	454173.4	4614858.0	178.2	0.91	1.42	0.85	NO	HRDOW
V11	0	0.25100E-01	454170.9	4614872.8	178.2	5.33	8.51	4.96	NO	HRDOW
V12	0	0.25100E-01	454179.6	4614840.6	178.2	5.33	8.51	4.96	NO	HRDOW
V13	0	0.71500E-01	454094.6	4614815.9	177.7	0.91	1.42	0.85	NO	HRDOW
VN1	0	0.29622E-06	454294.9	4614781.5	178.2	6.10	7.09	5.67	NO	HRDOW
VN2	0	0.82251E-07	454328.5	4614797.6	178.2	6.10	7.09	5.67	NO	HRDOW
VN3	0	0.16846E-06	454345.4	4614834.4	178.2	3.81	7.09	3.54	NO	HRDOW
VN4	0	0.72575E-08	454300.5	4614814.4	178.2	3.81	7.09	3.54	NO	HRDOW
VN5	0	0.47753E-08	454338.2	4614842.4	178.2	3.81	7.09	3.54	NO	HRDOW
VN6	0	0.67169E-07	454383.0	4614853.6	178.2	3.81	2.84	3.54	NO	HRDOW
AB_0001	0	0.21279E-01	454569.7	4615033.8	178.2	2.59	5.58	2.41	NO	HRDOW
AB_0002	0	0.21279E-01	454557.7	4615033.8	178.2	2.59	5.58	2.41	NO	HRDOW

AB_0003		0	0.21279E-01	454545.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0004		0	0.21279E-01	454533.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0005		0	0.21279E-01	454521.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0006		0	0.21279E-01	454509.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0007		0	0.21279E-01	454497.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0008		0	0.21279E-01	454485.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0009		0	0.21279E-01	454473.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0010		0	0.21279E-01	454461.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0001		0	0.41074E-02	454450.0	4615030.0	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0002		0	0.41074E-02	454440.1	4615023.2	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0003		0	0.41074E-02	454430.3	4615016.3	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0004		0	0.41074E-02	454420.7	4615009.2	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0005		0	0.41074E-02	454411.5	4615001.5	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0006		0	0.41074E-02	454402.3	4614993.8	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0007		0	0.41074E-02	454394.4	4614984.7	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0008		0	0.41074E-02	454386.6	4614975.6	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0009		0	0.41074E-02	454380.9	4614965.1	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0010		0	0.41074E-02	454375.7	4614954.3	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0011		0	0.41074E-02	454370.5	4614943.5	178.2	2.59	5.58	2.41	NO
HRDOW										

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** VOLUME SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	INIT. SY (METERS)	INIT. SZ (METERS)	URBAN SOURCE	EMISSION RATE SCALAR VARY BY
CDE_0012	0	0.41074E-02	454366.6	4614932.3	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0013	0	0.41074E-02	454364.9	4614920.4	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0014	0	0.41074E-02	454361.7	4614909.6	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0015	0	0.41074E-02	454351.2	4614903.8	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0016	0	0.41074E-02	454340.6	4614898.1	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0017	0	0.41074E-02	454330.1	4614892.3	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0018	0	0.41074E-02	454319.6	4614886.5	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0019	0	0.41074E-02	454309.1	4614880.8	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0020	0	0.41074E-02	454298.6	4614875.0	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0021	0	0.41074E-02	454288.0	4614869.2	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0022	0	0.41074E-02	454277.5	4614863.4	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0023	0	0.41074E-02	454267.0	4614857.7	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0024	0	0.41074E-02	454256.5	4614851.9	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0025	0	0.41074E-02	454246.0	4614846.1	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0026	0	0.41074E-02	454235.4	4614840.3	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0027	0	0.41074E-02	454224.9	4614834.6	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0028	0	0.41074E-02	454214.4	4614828.8	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0029	0	0.41074E-02	454203.9	4614823.0	178.2	2.59	5.58	2.41	NO	HRDOW
I_0001	0	0.96543E-03	454452.7	4615028.5	178.2	2.59	5.58	2.41	NO	HRDOW
I_0002	0	0.96543E-03	454447.6	4615017.6	178.2	2.59	5.58	2.41	NO	HRDOW
I_0003	0	0.96543E-03	454442.5	4615006.8	178.2	2.59	5.58	2.41	NO	HRDOW

I_0004		0	0.96543E-03	454437.4	4614995.9	178.2	2.59	5.58	2.41	NO	HRDOW
I_0005		0	0.96543E-03	454432.2	4614985.0	178.2	2.59	5.58	2.41	NO	HRDOW
I_0006		0	0.96543E-03	454427.1	4614974.2	178.2	2.59	5.58	2.41	NO	HRDOW
I_0007		0	0.96543E-03	454422.0	4614963.4	178.2	2.59	5.58	2.41	NO	HRDOW
I_0008		0	0.96543E-03	454416.8	4614952.5	178.2	2.59	5.58	2.41	NO	HRDOW
I_0009		0	0.96543E-03	454411.7	4614941.7	178.2	2.59	5.58	2.41	NO	HRDOW
I_0010		0	0.96543E-03	454406.6	4614930.8	178.2	2.59	5.58	2.41	NO	HRDOW
I_0011		0	0.96543E-03	454401.5	4614920.0	178.2	2.59	5.58	2.41	NO	HRDOW
I_0012		0	0.96543E-03	454396.3	4614909.1	178.2	2.59	5.58	2.41	NO	HRDOW
I_0013		0	0.96543E-03	454391.2	4614898.3	178.2	2.59	5.58	2.41	NO	HRDOW
I_0014		0	0.96543E-03	454386.1	4614887.4	178.2	2.59	5.58	2.41	NO	HRDOW
I_0015		0	0.96543E-03	454380.9	4614876.6	178.2	2.59	5.58	2.41	NO	HRDOW
I_0016		0	0.96543E-03	454375.8	4614865.7	178.2	2.59	5.58	2.41	NO	HRDOW
I_0017		0	0.96543E-03	454370.7	4614854.9	178.2	2.59	5.58	2.41	NO	HRDOW
H_0001		0	0.62096E-02	454569.7	4615048.6	178.2	2.59	5.58	2.41	NO	HRDOW
H_0002		0	0.62096E-02	454557.7	4615048.6	178.2	2.59	5.58	2.41	NO	HRDOW
H_0003		0	0.62096E-02	454545.7	4615048.5	178.2	2.59	5.58	2.41	NO	HRDOW
H_0004		0	0.62096E-02	454533.7	4615048.5	178.2	2.59	5.58	2.41	NO	HRDOW
H_0005		0	0.62096E-02	454521.7	4615048.5	178.2	2.59	5.58	2.41	NO	HRDOW

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** VOLUME SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	INIT. SY (METERS)	INIT. SZ (METERS)	URBAN SOURCE	EMISSION RATE SCALAR VARY BY
H_0006	0	0.62096E-02	454509.7	4615048.5	178.2	2.59	5.58	2.41	NO	HRDOW
H_0007	0	0.62096E-02	454497.7	4615048.4	178.2	2.59	5.58	2.41	NO	HRDOW
H_0008	0	0.62096E-02	454485.7	4615048.4	178.2	2.59	5.58	2.41	NO	HRDOW
H_0009	0	0.62096E-02	454473.8	4615049.5	178.2	2.59	5.58	2.41	NO	HRDOW
H_0010	0	0.62096E-02	454462.4	4615053.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0001	0	0.39933E-02	454450.4	4615031.4	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0002	0	0.39933E-02	454439.8	4615025.7	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0003	0	0.39933E-02	454429.3	4615020.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0004	0	0.39933E-02	454418.8	4615014.2	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0005	0	0.39933E-02	454408.2	4615008.5	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0006	0	0.39933E-02	454397.7	4615002.7	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0007	0	0.39933E-02	454387.2	4614997.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0008	0	0.39933E-02	454376.6	4614991.2	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0009	0	0.39933E-02	454366.1	4614985.5	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0010	0	0.39933E-02	454355.5	4614979.8	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0011	0	0.39933E-02	454345.0	4614974.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0012	0	0.39933E-02	454334.5	4614968.3	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0013	0	0.39933E-02	454323.9	4614962.5	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0014	0	0.39933E-02	454313.4	4614956.8	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0015	0	0.39933E-02	454301.7	4614955.4	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0016	0	0.39933E-02	454289.7	4614955.1	178.2	2.59	5.58	2.41	NO	HRDOW

FG_0017		0	0.39933E-02	454277.7	4614954.8	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0018		0	0.39933E-02	454267.0	4614950.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0019		0	0.39933E-02	454256.5	4614944.1	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0020		0	0.39933E-02	454246.1	4614938.1	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0021		0	0.39933E-02	454235.6	4614932.2	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0022		0	0.39933E-02	454225.2	4614926.3	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0023		0	0.39933E-02	454214.8	4614920.4	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0024		0	0.39933E-02	454204.3	4614914.5	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0025		0	0.39933E-02	454193.9	4614908.6	178.2	2.59	5.58	2.41	NO	HRDOW

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 *** AERMOD - VERSION  19191 ***   *** PM10 Modeling
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 *** AERMET - VERSION  18081 ***   ***
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 *** MODELOPTs:    RegDFAULT  CONC  ELEV  NODRYDPLT  NOWETDPLT  RURAL  ADJ_U*


                                          *** SOURCE IDs DEFINING SOURCE GROUPS ***

 SRCGROUP ID                                                SOURCE IDs
 -----------                                                ----------


  ALL        RTO         , DC1         , V1          , V2          , V3          , V4
, V5          , V6          ,

             V7          , V8          , V9          , V10         , V11         , V12
, V13         , VN1         ,

             VN2         , VN3         , VN4         , VN5         , VN6         ,
AB_0001     , AB_0002     , AB_0003     ,

             AB_0004     , AB_0005     , AB_0006     , AB_0007     , AB_0008     ,
AB_0009     , AB_0010     , CDE_0001    ,

             CDE_0002    , CDE_0003    , CDE_0004    , CDE_0005    , CDE_0006    ,
CDE_0007    , CDE_0008    , CDE_0009    ,

             CDE_0010    , CDE_0011    , CDE_0012    , CDE_0013    , CDE_0014    ,
CDE_0015    , CDE_0016    , CDE_0017    ,

             CDE_0018    , CDE_0019    , CDE_0020    , CDE_0021    , CDE_0022    ,
CDE_0023    , CDE_0024    , CDE_0025    ,

             CDE_0026    , CDE_0027    , CDE_0028    , CDE_0029    , I_0001      ,
I_0002      , I_0003      , I_0004      ,

             I_0005      , I_0006      , I_0007      , I_0008      , I_0009      ,
I_0010      , I_0011      , I_0012      ,

             I_0013      , I_0014      , I_0015      , I_0016      , I_0017      ,
H_0001      , H_0002      , H_0003      ,

             H_0004      , H_0005      , H_0006      , H_0007      , H_0008      ,
H_0009      , H_0010      , FG_0001     ,

             FG_0002     , FG_0003     , FG_0004     , FG_0005     , FG_0006     ,
FG_0007     , FG_0008     , FG_0009     ,

             FG_0010     , FG_0011     , FG_0012     , FG_0013     , FG_0014     ,
FG_0015     , FG_0016     , FG_0017     ,

             FG_0018     , FG_0019     , FG_0020     , FG_0021     , FG_0022     ,
FG_0023     , FG_0024     , FG_0025     ,
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DIRECTION SPECIFIC BUILDING DIMENSIONS ***

SOURCE ID: RTO

IFV	BH	BW	BL	XADJ	YADJ	IFV	BH	BW	BL	XADJ	YADJ
1	18.3,	39.0,	36.0,	6.9,	21.1,	2	18.3,	39.8,	34.8,	3.9,	24.8,
3	18.3,	39.3,	32.6,	0.7,	27.7,	4	0.0,	0.0,	0.0,	0.0,	0.0,
5	0.0,	0.0,	0.0,	0.0,	0.0,	6	0.0,	0.0,	0.0,	0.0,	0.0,
7	0.0,	0.0,	0.0,	0.0,	0.0,	8	0.0,	0.0,	0.0,	0.0,	0.0,
9	0.0,	0.0,	0.0,	0.0,	0.0,	10	18.3,	36.0,	39.0,	-40.6,	24.9,
11	18.3,	34.8,	39.8,	-44.7,	21.3,	12	18.3,	32.6,	39.3,	-47.4,	17.0,
13	18.3,	29.7,	37.7,	-48.6,	12.1,	14	18.3,	28.3,	34.9,	-48.4,	5.5,
15	18.3,	26.1,	31.1,	-46.7,	-1.2,	16	18.3,	29.9,	33.0,	-47.4,	-6.8,
17	18.3,	34.0,	35.1,	-47.4,	-12.0,	18	18.3,	37.0,	36.1,	-45.8,	-16.8,
19	18.3,	39.0,	36.0,	-42.9,	-21.1,	20	18.3,	39.8,	34.8,	-38.7,	-24.8,
21	18.3,	39.3,	32.6,	-33.3,	-27.7,	22	0.0,	0.0,	0.0,	0.0,	0.0,
23	0.0,	0.0,	0.0,	0.0,	0.0,	24	0.0,	0.0,	0.0,	0.0,	0.0,
25	0.0,	0.0,	0.0,	0.0,	0.0,	26	0.0,	0.0,	0.0,	0.0,	0.0,
27	0.0,	0.0,	0.0,	0.0,	0.0,	28	18.3,	36.0,	39.0,	1.6,	-24.9,
29	18.3,	34.8,	39.8,	4.9,	-21.3,	30	18.3,	32.6,	39.3,	8.0,	-17.0,
31	18.3,	29.7,	37.7,	10.9,	-12.1,	32	18.3,	28.3,	34.9,	13.5,	-5.5,
33	18.3,	26.1,	31.1,	15.6,	1.2,	34	18.3,	29.9,	33.0,	14.4,	6.8,
35	18.3,	34.0,	35.1,	12.2,	12.0,	36	18.3,	37.0,	36.1,	9.7,	16.8,

SOURCE ID: DC1

IFV	BH	BW	BL	XADJ	YADJ	IFV	BH	BW	BL	XADJ	YADJ
1	13.7,	66.6,	68.8,	-55.4,	12.1,	2	13.7,	68.6,	67.4,	-56.5,	8.2,
3	13.7,	68.5,	64.0,	-55.9,	4.2,	4	13.7,	66.3,	58.7,	-53.5,	-0.0,
5	13.7,	62.1,	51.6,	-49.6,	-4.2,	6	13.7,	56.0,	42.9,	-44.2,	-8.3,

```
    7   13.7,   60.4,   49.1,  -45.5,  -12.1,      8   13.7,   65.2,   56.8,  -46.9,  -
15.6,
    9   13.7,   68.0,   62.6,  -46.9,  -18.6,     10   13.7,   68.8,   66.6,  -45.4,  -
21.0,
   11   13.7,   67.4,   68.6,  -42.5,  -22.8,     12   13.7,   64.0,   68.5,  -38.4,  -
23.8,
   13   13.7,   58.7,   66.3,  -33.1,  -24.2,     14   13.7,   51.6,   62.1,  -26.8,  -
23.8,
   15   13.7,   42.9,   56.0,  -19.7,  -22.7,     16   13.7,   49.1,   60.4,  -18.1,  -
20.9,
   17   13.7,   56.8,   65.2,  -17.0,  -18.5,     18   13.7,   62.6,   68.0,  -15.5,  -
15.5,
   19   13.7,   66.6,   68.8,  -13.4,  -12.1,     20   13.7,   68.6,   67.4,  -11.0,
-8.2,
   21   13.7,   68.5,   64.0,   -8.2,   -4.2,     22   13.7,   66.3,   58.7,   -5.1,
0.0,
   23   13.7,   62.1,   51.6,   -2.0,    4.2,     24   13.7,   56.0,   42.9,    1.3,
8.3,
   25   13.7,   60.4,   49.1,   -3.6,   12.1,     26   13.7,   65.2,   56.8,   -9.9,
15.6,
   27   13.7,   68.0,   62.6,  -15.8,   18.6,     28   13.7,   68.8,   66.6,  -21.2,
21.0,
   29   13.7,   67.4,   68.6,  -26.1,   22.8,     30   13.7,   64.0,   68.5,  -30.1,
23.8,
   31   13.7,   58.7,   66.3,  -33.2,   24.2,     32   13.7,   51.6,   62.1,  -35.3,
23.8,
   33   13.7,   42.9,   56.0,  -36.3,   22.7,     34   13.7,   49.1,   60.4,  -42.4,
20.9,
   35   13.7,   56.8,   65.2,  -48.2,   18.5,     36   13.7,   62.6,   68.0,  -52.6,
15.5,
```

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = RTO ; SOURCE TYPE = POINT :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V1 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.6840E-01	2	.6840E-01	3	.6840E-01	4	.6840E-01	5	.6840E-01	6	.6840E-01	7	.6840E-01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.6840E-01	21	.6840E-01	22	.6840E-01	23	.6840E-01	24	.6840E-01
DAY OF WEEK = SATURDAY															
1	.6840E-01	2	.6840E-01	3	.6840E-01	4	.6840E-01	5	.6840E-01	6	.6840E-01	7	.6840E-01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.6840E-01	19	.6840E-01	20	.6840E-01	21	.6840E-01	22	.6840E-01	23	.6840E-01	24	.6840E-01
DAY OF WEEK = SUNDAY															
1	.6840E-01	2	.6840E-01	3	.6840E-01	4	.6840E-01	5	.6840E-01	6	.6840E-01	7	.6840E-01	8	.6840E-01
9	.6840E-01	10	.6840E-01	11	.6840E-01	12	.6840E-01	13	.6840E-01	14	.6840E-01	15	.6840E-01	16	.6840E-01
17	.6840E-01	18	.6840E-01	19	.6840E-01	20	.6840E-01	21	.6840E-01	22	.6840E-01	23	.6840E-01	24	.6840E-01

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V2 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V3 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V4 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.1000E+00	2	.1000E+00	3	.1000E+00	4	.1000E+00	5	.1000E+00	6	.1000E+00	7	.1000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+00	21	.1000E+00	22	.1000E+00	23	.1000E+00	24	.1000E+00
DAY OF WEEK = SATURDAY															
1	.1000E+00	2	.1000E+00	3	.1000E+00	4	.1000E+00	5	.1000E+00	6	.1000E+00	7	.1000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+00	19	.1000E+00	20	.1000E+00	21	.1000E+00	22	.1000E+00	23	.1000E+00	24	.1000E+00
DAY OF WEEK = SUNDAY															
1	.1000E+00	2	.1000E+00	3	.1000E+00	4	.1000E+00	5	.1000E+00	6	.1000E+00	7	.1000E+00	8	.1000E+00
9	.1000E+00	10	.1000E+00	11	.1000E+00	12	.1000E+00	13	.1000E+00	14	.1000E+00	15	.1000E+00	16	.1000E+00
17	.1000E+00	18	.1000E+00	19	.1000E+00	20	.1000E+00	21	.1000E+00	22	.1000E+00	23	.1000E+00	24	.1000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V5 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V6 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.1778E+00	2	.1778E+00	3	.1778E+00	4	.1778E+00	5	.1778E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1778E+00
DAY OF WEEK = SATURDAY															
1	.1778E+00	2	.1778E+00	3	.1778E+00	4	.1778E+00	5	.1778E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1778E+00
DAY OF WEEK = SUNDAY															
1	.1778E+00	2	.1778E+00	3	.1778E+00	4	.1778E+00	5	.1778E+00	6	.1778E+00	7	.1778E+00	8	.1778E+00
9	.1778E+00	10	.1778E+00	11	.1778E+00	12	.1778E+00	13	.1778E+00	14	.1778E+00	15	.1778E+00	16	.1778E+00
17	.1778E+00	18	.1778E+00	19	.1778E+00	20	.1778E+00	21	.1778E+00	22	.1778E+00	23	.1778E+00	24	.1778E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V7 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V8 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V9 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.1950E-01	2	.1950E-01	3	.1950E-01	4	.1950E-01	5	.1950E-01	6	.1950E-01	7	.1950E-01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1950E-01	21	.1950E-01	22	.1950E-01	23	.1950E-01	24	.1950E-01

DAY OF WEEK = SATURDAY

1	.1950E-01	2	.1950E-01	3	.1950E-01	4	.1950E-01	5	.1950E-01	6	.1950E-01	7	.1950E-01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1950E-01	19	.1950E-01	20	.1950E-01	21	.1950E-01	22	.1950E-01	23	.1950E-01	24	.1950E-01

DAY OF WEEK = SUNDAY

1	.1950E-01	2	.1950E-01	3	.1950E-01	4	.1950E-01	5	.1950E-01	6	.1950E-01	7	.1950E-01	8	.1950E-01
9	.1950E-01	10	.1950E-01	11	.1950E-01	12	.1950E-01	13	.1950E-01	14	.1950E-01	15	.1950E-01	16	.1950E-01
17	.1950E-01	18	.1950E-01	19	.1950E-01	20	.1950E-01	21	.1950E-01	22	.1950E-01	23	.1950E-01	24	.1950E-01

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V10 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1746E+01
17	.1746E+01	18	.1746E+01	19	.1746E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1746E+01
17	.1746E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V11 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.2164E+01
17	.2164E+01	18	.2164E+01	19	.2164E+01	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00
DAY OF WEEK = SATURDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.2164E+01
17	.2164E+01	18	.2650E+00	19	.2650E+00	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00
DAY OF WEEK = SUNDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.2650E+00
9	.2650E+00	10	.2650E+00	11	.2650E+00	12	.2650E+00	13	.2650E+00	14	.2650E+00	15	.2650E+00	16	.2650E+00
17	.2650E+00	18	.2650E+00	19	.2650E+00	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V12 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.2164E+01
17	.2164E+01	18	.2164E+01	19	.2164E+01	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00
DAY OF WEEK = SATURDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.2164E+01
17	.2164E+01	18	.2650E+00	19	.2650E+00	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00
DAY OF WEEK = SUNDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.2650E+00
9	.2650E+00	10	.2650E+00	11	.2650E+00	12	.2650E+00	13	.2650E+00	14	.2650E+00	15	.2650E+00	16	.2650E+00
17	.2650E+00	18	.2650E+00	19	.2650E+00	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V13 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN1 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.1030E-03	2	.1030E-03	3	.1030E-03	4	.1030E-03	5	.1030E-03	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1030E-03
DAY OF WEEK = SATURDAY															
1	.1030E-03	2	.1030E-03	3	.1030E-03	4	.1030E-03	5	.1030E-03	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1030E-03
DAY OF WEEK = SUNDAY															
1	.1030E-03	2	.1030E-03	3	.1030E-03	4	.1030E-03	5	.1030E-03	6	.1030E-03	7	.1030E-03	8	.1030E-03
9	.1030E-03	10	.1030E-03	11	.1030E-03	12	.1030E-03	13	.1030E-03	14	.1030E-03	15	.1030E-03	16	.1030E-03
17	.1030E-03	18	.1030E-03	19	.1030E-03	20	.1030E-03	21	.1030E-03	22	.1030E-03	23	.1030E-03	24	.1030E-03

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN2 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN3 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN4 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.5670E-01	2	.5670E-01	3	.5670E-01	4	.5670E-01	5	.5670E-01	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.5670E-01
DAY OF WEEK = SATURDAY															
1	.5670E-01	2	.5670E-01	3	.5670E-01	4	.5670E-01	5	.5670E-01	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.5670E-01
DAY OF WEEK = SUNDAY															
1	.5670E-01	2	.5670E-01	3	.5670E-01	4	.5670E-01	5	.5670E-01	6	.5670E-01	7	.5670E-01	8	.5670E-01
9	.5670E-01	10	.5670E-01	11	.5670E-01	12	.5670E-01	13	.5670E-01	14	.5670E-01	15	.5670E-01	16	.5670E-01
17	.5670E-01	18	.5670E-01	19	.5670E-01	20	.5670E-01	21	.5670E-01	22	.5670E-01	23	.5670E-01	24	.5670E-01

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN5 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.1438E+00	2	.1438E+00	3	.1438E+00	4	.1438E+00	5	.1438E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1438E+00
DAY OF WEEK = SATURDAY															
1	.1438E+00	2	.1438E+00	3	.1438E+00	4	.1438E+00	5	.1438E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1438E+00
DAY OF WEEK = SUNDAY															
1	.1438E+00	2	.1438E+00	3	.1438E+00	4	.1438E+00	5	.1438E+00	6	.1438E+00	7	.1438E+00	8	.1438E+00
9	.1438E+00	10	.1438E+00	11	.1438E+00	12	.1438E+00	13	.1438E+00	14	.1438E+00	15	.1438E+00	16	.1438E+00
17	.1438E+00	18	.1438E+00	19	.1438E+00	20	.1438E+00	21	.1438E+00	22	.1438E+00	23	.1438E+00	24	.1438E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN6 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.9500E-02	2	.9500E-02	3	.9500E-02	4	.9500E-02	5	.9500E-02	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.9500E-02
DAY OF WEEK = SATURDAY															
1	.9500E-02	2	.9500E-02	3	.9500E-02	4	.9500E-02	5	.9500E-02	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.9500E-02
DAY OF WEEK = SUNDAY															
1	.9500E-02	2	.9500E-02	3	.9500E-02	4	.9500E-02	5	.9500E-02	6	.9500E-02	7	.9500E-02	8	.9500E-02
9	.9500E-02	10	.9500E-02	11	.9500E-02	12	.9500E-02	13	.9500E-02	14	.9500E-02	15	.9500E-02	16	.9500E-02
17	.9500E-02	18	.9500E-02	19	.9500E-02	20	.9500E-02	21	.9500E-02	22	.9500E-02	23	.9500E-02	24	.9500E-02

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0011 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0012 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0013 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0014 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0015 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0016 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0017 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0018 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0019 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0020 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0021 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0022 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0023 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0024 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0025 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0026 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0027 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0028 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0029 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0011 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0012 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0013 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0014 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0015 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0016 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0017 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0011 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0012 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0013 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0014 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0015 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0016 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0017 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0018 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0019 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0020 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0021 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0022 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0023 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0024 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0025 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454084.4, 4615065.4, 176.2, 178.2, 0.0); (454083.3, 4615039.8, 176.1, 178.2, 0.0);
(454082.2, 4615014.1, 175.9, 178.2, 0.0); (454085.1, 4614964.6, 176.4, 178.2, 0.0);
(454088.0, 4614915.0, 176.8, 176.8, 0.0); (454091.0, 4614865.5, 177.2, 177.2, 0.0);
(454093.9, 4614816.0, 177.6, 177.6, 0.0); (454096.8, 4614766.4, 178.0, 178.0, 0.0);
(454099.7, 4614716.9, 178.2, 178.2, 0.0); (454102.6, 4614667.3, 176.8, 176.8, 0.0);
(454105.5, 4614617.8, 176.3, 178.2, 0.0); (454108.5, 4614568.3, 176.7, 178.2, 0.0);
(454111.4, 4614518.7, 177.1, 177.1, 0.0); (454114.3, 4614469.2, 177.6, 178.2, 0.0);
(454107.8, 4614425.2, 176.8, 176.8, 0.0); (454101.3, 4614381.1, 178.1, 178.1, 0.0);
(454094.7, 4614337.1, 177.9, 177.9, 0.0); (454088.2, 4614293.0, 177.6, 178.6, 0.0);
(454081.7, 4614249.0, 176.5, 178.2, 0.0); (454082.2, 4614201.8, 177.2, 177.2, 0.0);
(454082.8, 4614154.7, 177.4, 177.4, 0.0); (454121.4, 4614157.8, 178.2, 178.2, 0.0);
(454160.0, 4614160.9, 178.2, 178.2, 0.0); (454191.3, 4614179.4, 178.2, 178.2, 0.0);
(454222.7, 4614198.0, 178.2, 178.2, 0.0); (454254.0, 4614216.5, 178.2, 178.2, 0.0);
(454253.2, 4614226.3, 178.2, 178.2, 0.0); (454296.0, 4614249.3, 178.2, 178.2, 0.0);
(454338.8, 4614272.3, 178.2, 178.2, 0.0); (454381.7, 4614295.3, 178.2, 178.2, 0.0);
(454424.5, 4614318.3, 178.2, 178.2, 0.0); (454467.3, 4614341.4, 178.2, 178.2, 0.0);
(454510.2, 4614364.4, 178.2, 178.2, 0.0); (454553.0, 4614387.4, 178.2, 178.2, 0.0);
(454595.8, 4614410.4, 178.2, 178.2, 0.0); (454595.8, 4614459.2, 178.2, 178.2, 0.0);
(454595.8, 4614507.9, 178.2, 178.2, 0.0); (454595.8, 4614556.7, 178.2, 178.2, 0.0);
(454595.8, 4614605.5, 178.2, 178.2, 0.0); (454595.8, 4614654.3, 178.2, 178.2, 0.0);
(454595.8, 4614703.0, 178.2, 178.2, 0.0); (454595.8, 4614751.8, 178.2, 178.2, 0.0);
(454595.8, 4614800.6, 178.2, 178.2, 0.0); (454595.8, 4614849.3, 178.2, 178.2, 0.0);
(454595.8, 4614898.1, 178.2, 178.2, 0.0); (454595.8, 4614946.9, 178.2, 178.2, 0.0);
(454595.8, 4614995.6, 178.2, 178.2, 0.0); (454595.8, 4615044.4, 178.2, 178.2, 0.0);
(454595.8, 4615093.2, 178.2, 178.2, 0.0); (454595.8, 4615142.0, 178.2, 178.2, 0.0);

```
     ( 454595.8, 4615190.7,     178.2,     178.2,       0.0);         ( 454595.8,
4615239.5,     178.2,     178.2,       0.0);
     ( 454551.9, 4615219.2,     178.2,     178.2,       0.0);         ( 454508.0,
4615199.0,     178.2,     178.2,       0.0);
     ( 454484.5, 4615239.5,     178.2,     178.2,       0.0);         ( 454461.1,
4615279.9,     178.2,     178.2,       0.0);
     ( 454413.6, 4615286.6,     178.2,     178.2,       0.0);         ( 454376.8,
4615266.9,     178.2,     178.2,       0.0);
     ( 454340.0, 4615247.2,     178.2,     178.2,       0.0);         ( 454303.1,
4615227.5,     178.2,     178.2,       0.0);
     ( 454266.3, 4615207.8,     178.2,     178.2,       0.0);         ( 454229.5,
4615188.1,     178.2,     178.2,       0.0);
     ( 454251.0, 4615155.9,     178.2,     178.2,       0.0);         ( 454209.3,
4615133.3,     178.2,     178.2,       0.0);
     ( 454167.7, 4615110.7,     178.2,     178.2,       0.0);         ( 454126.1,
4615088.0,     178.2,     178.2,       0.0);
     ( 452000.0, 4612100.0,     178.9,     225.3,       0.0);         ( 452100.0,
4612100.0,     179.7,     225.2,       0.0);
     ( 452200.0, 4612100.0,     183.3,     183.3,       0.0);         ( 452300.0,
4612100.0,     175.2,     186.7,       0.0);
     ( 452400.0, 4612100.0,     185.7,     185.7,       0.0);         ( 452500.0,
4612100.0,     181.9,     181.9,       0.0);
     ( 452600.0, 4612100.0,     179.4,     179.4,       0.0);         ( 452700.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 452800.0, 4612100.0,     178.4,     178.4,       0.0);         ( 452900.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 453000.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453100.0,
4612100.0,     178.6,     178.6,       0.0);
     ( 453200.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453300.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 453400.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453500.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 453600.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453700.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 453800.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453900.0,
4612100.0,     178.5,     178.5,       0.0);
     ( 454000.0, 4612100.0,     180.1,     180.1,       0.0);         ( 454100.0,
4612100.0,     179.1,     179.1,       0.0);
     ( 454200.0, 4612100.0,     178.2,     178.2,       0.0);         ( 454300.0,
4612100.0,     178.2,     178.2,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454400.0, 4612100.0, 178.2, 178.2, 0.0); (454500.0, 4612100.0, 178.2, 178.2, 0.0);
(454600.0, 4612100.0, 178.2, 178.2, 0.0); (454700.0, 4612100.0, 181.1, 181.1, 0.0);
(454800.0, 4612100.0, 183.5, 183.5, 0.0); (454900.0, 4612100.0, 178.4, 178.4, 0.0);
(455000.0, 4612100.0, 178.2, 178.2, 0.0); (455100.0, 4612100.0, 178.2, 178.2, 0.0);
(455200.0, 4612100.0, 178.2, 178.2, 0.0); (455300.0, 4612100.0, 177.9, 177.9, 0.0);
(455400.0, 4612100.0, 177.6, 177.6, 0.0); (455500.0, 4612100.0, 177.7, 177.7, 0.0);
(455600.0, 4612100.0, 178.3, 178.3, 0.0); (455700.0, 4612100.0, 177.6, 177.6, 0.0);
(455800.0, 4612100.0, 177.6, 177.6, 0.0); (455900.0, 4612100.0, 177.7, 177.7, 0.0);
(456000.0, 4612100.0, 178.2, 178.2, 0.0); (456100.0, 4612100.0, 177.2, 177.2, 0.0);
(456200.0, 4612100.0, 177.2, 177.2, 0.0); (456300.0, 4612100.0, 178.0, 178.0, 0.0);
(456400.0, 4612100.0, 178.6, 178.6, 0.0); (456500.0, 4612100.0, 178.7, 178.7, 0.0);
(456600.0, 4612100.0, 178.4, 178.4, 0.0); (452000.0, 4612200.0, 179.6, 179.6, 0.0);
(452100.0, 4612200.0, 180.1, 180.1, 0.0); (452200.0, 4612200.0, 180.0, 180.0, 0.0);
(452300.0, 4612200.0, 175.2, 185.8, 0.0); (452400.0, 4612200.0, 175.2, 186.7, 0.0);
(452500.0, 4612200.0, 178.4, 178.4, 0.0); (452600.0, 4612200.0, 178.7, 178.7, 0.0);
(452700.0, 4612200.0, 178.7, 178.7, 0.0); (452800.0, 4612200.0, 178.5, 178.5, 0.0);
(452900.0, 4612200.0, 178.4, 178.4, 0.0); (453000.0, 4612200.0, 178.4, 178.4, 0.0);
(453100.0, 4612200.0, 178.4, 178.4, 0.0); (453200.0, 4612200.0, 178.4, 178.4, 0.0);
(453300.0, 4612200.0, 178.4, 178.4, 0.0); (453400.0, 4612200.0, 178.4, 178.4, 0.0);
(453500.0, 4612200.0, 178.4, 178.4, 0.0); (453600.0, 4612200.0, 178.4, 178.4, 0.0);
(453700.0, 4612200.0, 178.4, 178.4, 0.0); (453800.0, 4612200.0, 178.4, 178.4, 0.0);
(453900.0, 4612200.0, 178.7, 178.7, 0.0); (454000.0, 4612200.0, 179.3, 179.3, 0.0);
(454100.0, 4612200.0, 179.1, 179.1, 0.0); (454200.0, 4612200.0, 178.5, 178.5, 0.0);
(454300.0, 4612200.0, 178.2, 178.2, 0.0); (454400.0, 4612200.0, 178.2, 178.2, 0.0);
(454500.0, 4612200.0, 178.2, 178.2, 0.0); (454600.0, 4612200.0, 182.1, 182.1, 0.0);

```
     ( 454700.0, 4612200.0,     183.9,     183.9,       0.0);         ( 454800.0,
4612200.0,     184.3,     184.3,       0.0);
     ( 454900.0, 4612200.0,     181.0,     181.0,       0.0);         ( 455000.0,
4612200.0,     178.3,     178.3,       0.0);
     ( 455100.0, 4612200.0,     178.2,     178.2,       0.0);         ( 455200.0,
4612200.0,     177.9,     177.9,       0.0);
     ( 455300.0, 4612200.0,     177.7,     177.7,       0.0);         ( 455400.0,
4612200.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4612200.0,     177.6,     177.6,       0.0);         ( 455600.0,
4612200.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4612200.0,     177.6,     177.6,       0.0);         ( 455800.0,
4612200.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4612200.0,     177.6,     177.6,       0.0);         ( 456000.0,
4612200.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4612200.0,     177.1,     177.1,       0.0);         ( 456200.0,
4612200.0,     177.4,     177.4,       0.0);
     ( 456300.0, 4612200.0,     178.2,     178.2,       0.0);         ( 456400.0,
4612200.0,     178.1,     178.1,       0.0);
     ( 456500.0, 4612200.0,     178.4,     178.4,       0.0);         ( 456600.0,
4612200.0,     178.5,     178.5,       0.0);
     ( 452000.0, 4612300.0,     179.2,     179.2,       0.0);         ( 452100.0,
4612300.0,     179.1,     179.1,       0.0);
     ( 452200.0, 4612300.0,     178.7,     178.7,       0.0);         ( 452300.0,
4612300.0,     175.2,     175.2,       0.0);
     ( 452400.0, 4612300.0,     175.2,     175.2,       0.0);         ( 452500.0,
4612300.0,     176.0,     176.0,       0.0);
     ( 452600.0, 4612300.0,     178.3,     178.3,       0.0);         ( 452700.0,
4612300.0,     178.6,     178.6,       0.0);
     ( 452800.0, 4612300.0,     178.7,     178.7,       0.0);         ( 452900.0,
4612300.0,     178.4,     178.4,       0.0);
     ( 453000.0, 4612300.0,     178.4,     178.4,       0.0);         ( 453100.0,
4612300.0,     178.4,     178.4,       0.0);
     ( 453200.0, 4612300.0,     178.4,     178.4,       0.0);         ( 453300.0,
4612300.0,     178.4,     178.4,       0.0);
     ( 453400.0, 4612300.0,     178.6,     178.6,       0.0);         ( 453500.0,
4612300.0,     178.5,     178.5,       0.0);
     ( 453600.0, 4612300.0,     178.4,     178.4,       0.0);         ( 453700.0,
4612300.0,     178.4,     178.4,       0.0);
     ( 453800.0, 4612300.0,     178.7,     178.7,       0.0);         ( 453900.0,
4612300.0,     178.9,     178.9,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454000.0, 4612300.0, 179.0, 179.0, 0.0); (454100.0, 4612300.0, 178.9, 178.9, 0.0);
(454200.0, 4612300.0, 178.4, 178.4, 0.0); (454300.0, 4612300.0, 178.2, 178.2, 0.0);
(454400.0, 4612300.0, 177.9, 177.9, 0.0); (454500.0, 4612300.0, 178.2, 178.2, 0.0);
(454600.0, 4612300.0, 184.2, 184.2, 0.0); (454700.0, 4612300.0, 182.4, 182.4, 0.0);
(454800.0, 4612300.0, 184.2, 184.2, 0.0); (454900.0, 4612300.0, 182.4, 182.4, 0.0);
(455000.0, 4612300.0, 178.2, 178.2, 0.0); (455100.0, 4612300.0, 178.2, 178.2, 0.0);
(455200.0, 4612300.0, 177.6, 177.6, 0.0); (455300.0, 4612300.0, 177.6, 177.6, 0.0);
(455400.0, 4612300.0, 177.6, 177.6, 0.0); (455500.0, 4612300.0, 177.6, 177.6, 0.0);
(455600.0, 4612300.0, 177.6, 177.6, 0.0); (455700.0, 4612300.0, 177.6, 177.6, 0.0);
(455800.0, 4612300.0, 177.6, 177.6, 0.0); (455900.0, 4612300.0, 177.6, 177.6, 0.0);
(456000.0, 4612300.0, 177.6, 177.6, 0.0); (456100.0, 4612300.0, 177.1, 177.1, 0.0);
(456200.0, 4612300.0, 177.1, 177.1, 0.0); (456300.0, 4612300.0, 178.2, 178.2, 0.0);
(456400.0, 4612300.0, 182.9, 182.9, 0.0); (456500.0, 4612300.0, 182.2, 182.2, 0.0);
(456600.0, 4612300.0, 177.7, 177.7, 0.0); (452000.0, 4612400.0, 178.5, 178.5, 0.0);
(452100.0, 4612400.0, 177.9, 177.9, 0.0); (452200.0, 4612400.0, 175.3, 175.3, 0.0);
(452300.0, 4612400.0, 175.2, 175.2, 0.0); (452400.0, 4612400.0, 175.2, 175.2, 0.0);
(452500.0, 4612400.0, 175.2, 175.2, 0.0); (452600.0, 4612400.0, 176.8, 178.8, 0.0);
(452700.0, 4612400.0, 178.3, 178.3, 0.0); (452800.0, 4612400.0, 178.6, 178.6, 0.0);
(452900.0, 4612400.0, 178.7, 178.7, 0.0); (453000.0, 4612400.0, 178.4, 178.4, 0.0);
(453100.0, 4612400.0, 178.4, 178.4, 0.0); (453200.0, 4612400.0, 178.5, 178.5, 0.0);
(453300.0, 4612400.0, 178.7, 178.7, 0.0); (453400.0, 4612400.0, 178.7, 178.7, 0.0);
(453500.0, 4612400.0, 178.7, 178.7, 0.0); (453600.0, 4612400.0, 178.6, 178.6, 0.0);
(453700.0, 4612400.0, 178.5, 178.5, 0.0); (453800.0, 4612400.0, 178.8, 178.8, 0.0);
(453900.0, 4612400.0, 178.9, 178.9, 0.0); (454000.0, 4612400.0, 178.9, 178.9, 0.0);
(454100.0, 4612400.0, 178.8, 178.8, 0.0); (454200.0, 4612400.0, 178.2, 178.2, 0.0);

```
     ( 454300.0, 4612400.0,     178.2,     178.2,       0.0);         ( 454400.0,
4612400.0,     176.9,     176.9,       0.0);
     ( 454500.0, 4612400.0,     178.2,     178.2,       0.0);         ( 454600.0,
4612400.0,     184.3,     184.3,       0.0);
     ( 454700.0, 4612400.0,     182.4,     182.4,       0.0);         ( 454800.0,
4612400.0,     182.9,     182.9,       0.0);
     ( 454900.0, 4612400.0,     182.4,     182.4,       0.0);         ( 455000.0,
4612400.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4612400.0,     178.2,     178.2,       0.0);         ( 455200.0,
4612400.0,     177.6,     177.6,       0.0);
     ( 455300.0, 4612400.0,     177.6,     177.6,       0.0);         ( 455400.0,
4612400.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4612400.0,     177.6,     177.6,       0.0);         ( 455600.0,
4612400.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4612400.0,     177.6,     177.6,       0.0);         ( 455800.0,
4612400.0,     178.0,     178.0,       0.0);
     ( 455900.0, 4612400.0,     177.6,     177.6,       0.0);         ( 456000.0,
4612400.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4612400.0,     177.1,     177.1,       0.0);         ( 456200.0,
4612400.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4612400.0,     177.2,     177.2,       0.0);         ( 456400.0,
4612400.0,     179.1,     179.1,       0.0);
     ( 456500.0, 4612400.0,     177.1,     184.9,       0.0);         ( 456600.0,
4612400.0,     177.1,     177.1,       0.0);
     ( 452000.0, 4612500.0,     175.2,     175.2,       0.0);         ( 452100.0,
4612500.0,     175.2,     175.2,       0.0);
     ( 452200.0, 4612500.0,     175.2,     175.2,       0.0);         ( 452300.0,
4612500.0,     175.2,     175.2,       0.0);
     ( 452400.0, 4612500.0,     175.2,     175.2,       0.0);         ( 452500.0,
4612500.0,     175.2,     175.2,       0.0);
     ( 452600.0, 4612500.0,     175.2,     175.2,       0.0);         ( 452700.0,
4612500.0,     175.2,     175.2,       0.0);
     ( 452800.0, 4612500.0,     176.4,     176.4,       0.0);         ( 452900.0,
4612500.0,     178.8,     178.8,       0.0);
     ( 453000.0, 4612500.0,     178.4,     178.4,       0.0);         ( 453100.0,
4612500.0,     178.4,     178.4,       0.0);
     ( 453200.0, 4612500.0,     178.8,     178.8,       0.0);         ( 453300.0,
4612500.0,     178.9,     178.9,       0.0);
     ( 453400.0, 4612500.0,     178.9,     178.9,       0.0);         ( 453500.0,
4612500.0,     178.9,     178.9,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453600.0, 4612500.0, 178.8, 178.8, 0.0); (453700.0, 4612500.0, 178.9, 178.9, 0.0);
(453800.0, 4612500.0, 178.9, 178.9, 0.0); (453900.0, 4612500.0, 178.8, 178.8, 0.0);
(454000.0, 4612500.0, 179.1, 179.1, 0.0); (454100.0, 4612500.0, 179.7, 179.7, 0.0);
(454200.0, 4612500.0, 178.4, 178.4, 0.0); (454300.0, 4612500.0, 178.2, 178.2, 0.0);
(454400.0, 4612500.0, 177.4, 177.4, 0.0); (454500.0, 4612500.0, 178.2, 178.2, 0.0);
(454600.0, 4612500.0, 184.5, 184.5, 0.0); (454700.0, 4612500.0, 182.1, 182.1, 0.0);
(454800.0, 4612500.0, 183.0, 183.0, 0.0); (454900.0, 4612500.0, 182.3, 182.3, 0.0);
(455000.0, 4612500.0, 178.2, 178.2, 0.0); (455100.0, 4612500.0, 178.3, 178.3, 0.0);
(455200.0, 4612500.0, 177.6, 177.6, 0.0); (455300.0, 4612500.0, 178.1, 178.1, 0.0);
(455400.0, 4612500.0, 177.6, 177.6, 0.0); (455500.0, 4612500.0, 177.6, 177.6, 0.0);
(455600.0, 4612500.0, 177.6, 177.6, 0.0); (455700.0, 4612500.0, 177.6, 177.6, 0.0);
(455800.0, 4612500.0, 177.6, 177.6, 0.0); (455900.0, 4612500.0, 177.6, 177.6, 0.0);
(456000.0, 4612500.0, 177.6, 177.6, 0.0); (456100.0, 4612500.0, 177.1, 177.1, 0.0);
(456200.0, 4612500.0, 177.1, 177.1, 0.0); (456300.0, 4612500.0, 177.2, 177.2, 0.0);
(456400.0, 4612500.0, 178.4, 178.4, 0.0); (456500.0, 4612500.0, 177.1, 177.1, 0.0);
(456600.0, 4612500.0, 177.1, 177.1, 0.0); (452000.0, 4612600.0, 177.1, 177.8, 0.0);
(452100.0, 4612600.0, 177.9, 177.9, 0.0); (452200.0, 4612600.0, 178.0, 178.0, 0.0);
(452300.0, 4612600.0, 178.2, 178.2, 0.0); (452400.0, 4612600.0, 178.2, 178.2, 0.0);
(452500.0, 4612600.0, 178.2, 178.2, 0.0); (452600.0, 4612600.0, 177.2, 177.2, 0.0);
(452700.0, 4612600.0, 175.2, 175.2, 0.0); (452800.0, 4612600.0, 175.2, 175.2, 0.0);
(452900.0, 4612600.0, 178.7, 178.7, 0.0); (453000.0, 4612600.0, 179.5, 179.5, 0.0);
(453100.0, 4612600.0, 179.3, 179.3, 0.0); (453200.0, 4612600.0, 179.2, 179.2, 0.0);
(453300.0, 4612600.0, 179.2, 179.2, 0.0); (453400.0, 4612600.0, 179.1, 179.1, 0.0);
(453500.0, 4612600.0, 179.1, 179.1, 0.0); (453600.0, 4612600.0, 179.0, 179.0, 0.0);
(453700.0, 4612600.0, 179.1, 179.1, 0.0); (453800.0, 4612600.0, 179.1, 179.1, 0.0);

```
     ( 453900.0, 4612600.0,     178.8,     178.8,       0.0);         ( 454000.0,
4612600.0,     179.6,     179.6,       0.0);
     ( 454100.0, 4612600.0,     178.6,     178.6,       0.0);         ( 454200.0,
4612600.0,     178.4,     178.4,       0.0);
     ( 454300.0, 4612600.0,     178.2,     178.2,       0.0);         ( 454400.0,
4612600.0,     177.5,     177.5,       0.0);
     ( 454500.0, 4612600.0,     178.2,     178.2,       0.0);         ( 454600.0,
4612600.0,     182.0,     182.0,       0.0);
     ( 454700.0, 4612600.0,     182.2,     194.0,       0.0);         ( 454800.0,
4612600.0,     183.9,     194.0,       0.0);
     ( 454900.0, 4612600.0,     183.7,     183.7,       0.0);         ( 455000.0,
4612600.0,     178.4,     178.4,       0.0);
     ( 455100.0, 4612600.0,     178.2,     178.2,       0.0);         ( 455200.0,
4612600.0,     178.1,     178.1,       0.0);
     ( 455300.0, 4612600.0,     177.6,     177.6,       0.0);         ( 455400.0,
4612600.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4612600.0,     177.9,     177.9,       0.0);         ( 455600.0,
4612600.0,     178.0,     178.0,       0.0);
     ( 455700.0, 4612600.0,     177.6,     177.6,       0.0);         ( 455800.0,
4612600.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4612600.0,     177.6,     177.6,       0.0);         ( 456000.0,
4612600.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4612600.0,     177.1,     177.1,       0.0);         ( 456200.0,
4612600.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4612600.0,     177.2,     177.2,       0.0);         ( 456400.0,
4612600.0,     177.6,     177.6,       0.0);
     ( 456500.0, 4612600.0,     177.1,     177.1,       0.0);         ( 456600.0,
4612600.0,     177.1,     177.1,       0.0);
     ( 452000.0, 4612700.0,     178.3,     178.3,       0.0);         ( 452100.0,
4612700.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4612700.0,     178.3,     178.3,       0.0);         ( 452300.0,
4612700.0,     178.5,     178.5,       0.0);
     ( 452400.0, 4612700.0,     178.3,     178.3,       0.0);         ( 452500.0,
4612700.0,     178.3,     178.3,       0.0);
     ( 452600.0, 4612700.0,     178.3,     178.3,       0.0);         ( 452700.0,
4612700.0,     178.3,     178.3,       0.0);
     ( 452800.0, 4612700.0,     175.2,     175.2,       0.0);         ( 452900.0,
4612700.0,     175.9,     175.9,       0.0);
     ( 453000.0, 4612700.0,     179.1,     179.1,       0.0);         ( 453100.0,
4612700.0,     179.5,     179.5,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453200.0, 4612700.0, 179.4, 179.4, 0.0); (453300.0, 4612700.0, 179.4, 179.4, 0.0);
(453400.0, 4612700.0, 179.1, 179.1, 0.0); (453500.0, 4612700.0, 179.0, 179.0, 0.0);
(453600.0, 4612700.0, 179.0, 179.0, 0.0); (453700.0, 4612700.0, 179.3, 179.3, 0.0);
(453800.0, 4612700.0, 179.4, 179.4, 0.0); (453900.0, 4612700.0, 179.4, 179.4, 0.0);
(454000.0, 4612700.0, 179.3, 179.3, 0.0); (454100.0, 4612700.0, 177.9, 177.9, 0.0);
(454200.0, 4612700.0, 178.4, 178.4, 0.0); (454300.0, 4612700.0, 177.7, 177.7, 0.0);
(454400.0, 4612700.0, 176.1, 176.1, 0.0); (454500.0, 4612700.0, 178.2, 192.9, 0.0);
(454600.0, 4612700.0, 187.7, 192.9, 0.0); (454700.0, 4612700.0, 192.8, 192.8, 0.0);
(454800.0, 4612700.0, 188.7, 194.0, 0.0); (454900.0, 4612700.0, 184.3, 185.7, 0.0);
(455000.0, 4612700.0, 178.4, 178.4, 0.0); (455100.0, 4612700.0, 178.2, 178.2, 0.0);
(455200.0, 4612700.0, 178.4, 178.4, 0.0); (455300.0, 4612700.0, 177.6, 177.6, 0.0);
(455400.0, 4612700.0, 177.6, 177.6, 0.0); (455500.0, 4612700.0, 177.6, 177.6, 0.0);
(455600.0, 4612700.0, 177.6, 177.6, 0.0); (455700.0, 4612700.0, 177.6, 177.6, 0.0);
(455800.0, 4612700.0, 177.6, 177.6, 0.0); (455900.0, 4612700.0, 177.6, 177.6, 0.0);
(456000.0, 4612700.0, 177.6, 177.6, 0.0); (456100.0, 4612700.0, 177.1, 177.1, 0.0);
(456200.0, 4612700.0, 177.1, 177.1, 0.0); (456300.0, 4612700.0, 177.2, 177.2, 0.0);
(456400.0, 4612700.0, 177.5, 177.5, 0.0); (456500.0, 4612700.0, 177.1, 177.1, 0.0);
(456600.0, 4612700.0, 177.1, 177.1, 0.0); (452000.0, 4612800.0, 178.3, 178.3, 0.0);
(452100.0, 4612800.0, 178.3, 178.3, 0.0); (452200.0, 4612800.0, 178.0, 178.0, 0.0);
(452300.0, 4612800.0, 178.3, 178.3, 0.0); (452400.0, 4612800.0, 178.6, 178.6, 0.0);
(452500.0, 4612800.0, 178.5, 178.5, 0.0); (452600.0, 4612800.0, 178.3, 178.3, 0.0);
(452700.0, 4612800.0, 178.9, 178.9, 0.0); (452800.0, 4612800.0, 175.2, 178.9, 0.0);
(452900.0, 4612800.0, 175.2, 175.2, 0.0); (453000.0, 4612800.0, 175.5, 178.8, 0.0);
(453100.0, 4612800.0, 179.7, 179.7, 0.0); (453200.0, 4612800.0, 179.5, 179.5, 0.0);
(453300.0, 4612800.0, 179.2, 179.2, 0.0); (453400.0, 4612800.0, 179.0, 179.0, 0.0);

```
     ( 453500.0, 4612800.0,     179.0,     179.0,       0.0);         ( 453600.0,
4612800.0,     179.0,     179.0,       0.0);
     ( 453700.0, 4612800.0,     179.2,     179.2,       0.0);         ( 453800.0,
4612800.0,     179.5,     179.5,       0.0);
     ( 453900.0, 4612800.0,     179.8,     179.8,       0.0);         ( 454000.0,
4612800.0,     178.3,     178.3,       0.0);
     ( 454100.0, 4612800.0,     177.2,     177.2,       0.0);         ( 454200.0,
4612800.0,     178.1,     178.1,       0.0);
     ( 454300.0, 4612800.0,     177.9,     177.9,       0.0);         ( 454400.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 454500.0, 4612800.0,     178.1,     178.1,       0.0);         ( 454600.0,
4612800.0,     178.3,     193.1,       0.0);
     ( 454700.0, 4612800.0,     178.6,     194.0,       0.0);         ( 454800.0,
4612800.0,     179.2,     194.0,       0.0);
     ( 454900.0, 4612800.0,     179.2,     179.2,       0.0);         ( 455000.0,
4612800.0,     178.9,     178.9,       0.0);
     ( 455100.0, 4612800.0,     178.2,     178.2,       0.0);         ( 455200.0,
4612800.0,     178.4,     178.4,       0.0);
     ( 455300.0, 4612800.0,     177.6,     177.6,       0.0);         ( 455400.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4612800.0,     177.6,     177.6,       0.0);         ( 455600.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4612800.0,     177.6,     177.6,       0.0);         ( 455800.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4612800.0,     177.6,     177.6,       0.0);         ( 456000.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4612800.0,     177.1,     177.1,       0.0);         ( 456200.0,
4612800.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4612800.0,     177.3,     177.3,       0.0);         ( 456400.0,
4612800.0,     177.8,     177.8,       0.0);
     ( 456500.0, 4612800.0,     177.1,     177.1,       0.0);         ( 456600.0,
4612800.0,     177.1,     177.1,       0.0);
     ( 452000.0, 4612900.0,     178.3,     178.3,       0.0);         ( 452100.0,
4612900.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4612900.0,     176.1,     176.1,       0.0);         ( 452300.0,
4612900.0,     177.9,     177.9,       0.0);
     ( 452400.0, 4612900.0,     178.6,     178.6,       0.0);         ( 452500.0,
4612900.0,     179.0,     179.0,       0.0);
     ( 452600.0, 4612900.0,     179.1,     179.1,       0.0);         ( 452700.0,
4612900.0,     179.7,     179.7,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452800.0, 4612900.0, 179.7, 179.7, 0.0); (452900.0, 4612900.0, 175.5, 179.7, 0.0);
(453000.0, 4612900.0, 178.2, 178.9, 0.0); (453100.0, 4612900.0, 175.2, 175.2, 0.0);
(453200.0, 4612900.0, 175.7, 179.6, 0.0); (453300.0, 4612900.0, 179.5, 179.5, 0.0);
(453400.0, 4612900.0, 179.0, 179.0, 0.0); (453500.0, 4612900.0, 179.0, 179.0, 0.0);
(453600.0, 4612900.0, 179.0, 179.0, 0.0); (453700.0, 4612900.0, 179.2, 179.2, 0.0);
(453800.0, 4612900.0, 179.6, 179.6, 0.0); (453900.0, 4612900.0, 178.7, 178.7, 0.0);
(454000.0, 4612900.0, 178.2, 178.2, 0.0); (454100.0, 4612900.0, 177.1, 177.1, 0.0);
(454200.0, 4612900.0, 178.2, 178.2, 0.0); (454300.0, 4612900.0, 178.2, 178.2, 0.0);
(454400.0, 4612900.0, 178.3, 178.3, 0.0); (454500.0, 4612900.0, 178.2, 178.2, 0.0);
(454600.0, 4612900.0, 178.3, 178.3, 0.0); (454700.0, 4612900.0, 179.2, 179.2, 0.0);
(454800.0, 4612900.0, 180.0, 180.0, 0.0); (454900.0, 4612900.0, 180.4, 180.4, 0.0);
(455000.0, 4612900.0, 180.4, 180.4, 0.0); (455100.0, 4612900.0, 178.2, 178.2, 0.0);
(455200.0, 4612900.0, 178.2, 178.2, 0.0); (455300.0, 4612900.0, 177.6, 177.6, 0.0);
(455400.0, 4612900.0, 177.6, 177.6, 0.0); (455500.0, 4612900.0, 177.6, 177.6, 0.0);
(455600.0, 4612900.0, 177.6, 177.6, 0.0); (455700.0, 4612900.0, 177.6, 177.6, 0.0);
(455800.0, 4612900.0, 177.6, 177.6, 0.0); (455900.0, 4612900.0, 177.9, 177.9, 0.0);
(456000.0, 4612900.0, 177.6, 177.6, 0.0); (456100.0, 4612900.0, 177.1, 177.1, 0.0);
(456200.0, 4612900.0, 177.1, 177.1, 0.0); (456300.0, 4612900.0, 177.2, 177.2, 0.0);
(456400.0, 4612900.0, 177.1, 177.1, 0.0); (456500.0, 4612900.0, 177.1, 177.1, 0.0);
(456600.0, 4612900.0, 177.1, 177.1, 0.0); (452000.0, 4613000.0, 178.3, 178.3, 0.0);
(452100.0, 4613000.0, 178.3, 178.3, 0.0); (452200.0, 4613000.0, 176.1, 176.1, 0.0);
(452300.0, 4613000.0, 177.9, 177.9, 0.0); (452400.0, 4613000.0, 178.9, 178.9, 0.0);
(452500.0, 4613000.0, 179.2, 179.2, 0.0); (452600.0, 4613000.0, 179.7, 179.7, 0.0);
(452700.0, 4613000.0, 179.7, 179.7, 0.0); (452800.0, 4613000.0, 179.7, 179.7, 0.0);
(452900.0, 4613000.0, 179.7, 179.7, 0.0); (453000.0, 4613000.0, 178.5, 178.5, 0.0);

```
     ( 453100.0, 4613000.0,     176.9,     176.9,       0.0);         ( 453200.0,
4613000.0,     175.2,     175.2,       0.0);
     ( 453300.0, 4613000.0,     176.4,     179.6,       0.0);         ( 453400.0,
4613000.0,     179.0,     179.0,       0.0);
     ( 453500.0, 4613000.0,     179.0,     179.0,       0.0);         ( 453600.0,
4613000.0,     179.0,     179.0,       0.0);
     ( 453700.0, 4613000.0,     179.3,     179.3,       0.0);         ( 453800.0,
4613000.0,     179.8,     179.8,       0.0);
     ( 453900.0, 4613000.0,     178.6,     178.6,       0.0);         ( 454000.0,
4613000.0,     178.4,     178.4,       0.0);
     ( 454100.0, 4613000.0,     177.3,     177.3,       0.0);         ( 454200.0,
4613000.0,     178.2,     178.2,       0.0);
     ( 454300.0, 4613000.0,     178.4,     178.4,       0.0);         ( 454400.0,
4613000.0,     178.8,     178.8,       0.0);
     ( 454500.0, 4613000.0,     178.2,     178.2,       0.0);         ( 454600.0,
4613000.0,     178.3,     178.3,       0.0);
     ( 454700.0, 4613000.0,     179.1,     179.1,       0.0);         ( 454800.0,
4613000.0,     179.6,     179.6,       0.0);
     ( 454900.0, 4613000.0,     179.9,     179.9,       0.0);         ( 455000.0,
4613000.0,     180.3,     180.3,       0.0);
     ( 455100.0, 4613000.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613000.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4613000.0,     178.5,     178.5,       0.0);         ( 455400.0,
4613000.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4613000.0,     177.6,     177.6,       0.0);         ( 455600.0,
4613000.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4613000.0,     177.6,     177.6,       0.0);         ( 455800.0,
4613000.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4613000.0,     179.1,     179.1,       0.0);         ( 456000.0,
4613000.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4613000.0,     177.1,     177.1,       0.0);         ( 456200.0,
4613000.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4613000.0,     177.7,     177.7,       0.0);         ( 456400.0,
4613000.0,     177.8,     177.8,       0.0);
     ( 456500.0, 4613000.0,     177.9,     177.9,       0.0);         ( 456600.0,
4613000.0,     177.9,     177.9,       0.0);
     ( 452000.0, 4613100.0,     178.3,     178.3,       0.0);         ( 452100.0,
4613100.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4613100.0,     176.1,     176.1,       0.0);         ( 452300.0,
4613100.0,     178.6,     178.6,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452400.0, 4613100.0, 179.7, 179.7, 0.0); (452500.0, 4613100.0, 179.5, 179.5, 0.0);
(452600.0, 4613100.0, 179.7, 179.7, 0.0); (452700.0, 4613100.0, 179.7, 179.7, 0.0);
(452800.0, 4613100.0, 179.7, 179.7, 0.0); (452900.0, 4613100.0, 179.7, 179.7, 0.0);
(453000.0, 4613100.0, 178.5, 178.5, 0.0); (453100.0, 4613100.0, 179.1, 179.1, 0.0);
(453200.0, 4613100.0, 177.4, 177.4, 0.0); (453300.0, 4613100.0, 175.2, 175.2, 0.0);
(453400.0, 4613100.0, 178.9, 183.4, 0.0); (453500.0, 4613100.0, 179.0, 179.0, 0.0);
(453600.0, 4613100.0, 179.2, 179.2, 0.0); (453700.0, 4613100.0, 179.6, 179.6, 0.0);
(453800.0, 4613100.0, 179.6, 179.6, 0.0); (453900.0, 4613100.0, 179.0, 179.0, 0.0);
(454000.0, 4613100.0, 178.3, 178.3, 0.0); (454100.0, 4613100.0, 178.6, 178.6, 0.0);
(454200.0, 4613100.0, 178.2, 178.2, 0.0); (454300.0, 4613100.0, 178.2, 189.2, 0.0);
(454400.0, 4613100.0, 178.8, 178.8, 0.0); (454500.0, 4613100.0, 178.2, 178.2, 0.0);
(454600.0, 4613100.0, 178.3, 178.3, 0.0); (454700.0, 4613100.0, 179.0, 179.0, 0.0);
(454800.0, 4613100.0, 179.3, 179.3, 0.0); (454900.0, 4613100.0, 179.7, 179.7, 0.0);
(455000.0, 4613100.0, 179.7, 179.7, 0.0); (455100.0, 4613100.0, 178.2, 178.2, 0.0);
(455200.0, 4613100.0, 178.3, 178.3, 0.0); (455300.0, 4613100.0, 178.5, 178.5, 0.0);
(455400.0, 4613100.0, 177.6, 177.6, 0.0); (455500.0, 4613100.0, 177.6, 177.6, 0.0);
(455600.0, 4613100.0, 177.6, 177.6, 0.0); (455700.0, 4613100.0, 179.4, 179.4, 0.0);
(455800.0, 4613100.0, 177.7, 177.7, 0.0); (455900.0, 4613100.0, 177.6, 177.6, 0.0);
(456000.0, 4613100.0, 177.6, 177.6, 0.0); (456100.0, 4613100.0, 177.1, 177.1, 0.0);
(456200.0, 4613100.0, 177.1, 177.1, 0.0); (456300.0, 4613100.0, 177.4, 177.4, 0.0);
(456400.0, 4613100.0, 177.1, 177.1, 0.0); (456500.0, 4613100.0, 177.1, 177.1, 0.0);
(456600.0, 4613100.0, 177.1, 177.1, 0.0); (452000.0, 4613200.0, 178.3, 178.3, 0.0);
(452100.0, 4613200.0, 178.3, 178.3, 0.0); (452200.0, 4613200.0, 176.1, 176.1, 0.0);
(452300.0, 4613200.0, 178.5, 178.5, 0.0); (452400.0, 4613200.0, 179.4, 179.4, 0.0);
(452500.0, 4613200.0, 179.7, 179.7, 0.0); (452600.0, 4613200.0, 179.7, 179.7, 0.0);

(452700.0, 4613200.0, 179.7, 179.7, 0.0); (452800.0, 4613200.0, 179.7, 179.7, 0.0);
(452900.0, 4613200.0, 179.2, 179.2, 0.0); (453000.0, 4613200.0, 178.5, 178.5, 0.0);
(453100.0, 4613200.0, 179.1, 179.1, 0.0); (453200.0, 4613200.0, 179.1, 179.1, 0.0);
(453300.0, 4613200.0, 177.6, 179.1, 0.0); (453400.0, 4613200.0, 175.2, 183.8, 0.0);
(453500.0, 4613200.0, 175.3, 183.8, 0.0); (453600.0, 4613200.0, 179.5, 179.5, 0.0);
(453700.0, 4613200.0, 178.9, 178.9, 0.0); (453800.0, 4613200.0, 179.3, 179.3, 0.0);
(453900.0, 4613200.0, 178.8, 178.8, 0.0); (454000.0, 4613200.0, 178.3, 178.3, 0.0);
(454100.0, 4613200.0, 179.7, 179.7, 0.0); (454200.0, 4613200.0, 178.2, 191.5, 0.0);
(454300.0, 4613200.0, 186.3, 191.5, 0.0); (454400.0, 4613200.0, 183.9, 183.9, 0.0);
(454500.0, 4613200.0, 178.4, 178.4, 0.0); (454600.0, 4613200.0, 178.2, 178.2, 0.0);
(454700.0, 4613200.0, 179.3, 179.3, 0.0); (454800.0, 4613200.0, 180.6, 180.6, 0.0);
(454900.0, 4613200.0, 179.5, 179.5, 0.0); (455000.0, 4613200.0, 178.6, 178.6, 0.0);
(455100.0, 4613200.0, 178.2, 178.2, 0.0); (455200.0, 4613200.0, 178.3, 178.3, 0.0);
(455300.0, 4613200.0, 178.6, 178.6, 0.0); (455400.0, 4613200.0, 178.1, 178.1, 0.0);
(455500.0, 4613200.0, 177.6, 177.6, 0.0); (455600.0, 4613200.0, 177.6, 177.6, 0.0);
(455700.0, 4613200.0, 177.6, 177.6, 0.0); (455800.0, 4613200.0, 177.6, 177.6, 0.0);
(455900.0, 4613200.0, 177.6, 177.6, 0.0); (456000.0, 4613200.0, 178.3, 178.3, 0.0);
(456100.0, 4613200.0, 177.1, 177.1, 0.0); (456200.0, 4613200.0, 177.1, 177.1, 0.0);
(456300.0, 4613200.0, 177.4, 177.4, 0.0); (456400.0, 4613200.0, 177.1, 177.1, 0.0);
(456500.0, 4613200.0, 177.1, 177.1, 0.0); (456600.0, 4613200.0, 177.1, 177.1, 0.0);

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452000.0, 4613300.0, 178.3, 178.3, 0.0); (452100.0, 4613300.0, 178.3, 178.3, 0.0);
(452200.0, 4613300.0, 176.1, 176.1, 0.0); (452300.0, 4613300.0, 178.6, 178.6, 0.0);
(452400.0, 4613300.0, 179.6, 179.6, 0.0); (452500.0, 4613300.0, 179.7, 179.7, 0.0);
(452600.0, 4613300.0, 179.7, 179.7, 0.0); (452700.0, 4613300.0, 179.7, 179.7, 0.0);
(452800.0, 4613300.0, 179.4, 179.4, 0.0); (452900.0, 4613300.0, 178.9, 178.9, 0.0);
(453000.0, 4613300.0, 179.6, 179.6, 0.0); (453100.0, 4613300.0, 179.1, 179.1, 0.0);
(453200.0, 4613300.0, 179.1, 179.1, 0.0); (453300.0, 4613300.0, 179.1, 179.1, 0.0);
(453400.0, 4613300.0, 180.5, 180.5, 0.0); (453500.0, 4613300.0, 176.4, 183.0, 0.0);
(453600.0, 4613300.0, 175.2, 175.2, 0.0); (453700.0, 4613300.0, 178.9, 178.9, 0.0);
(453800.0, 4613300.0, 178.5, 178.5, 0.0); (453900.0, 4613300.0, 178.7, 178.7, 0.0);
(454000.0, 4613300.0, 178.2, 178.2, 0.0); (454100.0, 4613300.0, 178.6, 178.6, 0.0);
(454200.0, 4613300.0, 178.2, 191.7, 0.0); (454300.0, 4613300.0, 191.0, 191.0, 0.0);
(454400.0, 4613300.0, 185.1, 191.1, 0.0); (454500.0, 4613300.0, 178.6, 178.6, 0.0);
(454600.0, 4613300.0, 178.2, 178.2, 0.0); (454700.0, 4613300.0, 179.4, 179.4, 0.0);
(454800.0, 4613300.0, 180.0, 180.0, 0.0); (454900.0, 4613300.0, 178.6, 178.6, 0.0);
(455000.0, 4613300.0, 178.2, 178.2, 0.0); (455100.0, 4613300.0, 178.2, 178.2, 0.0);
(455200.0, 4613300.0, 178.4, 178.4, 0.0); (455300.0, 4613300.0, 178.6, 178.6, 0.0);
(455400.0, 4613300.0, 179.1, 179.1, 0.0); (455500.0, 4613300.0, 177.6, 177.6, 0.0);
(455600.0, 4613300.0, 177.6, 177.6, 0.0); (455700.0, 4613300.0, 177.6, 177.6, 0.0);
(455800.0, 4613300.0, 177.6, 177.6, 0.0); (455900.0, 4613300.0, 177.6, 177.6, 0.0);
(456000.0, 4613300.0, 178.2, 178.2, 0.0); (456100.0, 4613300.0, 177.1, 177.1, 0.0);
(456200.0, 4613300.0, 177.1, 177.1, 0.0); (456300.0, 4613300.0, 177.4, 177.4, 0.0);
(456400.0, 4613300.0, 177.1, 177.1, 0.0); (456500.0, 4613300.0, 177.1, 177.1, 0.0);
(456600.0, 4613300.0, 177.1, 181.5, 0.0); (452000.0, 4613400.0, 178.4, 178.4, 0.0);
(452100.0, 4613400.0, 178.3, 178.3, 0.0); (452200.0, 4613400.0, 176.1, 176.1, 0.0);

```
     ( 452300.0, 4613400.0,     178.6,     178.6,       0.0);         ( 452400.0,
4613400.0,     179.8,     179.8,       0.0);
     ( 452500.0, 4613400.0,     179.8,     179.8,       0.0);         ( 452600.0,
4613400.0,     179.9,     179.9,       0.0);
     ( 452700.0, 4613400.0,     179.7,     179.7,       0.0);         ( 452800.0,
4613400.0,     179.3,     179.3,       0.0);
     ( 452900.0, 4613400.0,     179.3,     179.3,       0.0);         ( 453000.0,
4613400.0,     179.7,     179.7,       0.0);
     ( 453100.0, 4613400.0,     179.4,     179.4,       0.0);         ( 453200.0,
4613400.0,     179.2,     179.2,       0.0);
     ( 453300.0, 4613400.0,     179.2,     179.2,       0.0);         ( 453400.0,
4613400.0,     178.6,     178.6,       0.0);
     ( 453500.0, 4613400.0,     178.3,     178.3,       0.0);         ( 453600.0,
4613400.0,     175.4,     175.4,       0.0);
     ( 453700.0, 4613400.0,     175.2,     175.2,       0.0);         ( 453800.0,
4613400.0,     178.1,     178.1,       0.0);
     ( 453900.0, 4613400.0,     178.2,     178.2,       0.0);         ( 454000.0,
4613400.0,     178.2,     178.2,       0.0);
     ( 454100.0, 4613400.0,     178.3,     178.3,       0.0);         ( 454200.0,
4613400.0,     178.2,     190.9,       0.0);
     ( 454300.0, 4613400.0,     183.3,     191.4,       0.0);         ( 454400.0,
4613400.0,     186.9,     188.6,       0.0);
     ( 454500.0, 4613400.0,     178.8,     189.9,       0.0);         ( 454600.0,
4613400.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4613400.0,     178.2,     178.2,       0.0);         ( 454800.0,
4613400.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4613400.0,     178.2,     178.2,       0.0);         ( 455000.0,
4613400.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4613400.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613400.0,     178.3,     178.3,       0.0);
     ( 455300.0, 4613400.0,     178.8,     178.8,       0.0);         ( 455400.0,
4613400.0,     179.2,     179.2,       0.0);
     ( 455500.0, 4613400.0,     177.6,     177.6,       0.0);         ( 455600.0,
4613400.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4613400.0,     177.6,     177.6,       0.0);         ( 455800.0,
4613400.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4613400.0,     177.6,     177.6,       0.0);         ( 456000.0,
4613400.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4613400.0,     177.1,     177.1,       0.0);         ( 456200.0,
4613400.0,     177.1,     177.1,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(456300.0, 4613400.0, 177.5, 177.5, 0.0); (456400.0, 4613400.0, 177.1, 177.1, 0.0);
(456500.0, 4613400.0, 177.1, 177.1, 0.0); (456600.0, 4613400.0, 179.7, 181.7, 0.0);
(452000.0, 4613500.0, 178.8, 178.8, 0.0); (452100.0, 4613500.0, 178.3, 178.3, 0.0);
(452200.0, 4613500.0, 176.1, 176.1, 0.0); (452300.0, 4613500.0, 178.5, 178.5, 0.0);
(452400.0, 4613500.0, 179.4, 179.4, 0.0); (452500.0, 4613500.0, 179.7, 179.7, 0.0);
(452600.0, 4613500.0, 179.7, 179.7, 0.0); (452700.0, 4613500.0, 179.6, 179.6, 0.0);
(452800.0, 4613500.0, 179.7, 179.7, 0.0); (452900.0, 4613500.0, 179.7, 179.7, 0.0);
(453000.0, 4613500.0, 179.7, 179.7, 0.0); (453100.0, 4613500.0, 179.4, 179.4, 0.0);
(453200.0, 4613500.0, 179.1, 179.1, 0.0); (453300.0, 4613500.0, 178.8, 178.8, 0.0);
(453400.0, 4613500.0, 178.5, 178.5, 0.0); (453500.0, 4613500.0, 178.3, 178.3, 0.0);
(453600.0, 4613500.0, 178.6, 178.6, 0.0); (453700.0, 4613500.0, 176.7, 178.8, 0.0);
(453800.0, 4613500.0, 175.2, 175.2, 0.0); (453900.0, 4613500.0, 175.2, 179.6, 0.0);
(454000.0, 4613500.0, 178.7, 178.7, 0.0); (454100.0, 4613500.0, 178.2, 178.2, 0.0);
(454200.0, 4613500.0, 178.2, 178.2, 0.0); (454300.0, 4613500.0, 179.6, 190.1, 0.0);
(454400.0, 4613500.0, 179.7, 190.1, 0.0); (454500.0, 4613500.0, 178.8, 189.9, 0.0);
(454600.0, 4613500.0, 178.2, 178.2, 0.0); (454700.0, 4613500.0, 178.2, 178.2, 0.0);
(454800.0, 4613500.0, 178.2, 178.2, 0.0); (454900.0, 4613500.0, 178.2, 178.2, 0.0);
(455000.0, 4613500.0, 178.2, 178.2, 0.0); (455100.0, 4613500.0, 178.2, 178.2, 0.0);
(455200.0, 4613500.0, 178.2, 178.2, 0.0); (455300.0, 4613500.0, 178.7, 178.7, 0.0);
(455400.0, 4613500.0, 179.2, 179.2, 0.0); (455500.0, 4613500.0, 177.6, 177.6, 0.0);
(455600.0, 4613500.0, 177.6, 177.6, 0.0); (455700.0, 4613500.0, 177.6, 177.6, 0.0);
(455800.0, 4613500.0, 177.6, 177.6, 0.0); (455900.0, 4613500.0, 177.6, 177.6, 0.0);
(456000.0, 4613500.0, 177.6, 177.6, 0.0); (456100.0, 4613500.0, 177.3, 177.3, 0.0);
(456200.0, 4613500.0, 177.1, 177.1, 0.0); (456300.0, 4613500.0, 177.2, 177.2, 0.0);
(456400.0, 4613500.0, 177.1, 177.1, 0.0); (456500.0, 4613500.0, 177.1, 177.1, 0.0);

```
     ( 456600.0, 4613500.0,     182.0,     182.0,       0.0);         ( 452000.0,
4613600.0,     179.2,     179.2,       0.0);
     ( 452100.0, 4613600.0,     178.3,     178.3,       0.0);         ( 452200.0,
4613600.0,     176.1,     176.1,       0.0);
     ( 452300.0, 4613600.0,     176.4,     176.4,       0.0);         ( 452400.0,
4613600.0,     179.7,     179.7,       0.0);
     ( 452500.0, 4613600.0,     179.8,     179.8,       0.0);         ( 452600.0,
4613600.0,     179.7,     179.7,       0.0);
     ( 452700.0, 4613600.0,     179.9,     179.9,       0.0);         ( 452800.0,
4613600.0,     179.8,     179.8,       0.0);
     ( 452900.0, 4613600.0,     179.7,     179.7,       0.0);         ( 453000.0,
4613600.0,     179.9,     179.9,       0.0);
     ( 453100.0, 4613600.0,     179.4,     179.4,       0.0);         ( 453200.0,
4613600.0,     178.5,     178.5,       0.0);
     ( 453300.0, 4613600.0,     178.5,     178.5,       0.0);         ( 453400.0,
4613600.0,     178.6,     178.6,       0.0);
     ( 453500.0, 4613600.0,     178.3,     178.3,       0.0);         ( 453600.0,
4613600.0,     178.7,     178.7,       0.0);
     ( 453700.0, 4613600.0,     178.6,     178.6,       0.0);         ( 453800.0,
4613600.0,     178.4,     178.4,       0.0);
     ( 453900.0, 4613600.0,     175.2,     175.2,       0.0);         ( 454000.0,
4613600.0,     175.2,     175.2,       0.0);
     ( 454100.0, 4613600.0,     178.2,     178.2,       0.0);         ( 454200.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 454300.0, 4613600.0,     178.3,     178.3,       0.0);         ( 454400.0,
4613600.0,     178.6,     178.6,       0.0);
     ( 454500.0, 4613600.0,     178.2,     178.2,       0.0);         ( 454600.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4613600.0,     178.2,     178.2,       0.0);         ( 454800.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4613600.0,     178.2,     178.2,       0.0);         ( 455000.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4613600.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4613600.0,     178.4,     178.4,       0.0);         ( 455400.0,
4613600.0,     178.9,     178.9,       0.0);
     ( 455500.0, 4613600.0,     179.5,     179.5,       0.0);         ( 455600.0,
4613600.0,     177.7,     177.7,       0.0);
     ( 455700.0, 4613600.0,     177.6,     177.6,       0.0);         ( 455800.0,
4613600.0,     177.6,     177.6,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455900.0, 4613600.0, 177.6, 177.6, 0.0); (456000.0, 4613600.0, 177.6, 177.6, 0.0);
(456100.0, 4613600.0, 177.1, 177.1, 0.0); (456200.0, 4613600.0, 177.1, 177.1, 0.0);
(456300.0, 4613600.0, 177.1, 177.1, 0.0); (456400.0, 4613600.0, 177.1, 177.1, 0.0);
(456500.0, 4613600.0, 177.1, 177.1, 0.0); (456600.0, 4613600.0, 179.3, 182.0, 0.0);
(452000.0, 4613700.0, 179.3, 179.3, 0.0); (452100.0, 4613700.0, 179.5, 179.5, 0.0);
(452200.0, 4613700.0, 178.2, 196.2, 0.0); (452300.0, 4613700.0, 178.5, 195.0, 0.0);
(452400.0, 4613700.0, 178.7, 178.7, 0.0); (452500.0, 4613700.0, 179.8, 179.8, 0.0);
(452600.0, 4613700.0, 179.8, 179.8, 0.0); (452700.0, 4613700.0, 180.2, 180.2, 0.0);
(452800.0, 4613700.0, 180.3, 180.3, 0.0); (452900.0, 4613700.0, 180.1, 180.1, 0.0);
(453000.0, 4613700.0, 180.0, 180.0, 0.0); (453100.0, 4613700.0, 179.4, 179.4, 0.0);
(453200.0, 4613700.0, 179.6, 179.6, 0.0); (453300.0, 4613700.0, 179.7, 179.7, 0.0);
(453400.0, 4613700.0, 179.7, 179.7, 0.0); (453500.0, 4613700.0, 179.0, 179.0, 0.0);
(453600.0, 4613700.0, 179.0, 179.0, 0.0); (453700.0, 4613700.0, 178.8, 178.8, 0.0);
(453800.0, 4613700.0, 179.8, 179.8, 0.0); (453900.0, 4613700.0, 178.6, 178.6, 0.0);
(454000.0, 4613700.0, 175.2, 175.2, 0.0); (454100.0, 4613700.0, 178.2, 178.2, 0.0);
(454200.0, 4613700.0, 178.2, 178.2, 0.0); (454300.0, 4613700.0, 178.2, 178.2, 0.0);
(454400.0, 4613700.0, 178.2, 178.2, 0.0); (454500.0, 4613700.0, 178.2, 178.2, 0.0);
(454600.0, 4613700.0, 178.2, 178.2, 0.0); (454700.0, 4613700.0, 178.2, 178.2, 0.0);
(454800.0, 4613700.0, 178.2, 178.2, 0.0); (454900.0, 4613700.0, 178.2, 178.2, 0.0);
(455000.0, 4613700.0, 178.2, 178.2, 0.0); (455100.0, 4613700.0, 178.2, 178.2, 0.0);
(455200.0, 4613700.0, 178.2, 178.2, 0.0); (455300.0, 4613700.0, 178.2, 178.2, 0.0);
(455400.0, 4613700.0, 178.4, 178.4, 0.0); (455500.0, 4613700.0, 178.9, 178.9, 0.0);
(455600.0, 4613700.0, 179.8, 179.8, 0.0); (455700.0, 4613700.0, 177.6, 177.6, 0.0);
(455800.0, 4613700.0, 177.6, 177.6, 0.0); (455900.0, 4613700.0, 177.6, 177.6, 0.0);
(456000.0, 4613700.0, 177.6, 177.6, 0.0); (456100.0, 4613700.0, 177.1, 177.1, 0.0);

```
     ( 456200.0, 4613700.0,     177.5,     177.5,       0.0);         ( 456300.0,
4613700.0,     178.5,     178.5,       0.0);
     ( 456400.0, 4613700.0,     178.4,     178.4,       0.0);         ( 456500.0,
4613700.0,     177.3,     177.3,       0.0);
     ( 456600.0, 4613700.0,     178.3,     178.3,       0.0);         ( 452000.0,
4613800.0,     179.2,     179.2,       0.0);
     ( 452100.0, 4613800.0,     179.6,     197.6,       0.0);         ( 452200.0,
4613800.0,     192.7,     193.5,       0.0);
     ( 452300.0, 4613800.0,     182.3,     197.6,       0.0);         ( 452400.0,
4613800.0,     178.8,     196.3,       0.0);
     ( 452500.0, 4613800.0,     179.8,     179.8,       0.0);         ( 452600.0,
4613800.0,     180.3,     180.3,       0.0);
     ( 452700.0, 4613800.0,     180.7,     180.7,       0.0);         ( 452800.0,
4613800.0,     180.8,     180.8,       0.0);
     ( 452900.0, 4613800.0,     180.4,     180.4,       0.0);         ( 453000.0,
4613800.0,     180.0,     180.0,       0.0);
     ( 453100.0, 4613800.0,     179.4,     179.4,       0.0);         ( 453200.0,
4613800.0,     179.4,     179.4,       0.0);
     ( 453300.0, 4613800.0,     179.4,     179.4,       0.0);         ( 453400.0,
4613800.0,     178.8,     178.8,       0.0);
     ( 453500.0, 4613800.0,     179.1,     179.1,       0.0);         ( 453600.0,
4613800.0,     179.3,     179.3,       0.0);
     ( 453700.0, 4613800.0,     179.0,     179.0,       0.0);         ( 453800.0,
4613800.0,     179.7,     179.7,       0.0);
     ( 453900.0, 4613800.0,     180.6,     180.6,       0.0);         ( 454000.0,
4613800.0,     175.2,     180.1,       0.0);
     ( 454100.0, 4613800.0,     175.2,     179.6,       0.0);         ( 454200.0,
4613800.0,     177.8,     177.8,       0.0);
     ( 454300.0, 4613800.0,     178.2,     178.2,       0.0);         ( 454400.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4613800.0,     178.2,     178.2,       0.0);         ( 454600.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4613800.0,     178.2,     178.2,       0.0);         ( 454800.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4613800.0,     178.2,     178.2,       0.0);         ( 455000.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4613800.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4613800.0,     178.2,     178.2,       0.0);         ( 455400.0,
4613800.0,     178.2,     178.2,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455500.0, 4613800.0, 178.8, 178.8, 0.0); (455600.0, 4613800.0, 180.1, 180.1, 0.0);
(455700.0, 4613800.0, 178.8, 180.8, 0.0); (455800.0, 4613800.0, 179.5, 181.1, 0.0);
(455900.0, 4613800.0, 179.6, 181.1, 0.0); (456000.0, 4613800.0, 178.7, 178.7, 0.0);
(456100.0, 4613800.0, 177.2, 177.2, 0.0); (456200.0, 4613800.0, 178.3, 178.3, 0.0);
(456300.0, 4613800.0, 178.7, 178.7, 0.0); (456400.0, 4613800.0, 178.0, 178.0, 0.0);
(456500.0, 4613800.0, 177.9, 181.4, 0.0); (456600.0, 4613800.0, 179.0, 179.0, 0.0);
(452000.0, 4613900.0, 179.2, 179.2, 0.0); (452100.0, 4613900.0, 179.6, 198.9, 0.0);
(452200.0, 4613900.0, 196.7, 196.7, 0.0); (452300.0, 4613900.0, 192.0, 196.3, 0.0);
(452400.0, 4613900.0, 179.1, 198.9, 0.0); (452500.0, 4613900.0, 179.9, 179.9, 0.0);
(452600.0, 4613900.0, 180.6, 180.6, 0.0); (452700.0, 4613900.0, 183.1, 183.1, 0.0);
(452800.0, 4613900.0, 181.1, 181.1, 0.0); (452900.0, 4613900.0, 180.6, 180.6, 0.0);
(453000.0, 4613900.0, 180.0, 180.0, 0.0); (453100.0, 4613900.0, 178.8, 178.8, 0.0);
(453200.0, 4613900.0, 179.1, 179.1, 0.0); (453300.0, 4613900.0, 179.1, 179.1, 0.0);
(453400.0, 4613900.0, 178.5, 178.5, 0.0); (453500.0, 4613900.0, 179.8, 179.8, 0.0);
(453600.0, 4613900.0, 179.4, 179.4, 0.0); (453700.0, 4613900.0, 179.2, 179.2, 0.0);
(453800.0, 4613900.0, 179.7, 179.7, 0.0); (453900.0, 4613900.0, 179.5, 179.5, 0.0);
(454000.0, 4613900.0, 175.2, 179.3, 0.0); (454100.0, 4613900.0, 175.2, 175.2, 0.0);
(454200.0, 4613900.0, 175.2, 175.2, 0.0); (454300.0, 4613900.0, 178.2, 178.2, 0.0);
(454400.0, 4613900.0, 178.2, 178.2, 0.0); (454500.0, 4613900.0, 178.2, 178.2, 0.0);
(454600.0, 4613900.0, 178.2, 178.2, 0.0); (454700.0, 4613900.0, 178.2, 178.2, 0.0);
(454800.0, 4613900.0, 178.2, 178.2, 0.0); (454900.0, 4613900.0, 178.2, 178.2, 0.0);
(455000.0, 4613900.0, 178.2, 178.2, 0.0); (455100.0, 4613900.0, 178.2, 178.2, 0.0);
(455200.0, 4613900.0, 178.2, 178.2, 0.0); (455300.0, 4613900.0, 178.2, 178.2, 0.0);
(455400.0, 4613900.0, 178.2, 178.2, 0.0); (455500.0, 4613900.0, 178.4, 178.4, 0.0);
(455600.0, 4613900.0, 179.7, 179.7, 0.0); (455700.0, 4613900.0, 181.3, 181.3, 0.0);

```
     ( 455800.0, 4613900.0,     181.3,     181.3,       0.0);         ( 455900.0,
4613900.0,     181.3,     181.3,       0.0);
     ( 456000.0, 4613900.0,     181.3,     181.3,       0.0);         ( 456100.0,
4613900.0,     180.2,     180.2,       0.0);
     ( 456200.0, 4613900.0,     178.8,     178.8,       0.0);         ( 456300.0,
4613900.0,     178.4,     178.4,       0.0);
     ( 456400.0, 4613900.0,     178.0,     178.0,       0.0);         ( 456500.0,
4613900.0,     181.2,     181.2,       0.0);
     ( 456600.0, 4613900.0,     178.7,     178.7,       0.0);         ( 452000.0,
4614000.0,     179.2,     179.2,       0.0);
     ( 452100.0, 4614000.0,     179.6,     198.9,       0.0);         ( 452200.0,
4614000.0,     196.9,     196.9,       0.0);
     ( 452300.0, 4614000.0,     194.2,     198.9,       0.0);         ( 452400.0,
4614000.0,     179.1,     198.9,       0.0);
     ( 452500.0, 4614000.0,     180.1,     180.1,       0.0);         ( 452600.0,
4614000.0,     180.8,     180.8,       0.0);
     ( 452700.0, 4614000.0,     182.5,     182.5,       0.0);         ( 452800.0,
4614000.0,     181.5,     181.5,       0.0);
     ( 452900.0, 4614000.0,     181.0,     181.0,       0.0);         ( 453000.0,
4614000.0,     180.2,     180.2,       0.0);
     ( 453100.0, 4614000.0,     178.4,     178.4,       0.0);         ( 453200.0,
4614000.0,     179.1,     179.1,       0.0);
     ( 453300.0, 4614000.0,     178.9,     178.9,       0.0);         ( 453400.0,
4614000.0,     178.5,     178.5,       0.0);
     ( 453500.0, 4614000.0,     179.8,     179.8,       0.0);         ( 453600.0,
4614000.0,     179.4,     179.4,       0.0);
     ( 453700.0, 4614000.0,     179.2,     179.2,       0.0);         ( 453800.0,
4614000.0,     179.7,     179.7,       0.0);
     ( 453900.0, 4614000.0,     179.1,     179.1,       0.0);         ( 454000.0,
4614000.0,     175.3,     179.1,       0.0);
     ( 454100.0, 4614000.0,     175.3,     175.3,       0.0);         ( 454200.0,
4614000.0,     178.3,     178.3,       0.0);
     ( 454300.0, 4614000.0,     178.2,     178.2,       0.0);         ( 454400.0,
4614000.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4614000.0,     178.2,     178.2,       0.0);         ( 454600.0,
4614000.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4614000.0,     178.2,     178.2,       0.0);         ( 454800.0,
4614000.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4614000.0,     178.2,     178.2,       0.0);         ( 455000.0,
4614000.0,     178.2,     178.2,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455100.0, 4614000.0, 178.2, 178.2, 0.0); (455200.0, 4614000.0, 178.2, 178.2, 0.0);
(455300.0, 4614000.0, 178.2, 178.2, 0.0); (455400.0, 4614000.0, 178.2, 178.2, 0.0);
(455500.0, 4614000.0, 178.9, 178.9, 0.0); (455600.0, 4614000.0, 180.2, 180.2, 0.0);
(455700.0, 4614000.0, 181.2, 181.2, 0.0); (455800.0, 4614000.0, 181.5, 181.5, 0.0);
(455900.0, 4614000.0, 181.4, 181.4, 0.0); (456000.0, 4614000.0, 181.4, 181.4, 0.0);
(456100.0, 4614000.0, 181.3, 181.3, 0.0); (456200.0, 4614000.0, 180.7, 180.7, 0.0);
(456300.0, 4614000.0, 178.4, 178.4, 0.0); (456400.0, 4614000.0, 178.3, 178.3, 0.0);
(456500.0, 4614000.0, 182.4, 182.4, 0.0); (456600.0, 4614000.0, 178.7, 178.7, 0.0);
(452000.0, 4614100.0, 179.1, 179.1, 0.0); (452100.0, 4614100.0, 179.6, 198.8, 0.0);
(452200.0, 4614100.0, 197.1, 197.1, 0.0); (452300.0, 4614100.0, 195.2, 198.2, 0.0);
(452400.0, 4614100.0, 179.1, 198.9, 0.0); (452500.0, 4614100.0, 180.4, 180.4, 0.0);
(452600.0, 4614100.0, 181.7, 181.7, 0.0); (452700.0, 4614100.0, 180.9, 180.9, 0.0);
(452800.0, 4614100.0, 181.0, 181.0, 0.0); (452900.0, 4614100.0, 182.9, 182.9, 0.0);
(453000.0, 4614100.0, 180.4, 180.4, 0.0); (453100.0, 4614100.0, 178.3, 178.3, 0.0);
(453200.0, 4614100.0, 178.9, 178.9, 0.0); (453300.0, 4614100.0, 178.8, 178.8, 0.0);
(453400.0, 4614100.0, 178.5, 178.5, 0.0); (453500.0, 4614100.0, 179.7, 179.7, 0.0);
(453600.0, 4614100.0, 179.4, 179.4, 0.0); (453700.0, 4614100.0, 179.0, 179.0, 0.0);
(453800.0, 4614100.0, 179.7, 179.7, 0.0); (453900.0, 4614100.0, 179.1, 179.1, 0.0);
(454000.0, 4614100.0, 175.2, 175.2, 0.0); (454100.0, 4614100.0, 178.2, 178.2, 0.0);
(454200.0, 4614100.0, 178.2, 178.2, 0.0); (454300.0, 4614100.0, 178.2, 178.2, 0.0);
(454400.0, 4614100.0, 178.2, 178.2, 0.0); (454500.0, 4614100.0, 178.2, 178.2, 0.0);
(454600.0, 4614100.0, 178.2, 178.2, 0.0); (454700.0, 4614100.0, 178.2, 178.2, 0.0);
(454800.0, 4614100.0, 178.2, 178.2, 0.0); (454900.0, 4614100.0, 178.2, 178.2, 0.0);
(455000.0, 4614100.0, 178.2, 178.2, 0.0); (455100.0, 4614100.0, 178.2, 178.2, 0.0);
(455200.0, 4614100.0, 178.2, 178.2, 0.0); (455300.0, 4614100.0, 178.2, 178.2, 0.0);

```
     ( 455400.0, 4614100.0,     178.2,     178.2,       0.0);         ( 455500.0,
4614100.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4614100.0,     179.6,     179.6,       0.0);         ( 455700.0,
4614100.0,     180.6,     180.6,       0.0);
     ( 455800.0, 4614100.0,     181.1,     181.1,       0.0);         ( 455900.0,
4614100.0,     181.1,     181.1,       0.0);
     ( 456000.0, 4614100.0,     181.0,     181.0,       0.0);         ( 456100.0,
4614100.0,     181.0,     181.0,       0.0);
     ( 456200.0, 4614100.0,     180.2,     180.2,       0.0);         ( 456300.0,
4614100.0,     178.8,     178.8,       0.0);
     ( 456400.0, 4614100.0,     178.5,     178.5,       0.0);         ( 456500.0,
4614100.0,     184.0,     184.0,       0.0);
     ( 456600.0, 4614100.0,     179.0,     179.0,       0.0);         ( 452000.0,
4614200.0,     178.9,     178.9,       0.0);
     ( 452100.0, 4614200.0,     179.5,     198.1,       0.0);         ( 452200.0,
4614200.0,     197.1,     197.1,       0.0);
     ( 452300.0, 4614200.0,     190.9,     197.9,       0.0);         ( 452400.0,
4614200.0,     179.4,     198.5,       0.0);
     ( 452500.0, 4614200.0,     183.2,     183.2,       0.0);         ( 452600.0,
4614200.0,     181.2,     181.2,       0.0);
     ( 452700.0, 4614200.0,     180.8,     180.8,       0.0);         ( 452800.0,
4614200.0,     180.6,     180.6,       0.0);
     ( 452900.0, 4614200.0,     180.8,     180.8,       0.0);         ( 453000.0,
4614200.0,     180.1,     180.1,       0.0);
     ( 453100.0, 4614200.0,     178.3,     178.3,       0.0);         ( 453200.0,
4614200.0,     178.7,     178.7,       0.0);
     ( 453300.0, 4614200.0,     178.8,     178.8,       0.0);         ( 453400.0,
4614200.0,     178.4,     178.4,       0.0);
     ( 453500.0, 4614200.0,     179.6,     179.6,       0.0);         ( 453600.0,
4614200.0,     178.7,     178.7,       0.0);
     ( 453700.0, 4614200.0,     179.0,     179.0,       0.0);         ( 453800.0,
4614200.0,     179.7,     179.7,       0.0);
     ( 453900.0, 4614200.0,     179.1,     179.1,       0.0);         ( 454000.0,
4614200.0,     175.4,     178.0,       0.0);
     ( 454300.0, 4614200.0,     178.2,     178.2,       0.0);         ( 454400.0,
4614200.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4614200.0,     178.2,     178.2,       0.0);         ( 454600.0,
4614200.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4614200.0,     178.2,     178.2,       0.0);         ( 454800.0,
4614200.0,     178.2,     178.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454900.0, 4614200.0, 178.2, 178.2, 0.0); (455000.0, 4614200.0, 178.2, 178.2, 0.0);
(455100.0, 4614200.0, 178.2, 178.2, 0.0); (455200.0, 4614200.0, 178.2, 178.2, 0.0);
(455300.0, 4614200.0, 178.2, 178.2, 0.0); (455400.0, 4614200.0, 178.2, 178.2, 0.0);
(455500.0, 4614200.0, 178.2, 178.2, 0.0); (455600.0, 4614200.0, 178.6, 178.6, 0.0);
(455700.0, 4614200.0, 180.0, 180.0, 0.0); (455800.0, 4614200.0, 180.5, 180.5, 0.0);
(455900.0, 4614200.0, 180.7, 180.7, 0.0); (456000.0, 4614200.0, 180.8, 180.8, 0.0);
(456100.0, 4614200.0, 180.8, 180.8, 0.0); (456200.0, 4614200.0, 179.8, 179.8, 0.0);
(456300.0, 4614200.0, 179.2, 179.2, 0.0); (456400.0, 4614200.0, 178.4, 178.4, 0.0);
(456500.0, 4614200.0, 185.7, 185.7, 0.0); (456600.0, 4614200.0, 178.9, 178.9, 0.0);
(452000.0, 4614300.0, 178.8, 178.8, 0.0); (452100.0, 4614300.0, 179.5, 198.4, 0.0);
(452200.0, 4614300.0, 197.0, 197.0, 0.0); (452300.0, 4614300.0, 195.3, 198.0, 0.0);
(452400.0, 4614300.0, 179.9, 207.7, 0.0); (452500.0, 4614300.0, 180.6, 180.6, 0.0);
(452600.0, 4614300.0, 181.2, 181.2, 0.0); (452700.0, 4614300.0, 180.9, 180.9, 0.0);
(452800.0, 4614300.0, 180.7, 180.7, 0.0); (452900.0, 4614300.0, 180.3, 180.3, 0.0);
(453000.0, 4614300.0, 179.9, 179.9, 0.0); (453100.0, 4614300.0, 178.3, 178.3, 0.0);
(453200.0, 4614300.0, 178.6, 178.6, 0.0); (453300.0, 4614300.0, 178.7, 178.7, 0.0);
(453400.0, 4614300.0, 178.4, 178.4, 0.0); (453500.0, 4614300.0, 179.6, 179.6, 0.0);
(453600.0, 4614300.0, 178.6, 178.6, 0.0); (453700.0, 4614300.0, 179.4, 179.4, 0.0);
(453800.0, 4614300.0, 179.1, 179.1, 0.0); (453900.0, 4614300.0, 179.1, 179.1, 0.0);
(454000.0, 4614300.0, 175.6, 179.4, 0.0); (454400.0, 4614300.0, 178.2, 178.2, 0.0);
(454500.0, 4614300.0, 178.2, 178.2, 0.0); (454600.0, 4614300.0, 178.2, 178.2, 0.0);
(454700.0, 4614300.0, 178.2, 178.2, 0.0); (454800.0, 4614300.0, 178.2, 178.2, 0.0);
(454900.0, 4614300.0, 178.2, 178.2, 0.0); (455000.0, 4614300.0, 178.2, 178.2, 0.0);
(455100.0, 4614300.0, 178.2, 178.2, 0.0); (455200.0, 4614300.0, 178.2, 178.2, 0.0);
(455300.0, 4614300.0, 178.2, 178.2, 0.0); (455400.0, 4614300.0, 178.2, 178.2, 0.0);

```
     ( 455500.0, 4614300.0,     178.2,     178.2,       0.0);         ( 455600.0,
4614300.0,     178.2,     178.2,       0.0);
     ( 455700.0, 4614300.0,     179.2,     179.2,       0.0);         ( 455800.0,
4614300.0,     180.1,     180.1,       0.0);
     ( 455900.0, 4614300.0,     180.4,     180.4,       0.0);         ( 456000.0,
4614300.0,     180.5,     180.5,       0.0);
     ( 456100.0, 4614300.0,     180.8,     180.8,       0.0);         ( 456200.0,
4614300.0,     180.5,     180.5,       0.0);
     ( 456300.0, 4614300.0,     179.7,     179.7,       0.0);         ( 456400.0,
4614300.0,     178.8,     178.8,       0.0);
     ( 456500.0, 4614300.0,     186.7,     186.7,       0.0);         ( 456600.0,
4614300.0,     178.5,     178.5,       0.0);
     ( 452000.0, 4614400.0,     178.9,     178.9,       0.0);         ( 452100.0,
4614400.0,     179.6,     209.4,       0.0);
     ( 452200.0, 4614400.0,     189.9,     198.0,       0.0);         ( 452300.0,
4614400.0,     182.1,     209.9,       0.0);
     ( 452400.0, 4614400.0,     180.8,     209.9,       0.0);         ( 452500.0,
4614400.0,     181.5,     209.7,       0.0);
     ( 452600.0, 4614400.0,     182.6,     209.7,       0.0);         ( 452700.0,
4614400.0,     183.2,     207.9,       0.0);
     ( 452800.0, 4614400.0,     180.9,     180.9,       0.0);         ( 452900.0,
4614400.0,     180.4,     180.4,       0.0);
     ( 453000.0, 4614400.0,     179.9,     179.9,       0.0);         ( 453100.0,
4614400.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4614400.0,     178.6,     178.6,       0.0);         ( 453300.0,
4614400.0,     178.6,     178.6,       0.0);
     ( 453400.0, 4614400.0,     178.4,     178.4,       0.0);         ( 453500.0,
4614400.0,     179.5,     179.5,       0.0);
     ( 453600.0, 4614400.0,     178.4,     178.4,       0.0);         ( 453700.0,
4614400.0,     178.3,     178.3,       0.0);
     ( 453800.0, 4614400.0,     179.2,     179.2,       0.0);         ( 453900.0,
4614400.0,     179.1,     179.1,       0.0);
     ( 454000.0, 4614400.0,     175.7,     179.4,       0.0);         ( 454100.0,
4614400.0,     176.6,     176.6,       0.0);
     ( 454600.0, 4614400.0,     178.2,     178.2,       0.0);         ( 454700.0,
4614400.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4614400.0,     178.2,     178.2,       0.0);         ( 454900.0,
4614400.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4614400.0,     178.2,     178.2,       0.0);         ( 455100.0,
4614400.0,     178.2,     178.2,       0.0);
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*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455200.0, 4614400.0, 178.2, 178.2, 0.0); (455300.0, 4614400.0, 178.2, 178.2, 0.0);
(455400.0, 4614400.0, 178.2, 178.2, 0.0); (455500.0, 4614400.0, 178.2, 178.2, 0.0);
(455600.0, 4614400.0, 178.2, 178.2, 0.0); (455700.0, 4614400.0, 178.5, 178.5, 0.0);
(455800.0, 4614400.0, 179.8, 179.8, 0.0); (455900.0, 4614400.0, 180.0, 180.0, 0.0);
(456000.0, 4614400.0, 180.1, 180.1, 0.0); (456100.0, 4614400.0, 180.3, 180.3, 0.0);
(456200.0, 4614400.0, 180.1, 180.1, 0.0); (456300.0, 4614400.0, 180.1, 180.1, 0.0);
(456400.0, 4614400.0, 179.2, 179.2, 0.0); (456500.0, 4614400.0, 184.0, 187.3, 0.0);
(456600.0, 4614400.0, 178.1, 187.3, 0.0); (452000.0, 4614500.0, 178.9, 209.3, 0.0);
(452100.0, 4614500.0, 179.6, 209.7, 0.0); (452200.0, 4614500.0, 181.9, 209.9, 0.0);
(452300.0, 4614500.0, 184.6, 209.9, 0.0); (452400.0, 4614500.0, 186.0, 209.9, 0.0);
(452500.0, 4614500.0, 186.2, 209.9, 0.0); (452600.0, 4614500.0, 187.9, 209.7, 0.0);
(452700.0, 4614500.0, 183.1, 209.7, 0.0); (452800.0, 4614500.0, 181.1, 207.9, 0.0);
(452900.0, 4614500.0, 180.8, 180.8, 0.0); (453000.0, 4614500.0, 180.0, 180.0, 0.0);
(453100.0, 4614500.0, 177.1, 177.1, 0.0); (453200.0, 4614500.0, 178.5, 178.5, 0.0);
(453300.0, 4614500.0, 178.6, 178.6, 0.0); (453400.0, 4614500.0, 178.4, 178.4, 0.0);
(453500.0, 4614500.0, 178.3, 178.3, 0.0); (453600.0, 4614500.0, 178.5, 178.5, 0.0);
(453700.0, 4614500.0, 178.3, 178.3, 0.0); (453800.0, 4614500.0, 178.7, 178.7, 0.0);
(453900.0, 4614500.0, 179.0, 179.0, 0.0); (454000.0, 4614500.0, 175.9, 179.4, 0.0);
(454100.0, 4614500.0, 175.7, 178.2, 0.0); (454600.0, 4614500.0, 178.2, 178.2, 0.0);
(454700.0, 4614500.0, 178.2, 178.2, 0.0); (454800.0, 4614500.0, 178.2, 178.2, 0.0);
(454900.0, 4614500.0, 178.2, 178.2, 0.0); (455000.0, 4614500.0, 178.2, 178.2, 0.0);
(455100.0, 4614500.0, 178.2, 178.2, 0.0); (455200.0, 4614500.0, 178.2, 178.2, 0.0);
(455300.0, 4614500.0, 178.2, 178.2, 0.0); (455400.0, 4614500.0, 178.2, 178.2, 0.0);
(455500.0, 4614500.0, 178.2, 178.2, 0.0); (455600.0, 4614500.0, 178.2, 178.2, 0.0);
(455700.0, 4614500.0, 178.2, 178.2, 0.0); (455800.0, 4614500.0, 178.3, 178.3, 0.0);

```
     ( 455900.0, 4614500.0,     179.0,     179.0,       0.0);         ( 456000.0,
4614500.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4614500.0,     177.8,     177.8,       0.0);         ( 456200.0,
4614500.0,     178.0,     178.0,       0.0);
     ( 456300.0, 4614500.0,     177.9,     177.9,       0.0);         ( 456400.0,
4614500.0,     179.7,     179.7,       0.0);
     ( 456500.0, 4614500.0,     178.6,     186.5,       0.0);         ( 456600.0,
4614500.0,     178.4,     178.4,       0.0);
     ( 452000.0, 4614600.0,     178.9,     209.6,       0.0);         ( 452100.0,
4614600.0,     180.3,     209.9,       0.0);
     ( 452200.0, 4614600.0,     203.8,     208.9,       0.0);         ( 452300.0,
4614600.0,     208.7,     208.7,       0.0);
     ( 452400.0, 4614600.0,     209.1,     209.1,       0.0);         ( 452500.0,
4614600.0,     209.2,     209.2,       0.0);
     ( 452600.0, 4614600.0,     196.4,     209.7,       0.0);         ( 452700.0,
4614600.0,     183.5,     209.7,       0.0);
     ( 452800.0, 4614600.0,     182.2,     207.9,       0.0);         ( 452900.0,
4614600.0,     181.4,     181.4,       0.0);
     ( 453000.0, 4614600.0,     180.2,     180.2,       0.0);         ( 453100.0,
4614600.0,     177.2,     177.2,       0.0);
     ( 453200.0, 4614600.0,     177.0,     177.0,       0.0);         ( 453300.0,
4614600.0,     178.5,     178.5,       0.0);
     ( 453400.0, 4614600.0,     178.4,     178.4,       0.0);         ( 453500.0,
4614600.0,     178.3,     178.3,       0.0);
     ( 453600.0, 4614600.0,     178.3,     178.3,       0.0);         ( 453700.0,
4614600.0,     178.4,     178.4,       0.0);
     ( 453800.0, 4614600.0,     178.6,     178.6,       0.0);         ( 453900.0,
4614600.0,     178.9,     178.9,       0.0);
     ( 454000.0, 4614600.0,     176.0,     179.4,       0.0);         ( 454100.0,
4614600.0,     175.6,     178.2,       0.0);
     ( 454600.0, 4614600.0,     178.2,     178.2,       0.0);         ( 454700.0,
4614600.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4614600.0,     178.2,     178.2,       0.0);         ( 454900.0,
4614600.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4614600.0,     178.2,     178.2,       0.0);         ( 455100.0,
4614600.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4614600.0,     178.2,     178.2,       0.0);         ( 455300.0,
4614600.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4614600.0,     178.2,     178.2,       0.0);         ( 455500.0,
4614600.0,     178.2,     178.2,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455600.0, 4614600.0, 178.2, 178.2, 0.0); (455700.0, 4614600.0, 178.2, 178.2, 0.0);
(455800.0, 4614600.0, 178.2, 178.2, 0.0); (455900.0, 4614600.0, 178.7, 178.7, 0.0);
(456000.0, 4614600.0, 178.2, 178.2, 0.0); (456100.0, 4614600.0, 177.6, 177.6, 0.0);
(456200.0, 4614600.0, 177.8, 177.8, 0.0); (456300.0, 4614600.0, 178.0, 178.0, 0.0);
(456400.0, 4614600.0, 180.3, 180.3, 0.0); (456500.0, 4614600.0, 182.2, 184.3, 0.0);
(456600.0, 4614600.0, 178.2, 178.2, 0.0); (452000.0, 4614700.0, 178.6, 209.6, 0.0);
(452100.0, 4614700.0, 182.1, 209.9, 0.0); (452200.0, 4614700.0, 205.0, 205.3, 0.0);
(452300.0, 4614700.0, 209.0, 209.0, 0.0); (452400.0, 4614700.0, 209.7, 209.7, 0.0);
(452500.0, 4614700.0, 206.4, 206.7, 0.0); (452600.0, 4614700.0, 189.8, 209.7, 0.0);
(452700.0, 4614700.0, 181.7, 209.7, 0.0); (452800.0, 4614700.0, 181.8, 181.8, 0.0);
(452900.0, 4614700.0, 179.7, 179.7, 0.0); (453000.0, 4614700.0, 179.5, 179.5, 0.0);
(453100.0, 4614700.0, 177.2, 177.2, 0.0); (453200.0, 4614700.0, 178.4, 178.4, 0.0);
(453300.0, 4614700.0, 178.4, 178.4, 0.0); (453400.0, 4614700.0, 178.3, 178.3, 0.0);
(453500.0, 4614700.0, 178.3, 178.3, 0.0); (453600.0, 4614700.0, 178.3, 178.3, 0.0);
(453700.0, 4614700.0, 178.5, 178.5, 0.0); (453800.0, 4614700.0, 178.5, 178.5, 0.0);
(453900.0, 4614700.0, 178.7, 178.7, 0.0); (454000.0, 4614700.0, 175.7, 175.7, 0.0);
(454100.0, 4614700.0, 178.5, 178.5, 0.0); (454600.0, 4614700.0, 178.2, 178.2, 0.0);
(454700.0, 4614700.0, 178.2, 178.2, 0.0); (454800.0, 4614700.0, 178.2, 178.2, 0.0);
(454900.0, 4614700.0, 178.2, 178.2, 0.0); (455000.0, 4614700.0, 178.2, 178.2, 0.0);
(455100.0, 4614700.0, 178.2, 178.2, 0.0); (455200.0, 4614700.0, 178.2, 178.2, 0.0);
(455300.0, 4614700.0, 178.2, 178.2, 0.0); (455400.0, 4614700.0, 178.2, 178.2, 0.0);
(455500.0, 4614700.0, 178.2, 178.2, 0.0); (455600.0, 4614700.0, 178.2, 178.2, 0.0);
(455700.0, 4614700.0, 178.2, 178.2, 0.0); (455800.0, 4614700.0, 178.2, 178.2, 0.0);
(455900.0, 4614700.0, 178.3, 178.3, 0.0); (456000.0, 4614700.0, 178.2, 178.2, 0.0);
(456100.0, 4614700.0, 177.5, 177.5, 0.0); (456200.0, 4614700.0, 177.7, 177.7, 0.0);

```
     ( 456300.0, 4614700.0,     177.8,     177.8,       0.0);         ( 456400.0,
4614700.0,     180.2,     180.2,       0.0);
     ( 456500.0, 4614700.0,     182.0,     186.8,       0.0);         ( 456600.0,
4614700.0,     178.4,     186.8,       0.0);
     ( 452000.0, 4614800.0,     178.3,     209.0,       0.0);         ( 452100.0,
4614800.0,     180.9,     209.9,       0.0);
     ( 452200.0, 4614800.0,     183.2,     209.9,       0.0);         ( 452300.0,
4614800.0,     200.6,     209.8,       0.0);
     ( 452400.0, 4614800.0,     201.0,     209.9,       0.0);         ( 452500.0,
4614800.0,     200.5,     206.7,       0.0);
     ( 452600.0, 4614800.0,     187.8,     209.8,       0.0);         ( 452700.0,
4614800.0,     179.3,     209.8,       0.0);
     ( 452800.0, 4614800.0,     183.4,     183.4,       0.0);         ( 452900.0,
4614800.0,     180.0,     180.0,       0.0);
     ( 453000.0, 4614800.0,     178.3,     178.3,       0.0);         ( 453100.0,
4614800.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4614800.0,     178.3,     178.3,       0.0);         ( 453300.0,
4614800.0,     178.3,     178.3,       0.0);
     ( 453400.0, 4614800.0,     178.3,     178.3,       0.0);         ( 453500.0,
4614800.0,     178.3,     178.3,       0.0);
     ( 453600.0, 4614800.0,     178.3,     178.3,       0.0);         ( 453700.0,
4614800.0,     178.5,     178.5,       0.0);
     ( 453800.0, 4614800.0,     178.5,     178.5,       0.0);         ( 453900.0,
4614800.0,     178.7,     178.7,       0.0);
     ( 454000.0, 4614800.0,     175.4,     175.4,       0.0);         ( 454600.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4614800.0,     178.2,     178.2,       0.0);         ( 454800.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455000.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455200.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455400.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455500.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455600.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455700.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455800.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4614800.0,     178.2,     178.2,       0.0);         ( 456000.0,
4614800.0,     178.2,     178.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(456100.0, 4614800.0, 177.6, 177.6, 0.0); (456200.0, 4614800.0, 177.4, 177.4, 0.0);
(456300.0, 4614800.0, 177.7, 177.7, 0.0); (456400.0, 4614800.0, 180.1, 180.1, 0.0);
(456500.0, 4614800.0, 180.3, 186.1, 0.0); (456600.0, 4614800.0, 178.8, 186.0, 0.0);
(452000.0, 4614900.0, 178.3, 178.3, 0.0); (452100.0, 4614900.0, 178.3, 209.8, 0.0);
(452200.0, 4614900.0, 178.3, 209.9, 0.0); (452300.0, 4614900.0, 178.3, 209.9, 0.0);
(452400.0, 4614900.0, 178.4, 209.9, 0.0); (452500.0, 4614900.0, 178.4, 209.9, 0.0);
(452600.0, 4614900.0, 178.5, 209.9, 0.0); (452700.0, 4614900.0, 178.3, 206.7, 0.0);
(452800.0, 4614900.0, 178.3, 178.3, 0.0); (452900.0, 4614900.0, 178.3, 178.3, 0.0);
(453000.0, 4614900.0, 178.3, 178.3, 0.0); (453100.0, 4614900.0, 178.3, 178.3, 0.0);
(453200.0, 4614900.0, 178.3, 178.3, 0.0); (453300.0, 4614900.0, 178.3, 178.3, 0.0);
(453400.0, 4614900.0, 178.3, 178.3, 0.0); (453500.0, 4614900.0, 178.3, 178.3, 0.0);
(453600.0, 4614900.0, 178.3, 178.3, 0.0); (453700.0, 4614900.0, 178.5, 178.5, 0.0);
(453800.0, 4614900.0, 178.5, 178.5, 0.0); (453900.0, 4614900.0, 178.3, 178.3, 0.0);
(454000.0, 4614900.0, 175.2, 175.2, 0.0); (454600.0, 4614900.0, 178.2, 178.2, 0.0);
(454700.0, 4614900.0, 178.2, 178.2, 0.0); (454800.0, 4614900.0, 178.2, 178.2, 0.0);
(454900.0, 4614900.0, 178.2, 178.2, 0.0); (455000.0, 4614900.0, 178.2, 178.2, 0.0);
(455100.0, 4614900.0, 178.2, 178.2, 0.0); (455200.0, 4614900.0, 178.2, 178.2, 0.0);
(455300.0, 4614900.0, 178.2, 178.2, 0.0); (455400.0, 4614900.0, 178.2, 178.2, 0.0);
(455500.0, 4614900.0, 178.2, 178.2, 0.0); (455600.0, 4614900.0, 178.2, 178.2, 0.0);
(455700.0, 4614900.0, 178.2, 178.2, 0.0); (455800.0, 4614900.0, 178.2, 178.2, 0.0);
(455900.0, 4614900.0, 178.2, 178.2, 0.0); (456000.0, 4614900.0, 178.2, 178.2, 0.0);
(456100.0, 4614900.0, 178.7, 178.7, 0.0); (456200.0, 4614900.0, 177.4, 177.4, 0.0);
(456300.0, 4614900.0, 177.7, 177.7, 0.0); (456400.0, 4614900.0, 179.6, 179.6, 0.0);
(456500.0, 4614900.0, 179.7, 184.8, 0.0); (456600.0, 4614900.0, 179.0, 184.2, 0.0);
(452000.0, 4615000.0, 178.3, 178.3, 0.0); (452100.0, 4615000.0, 178.3, 178.3, 0.0);

```
     ( 452200.0, 4615000.0,     178.3,     209.8,       0.0);         ( 452300.0,
4615000.0,     178.3,     209.9,       0.0);
     ( 452400.0, 4615000.0,     178.3,     209.9,       0.0);         ( 452500.0,
4615000.0,     178.3,     209.9,       0.0);
     ( 452600.0, 4615000.0,     178.3,     209.8,       0.0);         ( 452700.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 452800.0, 4615000.0,     178.3,     178.3,       0.0);         ( 452900.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4615000.0,     178.3,     178.3,       0.0);         ( 453100.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4615000.0,     178.3,     178.3,       0.0);         ( 453300.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 453400.0, 4615000.0,     178.3,     178.3,       0.0);         ( 453500.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 453600.0, 4615000.0,     178.3,     178.3,       0.0);         ( 453700.0,
4615000.0,     178.4,     178.4,       0.0);
     ( 453800.0, 4615000.0,     178.4,     178.4,       0.0);         ( 453900.0,
4615000.0,     178.4,     178.4,       0.0);
     ( 454000.0, 4615000.0,     175.2,     175.2,       0.0);         ( 454600.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4615000.0,     178.2,     178.2,       0.0);         ( 454800.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 454900.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455000.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455200.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455400.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455500.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455600.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455700.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455800.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4615000.0,     178.2,     178.2,       0.0);         ( 456000.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4615000.0,     178.1,     178.1,       0.0);         ( 456200.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 456300.0, 4615000.0,     177.6,     177.6,       0.0);         ( 456400.0,
4615000.0,     179.5,     179.5,       0.0);
     ( 456500.0, 4615000.0,     179.3,     182.7,       0.0);         ( 456600.0,
4615000.0,     179.4,     182.4,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452000.0, 4615100.0, 178.3, 178.3, 0.0); (452100.0, 4615100.0, 178.0, 178.0, 0.0);
(452200.0, 4615100.0, 177.6, 177.6, 0.0); (452300.0, 4615100.0, 178.3, 178.3, 0.0);
(452400.0, 4615100.0, 178.3, 178.3, 0.0); (452500.0, 4615100.0, 178.3, 178.3, 0.0);
(452600.0, 4615100.0, 178.3, 178.3, 0.0); (452700.0, 4615100.0, 178.3, 178.3, 0.0);
(452800.0, 4615100.0, 178.3, 178.3, 0.0); (452900.0, 4615100.0, 178.3, 178.3, 0.0);
(453000.0, 4615100.0, 178.3, 178.3, 0.0); (453100.0, 4615100.0, 178.3, 178.3, 0.0);
(453200.0, 4615100.0, 178.4, 178.4, 0.0); (453300.0, 4615100.0, 178.3, 178.3, 0.0);
(453400.0, 4615100.0, 178.3, 178.3, 0.0); (453500.0, 4615100.0, 178.3, 178.3, 0.0);
(453600.0, 4615100.0, 178.3, 178.3, 0.0); (453700.0, 4615100.0, 178.3, 178.3, 0.0);
(453800.0, 4615100.0, 178.3, 178.3, 0.0); (453900.0, 4615100.0, 175.2, 175.2, 0.0);
(454000.0, 4615100.0, 178.2, 178.2, 0.0); (454100.0, 4615100.0, 178.2, 178.2, 0.0);
(454600.0, 4615100.0, 178.2, 178.2, 0.0); (454700.0, 4615100.0, 178.2, 178.2, 0.0);
(454800.0, 4615100.0, 178.2, 178.2, 0.0); (454900.0, 4615100.0, 178.2, 178.2, 0.0);
(455000.0, 4615100.0, 178.2, 178.2, 0.0); (455100.0, 4615100.0, 178.2, 178.2, 0.0);
(455200.0, 4615100.0, 178.2, 178.2, 0.0); (455300.0, 4615100.0, 178.2, 178.2, 0.0);
(455400.0, 4615100.0, 178.2, 178.2, 0.0); (455500.0, 4615100.0, 178.2, 178.2, 0.0);
(455600.0, 4615100.0, 178.2, 178.2, 0.0); (455700.0, 4615100.0, 178.2, 178.2, 0.0);
(455800.0, 4615100.0, 178.2, 178.2, 0.0); (455900.0, 4615100.0, 178.2, 178.2, 0.0);
(456000.0, 4615100.0, 178.2, 178.2, 0.0); (456100.0, 4615100.0, 177.8, 177.8, 0.0);
(456200.0, 4615100.0, 177.9, 177.9, 0.0); (456300.0, 4615100.0, 177.9, 177.9, 0.0);
(456400.0, 4615100.0, 179.7, 179.7, 0.0); (456500.0, 4615100.0, 180.0, 180.0, 0.0);
(456600.0, 4615100.0, 180.0, 180.0, 0.0); (452000.0, 4615200.0, 178.3, 178.3, 0.0);
(452100.0, 4615200.0, 177.6, 177.6, 0.0); (452200.0, 4615200.0, 178.3, 178.3, 0.0);
(452300.0, 4615200.0, 178.3, 178.3, 0.0); (452400.0, 4615200.0, 178.3, 178.3, 0.0);
(452500.0, 4615200.0, 178.3, 178.3, 0.0); (452600.0, 4615200.0, 178.3, 178.3, 0.0);

```
     ( 452700.0, 4615200.0,     178.3,     178.3,       0.0);         ( 452800.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 452900.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453000.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 453100.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453200.0,
4615200.0,     178.5,     178.5,       0.0);
     ( 453300.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453400.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 453500.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453600.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 453700.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453800.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 453900.0, 4615200.0,     178.3,     178.3,       0.0);         ( 454000.0,
4615200.0,     175.5,     175.5,       0.0);
     ( 454100.0, 4615200.0,     178.1,     178.1,       0.0);         ( 454200.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4615200.0,     178.2,     178.2,       0.0);         ( 454700.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4615200.0,     178.2,     178.2,       0.0);         ( 454900.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455100.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455300.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455500.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455700.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455800.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455900.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 456000.0, 4615200.0,     178.2,     178.2,       0.0);         ( 456100.0,
4615200.0,     178.1,     178.1,       0.0);
     ( 456200.0, 4615200.0,     178.2,     178.2,       0.0);         ( 456300.0,
4615200.0,     177.9,     177.9,       0.0);
     ( 456400.0, 4615200.0,     179.3,     179.3,       0.0);         ( 456500.0,
4615200.0,     181.3,     181.3,       0.0);
     ( 456600.0, 4615200.0,     181.4,     181.4,       0.0);         ( 452000.0,
4615300.0,     178.3,     178.3,       0.0);
     ( 452100.0, 4615300.0,     177.3,     177.3,       0.0);         ( 452200.0,
4615300.0,     178.3,     178.3,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452300.0, 4615300.0, 177.7, 177.7, 0.0); (452400.0, 4615300.0, 177.7, 177.7, 0.0);
(452500.0, 4615300.0, 177.7, 177.7, 0.0); (452600.0, 4615300.0, 177.8, 177.8, 0.0);
(452700.0, 4615300.0, 178.3, 178.3, 0.0); (452800.0, 4615300.0, 178.3, 178.3, 0.0);
(452900.0, 4615300.0, 178.3, 178.3, 0.0); (453000.0, 4615300.0, 178.3, 178.3, 0.0);
(453100.0, 4615300.0, 178.4, 178.4, 0.0); (453200.0, 4615300.0, 178.6, 178.6, 0.0);
(453300.0, 4615300.0, 178.5, 178.5, 0.0); (453400.0, 4615300.0, 178.3, 178.3, 0.0);
(453500.0, 4615300.0, 178.3, 178.3, 0.0); (453600.0, 4615300.0, 178.3, 178.3, 0.0);
(453700.0, 4615300.0, 178.3, 178.3, 0.0); (453800.0, 4615300.0, 178.3, 178.3, 0.0);
(453900.0, 4615300.0, 178.4, 178.4, 0.0); (454000.0, 4615300.0, 175.5, 175.5, 0.0);
(454100.0, 4615300.0, 178.4, 178.4, 0.0); (454200.0, 4615300.0, 178.2, 178.2, 0.0);
(454300.0, 4615300.0, 178.2, 178.2, 0.0); (454400.0, 4615300.0, 178.2, 178.2, 0.0);
(454500.0, 4615300.0, 178.2, 178.2, 0.0); (454600.0, 4615300.0, 178.2, 178.2, 0.0);
(454700.0, 4615300.0, 178.2, 178.2, 0.0); (454800.0, 4615300.0, 178.2, 178.2, 0.0);
(454900.0, 4615300.0, 178.2, 178.2, 0.0); (455000.0, 4615300.0, 178.2, 178.2, 0.0);
(455100.0, 4615300.0, 178.2, 178.2, 0.0); (455200.0, 4615300.0, 178.2, 178.2, 0.0);
(455300.0, 4615300.0, 178.2, 178.2, 0.0); (455400.0, 4615300.0, 178.2, 178.2, 0.0);
(455500.0, 4615300.0, 178.2, 178.2, 0.0); (455600.0, 4615300.0, 178.2, 178.2, 0.0);
(455700.0, 4615300.0, 178.2, 178.2, 0.0); (455800.0, 4615300.0, 178.2, 178.2, 0.0);
(455900.0, 4615300.0, 178.2, 178.2, 0.0); (456000.0, 4615300.0, 178.2, 178.2, 0.0);
(456100.0, 4615300.0, 178.3, 178.3, 0.0); (456200.0, 4615300.0, 178.2, 178.2, 0.0);
(456300.0, 4615300.0, 177.9, 177.9, 0.0); (456400.0, 4615300.0, 179.6, 179.6, 0.0);
(456500.0, 4615300.0, 182.3, 182.3, 0.0); (456600.0, 4615300.0, 181.8, 181.8, 0.0);
(452000.0, 4615400.0, 178.3, 178.3, 0.0); (452100.0, 4615400.0, 178.2, 178.2, 0.0);
(452200.0, 4615400.0, 178.0, 178.0, 0.0); (452300.0, 4615400.0, 177.0, 177.0, 0.0);
(452400.0, 4615400.0, 177.0, 177.0, 0.0); (452500.0, 4615400.0, 177.0, 177.0, 0.0);

```
     ( 452600.0, 4615400.0,     177.0,     177.0,       0.0);         ( 452700.0,
4615400.0,     177.1,     177.1,       0.0);
     ( 452800.0, 4615400.0,     177.0,     177.0,       0.0);         ( 452900.0,
4615400.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4615400.0,     178.3,     178.3,       0.0);         ( 453100.0,
4615400.0,     178.4,     178.4,       0.0);
     ( 453200.0, 4615400.0,     178.5,     178.5,       0.0);         ( 453300.0,
4615400.0,     178.6,     178.6,       0.0);
     ( 453400.0, 4615400.0,     178.3,     178.3,       0.0);         ( 453500.0,
4615400.0,     178.3,     178.3,       0.0);
     ( 453600.0, 4615400.0,     178.3,     178.3,       0.0);         ( 453700.0,
4615400.0,     178.3,     178.3,       0.0);
     ( 453800.0, 4615400.0,     178.4,     178.4,       0.0);         ( 453900.0,
4615400.0,     178.4,     178.4,       0.0);
     ( 454000.0, 4615400.0,     175.4,     175.4,       0.0);         ( 454100.0,
4615400.0,     178.6,     178.6,       0.0);
     ( 454200.0, 4615400.0,     178.2,     178.2,       0.0);         ( 454300.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4615400.0,     178.2,     178.2,       0.0);         ( 454500.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4615400.0,     178.2,     178.2,       0.0);         ( 454700.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4615400.0,     178.2,     178.2,       0.0);         ( 454900.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455100.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455300.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455500.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455700.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455800.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455900.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 456000.0, 4615400.0,     178.2,     178.2,       0.0);         ( 456100.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 456200.0, 4615400.0,     178.2,     178.2,       0.0);         ( 456300.0,
4615400.0,     177.8,     177.8,       0.0);
     ( 456400.0, 4615400.0,     179.6,     179.6,       0.0);         ( 456500.0,
4615400.0,     181.1,     181.1,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(456600.0, 4615400.0, 182.3, 182.3, 0.0); (452000.0, 4615500.0, 178.3, 178.3, 0.0);
(452100.0, 4615500.0, 178.3, 178.3, 0.0); (452200.0, 4615500.0, 178.3, 178.3, 0.0);
(452300.0, 4615500.0, 177.0, 177.0, 0.0); (452400.0, 4615500.0, 177.0, 177.0, 0.0);
(452500.0, 4615500.0, 177.0, 177.0, 0.0); (452600.0, 4615500.0, 178.3, 178.3, 0.0);
(452700.0, 4615500.0, 177.0, 177.0, 0.0); (452800.0, 4615500.0, 177.0, 177.0, 0.0);
(452900.0, 4615500.0, 178.3, 178.3, 0.0); (453000.0, 4615500.0, 178.3, 178.3, 0.0);
(453100.0, 4615500.0, 178.4, 178.4, 0.0); (453200.0, 4615500.0, 178.6, 178.6, 0.0);
(453300.0, 4615500.0, 178.7, 178.7, 0.0); (453400.0, 4615500.0, 178.4, 178.4, 0.0);
(453500.0, 4615500.0, 178.3, 178.3, 0.0); (453600.0, 4615500.0, 178.6, 178.6, 0.0);
(453700.0, 4615500.0, 178.4, 178.4, 0.0); (453800.0, 4615500.0, 178.6, 178.6, 0.0);
(453900.0, 4615500.0, 178.3, 178.3, 0.0); (454000.0, 4615500.0, 175.6, 178.3, 0.0);
(454100.0, 4615500.0, 176.8, 176.8, 0.0); (454200.0, 4615500.0, 178.2, 178.2, 0.0);
(454300.0, 4615500.0, 178.2, 178.2, 0.0); (454400.0, 4615500.0, 178.2, 178.2, 0.0);
(454500.0, 4615500.0, 178.2, 178.2, 0.0); (454600.0, 4615500.0, 178.2, 178.2, 0.0);
(454700.0, 4615500.0, 178.2, 178.2, 0.0); (454800.0, 4615500.0, 178.2, 178.2, 0.0);
(454900.0, 4615500.0, 178.2, 178.2, 0.0); (455000.0, 4615500.0, 178.2, 178.2, 0.0);
(455100.0, 4615500.0, 178.2, 178.2, 0.0); (455200.0, 4615500.0, 178.2, 178.2, 0.0);
(455300.0, 4615500.0, 178.2, 178.2, 0.0); (455400.0, 4615500.0, 178.2, 178.2, 0.0);
(455500.0, 4615500.0, 178.2, 178.2, 0.0); (455600.0, 4615500.0, 178.2, 178.2, 0.0);
(455700.0, 4615500.0, 178.2, 178.2, 0.0); (455800.0, 4615500.0, 178.2, 178.2, 0.0);
(455900.0, 4615500.0, 178.2, 178.2, 0.0); (456000.0, 4615500.0, 178.2, 178.2, 0.0);
(456100.0, 4615500.0, 177.9, 177.9, 0.0); (456200.0, 4615500.0, 178.2, 178.2, 0.0);
(456300.0, 4615500.0, 177.5, 177.5, 0.0); (456400.0, 4615500.0, 178.8, 178.8, 0.0);
(456500.0, 4615500.0, 179.9, 183.2, 0.0); (456600.0, 4615500.0, 179.8, 183.3, 0.0);
(452000.0, 4615600.0, 178.3, 178.3, 0.0); (452100.0, 4615600.0, 178.3, 178.3, 0.0);

```
     ( 452200.0, 4615600.0,     178.3,     178.3,       0.0);         ( 452300.0,
4615600.0,     177.0,     177.0,       0.0);
     ( 452400.0, 4615600.0,     177.8,     177.8,       0.0);         ( 452500.0,
4615600.0,     177.0,     177.0,       0.0);
     ( 452600.0, 4615600.0,     177.0,     177.0,       0.0);         ( 452700.0,
4615600.0,     178.0,     178.0,       0.0);
     ( 452800.0, 4615600.0,     177.9,     177.9,       0.0);         ( 452900.0,
4615600.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4615600.0,     178.3,     178.3,       0.0);         ( 453100.0,
4615600.0,     178.5,     178.5,       0.0);
     ( 453200.0, 4615600.0,     178.7,     178.7,       0.0);         ( 453300.0,
4615600.0,     178.8,     178.8,       0.0);
     ( 453400.0, 4615600.0,     178.9,     178.9,       0.0);         ( 453500.0,
4615600.0,     178.7,     178.7,       0.0);
     ( 453600.0, 4615600.0,     178.8,     178.8,       0.0);         ( 453700.0,
4615600.0,     178.8,     178.8,       0.0);
     ( 453800.0, 4615600.0,     178.7,     178.7,       0.0);         ( 453900.0,
4615600.0,     178.5,     178.5,       0.0);
     ( 454000.0, 4615600.0,     176.6,     176.6,       0.0);         ( 454100.0,
4615600.0,     177.2,     177.2,       0.0);
     ( 454200.0, 4615600.0,     178.2,     178.2,       0.0);         ( 454300.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4615600.0,     178.2,     178.2,       0.0);         ( 454500.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4615600.0,     178.2,     178.2,       0.0);         ( 454700.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4615600.0,     178.2,     178.2,       0.0);         ( 454900.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455100.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455300.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455500.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455700.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455800.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455900.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 456000.0, 4615600.0,     178.2,     178.2,       0.0);         ( 456100.0,
4615600.0,     177.5,     177.5,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(456200.0, 4615600.0, 178.0, 178.0, 0.0); (456300.0, 4615600.0, 178.4, 178.4, 0.0);
(456400.0, 4615600.0, 178.8, 178.8, 0.0); (456500.0, 4615600.0, 179.0, 183.5, 0.0);
(456600.0, 4615600.0, 178.9, 183.7, 0.0); (452000.0, 4615700.0, 178.3, 178.3, 0.0);
(452100.0, 4615700.0, 178.3, 178.3, 0.0); (452200.0, 4615700.0, 178.3, 178.3, 0.0);
(452300.0, 4615700.0, 177.6, 177.6, 0.0); (452400.0, 4615700.0, 177.7, 177.7, 0.0);
(452500.0, 4615700.0, 177.0, 177.0, 0.0); (452600.0, 4615700.0, 177.0, 177.0, 0.0);
(452700.0, 4615700.0, 177.0, 177.0, 0.0); (452800.0, 4615700.0, 177.2, 177.2, 0.0);
(452900.0, 4615700.0, 177.0, 177.0, 0.0); (453000.0, 4615700.0, 178.3, 178.3, 0.0);
(453100.0, 4615700.0, 178.5, 178.5, 0.0); (453200.0, 4615700.0, 178.8, 178.8, 0.0);
(453300.0, 4615700.0, 179.0, 179.0, 0.0); (453400.0, 4615700.0, 179.2, 179.2, 0.0);
(453500.0, 4615700.0, 179.2, 179.2, 0.0); (453600.0, 4615700.0, 179.1, 179.1, 0.0);
(453700.0, 4615700.0, 179.1, 179.1, 0.0); (453800.0, 4615700.0, 178.8, 178.8, 0.0);
(453900.0, 4615700.0, 178.4, 178.4, 0.0); (454000.0, 4615700.0, 177.6, 177.6, 0.0);
(454100.0, 4615700.0, 175.2, 178.4, 0.0); (454200.0, 4615700.0, 178.2, 178.2, 0.0);
(454300.0, 4615700.0, 178.2, 178.2, 0.0); (454400.0, 4615700.0, 178.2, 178.2, 0.0);
(454500.0, 4615700.0, 178.2, 178.2, 0.0); (454600.0, 4615700.0, 178.2, 178.2, 0.0);
(454700.0, 4615700.0, 178.2, 178.2, 0.0); (454800.0, 4615700.0, 178.2, 178.2, 0.0);
(454900.0, 4615700.0, 178.2, 178.2, 0.0); (455000.0, 4615700.0, 178.2, 178.2, 0.0);
(455100.0, 4615700.0, 178.2, 178.2, 0.0); (455200.0, 4615700.0, 178.2, 178.2, 0.0);
(455300.0, 4615700.0, 178.2, 178.2, 0.0); (455400.0, 4615700.0, 178.2, 178.2, 0.0);
(455500.0, 4615700.0, 178.2, 178.2, 0.0); (455600.0, 4615700.0, 178.2, 178.2, 0.0);
(455700.0, 4615700.0, 178.2, 178.2, 0.0); (455800.0, 4615700.0, 178.2, 178.2, 0.0);
(455900.0, 4615700.0, 178.2, 178.2, 0.0); (456000.0, 4615700.0, 178.2, 178.2, 0.0);
(456100.0, 4615700.0, 178.5, 178.5, 0.0); (456200.0, 4615700.0, 178.6, 178.6, 0.0);
(456300.0, 4615700.0, 178.6, 178.6, 0.0); (456400.0, 4615700.0, 178.5, 178.5, 0.0);

```
     ( 456500.0, 4615700.0,     178.3,     183.6,       0.0);         ( 456600.0,
4615700.0,     178.8,     183.7,       0.0);
     ( 452000.0, 4615800.0,     178.3,     178.3,       0.0);         ( 452100.0,
4615800.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4615800.0,     178.3,     178.3,       0.0);         ( 452300.0,
4615800.0,     177.0,     177.0,       0.0);
     ( 452400.0, 4615800.0,     178.3,     178.3,       0.0);         ( 452500.0,
4615800.0,     178.3,     178.3,       0.0);
     ( 452600.0, 4615800.0,     178.3,     178.3,       0.0);         ( 452700.0,
4615800.0,     177.0,     177.0,       0.0);
     ( 452800.0, 4615800.0,     177.7,     177.7,       0.0);         ( 452900.0,
4615800.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4615800.0,     178.3,     178.3,       0.0);         ( 453100.0,
4615800.0,     178.5,     178.5,       0.0);
     ( 453200.0, 4615800.0,     178.8,     178.8,       0.0);         ( 453300.0,
4615800.0,     179.0,     179.0,       0.0);
     ( 453400.0, 4615800.0,     179.0,     179.0,       0.0);         ( 453500.0,
4615800.0,     179.4,     179.4,       0.0);
     ( 453600.0, 4615800.0,     179.4,     179.4,       0.0);         ( 453700.0,
4615800.0,     179.2,     179.2,       0.0);
     ( 453800.0, 4615800.0,     178.6,     178.6,       0.0);         ( 453900.0,
4615800.0,     178.4,     178.4,       0.0);
     ( 454000.0, 4615800.0,     176.8,     178.3,       0.0);         ( 454100.0,
4615800.0,     175.2,     178.1,       0.0);
     ( 454200.0, 4615800.0,     178.2,     178.2,       0.0);         ( 454300.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4615800.0,     178.2,     178.2,       0.0);         ( 454500.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4615800.0,     178.2,     178.2,       0.0);         ( 454700.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4615800.0,     178.2,     178.2,       0.0);         ( 454900.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4615800.0,     178.2,     178.2,       0.0);         ( 455100.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4615800.0,     178.2,     178.2,       0.0);         ( 455300.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4615800.0,     178.2,     178.2,       0.0);         ( 455500.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4615800.0,     178.2,     178.2,       0.0);         ( 455700.0,
4615800.0,     178.2,     178.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455800.0, 4615800.0, 178.2, 178.2, 0.0); (455900.0, 4615800.0, 178.2, 178.2, 0.0);
(456000.0, 4615800.0, 178.2, 178.2, 0.0); (456100.0, 4615800.0, 178.0, 178.0, 0.0);
(456200.0, 4615800.0, 178.3, 178.3, 0.0); (456300.0, 4615800.0, 178.4, 178.4, 0.0);
(456400.0, 4615800.0, 178.5, 178.5, 0.0); (456500.0, 4615800.0, 178.4, 183.4, 0.0);
(456600.0, 4615800.0, 179.3, 183.7, 0.0); (452000.0, 4615900.0, 178.3, 178.3, 0.0);
(452100.0, 4615900.0, 178.3, 178.3, 0.0); (452200.0, 4615900.0, 178.3, 178.3, 0.0);
(452300.0, 4615900.0, 178.3, 178.3, 0.0); (452400.0, 4615900.0, 178.3, 178.3, 0.0);
(452500.0, 4615900.0, 178.3, 178.3, 0.0); (452600.0, 4615900.0, 177.9, 177.9, 0.0);
(452700.0, 4615900.0, 177.0, 177.0, 0.0); (452800.0, 4615900.0, 178.2, 178.2, 0.0);
(452900.0, 4615900.0, 178.3, 178.3, 0.0); (453000.0, 4615900.0, 178.3, 178.3, 0.0);
(453100.0, 4615900.0, 178.5, 178.5, 0.0); (453200.0, 4615900.0, 178.8, 178.8, 0.0);
(453300.0, 4615900.0, 179.1, 179.1, 0.0); (453400.0, 4615900.0, 179.0, 179.0, 0.0);
(453500.0, 4615900.0, 179.3, 179.3, 0.0); (453600.0, 4615900.0, 179.6, 179.6, 0.0);
(453700.0, 4615900.0, 177.9, 177.9, 0.0); (453800.0, 4615900.0, 177.8, 177.8, 0.0);
(453900.0, 4615900.0, 177.8, 177.8, 0.0); (454000.0, 4615900.0, 175.4, 175.4, 0.0);
(454100.0, 4615900.0, 175.2, 178.7, 0.0); (454200.0, 4615900.0, 178.2, 178.2, 0.0);
(454300.0, 4615900.0, 178.2, 178.2, 0.0); (454400.0, 4615900.0, 178.2, 178.2, 0.0);
(454500.0, 4615900.0, 178.2, 178.2, 0.0); (454600.0, 4615900.0, 178.2, 178.2, 0.0);
(454700.0, 4615900.0, 178.2, 178.2, 0.0); (454800.0, 4615900.0, 178.2, 178.2, 0.0);
(454900.0, 4615900.0, 178.2, 178.2, 0.0); (455000.0, 4615900.0, 178.2, 178.2, 0.0);
(455100.0, 4615900.0, 178.2, 178.2, 0.0); (455200.0, 4615900.0, 178.2, 178.2, 0.0);
(455300.0, 4615900.0, 178.2, 178.2, 0.0); (455400.0, 4615900.0, 178.2, 178.2, 0.0);
(455500.0, 4615900.0, 178.2, 178.2, 0.0); (455600.0, 4615900.0, 178.2, 178.2, 0.0);
(455700.0, 4615900.0, 178.2, 178.2, 0.0); (455800.0, 4615900.0, 178.2, 178.2, 0.0);
(455900.0, 4615900.0, 178.2, 178.2, 0.0); (456000.0, 4615900.0, 178.2, 178.2, 0.0);

```
     ( 456100.0, 4615900.0,     178.0,     178.0,       0.0);         ( 456200.0,
4615900.0,     178.2,     178.2,       0.0);
     ( 456300.0, 4615900.0,     178.3,     178.3,       0.0);         ( 456400.0,
4615900.0,     178.3,     178.3,       0.0);
     ( 456500.0, 4615900.0,     179.9,     179.9,       0.0);         ( 456600.0,
4615900.0,     179.2,     183.2,       0.0);
     ( 452000.0, 4616000.0,     178.4,     178.4,       0.0);         ( 452100.0,
4616000.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4616000.0,     178.3,     178.3,       0.0);         ( 452300.0,
4616000.0,     178.3,     178.3,       0.0);
     ( 452400.0, 4616000.0,     178.3,     178.3,       0.0);         ( 452500.0,
4616000.0,     178.3,     178.3,       0.0);
     ( 452600.0, 4616000.0,     177.0,     177.0,       0.0);         ( 452700.0,
4616000.0,     177.0,     177.0,       0.0);
     ( 452800.0, 4616000.0,     178.0,     178.0,       0.0);         ( 452900.0,
4616000.0,     177.2,     177.2,       0.0);
     ( 453000.0, 4616000.0,     178.3,     178.3,       0.0);         ( 453100.0,
4616000.0,     178.5,     178.5,       0.0);
     ( 453200.0, 4616000.0,     178.8,     178.8,       0.0);         ( 453300.0,
4616000.0,     179.1,     179.1,       0.0);
     ( 453400.0, 4616000.0,     179.4,     179.4,       0.0);         ( 453500.0,
4616000.0,     179.7,     179.7,       0.0);
     ( 453600.0, 4616000.0,     180.0,     180.0,       0.0);         ( 453700.0,
4616000.0,     178.8,     178.8,       0.0);
     ( 453800.0, 4616000.0,     178.8,     178.8,       0.0);         ( 453900.0,
4616000.0,     178.8,     178.8,       0.0);
     ( 454000.0, 4616000.0,     175.2,     175.2,       0.0);         ( 454100.0,
4616000.0,     177.7,     177.7,       0.0);
     ( 454200.0, 4616000.0,     178.2,     178.2,       0.0);         ( 454300.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4616000.0,     178.2,     178.2,       0.0);         ( 454500.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4616000.0,     178.2,     178.2,       0.0);         ( 454700.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4616000.0,     178.2,     178.2,       0.0);         ( 454900.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4616000.0,     178.2,     178.2,       0.0);         ( 455100.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4616000.0,     178.2,     178.2,       0.0);         ( 455300.0,
4616000.0,     178.2,     178.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455400.0, 4616000.0, 178.2, 178.2, 0.0); (455500.0, 4616000.0, 178.2, 178.2, 0.0);
(455600.0, 4616000.0, 178.2, 178.2, 0.0); (455700.0, 4616000.0, 178.2, 178.2, 0.0);
(455800.0, 4616000.0, 178.2, 178.2, 0.0); (455900.0, 4616000.0, 178.2, 178.2, 0.0);
(456000.0, 4616000.0, 178.2, 178.2, 0.0); (456100.0, 4616000.0, 178.0, 178.0, 0.0);
(456200.0, 4616000.0, 178.2, 178.2, 0.0); (456300.0, 4616000.0, 178.6, 178.6, 0.0);
(456400.0, 4616000.0, 178.2, 178.2, 0.0); (456500.0, 4616000.0, 179.4, 179.4, 0.0);
(456600.0, 4616000.0, 179.8, 182.4, 0.0); (452000.0, 4616100.0, 179.4, 179.4, 0.0);
(452100.0, 4616100.0, 178.3, 178.3, 0.0); (452200.0, 4616100.0, 178.3, 178.3, 0.0);
(452300.0, 4616100.0, 178.3, 178.3, 0.0); (452400.0, 4616100.0, 177.7, 177.7, 0.0);
(452500.0, 4616100.0, 177.7, 177.7, 0.0); (452600.0, 4616100.0, 177.0, 177.0, 0.0);
(452700.0, 4616100.0, 177.6, 177.6, 0.0); (452800.0, 4616100.0, 177.9, 177.9, 0.0);
(452900.0, 4616100.0, 178.1, 178.1, 0.0); (453000.0, 4616100.0, 178.3, 178.3, 0.0);
(453100.0, 4616100.0, 178.4, 178.4, 0.0); (453200.0, 4616100.0, 178.4, 178.4, 0.0);
(453300.0, 4616100.0, 178.5, 178.5, 0.0); (453400.0, 4616100.0, 178.6, 178.6, 0.0);
(453500.0, 4616100.0, 179.7, 179.7, 0.0); (453600.0, 4616100.0, 180.2, 180.2, 0.0);
(453700.0, 4616100.0, 180.5, 180.5, 0.0); (453800.0, 4616100.0, 180.3, 180.3, 0.0);
(453900.0, 4616100.0, 180.2, 180.2, 0.0); (454000.0, 4616100.0, 175.2, 175.2, 0.0);
(454100.0, 4616100.0, 178.2, 178.2, 0.0); (454200.0, 4616100.0, 178.2, 178.2, 0.0);
(454300.0, 4616100.0, 178.3, 178.3, 0.0); (454400.0, 4616100.0, 178.2, 178.2, 0.0);
(454500.0, 4616100.0, 178.2, 178.2, 0.0); (454600.0, 4616100.0, 178.2, 178.2, 0.0);
(454700.0, 4616100.0, 178.2, 178.2, 0.0); (454800.0, 4616100.0, 178.2, 178.2, 0.0);
(454900.0, 4616100.0, 178.2, 178.2, 0.0); (455000.0, 4616100.0, 178.2, 178.2, 0.0);
(455100.0, 4616100.0, 178.2, 178.2, 0.0); (455200.0, 4616100.0, 178.2, 178.2, 0.0);
(455300.0, 4616100.0, 178.2, 178.2, 0.0); (455400.0, 4616100.0, 178.4, 178.4, 0.0);
(455500.0, 4616100.0, 178.2, 178.2, 0.0); (455600.0, 4616100.0, 178.2, 178.2, 0.0);

```
     ( 455700.0, 4616100.0,     178.2,     178.2,       0.0);         ( 455800.0,
4616100.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4616100.0,     178.2,     178.2,       0.0);         ( 456000.0,
4616100.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4616100.0,     178.1,     178.1,       0.0);         ( 456200.0,
4616100.0,     178.3,     178.3,       0.0);
     ( 456300.0, 4616100.0,     178.5,     178.5,       0.0);         ( 456400.0,
4616100.0,     178.4,     178.4,       0.0);
     ( 456500.0, 4616100.0,     179.0,     179.0,       0.0);         ( 456600.0,
4616100.0,     180.7,     180.7,       0.0);
     ( 452000.0, 4616200.0,     179.6,     179.6,       0.0);         ( 452100.0,
4616200.0,     178.6,     178.6,       0.0);
     ( 452200.0, 4616200.0,     178.4,     178.4,       0.0);         ( 452300.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 452400.0, 4616200.0,     178.3,     178.3,       0.0);         ( 452500.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 452600.0, 4616200.0,     178.4,     178.4,       0.0);         ( 452700.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 452800.0, 4616200.0,     178.3,     178.3,       0.0);         ( 452900.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4616200.0,     178.3,     178.3,       0.0);         ( 453100.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4616200.0,     178.3,     178.3,       0.0);         ( 453300.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 453400.0, 4616200.0,     178.3,     178.3,       0.0);         ( 453500.0,
4616200.0,     179.7,     179.7,       0.0);
     ( 453600.0, 4616200.0,     180.2,     180.2,       0.0);         ( 453700.0,
4616200.0,     180.1,     180.1,       0.0);
     ( 453800.0, 4616200.0,     178.5,     178.5,       0.0);         ( 453900.0,
4616200.0,     177.6,     177.6,       0.0);
     ( 454000.0, 4616200.0,     176.1,     177.7,       0.0);         ( 454100.0,
4616200.0,     178.2,     178.2,       0.0);
     ( 454200.0, 4616200.0,     178.2,     178.2,       0.0);         ( 454300.0,
4616200.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4616200.0,     178.3,     178.3,       0.0);         ( 454500.0,
4616200.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4616200.0,     178.2,     178.2,       0.0);         ( 454700.0,
4616200.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4616200.0,     178.2,     178.2,       0.0);         ( 454900.0,
4616200.0,     178.2,     178.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455000.0, 4616200.0, 178.2, 178.2, 0.0); (455100.0, 4616200.0, 178.2, 178.2, 0.0);
(455200.0, 4616200.0, 178.2, 178.2, 0.0); (455300.0, 4616200.0, 178.2, 178.2, 0.0);
(455400.0, 4616200.0, 178.3, 178.3, 0.0); (455500.0, 4616200.0, 178.3, 178.3, 0.0);
(455600.0, 4616200.0, 178.2, 178.2, 0.0); (455700.0, 4616200.0, 178.2, 178.2, 0.0);
(455800.0, 4616200.0, 178.2, 178.2, 0.0); (455900.0, 4616200.0, 178.2, 178.2, 0.0);
(456000.0, 4616200.0, 178.2, 178.2, 0.0); (456100.0, 4616200.0, 178.1, 178.1, 0.0);
(456200.0, 4616200.0, 178.3, 178.3, 0.0); (456300.0, 4616200.0, 178.5, 178.5, 0.0);
(456400.0, 4616200.0, 178.2, 178.2, 0.0); (456500.0, 4616200.0, 178.9, 178.9, 0.0);
(456600.0, 4616200.0, 180.6, 180.6, 0.0); (452000.0, 4616300.0, 179.4, 179.4, 0.0);
(452100.0, 4616300.0, 178.9, 178.9, 0.0); (452200.0, 4616300.0, 178.5, 178.5, 0.0);
(452300.0, 4616300.0, 178.3, 178.3, 0.0); (452400.0, 4616300.0, 178.5, 178.5, 0.0);
(452500.0, 4616300.0, 178.6, 178.6, 0.0); (452600.0, 4616300.0, 178.7, 178.7, 0.0);
(452700.0, 4616300.0, 178.5, 178.5, 0.0); (452800.0, 4616300.0, 178.5, 178.5, 0.0);
(452900.0, 4616300.0, 178.5, 178.5, 0.0); (453000.0, 4616300.0, 178.3, 178.3, 0.0);
(453100.0, 4616300.0, 178.3, 178.3, 0.0); (453200.0, 4616300.0, 178.3, 178.3, 0.0);
(453300.0, 4616300.0, 178.3, 178.3, 0.0); (453400.0, 4616300.0, 178.3, 178.3, 0.0);
(453500.0, 4616300.0, 179.8, 179.8, 0.0); (453600.0, 4616300.0, 178.5, 178.5, 0.0);
(453700.0, 4616300.0, 178.4, 178.4, 0.0); (453800.0, 4616300.0, 178.4, 178.4, 0.0);
(453900.0, 4616300.0, 178.4, 178.4, 0.0); (454000.0, 4616300.0, 176.3, 178.5, 0.0);
(454100.0, 4616300.0, 178.2, 178.2, 0.0); (454200.0, 4616300.0, 178.2, 178.2, 0.0);
(454300.0, 4616300.0, 178.2, 178.2, 0.0); (454400.0, 4616300.0, 178.4, 178.4, 0.0);
(454500.0, 4616300.0, 178.2, 178.2, 0.0); (454600.0, 4616300.0, 178.2, 178.2, 0.0);
(454700.0, 4616300.0, 178.2, 178.2, 0.0); (454800.0, 4616300.0, 178.2, 178.2, 0.0);
(454900.0, 4616300.0, 178.2, 178.2, 0.0); (455000.0, 4616300.0, 178.2, 178.2, 0.0);
(455100.0, 4616300.0, 178.2, 178.2, 0.0); (455200.0, 4616300.0, 178.2, 178.2, 0.0);

```
     ( 455300.0, 4616300.0,     178.2,     178.2,       0.0);         ( 455400.0,
4616300.0,     178.4,     178.4,       0.0);
     ( 455500.0, 4616300.0,     178.5,     178.5,       0.0);         ( 455600.0,
4616300.0,     178.3,     178.3,       0.0);
     ( 455700.0, 4616300.0,     178.2,     178.2,       0.0);         ( 455800.0,
4616300.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4616300.0,     178.2,     178.2,       0.0);         ( 456000.0,
4616300.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4616300.0,     178.3,     178.3,       0.0);         ( 456200.0,
4616300.0,     178.3,     178.3,       0.0);
     ( 456300.0, 4616300.0,     178.4,     178.4,       0.0);         ( 456400.0,
4616300.0,     178.2,     178.2,       0.0);
     ( 456500.0, 4616300.0,     179.5,     179.5,       0.0);         ( 456600.0,
4616300.0,     178.6,     183.1,       0.0);
     ( 452000.0, 4616400.0,     179.2,     179.2,       0.0);         ( 452100.0,
4616400.0,     178.9,     178.9,       0.0);
     ( 452200.0, 4616400.0,     178.5,     178.5,       0.0);         ( 452300.0,
4616400.0,     178.3,     178.3,       0.0);
     ( 452400.0, 4616400.0,     178.6,     178.6,       0.0);         ( 452500.0,
4616400.0,     178.8,     178.8,       0.0);
     ( 452600.0, 4616400.0,     178.8,     178.8,       0.0);         ( 452700.0,
4616400.0,     178.9,     178.9,       0.0);
     ( 452800.0, 4616400.0,     178.9,     178.9,       0.0);         ( 452900.0,
4616400.0,     178.6,     178.6,       0.0);
     ( 453000.0, 4616400.0,     178.3,     178.3,       0.0);         ( 453100.0,
4616400.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4616400.0,     178.5,     178.5,       0.0);         ( 453300.0,
4616400.0,     178.8,     178.8,       0.0);
     ( 453400.0, 4616400.0,     179.2,     179.2,       0.0);         ( 453500.0,
4616400.0,     179.8,     179.8,       0.0);
     ( 453600.0, 4616400.0,     179.9,     179.9,       0.0);         ( 453700.0,
4616400.0,     179.5,     179.5,       0.0);
     ( 453800.0, 4616400.0,     179.4,     179.4,       0.0);         ( 453900.0,
4616400.0,     179.2,     179.2,       0.0);
     ( 454000.0, 4616400.0,     175.2,     175.2,       0.0);         ( 454100.0,
4616400.0,     178.2,     178.2,       0.0);
     ( 454200.0, 4616400.0,     178.2,     178.2,       0.0);         ( 454300.0,
4616400.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4616400.0,     178.5,     178.5,       0.0);         ( 454500.0,
4616400.0,     178.4,     178.4,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454600.0, 4616400.0, 178.2, 178.2, 0.0); (454700.0, 4616400.0, 178.2, 178.2, 0.0);
(454800.0, 4616400.0, 178.2, 178.2, 0.0); (454900.0, 4616400.0, 178.2, 178.2, 0.0);
(455000.0, 4616400.0, 178.2, 178.2, 0.0); (455100.0, 4616400.0, 178.2, 178.2, 0.0);
(455200.0, 4616400.0, 178.2, 178.2, 0.0); (455300.0, 4616400.0, 178.2, 178.2, 0.0);
(455400.0, 4616400.0, 178.4, 178.4, 0.0); (455500.0, 4616400.0, 178.6, 178.6, 0.0);
(455600.0, 4616400.0, 178.6, 178.6, 0.0); (455700.0, 4616400.0, 178.3, 178.3, 0.0);
(455800.0, 4616400.0, 178.2, 178.2, 0.0); (455900.0, 4616400.0, 178.2, 178.2, 0.0);
(456000.0, 4616400.0, 178.2, 178.2, 0.0); (456100.0, 4616400.0, 178.5, 178.5, 0.0);
(456200.0, 4616400.0, 178.3, 178.3, 0.0); (456300.0, 4616400.0, 178.4, 178.4, 0.0);
(456400.0, 4616400.0, 178.6, 178.6, 0.0); (456500.0, 4616400.0, 180.0, 180.0, 0.0);
(456600.0, 4616400.0, 179.9, 183.7, 0.0); (452000.0, 4616500.0, 178.6, 178.6, 0.0);
(452100.0, 4616500.0, 178.8, 178.8, 0.0); (452200.0, 4616500.0, 178.4, 178.4, 0.0);
(452300.0, 4616500.0, 178.4, 178.4, 0.0); (452400.0, 4616500.0, 178.6, 178.6, 0.0);
(452500.0, 4616500.0, 179.0, 179.0, 0.0); (452600.0, 4616500.0, 179.0, 179.0, 0.0);
(452700.0, 4616500.0, 179.2, 179.2, 0.0); (452800.0, 4616500.0, 179.3, 179.3, 0.0);
(452900.0, 4616500.0, 179.1, 179.1, 0.0); (453000.0, 4616500.0, 178.5, 178.5, 0.0);
(453100.0, 4616500.0, 178.3, 178.3, 0.0); (453200.0, 4616500.0, 178.5, 178.5, 0.0);
(453300.0, 4616500.0, 178.9, 178.9, 0.0); (453400.0, 4616500.0, 179.3, 179.3, 0.0);
(453500.0, 4616500.0, 179.8, 179.8, 0.0); (453600.0, 4616500.0, 180.1, 180.1, 0.0);
(453700.0, 4616500.0, 180.2, 180.2, 0.0); (453800.0, 4616500.0, 180.1, 180.1, 0.0);
(453900.0, 4616500.0, 180.2, 180.2, 0.0); (454000.0, 4616500.0, 178.8, 179.8, 0.0);
(454100.0, 4616500.0, 176.0, 176.0, 0.0); (454200.0, 4616500.0, 178.2, 178.2, 0.0);
(454300.0, 4616500.0, 178.2, 178.2, 0.0); (454400.0, 4616500.0, 178.5, 178.5, 0.0);
(454500.0, 4616500.0, 178.5, 178.5, 0.0); (454600.0, 4616500.0, 178.2, 178.2, 0.0);
(454700.0, 4616500.0, 178.2, 178.2, 0.0); (454800.0, 4616500.0, 178.2, 178.2, 0.0);

```
     ( 454900.0, 4616500.0,     178.2,     178.2,       0.0);         ( 455000.0,
4616500.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4616500.0,     178.2,     178.2,       0.0);         ( 455200.0,
4616500.0,     178.4,     178.4,       0.0);
     ( 455300.0, 4616500.0,     178.3,     178.3,       0.0);         ( 455400.0,
4616500.0,     178.5,     178.5,       0.0);
     ( 455500.0, 4616500.0,     178.8,     178.8,       0.0);         ( 455600.0,
4616500.0,     178.8,     178.8,       0.0);
     ( 455700.0, 4616500.0,     178.5,     178.5,       0.0);         ( 455800.0,
4616500.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4616500.0,     178.2,     178.2,       0.0);         ( 456000.0,
4616500.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4616500.0,     178.3,     178.3,       0.0);         ( 456200.0,
4616500.0,     178.2,     178.2,       0.0);
     ( 456300.0, 4616500.0,     178.1,     178.1,       0.0);         ( 456400.0,
4616500.0,     178.0,     178.0,       0.0);
     ( 456500.0, 4616500.0,     180.5,     183.1,       0.0);         ( 456600.0,
4616500.0,     179.3,     183.6,       0.0);
     ( 452000.0, 4616600.0,     178.2,     178.2,       0.0);         ( 452100.0,
4616600.0,     178.7,     178.7,       0.0);
     ( 452200.0, 4616600.0,     178.3,     178.3,       0.0);         ( 452300.0,
4616600.0,     178.4,     178.4,       0.0);
     ( 452400.0, 4616600.0,     178.7,     178.7,       0.0);         ( 452500.0,
4616600.0,     179.0,     179.0,       0.0);
     ( 452600.0, 4616600.0,     179.2,     179.2,       0.0);         ( 452700.0,
4616600.0,     179.4,     179.4,       0.0);
     ( 452800.0, 4616600.0,     179.6,     179.6,       0.0);         ( 452900.0,
4616600.0,     179.6,     179.6,       0.0);
     ( 453000.0, 4616600.0,     178.8,     178.8,       0.0);         ( 453100.0,
4616600.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4616600.0,     178.5,     178.5,       0.0);         ( 453300.0,
4616600.0,     178.8,     178.8,       0.0);
     ( 453400.0, 4616600.0,     179.3,     179.3,       0.0);         ( 453500.0,
4616600.0,     179.8,     179.8,       0.0);
     ( 453600.0, 4616600.0,     180.0,     180.0,       0.0);         ( 453700.0,
4616600.0,     180.3,     180.3,       0.0);
     ( 453800.0, 4616600.0,     180.0,     180.0,       0.0);         ( 453900.0,
4616600.0,     178.5,     178.5,       0.0);
     ( 454000.0, 4616600.0,     178.3,     178.3,       0.0);         ( 454100.0,
4616600.0,     175.5,     175.5,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454200.0, 4616600.0, 175.2, 175.2, 0.0); (454300.0, 4616600.0, 178.1, 178.1, 0.0);
(454400.0, 4616600.0, 178.2, 178.2, 0.0); (454500.0, 4616600.0, 178.6, 178.6, 0.0);
(454600.0, 4616600.0, 178.4, 178.4, 0.0); (454700.0, 4616600.0, 178.2, 178.2, 0.0);
(454800.0, 4616600.0, 178.2, 178.2, 0.0); (454900.0, 4616600.0, 178.2, 178.2, 0.0);
(455000.0, 4616600.0, 178.2, 178.2, 0.0); (455100.0, 4616600.0, 178.2, 178.2, 0.0);
(455200.0, 4616600.0, 178.3, 178.3, 0.0); (455300.0, 4616600.0, 178.6, 178.6, 0.0);
(455400.0, 4616600.0, 178.7, 178.7, 0.0); (455500.0, 4616600.0, 178.8, 178.8, 0.0);
(455600.0, 4616600.0, 179.0, 179.0, 0.0); (455700.0, 4616600.0, 178.7, 178.7, 0.0);
(455800.0, 4616600.0, 178.5, 178.5, 0.0); (455900.0, 4616600.0, 178.4, 178.4, 0.0);
(456000.0, 4616600.0, 178.2, 178.2, 0.0); (456100.0, 4616600.0, 178.3, 178.3, 0.0);
(456200.0, 4616600.0, 178.4, 178.4, 0.0); (456300.0, 4616600.0, 178.3, 178.3, 0.0);
(456400.0, 4616600.0, 178.0, 178.0, 0.0); (456500.0, 4616600.0, 180.6, 184.7, 0.0);
(456600.0, 4616600.0, 178.2, 184.9, 0.0); (452000.0, 4616700.0, 179.0, 179.0, 0.0);
(452100.0, 4616700.0, 178.7, 178.7, 0.0); (452200.0, 4616700.0, 178.3, 178.3, 0.0);
(452300.0, 4616700.0, 178.5, 178.5, 0.0); (452400.0, 4616700.0, 178.8, 178.8, 0.0);
(452500.0, 4616700.0, 179.0, 179.0, 0.0); (452600.0, 4616700.0, 179.3, 179.3, 0.0);
(452700.0, 4616700.0, 179.5, 179.5, 0.0); (452800.0, 4616700.0, 179.7, 179.7, 0.0);
(452900.0, 4616700.0, 179.4, 179.4, 0.0); (453000.0, 4616700.0, 178.8, 178.8, 0.0);
(453100.0, 4616700.0, 178.3, 178.3, 0.0); (453200.0, 4616700.0, 178.4, 178.4, 0.0);
(453300.0, 4616700.0, 178.6, 178.6, 0.0); (453400.0, 4616700.0, 179.1, 179.1, 0.0);
(453500.0, 4616700.0, 179.6, 179.6, 0.0); (453600.0, 4616700.0, 179.9, 179.9, 0.0);
(453700.0, 4616700.0, 180.3, 180.3, 0.0); (453800.0, 4616700.0, 180.0, 180.0, 0.0);
(453900.0, 4616700.0, 178.2, 178.2, 0.0); (454000.0, 4616700.0, 178.2, 178.2, 0.0);
(454100.0, 4616700.0, 178.3, 178.3, 0.0); (454200.0, 4616700.0, 178.7, 178.7, 0.0);
(454300.0, 4616700.0, 175.6, 175.6, 0.0); (454400.0, 4616700.0, 175.2, 175.2, 0.0);

```
     ( 454500.0, 4616700.0,     178.3,     178.3,       0.0);         ( 454600.0,
4616700.0,     178.5,     178.5,       0.0);
     ( 454700.0, 4616700.0,     178.3,     178.3,       0.0);         ( 454800.0,
4616700.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4616700.0,     178.4,     178.4,       0.0);         ( 455000.0,
4616700.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4616700.0,     178.2,     178.2,       0.0);         ( 455200.0,
4616700.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4616700.0,     178.7,     178.7,       0.0);         ( 455400.0,
4616700.0,     178.8,     178.8,       0.0);
     ( 455500.0, 4616700.0,     179.0,     179.0,       0.0);         ( 455600.0,
4616700.0,     179.2,     179.2,       0.0);
     ( 455700.0, 4616700.0,     178.9,     178.9,       0.0);         ( 455800.0,
4616700.0,     178.7,     178.7,       0.0);
     ( 455900.0, 4616700.0,     178.3,     178.3,       0.0);         ( 456000.0,
4616700.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4616700.0,     178.2,     178.2,       0.0);         ( 456200.0,
4616700.0,     178.4,     178.4,       0.0);
     ( 456300.0, 4616700.0,     178.2,     178.2,       0.0);         ( 456400.0,
4616700.0,     177.9,     177.9,       0.0);
     ( 456500.0, 4616700.0,     178.4,     178.4,       0.0);         ( 456600.0,
4616700.0,     178.7,     178.7,       0.0);
     ( 452000.0, 4616800.0,     179.1,     179.1,       0.0);         ( 452100.0,
4616800.0,     178.6,     178.6,       0.0);
     ( 452200.0, 4616800.0,     178.3,     178.3,       0.0);         ( 452300.0,
4616800.0,     178.6,     178.6,       0.0);
     ( 452400.0, 4616800.0,     178.9,     178.9,       0.0);         ( 452500.0,
4616800.0,     179.2,     179.2,       0.0);
     ( 452600.0, 4616800.0,     179.4,     179.4,       0.0);         ( 452700.0,
4616800.0,     179.7,     179.7,       0.0);
     ( 452800.0, 4616800.0,     179.6,     179.6,       0.0);         ( 452900.0,
4616800.0,     179.3,     179.3,       0.0);
     ( 453000.0, 4616800.0,     178.8,     178.8,       0.0);         ( 453100.0,
4616800.0,     178.6,     178.6,       0.0);
     ( 453200.0, 4616800.0,     178.3,     178.3,       0.0);         ( 453300.0,
4616800.0,     178.5,     178.5,       0.0);
     ( 453400.0, 4616800.0,     178.9,     178.9,       0.0);         ( 453500.0,
4616800.0,     179.4,     179.4,       0.0);
     ( 453600.0, 4616800.0,     179.8,     179.8,       0.0);         ( 453700.0,
4616800.0,     180.1,     180.1,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453800.0, 4616800.0, 179.0, 179.0, 0.0); (453900.0, 4616800.0, 178.3, 178.3, 0.0);
(454000.0, 4616800.0, 178.2, 178.2, 0.0); (454100.0, 4616800.0, 178.2, 178.2, 0.0);
(454200.0, 4616800.0, 178.2, 178.2, 0.0); (454300.0, 4616800.0, 178.2, 178.2, 0.0);
(454400.0, 4616800.0, 179.1, 179.1, 0.0); (454500.0, 4616800.0, 175.2, 178.5, 0.0);
(454600.0, 4616800.0, 179.0, 179.0, 0.0); (454700.0, 4616800.0, 179.1, 179.1, 0.0);
(454800.0, 4616800.0, 178.2, 178.2, 0.0); (454900.0, 4616800.0, 178.4, 178.4, 0.0);
(455000.0, 4616800.0, 178.4, 178.4, 0.0); (455100.0, 4616800.0, 178.2, 178.2, 0.0);
(455200.0, 4616800.0, 178.2, 178.2, 0.0); (455300.0, 4616800.0, 178.5, 178.5, 0.0);
(455400.0, 4616800.0, 178.9, 178.9, 0.0); (455500.0, 4616800.0, 179.1, 179.1, 0.0);
(455600.0, 4616800.0, 179.3, 179.3, 0.0); (455700.0, 4616800.0, 179.1, 179.1, 0.0);
(455800.0, 4616800.0, 179.0, 179.0, 0.0); (455900.0, 4616800.0, 178.5, 178.5, 0.0);
(456000.0, 4616800.0, 178.2, 178.2, 0.0); (456100.0, 4616800.0, 178.3, 178.3, 0.0);
(456200.0, 4616800.0, 178.6, 178.6, 0.0); (456300.0, 4616800.0, 178.4, 178.4, 0.0);
(456400.0, 4616800.0, 178.1, 178.1, 0.0); (456500.0, 4616800.0, 178.7, 178.7, 0.0);
(456600.0, 4616800.0, 178.9, 178.9, 0.0); (452000.0, 4616900.0, 178.9, 178.9, 0.0);
(452100.0, 4616900.0, 178.4, 178.4, 0.0); (452200.0, 4616900.0, 178.3, 178.3, 0.0);
(452300.0, 4616900.0, 178.7, 178.7, 0.0); (452400.0, 4616900.0, 179.0, 179.0, 0.0);
(452500.0, 4616900.0, 179.3, 179.3, 0.0); (452600.0, 4616900.0, 179.6, 179.6, 0.0);
(452700.0, 4616900.0, 179.7, 179.7, 0.0); (452800.0, 4616900.0, 179.5, 179.5, 0.0);
(452900.0, 4616900.0, 179.2, 179.2, 0.0); (453000.0, 4616900.0, 179.1, 179.1, 0.0);
(453100.0, 4616900.0, 178.7, 178.7, 0.0); (453200.0, 4616900.0, 178.3, 178.3, 0.0);
(453300.0, 4616900.0, 178.3, 178.3, 0.0); (453400.0, 4616900.0, 178.7, 178.7, 0.0);
(453500.0, 4616900.0, 178.8, 178.8, 0.0); (453600.0, 4616900.0, 179.3, 179.3, 0.0);
(453700.0, 4616900.0, 178.2, 178.2, 0.0); (453800.0, 4616900.0, 178.2, 178.2, 0.0);
(453900.0, 4616900.0, 178.2, 178.2, 0.0); (454000.0, 4616900.0, 178.2, 178.2, 0.0);

```
     ( 454100.0, 4616900.0,     178.2,     178.2,       0.0);         ( 454200.0,
4616900.0,     178.2,     178.2,       0.0);
     ( 454300.0, 4616900.0,     178.2,     178.2,       0.0);         ( 454400.0,
4616900.0,     178.4,     178.4,       0.0);
     ( 454500.0, 4616900.0,     180.8,     182.2,       0.0);         ( 454600.0,
4616900.0,     176.3,     182.2,       0.0);
     ( 454700.0, 4616900.0,     179.5,     179.5,       0.0);         ( 454800.0,
4616900.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4616900.0,     178.2,     178.2,       0.0);         ( 455000.0,
4616900.0,     178.3,     178.3,       0.0);
     ( 455100.0, 4616900.0,     178.2,     178.2,       0.0);         ( 455200.0,
4616900.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4616900.0,     178.6,     178.6,       0.0);         ( 455400.0,
4616900.0,     178.8,     178.8,       0.0);
     ( 455500.0, 4616900.0,     179.2,     179.2,       0.0);         ( 455600.0,
4616900.0,     179.4,     179.4,       0.0);
     ( 455700.0, 4616900.0,     179.2,     179.2,       0.0);         ( 455800.0,
4616900.0,     179.1,     179.1,       0.0);
     ( 455900.0, 4616900.0,     178.5,     178.5,       0.0);         ( 456000.0,
4616900.0,     178.3,     178.3,       0.0);
     ( 456100.0, 4616900.0,     178.9,     178.9,       0.0);         ( 456200.0,
4616900.0,     179.3,     179.3,       0.0);
     ( 456300.0, 4616900.0,     179.3,     179.3,       0.0);         ( 456400.0,
4616900.0,     179.1,     179.1,       0.0);
     ( 456500.0, 4616900.0,     179.3,     179.3,       0.0);         ( 456600.0,
4616900.0,     178.7,     178.7,       0.0);
     ( 452000.0, 4617000.0,     178.3,     178.3,       0.0);         ( 452100.0,
4617000.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4617000.0,     178.6,     178.6,       0.0);         ( 452300.0,
4617000.0,     178.9,     178.9,       0.0);
     ( 452400.0, 4617000.0,     179.2,     179.2,       0.0);         ( 452500.0,
4617000.0,     179.5,     179.5,       0.0);
     ( 452600.0, 4617000.0,     179.7,     179.7,       0.0);         ( 452700.0,
4617000.0,     179.6,     179.6,       0.0);
     ( 452800.0, 4617000.0,     179.4,     179.4,       0.0);         ( 452900.0,
4617000.0,     179.3,     179.3,       0.0);
     ( 453000.0, 4617000.0,     179.0,     179.0,       0.0);         ( 453100.0,
4617000.0,     178.6,     178.6,       0.0);
     ( 453200.0, 4617000.0,     178.4,     178.4,       0.0);         ( 453300.0,
4617000.0,     178.3,     178.3,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453400.0, 4617000.0, 178.6, 178.6, 0.0); (453500.0, 4617000.0, 178.2, 178.2, 0.0);
(453600.0, 4617000.0, 178.9, 178.9, 0.0); (453700.0, 4617000.0, 179.1, 179.1, 0.0);
(453800.0, 4617000.0, 178.5, 178.5, 0.0); (453900.0, 4617000.0, 178.2, 178.2, 0.0);
(454000.0, 4617000.0, 178.2, 178.2, 0.0); (454100.0, 4617000.0, 178.2, 178.2, 0.0);
(454200.0, 4617000.0, 178.2, 178.2, 0.0); (454300.0, 4617000.0, 178.7, 178.7, 0.0);
(454400.0, 4617000.0, 179.7, 179.7, 0.0); (454500.0, 4617000.0, 178.6, 178.6, 0.0);
(454600.0, 4617000.0, 175.2, 175.2, 0.0); (454700.0, 4617000.0, 178.6, 178.6, 0.0);
(454800.0, 4617000.0, 178.2, 178.2, 0.0); (454900.0, 4617000.0, 178.2, 178.2, 0.0);
(455000.0, 4617000.0, 178.2, 178.2, 0.0); (455100.0, 4617000.0, 178.4, 178.4, 0.0);
(455200.0, 4617000.0, 178.7, 178.7, 0.0); (455300.0, 4617000.0, 178.7, 178.7, 0.0);
(455400.0, 4617000.0, 178.8, 178.8, 0.0); (455500.0, 4617000.0, 179.1, 179.1, 0.0);
(455600.0, 4617000.0, 179.4, 179.4, 0.0); (455700.0, 4617000.0, 179.3, 179.3, 0.0);
(455800.0, 4617000.0, 179.1, 179.1, 0.0); (455900.0, 4617000.0, 178.7, 178.7, 0.0);
(456000.0, 4617000.0, 178.3, 178.3, 0.0); (456100.0, 4617000.0, 178.6, 178.6, 0.0);
(456200.0, 4617000.0, 178.7, 178.7, 0.0); (456300.0, 4617000.0, 179.5, 186.7, 0.0);
(456400.0, 4617000.0, 179.5, 179.5, 0.0); (456500.0, 4617000.0, 179.6, 179.6, 0.0);
(456600.0, 4617000.0, 179.1, 179.1, 0.0); (452000.0, 4617100.0, 178.9, 178.9, 0.0);
(452100.0, 4617100.0, 178.6, 178.6, 0.0); (452200.0, 4617100.0, 179.0, 179.0, 0.0);
(452300.0, 4617100.0, 179.1, 179.1, 0.0); (452400.0, 4617100.0, 179.4, 179.4, 0.0);
(452500.0, 4617100.0, 179.7, 179.7, 0.0); (452600.0, 4617100.0, 179.7, 179.7, 0.0);
(452700.0, 4617100.0, 179.5, 179.5, 0.0); (452800.0, 4617100.0, 179.4, 179.4, 0.0);
(452900.0, 4617100.0, 179.2, 179.2, 0.0); (453000.0, 4617100.0, 178.8, 178.8, 0.0);
(453100.0, 4617100.0, 178.6, 178.6, 0.0); (453200.0, 4617100.0, 178.5, 178.5, 0.0);
(453300.0, 4617100.0, 178.3, 178.3, 0.0); (453400.0, 4617100.0, 178.5, 178.5, 0.0);
(453500.0, 4617100.0, 178.2, 178.2, 0.0); (453600.0, 4617100.0, 178.5, 178.5, 0.0);

```
     ( 453700.0, 4617100.0,     178.9,     178.9,       0.0);         ( 453800.0,
4617100.0,     178.7,     178.7,       0.0);
     ( 453900.0, 4617100.0,     178.5,     178.5,       0.0);         ( 454000.0,
4617100.0,     178.2,     178.2,       0.0);
     ( 454100.0, 4617100.0,     178.2,     178.2,       0.0);         ( 454200.0,
4617100.0,     178.4,     178.4,       0.0);
     ( 454300.0, 4617100.0,     179.0,     179.0,       0.0);         ( 454400.0,
4617100.0,     179.1,     179.1,       0.0);
     ( 454500.0, 4617100.0,     178.3,     178.3,       0.0);         ( 454600.0,
4617100.0,     175.2,     175.2,       0.0);
     ( 454700.0, 4617100.0,     178.2,     178.2,       0.0);         ( 454800.0,
4617100.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4617100.0,     178.2,     178.2,       0.0);         ( 455000.0,
4617100.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4617100.0,     178.4,     178.4,       0.0);         ( 455200.0,
4617100.0,     178.8,     178.8,       0.0);
     ( 455300.0, 4617100.0,     179.0,     179.0,       0.0);         ( 455400.0,
4617100.0,     179.2,     179.2,       0.0);
     ( 455500.0, 4617100.0,     179.3,     179.3,       0.0);         ( 455600.0,
4617100.0,     179.4,     179.4,       0.0);
     ( 455700.0, 4617100.0,     179.4,     179.4,       0.0);         ( 455800.0,
4617100.0,     179.1,     179.1,       0.0);
     ( 455900.0, 4617100.0,     179.0,     179.0,       0.0);         ( 456000.0,
4617100.0,     178.4,     178.4,       0.0);
     ( 456100.0, 4617100.0,     178.6,     178.6,       0.0);         ( 456200.0,
4617100.0,     178.7,     187.1,       0.0);
     ( 456300.0, 4617100.0,     181.1,     187.1,       0.0);         ( 456400.0,
4617100.0,     179.2,     179.2,       0.0);
     ( 456500.0, 4617100.0,     179.6,     179.6,       0.0);         ( 456600.0,
4617100.0,     180.1,     180.1,       0.0);
     ( 452000.0, 4617200.0,     179.3,     179.3,       0.0);         ( 452100.0,
4617200.0,     179.1,     179.1,       0.0);
     ( 452200.0, 4617200.0,     179.3,     179.3,       0.0);         ( 452300.0,
4617200.0,     179.4,     179.4,       0.0);
     ( 452400.0, 4617200.0,     179.6,     179.6,       0.0);         ( 452500.0,
4617200.0,     179.7,     179.7,       0.0);
     ( 452600.0, 4617200.0,     179.6,     179.6,       0.0);         ( 452700.0,
4617200.0,     179.6,     179.6,       0.0);
     ( 452800.0, 4617200.0,     179.4,     179.4,       0.0);         ( 452900.0,
4617200.0,     179.1,     179.1,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453000.0, 4617200.0, 179.0, 179.0, 0.0); (453100.0, 4617200.0, 178.7, 178.7, 0.0);
(453200.0, 4617200.0, 178.4, 178.4, 0.0); (453300.0, 4617200.0, 178.4, 178.4, 0.0);
(453400.0, 4617200.0, 178.8, 178.8, 0.0); (453500.0, 4617200.0, 178.2, 178.2, 0.0);
(453600.0, 4617200.0, 178.4, 178.4, 0.0); (453700.0, 4617200.0, 178.7, 178.7, 0.0);
(453800.0, 4617200.0, 178.7, 178.7, 0.0); (453900.0, 4617200.0, 178.4, 178.4, 0.0);
(454000.0, 4617200.0, 176.9, 176.9, 0.0); (454100.0, 4617200.0, 176.8, 176.8, 0.0);
(454200.0, 4617200.0, 176.9, 176.9, 0.0); (454300.0, 4617200.0, 177.0, 177.0, 0.0);
(454400.0, 4617200.0, 177.1, 177.1, 0.0); (454500.0, 4617200.0, 176.8, 176.8, 0.0);
(454600.0, 4617200.0, 175.2, 175.2, 0.0); (454700.0, 4617200.0, 178.2, 178.2, 0.0);
(454800.0, 4617200.0, 178.2, 178.2, 0.0); (454900.0, 4617200.0, 178.2, 178.2, 0.0);
(455000.0, 4617200.0, 178.2, 178.2, 0.0); (455100.0, 4617200.0, 178.2, 178.2, 0.0);
(455200.0, 4617200.0, 178.8, 178.8, 0.0); (455300.0, 4617200.0, 179.2, 179.2, 0.0);
(455400.0, 4617200.0, 179.3, 179.3, 0.0); (455500.0, 4617200.0, 179.6, 179.6, 0.0);
(455600.0, 4617200.0, 179.6, 179.6, 0.0); (455700.0, 4617200.0, 179.5, 179.5, 0.0);
(455800.0, 4617200.0, 179.4, 179.4, 0.0); (455900.0, 4617200.0, 179.1, 179.1, 0.0);
(456000.0, 4617200.0, 178.5, 178.5, 0.0); (456100.0, 4617200.0, 178.7, 186.3, 0.0);
(456200.0, 4617200.0, 184.8, 186.5, 0.0); (456300.0, 4617200.0, 180.5, 180.5, 0.0);
(456400.0, 4617200.0, 179.5, 179.5, 0.0); (456500.0, 4617200.0, 180.7, 180.7, 0.0);
(456600.0, 4617200.0, 179.3, 179.3, 0.0); (452000.0, 4617300.0, 180.4, 180.4, 0.0);
(452100.0, 4617300.0, 180.2, 180.2, 0.0); (452200.0, 4617300.0, 179.7, 179.7, 0.0);
(452300.0, 4617300.0, 179.6, 179.6, 0.0); (452400.0, 4617300.0, 179.7, 179.7, 0.0);
(452500.0, 4617300.0, 179.9, 179.9, 0.0); (452600.0, 4617300.0, 180.0, 180.0, 0.0);
(452700.0, 4617300.0, 179.6, 179.6, 0.0); (452800.0, 4617300.0, 179.5, 179.5, 0.0);
(452900.0, 4617300.0, 179.2, 179.2, 0.0); (453000.0, 4617300.0, 178.8, 178.8, 0.0);
(453100.0, 4617300.0, 178.5, 178.5, 0.0); (453200.0, 4617300.0, 178.3, 178.3, 0.0);

```
     ( 453300.0, 4617300.0,     178.4,     178.4,       0.0);         ( 453400.0,
4617300.0,     179.3,     179.3,       0.0);
     ( 453500.0, 4617300.0,     178.8,     178.8,       0.0);         ( 453600.0,
4617300.0,     178.6,     178.6,       0.0);
     ( 453700.0, 4617300.0,     178.6,     178.6,       0.0);         ( 453800.0,
4617300.0,     178.3,     178.3,       0.0);
     ( 453900.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454000.0,
4617300.0,     178.3,     178.3,       0.0);
     ( 454100.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454200.0,
4617300.0,     178.2,     178.2,       0.0);
     ( 454300.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454400.0,
4617300.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454600.0,
4617300.0,     175.2,     175.2,       0.0);
     ( 454700.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454800.0,
4617300.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4617300.0,     178.2,     178.2,       0.0);         ( 455000.0,
4617300.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4617300.0,     178.2,     178.2,       0.0);         ( 455200.0,
4617300.0,     178.4,     178.4,       0.0);
     ( 455300.0, 4617300.0,     178.9,     178.9,       0.0);         ( 455400.0,
4617300.0,     179.2,     179.2,       0.0);
     ( 455500.0, 4617300.0,     179.5,     179.5,       0.0);         ( 455600.0,
4617300.0,     179.7,     179.7,       0.0);
     ( 455700.0, 4617300.0,     179.7,     179.7,       0.0);         ( 455800.0,
4617300.0,     179.6,     179.6,       0.0);
     ( 455900.0, 4617300.0,     179.4,     179.4,       0.0);         ( 456000.0,
4617300.0,     178.8,     178.8,       0.0);
     ( 456100.0, 4617300.0,     182.1,     182.1,       0.0);         ( 456200.0,
4617300.0,     179.9,     179.9,       0.0);
     ( 456300.0, 4617300.0,     179.8,     179.8,       0.0);         ( 456400.0,
4617300.0,     180.8,     180.8,       0.0);
     ( 456500.0, 4617300.0,     179.4,     179.4,       0.0);         ( 456600.0,
4617300.0,     178.4,     178.4,       0.0);
     ( 449000.0, 4609000.0,     183.4,     183.4,       0.0);         ( 449500.0,
4609000.0,     184.0,     184.0,       0.0);
     ( 450000.0, 4609000.0,     184.3,     184.3,       0.0);         ( 450500.0,
4609000.0,     182.9,     182.9,       0.0);
     ( 451000.0, 4609000.0,     180.3,     180.3,       0.0);         ( 451500.0,
4609000.0,     179.6,     179.6,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452000.0, 4609000.0, 179.2, 179.2, 0.0); (452500.0, 4609000.0, 179.0, 179.0, 0.0);
(453000.0, 4609000.0, 178.4, 178.4, 0.0); (453500.0, 4609000.0, 178.2, 178.2, 0.0);
(454000.0, 4609000.0, 178.2, 178.2, 0.0); (454500.0, 4609000.0, 178.3, 178.3, 0.0);
(455000.0, 4609000.0, 178.9, 178.9, 0.0); (455500.0, 4609000.0, 178.6, 178.6, 0.0);
(456000.0, 4609000.0, 178.1, 178.1, 0.0); (456500.0, 4609000.0, 178.9, 178.9, 0.0);
(457000.0, 4609000.0, 179.3, 179.3, 0.0); (457500.0, 4609000.0, 178.7, 178.7, 0.0);
(458000.0, 4609000.0, 178.4, 178.4, 0.0); (458500.0, 4609000.0, 178.5, 178.5, 0.0);
(459000.0, 4609000.0, 178.7, 178.7, 0.0); (459500.0, 4609000.0, 178.0, 178.0, 0.0);
(460000.0, 4609000.0, 178.5, 178.5, 0.0); (449000.0, 4609500.0, 182.8, 182.8, 0.0);
(449500.0, 4609500.0, 184.0, 184.0, 0.0); (450000.0, 4609500.0, 182.4, 182.4, 0.0);
(450500.0, 4609500.0, 179.4, 179.4, 0.0); (451000.0, 4609500.0, 179.1, 179.1, 0.0);
(451500.0, 4609500.0, 178.5, 178.5, 0.0); (452000.0, 4609500.0, 179.6, 179.6, 0.0);
(452500.0, 4609500.0, 178.2, 178.2, 0.0); (453000.0, 4609500.0, 178.2, 178.2, 0.0);
(453500.0, 4609500.0, 180.9, 180.9, 0.0); (454000.0, 4609500.0, 178.2, 178.2, 0.0);
(454500.0, 4609500.0, 178.4, 178.4, 0.0); (455000.0, 4609500.0, 178.2, 178.2, 0.0);
(455500.0, 4609500.0, 178.2, 178.2, 0.0); (456000.0, 4609500.0, 178.4, 178.4, 0.0);
(456500.0, 4609500.0, 179.0, 179.0, 0.0); (457000.0, 4609500.0, 178.9, 178.9, 0.0);
(457500.0, 4609500.0, 178.3, 178.3, 0.0); (458000.0, 4609500.0, 179.4, 179.4, 0.0);
(458500.0, 4609500.0, 179.4, 179.4, 0.0); (459000.0, 4609500.0, 179.0, 179.0, 0.0);
(459500.0, 4609500.0, 178.2, 178.2, 0.0); (460000.0, 4609500.0, 178.5, 178.5, 0.0);
(449000.0, 4610000.0, 183.1, 183.1, 0.0); (449500.0, 4610000.0, 182.0, 182.0, 0.0);
(450000.0, 4610000.0, 180.2, 180.2, 0.0); (450500.0, 4610000.0, 179.6, 179.6, 0.0);
(451000.0, 4610000.0, 179.0, 179.0, 0.0); (451500.0, 4610000.0, 179.3, 179.3, 0.0);
(452000.0, 4610000.0, 177.0, 177.0, 0.0); (452500.0, 4610000.0, 180.6, 221.9, 0.0);
(453000.0, 4610000.0, 177.0, 221.9, 0.0); (453500.0, 4610000.0, 178.7, 178.7, 0.0);

```
     ( 454000.0, 4610000.0,     178.2,     178.2,       0.0);         ( 454500.0,
4610000.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4610000.0,     178.4,     178.4,       0.0);         ( 455500.0,
4610000.0,     178.2,     178.2,       0.0);
     ( 456000.0, 4610000.0,     178.5,     178.5,       0.0);         ( 456500.0,
4610000.0,     178.5,     178.5,       0.0);
     ( 457000.0, 4610000.0,     178.4,     178.4,       0.0);         ( 457500.0,
4610000.0,     177.9,     177.9,       0.0);
     ( 458000.0, 4610000.0,     178.1,     178.1,       0.0);         ( 458500.0,
4610000.0,     178.4,     178.4,       0.0);
     ( 459000.0, 4610000.0,     178.3,     178.3,       0.0);         ( 459500.0,
4610000.0,     179.4,     179.4,       0.0);
     ( 460000.0, 4610000.0,     178.5,     178.5,       0.0);         ( 449000.0,
4610500.0,     182.7,     182.7,       0.0);
     ( 449500.0, 4610500.0,     179.8,     179.8,       0.0);         ( 450000.0,
4610500.0,     178.8,     183.9,       0.0);
     ( 450500.0, 4610500.0,     180.5,     197.1,       0.0);         ( 451000.0,
4610500.0,     178.6,     178.6,       0.0);
     ( 451500.0, 4610500.0,     178.5,     178.5,       0.0);         ( 452000.0,
4610500.0,     180.7,     180.7,       0.0);
     ( 452500.0, 4610500.0,     178.1,     221.9,       0.0);         ( 453000.0,
4610500.0,     178.5,     221.9,       0.0);
     ( 453500.0, 4610500.0,     178.5,     178.5,       0.0);         ( 454000.0,
4610500.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4610500.0,     178.3,     178.3,       0.0);         ( 455000.0,
4610500.0,     179.1,     179.1,       0.0);
     ( 455500.0, 4610500.0,     178.2,     178.2,       0.0);         ( 456000.0,
4610500.0,     177.7,     177.7,       0.0);
     ( 456500.0, 4610500.0,     178.3,     178.3,       0.0);         ( 457000.0,
4610500.0,     178.1,     178.1,       0.0);
     ( 457500.0, 4610500.0,     179.3,     179.3,       0.0);         ( 458000.0,
4610500.0,     177.5,     177.5,       0.0);
     ( 458500.0, 4610500.0,     178.6,     178.6,       0.0);         ( 459000.0,
4610500.0,     176.3,     176.3,       0.0);
     ( 459500.0, 4610500.0,     178.9,     178.9,       0.0);         ( 460000.0,
4610500.0,     178.6,     178.6,       0.0);
     ( 449000.0, 4611000.0,     180.3,     180.3,       0.0);         ( 449500.0,
4611000.0,     178.3,     178.3,       0.0);
     ( 450000.0, 4611000.0,     177.0,     177.0,       0.0);         ( 450500.0,
4611000.0,     177.0,     198.9,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(451000.0, 4611000.0, 182.8, 185.1, 0.0); (451500.0, 4611000.0, 178.5, 178.5, 0.0);
(452000.0, 4611000.0, 195.1, 196.9, 0.0); (452500.0, 4611000.0, 179.5, 179.5, 0.0);
(453000.0, 4611000.0, 177.0, 177.0, 0.0); (453500.0, 4611000.0, 178.2, 178.2, 0.0);
(454000.0, 4611000.0, 178.2, 178.2, 0.0); (454500.0, 4611000.0, 178.6, 178.6, 0.0);
(455000.0, 4611000.0, 178.2, 178.2, 0.0); (455500.0, 4611000.0, 178.2, 178.2, 0.0);
(456000.0, 4611000.0, 178.7, 178.7, 0.0); (456500.0, 4611000.0, 178.0, 178.0, 0.0);
(457000.0, 4611000.0, 178.6, 178.6, 0.0); (457500.0, 4611000.0, 178.8, 178.8, 0.0);
(458000.0, 4611000.0, 178.8, 178.8, 0.0); (458500.0, 4611000.0, 179.0, 179.0, 0.0);
(459000.0, 4611000.0, 178.3, 178.3, 0.0); (459500.0, 4611000.0, 179.9, 179.9, 0.0);
(460000.0, 4611000.0, 178.3, 178.3, 0.0); (449000.0, 4611500.0, 179.9, 179.9, 0.0);
(449500.0, 4611500.0, 179.1, 179.1, 0.0); (450000.0, 4611500.0, 178.6, 178.6, 0.0);
(450500.0, 4611500.0, 178.4, 178.4, 0.0); (451000.0, 4611500.0, 178.1, 178.1, 0.0);
(451500.0, 4611500.0, 180.6, 225.4, 0.0); (452000.0, 4611500.0, 211.8, 211.8, 0.0);
(452500.0, 4611500.0, 179.0, 179.0, 0.0); (453000.0, 4611500.0, 178.2, 178.2, 0.0);
(453500.0, 4611500.0, 178.2, 178.2, 0.0); (454000.0, 4611500.0, 180.8, 180.8, 0.0);
(454500.0, 4611500.0, 178.5, 178.5, 0.0); (455000.0, 4611500.0, 178.2, 178.2, 0.0);
(455500.0, 4611500.0, 178.6, 178.6, 0.0); (456000.0, 4611500.0, 179.9, 179.9, 0.0);
(456500.0, 4611500.0, 178.7, 178.7, 0.0); (457000.0, 4611500.0, 178.4, 178.4, 0.0);
(457500.0, 4611500.0, 178.2, 178.2, 0.0); (458000.0, 4611500.0, 179.4, 179.4, 0.0);
(458500.0, 4611500.0, 179.9, 179.9, 0.0); (459000.0, 4611500.0, 179.5, 179.5, 0.0);
(459500.0, 4611500.0, 179.2, 179.2, 0.0); (460000.0, 4611500.0, 179.5, 184.0, 0.0);
(449000.0, 4612000.0, 179.7, 179.7, 0.0); (449500.0, 4612000.0, 179.5, 179.5, 0.0);
(450000.0, 4612000.0, 179.4, 179.4, 0.0); (450500.0, 4612000.0, 178.3, 178.3, 0.0);
(451000.0, 4612000.0, 182.4, 182.4, 0.0); (451500.0, 4612000.0, 182.4, 225.1, 0.0);
(452000.0, 4612000.0, 181.5, 225.4, 0.0); (452500.0, 4612000.0, 184.1, 184.1, 0.0);

```
     ( 453000.0, 4612000.0,     185.0,     185.0,       0.0);         ( 453500.0,
4612000.0,     178.6,     178.6,       0.0);
     ( 454000.0, 4612000.0,     180.5,     180.5,       0.0);         ( 454500.0,
4612000.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4612000.0,     178.2,     178.2,       0.0);         ( 455500.0,
4612000.0,     178.5,     178.5,       0.0);
     ( 456000.0, 4612000.0,     177.6,     177.6,       0.0);         ( 456500.0,
4612000.0,     178.5,     178.5,       0.0);
     ( 457000.0, 4612000.0,     187.1,     187.1,       0.0);         ( 457500.0,
4612000.0,     178.9,     178.9,       0.0);
     ( 458000.0, 4612000.0,     180.2,     180.2,       0.0);         ( 458500.0,
4612000.0,     181.3,     181.3,       0.0);
     ( 459000.0, 4612000.0,     179.5,     179.5,       0.0);         ( 459500.0,
4612000.0,     179.2,     179.2,       0.0);
     ( 460000.0, 4612000.0,     179.4,     179.4,       0.0);         ( 449000.0,
4612500.0,     179.7,     179.7,       0.0);
     ( 449500.0, 4612500.0,     179.6,     179.6,       0.0);         ( 450000.0,
4612500.0,     179.8,     179.8,       0.0);
     ( 450500.0, 4612500.0,     178.5,     178.5,       0.0);         ( 451000.0,
4612500.0,     179.7,     179.7,       0.0);
     ( 451500.0, 4612500.0,     178.6,     178.6,       0.0);         ( 457000.0,
4612500.0,     179.0,     179.0,       0.0);
     ( 457500.0, 4612500.0,     179.4,     179.4,       0.0);         ( 458000.0,
4612500.0,     188.2,     188.2,       0.0);
     ( 458500.0, 4612500.0,     183.2,     183.2,       0.0);         ( 459000.0,
4612500.0,     178.1,     178.1,       0.0);
     ( 459500.0, 4612500.0,     178.9,     178.9,       0.0);         ( 460000.0,
4612500.0,     180.6,     180.6,       0.0);
     ( 449000.0, 4613000.0,     179.8,     179.8,       0.0);         ( 449500.0,
4613000.0,     178.5,     178.5,       0.0);
     ( 450000.0, 4613000.0,     179.7,     179.7,       0.0);         ( 450500.0,
4613000.0,     178.5,     178.5,       0.0);
     ( 451000.0, 4613000.0,     175.2,     175.2,       0.0);         ( 451500.0,
4613000.0,     178.3,     178.3,       0.0);
     ( 457000.0, 4613000.0,     177.1,     177.1,       0.0);         ( 457500.0,
4613000.0,     178.3,     178.3,       0.0);
     ( 458000.0, 4613000.0,     176.9,     176.9,       0.0);         ( 458500.0,
4613000.0,     177.3,     177.3,       0.0);
     ( 459000.0, 4613000.0,     178.5,     178.5,       0.0);         ( 459500.0,
4613000.0,     179.0,     179.0,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(460000.0, 4613000.0, 179.7, 179.7, 0.0); (449000.0, 4613500.0, 181.3, 181.3, 0.0);
(449500.0, 4613500.0, 179.7, 179.7, 0.0); (450000.0, 4613500.0, 179.2, 179.2, 0.0);
(450500.0, 4613500.0, 178.3, 178.3, 0.0); (451000.0, 4613500.0, 177.3, 178.5, 0.0);
(451500.0, 4613500.0, 178.4, 178.4, 0.0); (457000.0, 4613500.0, 177.1, 177.1, 0.0);
(457500.0, 4613500.0, 177.1, 177.1, 0.0); (458000.0, 4613500.0, 177.0, 177.0, 0.0);
(458500.0, 4613500.0, 180.9, 180.9, 0.0); (459000.0, 4613500.0, 178.2, 178.2, 0.0);
(459500.0, 4613500.0, 180.0, 180.0, 0.0); (460000.0, 4613500.0, 179.9, 179.9, 0.0);
(449000.0, 4614000.0, 182.5, 182.5, 0.0); (449500.0, 4614000.0, 179.7, 179.7, 0.0);
(450000.0, 4614000.0, 178.7, 178.7, 0.0); (450500.0, 4614000.0, 175.2, 175.2, 0.0);
(451000.0, 4614000.0, 175.2, 175.2, 0.0); (451500.0, 4614000.0, 178.3, 178.3, 0.0);
(457000.0, 4614000.0, 177.1, 177.1, 0.0); (457500.0, 4614000.0, 177.9, 177.9, 0.0);
(458000.0, 4614000.0, 177.9, 177.9, 0.0); (458500.0, 4614000.0, 177.9, 177.9, 0.0);
(459000.0, 4614000.0, 178.8, 178.8, 0.0); (459500.0, 4614000.0, 180.3, 180.3, 0.0);
(460000.0, 4614000.0, 179.3, 179.3, 0.0); (449000.0, 4614500.0, 180.5, 180.5, 0.0);
(449500.0, 4614500.0, 179.7, 179.7, 0.0); (450000.0, 4614500.0, 178.3, 178.3, 0.0);
(450500.0, 4614500.0, 175.2, 175.2, 0.0); (451000.0, 4614500.0, 175.2, 175.2, 0.0);
(451500.0, 4614500.0, 177.3, 177.3, 0.0); (457000.0, 4614500.0, 177.1, 177.1, 0.0);
(457500.0, 4614500.0, 177.7, 177.7, 0.0); (458000.0, 4614500.0, 178.4, 178.4, 0.0);
(458500.0, 4614500.0, 178.2, 178.2, 0.0); (459000.0, 4614500.0, 179.2, 179.2, 0.0);
(459500.0, 4614500.0, 180.7, 180.7, 0.0); (460000.0, 4614500.0, 175.5, 175.5, 0.0);
(449000.0, 4615000.0, 182.6, 182.6, 0.0); (449500.0, 4615000.0, 179.7, 179.7, 0.0);
(450000.0, 4615000.0, 178.7, 178.7, 0.0); (450500.0, 4615000.0, 178.3, 178.3, 0.0);
(451000.0, 4615000.0, 175.2, 175.2, 0.0); (451500.0, 4615000.0, 175.2, 175.2, 0.0);
(457000.0, 4615000.0, 177.1, 177.1, 0.0); (457500.0, 4615000.0, 177.7, 177.7, 0.0);
(458000.0, 4615000.0, 178.1, 178.1, 0.0); (458500.0, 4615000.0, 178.8, 178.8, 0.0);

```
     ( 459000.0, 4615000.0,     175.5,     175.5,       0.0);         ( 459500.0,
4615000.0,     175.5,     175.5,       0.0);
     ( 460000.0, 4615000.0,     175.5,     175.5,       0.0);         ( 449000.0,
4615500.0,     181.4,     181.4,       0.0);
     ( 449500.0, 4615500.0,     179.5,     179.5,       0.0);         ( 450000.0,
4615500.0,     178.6,     178.6,       0.0);
     ( 450500.0, 4615500.0,     180.6,     183.0,       0.0);         ( 451000.0,
4615500.0,     178.3,     178.3,       0.0);
     ( 451500.0, 4615500.0,     175.5,     175.5,       0.0);         ( 457000.0,
4615500.0,     178.5,     178.5,       0.0);
     ( 457500.0, 4615500.0,     178.2,     178.2,       0.0);         ( 458000.0,
4615500.0,     179.3,     179.3,       0.0);
     ( 458500.0, 4615500.0,     175.5,     175.5,       0.0);         ( 459000.0,
4615500.0,     175.5,     175.5,       0.0);
     ( 459500.0, 4615500.0,     175.5,     175.5,       0.0);         ( 460000.0,
4615500.0,     175.2,     175.2,       0.0);
     ( 449000.0, 4616000.0,     181.7,     181.7,       0.0);         ( 449500.0,
4616000.0,     180.8,     180.8,       0.0);
     ( 450000.0, 4616000.0,     179.3,     179.3,       0.0);         ( 450500.0,
4616000.0,     184.7,     184.7,       0.0);
     ( 451000.0, 4616000.0,     185.3,     185.3,       0.0);         ( 451500.0,
4616000.0,     176.6,     178.4,       0.0);
     ( 457000.0, 4616000.0,     178.6,     185.4,       0.0);         ( 457500.0,
4616000.0,     179.8,     179.8,       0.0);
     ( 458000.0, 4616000.0,     175.5,     175.5,       0.0);         ( 458500.0,
4616000.0,     175.5,     175.5,       0.0);
     ( 459000.0, 4616000.0,     175.5,     175.5,       0.0);         ( 459500.0,
4616000.0,     175.2,     175.2,       0.0);
     ( 460000.0, 4616000.0,     175.2,     175.2,       0.0);         ( 449000.0,
4616500.0,     182.2,     182.2,       0.0);
     ( 449500.0, 4616500.0,     181.9,     181.9,       0.0);         ( 450000.0,
4616500.0,     179.3,     179.3,       0.0);
     ( 450500.0, 4616500.0,     179.6,     179.6,       0.0);         ( 451000.0,
4616500.0,     191.5,     191.5,       0.0);
     ( 451500.0, 4616500.0,     194.0,     194.0,       0.0);         ( 457000.0,
4616500.0,     179.2,     179.2,       0.0);
     ( 457500.0, 4616500.0,     175.5,     175.5,       0.0);         ( 458000.0,
4616500.0,     175.5,     175.5,       0.0);
     ( 458500.0, 4616500.0,     175.4,     175.4,       0.0);         ( 459000.0,
4616500.0,     175.2,     175.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(459500.0, 4616500.0, 175.2, 175.2, 0.0); (460000.0, 4616500.0, 175.2, 175.2, 0.0);
(449000.0, 4617000.0, 182.1, 182.1, 0.0); (449500.0, 4617000.0, 182.5, 182.5, 0.0);
(450000.0, 4617000.0, 179.9, 179.9, 0.0); (450500.0, 4617000.0, 180.5, 180.5, 0.0);
(451000.0, 4617000.0, 184.0, 185.9, 0.0); (451500.0, 4617000.0, 183.1, 183.1, 0.0);
(457000.0, 4617000.0, 178.9, 178.9, 0.0); (457500.0, 4617000.0, 175.5, 175.5, 0.0);
(458000.0, 4617000.0, 175.3, 175.3, 0.0); (458500.0, 4617000.0, 175.2, 175.2, 0.0);
(459000.0, 4617000.0, 175.2, 175.2, 0.0); (459500.0, 4617000.0, 175.2, 175.2, 0.0);
(460000.0, 4617000.0, 175.2, 175.2, 0.0); (449000.0, 4617500.0, 181.8, 181.8, 0.0);
(449500.0, 4617500.0, 182.8, 182.8, 0.0); (450000.0, 4617500.0, 180.9, 180.9, 0.0);
(450500.0, 4617500.0, 179.7, 179.7, 0.0); (451000.0, 4617500.0, 179.7, 179.7, 0.0);
(451500.0, 4617500.0, 178.9, 178.9, 0.0); (452000.0, 4617500.0, 186.5, 186.5, 0.0);
(452500.0, 4617500.0, 183.1, 183.1, 0.0); (453000.0, 4617500.0, 178.7, 178.7, 0.0);
(453500.0, 4617500.0, 180.3, 180.3, 0.0); (454000.0, 4617500.0, 178.2, 178.2, 0.0);
(454500.0, 4617500.0, 178.2, 178.2, 0.0); (455000.0, 4617500.0, 178.2, 178.2, 0.0);
(455500.0, 4617500.0, 179.8, 179.8, 0.0); (456000.0, 4617500.0, 179.9, 179.9, 0.0);
(456500.0, 4617500.0, 178.4, 178.4, 0.0); (457000.0, 4617500.0, 175.5, 175.5, 0.0);
(457500.0, 4617500.0, 175.5, 175.5, 0.0); (458000.0, 4617500.0, 175.2, 175.2, 0.0);
(458500.0, 4617500.0, 175.2, 175.2, 0.0); (459000.0, 4617500.0, 175.2, 175.2, 0.0);
(459500.0, 4617500.0, 175.2, 175.2, 0.0); (460000.0, 4617500.0, 175.2, 175.2, 0.0);
(449000.0, 4618000.0, 181.5, 181.5, 0.0); (449500.0, 4618000.0, 181.7, 181.7, 0.0);
(450000.0, 4618000.0, 182.2, 182.2, 0.0); (450500.0, 4618000.0, 183.7, 183.7, 0.0);
(451000.0, 4618000.0, 179.8, 179.8, 0.0); (451500.0, 4618000.0, 180.3, 180.3, 0.0);
(452000.0, 4618000.0, 179.7, 179.7, 0.0); (452500.0, 4618000.0, 178.6, 178.6, 0.0);
(453000.0, 4618000.0, 178.5, 178.5, 0.0); (453500.0, 4618000.0, 181.2, 181.2, 0.0);
(454000.0, 4618000.0, 178.8, 178.8, 0.0); (454500.0, 4618000.0, 178.9, 178.9, 0.0);

```
     ( 455000.0, 4618000.0,     178.7,     178.7,       0.0);         ( 455500.0,
4618000.0,     180.3,     180.3,       0.0);
     ( 456000.0, 4618000.0,     179.5,     179.5,       0.0);         ( 456500.0,
4618000.0,     175.5,     175.5,       0.0);
     ( 457000.0, 4618000.0,     175.5,     175.5,       0.0);         ( 457500.0,
4618000.0,     175.4,     175.4,       0.0);
     ( 458000.0, 4618000.0,     175.2,     175.2,       0.0);         ( 458500.0,
4618000.0,     175.2,     175.2,       0.0);
     ( 459000.0, 4618000.0,     175.2,     175.2,       0.0);         ( 459500.0,
4618000.0,     175.2,     175.2,       0.0);
     ( 460000.0, 4618000.0,     175.2,     175.2,       0.0);         ( 449000.0,
4618500.0,     182.2,     182.2,       0.0);
     ( 449500.0, 4618500.0,     182.5,     182.5,       0.0);         ( 450000.0,
4618500.0,     181.8,     181.8,       0.0);
     ( 450500.0, 4618500.0,     183.5,     183.5,       0.0);         ( 451000.0,
4618500.0,     178.3,     178.3,       0.0);
     ( 451500.0, 4618500.0,     179.9,     179.9,       0.0);         ( 452000.0,
4618500.0,     179.2,     179.2,       0.0);
     ( 452500.0, 4618500.0,     178.6,     178.6,       0.0);         ( 453000.0,
4618500.0,     178.5,     178.5,       0.0);
     ( 453500.0, 4618500.0,     178.3,     178.3,       0.0);         ( 454000.0,
4618500.0,     178.6,     178.6,       0.0);
     ( 454500.0, 4618500.0,     179.5,     179.5,       0.0);         ( 455000.0,
4618500.0,     175.3,     187.0,       0.0);
     ( 455500.0, 4618500.0,     179.7,     179.7,       0.0);         ( 456000.0,
4618500.0,     179.8,     179.8,       0.0);
     ( 456500.0, 4618500.0,     175.5,     175.5,       0.0);         ( 457000.0,
4618500.0,     175.4,     175.4,       0.0);
     ( 457500.0, 4618500.0,     175.2,     175.2,       0.0);         ( 458000.0,
4618500.0,     175.2,     175.2,       0.0);
     ( 458500.0, 4618500.0,     175.2,     175.2,       0.0);         ( 459000.0,
4618500.0,     175.2,     175.2,       0.0);
     ( 459500.0, 4618500.0,     175.2,     175.2,       0.0);         ( 460000.0,
4618500.0,     175.2,     175.2,       0.0);
     ( 449000.0, 4619000.0,     182.3,     182.3,       0.0);         ( 449500.0,
4619000.0,     180.9,     180.9,       0.0);
     ( 450000.0, 4619000.0,     180.4,     180.4,       0.0);         ( 450500.0,
4619000.0,     178.6,     178.6,       0.0);
     ( 451000.0, 4619000.0,     178.3,     178.3,       0.0);         ( 451500.0,
4619000.0,     178.6,     178.6,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452000.0, 4619000.0, 178.3, 178.3, 0.0); (452500.0, 4619000.0, 178.2, 178.2, 0.0);
(453000.0, 4619000.0, 179.9, 179.9, 0.0); (453500.0, 4619000.0, 183.2, 183.2, 0.0);
(454000.0, 4619000.0, 178.2, 178.2, 0.0); (454500.0, 4619000.0, 182.7, 182.7, 0.0);
(455000.0, 4619000.0, 179.1, 179.1, 0.0); (455500.0, 4619000.0, 179.7, 179.7, 0.0);
(456000.0, 4619000.0, 182.4, 182.4, 0.0); (456500.0, 4619000.0, 175.2, 175.2, 0.0);
(457000.0, 4619000.0, 175.2, 175.2, 0.0); (457500.0, 4619000.0, 175.2, 175.2, 0.0);
(458000.0, 4619000.0, 175.2, 175.2, 0.0); (458500.0, 4619000.0, 175.2, 175.2, 0.0);
(459000.0, 4619000.0, 175.2, 175.2, 0.0); (459500.0, 4619000.0, 175.2, 175.2, 0.0);
(460000.0, 4619000.0, 175.2, 175.2, 0.0); (449000.0, 4619500.0, 181.6, 181.6, 0.0);
(449500.0, 4619500.0, 183.2, 183.2, 0.0); (450000.0, 4619500.0, 180.8, 180.8, 0.0);
(450500.0, 4619500.0, 179.9, 179.9, 0.0); (451000.0, 4619500.0, 180.4, 180.4, 0.0);
(451500.0, 4619500.0, 182.2, 182.2, 0.0); (452000.0, 4619500.0, 182.9, 182.9, 0.0);
(452500.0, 4619500.0, 182.6, 182.6, 0.0); (453000.0, 4619500.0, 180.9, 180.9, 0.0);
(453500.0, 4619500.0, 178.2, 178.2, 0.0); (454000.0, 4619500.0, 182.3, 182.3, 0.0);
(454500.0, 4619500.0, 179.2, 179.2, 0.0); (455000.0, 4619500.0, 176.8, 176.8, 0.0);
(455500.0, 4619500.0, 181.6, 181.6, 0.0); (456000.0, 4619500.0, 181.1, 181.1, 0.0);
(456500.0, 4619500.0, 175.2, 175.2, 0.0); (457000.0, 4619500.0, 175.2, 175.2, 0.0);
(457500.0, 4619500.0, 175.2, 175.2, 0.0); (458000.0, 4619500.0, 175.2, 175.2, 0.0);
(458500.0, 4619500.0, 175.2, 175.2, 0.0); (459000.0, 4619500.0, 175.2, 175.2, 0.0);
(459500.0, 4619500.0, 175.2, 175.2, 0.0); (460000.0, 4619500.0, 175.2, 175.2, 0.0);
(449000.0, 4620000.0, 178.1, 178.1, 0.0); (449500.0, 4620000.0, 181.2, 181.2, 0.0);
(450000.0, 4620000.0, 182.6, 182.6, 0.0); (450500.0, 4620000.0, 178.5, 178.5, 0.0);
(451000.0, 4620000.0, 178.9, 178.9, 0.0); (451500.0, 4620000.0, 178.5, 178.5, 0.0);
(452000.0, 4620000.0, 178.9, 178.9, 0.0); (452500.0, 4620000.0, 179.5, 179.5, 0.0);
(453000.0, 4620000.0, 178.9, 178.9, 0.0); (453500.0, 4620000.0, 184.2, 184.2, 0.0);

```
     ( 454000.0, 4620000.0,     179.8,     179.8,       0.0);         ( 454500.0,
4620000.0,     179.7,     179.7,       0.0);
     ( 455000.0, 4620000.0,     179.4,     179.4,       0.0);         ( 455500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 456000.0, 4620000.0,     182.5,     182.5,       0.0);         ( 456500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 457000.0, 4620000.0,     175.2,     175.2,       0.0);         ( 457500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 458000.0, 4620000.0,     175.2,     175.2,       0.0);         ( 458500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 459000.0, 4620000.0,     175.2,     175.2,       0.0);         ( 459500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 460000.0, 4620000.0,     175.2,     175.2,       0.0);         ( 449000.0,
4620500.0,     179.9,     179.9,       0.0);
     ( 449500.0, 4620500.0,     180.7,     180.7,       0.0);         ( 450000.0,
4620500.0,     181.2,     181.2,       0.0);
     ( 450500.0, 4620500.0,     179.9,     179.9,       0.0);         ( 451000.0,
4620500.0,     178.2,     178.2,       0.0);
     ( 451500.0, 4620500.0,     178.8,     178.8,       0.0);         ( 452000.0,
4620500.0,     180.5,     180.5,       0.0);
     ( 452500.0, 4620500.0,     182.0,     182.0,       0.0);         ( 453000.0,
4620500.0,     184.4,     184.4,       0.0);
     ( 453500.0, 4620500.0,     180.5,     180.5,       0.0);         ( 454000.0,
4620500.0,     179.8,     179.8,       0.0);
     ( 454500.0, 4620500.0,     178.9,     178.9,       0.0);         ( 455000.0,
4620500.0,     179.0,     179.0,       0.0);
     ( 455500.0, 4620500.0,     180.4,     180.4,       0.0);         ( 456000.0,
4620500.0,     176.8,     180.4,       0.0);
     ( 456500.0, 4620500.0,     175.2,     175.2,       0.0);         ( 457000.0,
4620500.0,     175.2,     175.2,       0.0);
     ( 457500.0, 4620500.0,     175.2,     175.2,       0.0);         ( 458000.0,
4620500.0,     175.2,     175.2,       0.0);
     ( 458500.0, 4620500.0,     175.2,     175.2,       0.0);         ( 459000.0,
4620500.0,     175.2,     175.2,       0.0);
     ( 459500.0, 4620500.0,     175.2,     175.2,       0.0);         ( 460000.0,
4620500.0,     175.2,     175.2,       0.0);
```

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE-RECEPTOR COMBINATIONS FOR WHICH CALCULATIONS MAY NOT BE PERFORMED *
LESS THAN 1.0 METER; WITHIN OPENPIT; OR BEYOND 80KM FOR FASTAREA/FASTALL

SOURCE ID	- - RECEPTOR LOCATION - - XR (METERS)	YR (METERS)	DISTANCE (METERS)
V13	454093.9	4614816.0	- 2.29

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***

(1=YES; 0=NO)

1 1 1

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** UP TO THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

Surface file: E:\CONSULTING\GEN_IRON.SFC
Met Version: 18081
Profile file: E:\CONSULTING\GEN_IRON.PFL
Surface format: FREE
Profile format: FREE
Surface station no.: 14819 Upper air station no.: 94982
Name: UNKNOWN Name: UNKNOWN
Year: 2012 Year: 2012

First 24 hours of scalar data

YR	MO	DY	JDY	HR	H0	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O LEN	Z0	BOWEN	ALBEDO	REF WS	WD	HT	REF TA	HT
12	01	01	1	01	-55.9	0.568	-9.000	-9.000	-999.	1027.	354.7	0.09	1.09	1.00	6.86	176.	10.0	278.8	2.0
12	01	01	1	02	-52.1	0.531	-9.000	-9.000	-999.	931.	310.0	0.09	1.09	1.00	6.43	177.	10.0	279.2	2.0
12	01	01	1	03	-44.7	0.456	-9.000	-9.000	-999.	744.	228.3	0.08	1.09	1.00	5.67	180.	10.0	279.2	2.0
12	01	01	1	04	-39.2	0.401	-9.000	-9.000	-999.	613.	177.0	0.08	1.09	1.00	5.02	200.	10.0	279.9	2.0
12	01	01	1	05	-44.7	0.457	-9.000	-9.000	-999.	741.	229.8	0.07	1.09	1.00	5.80	233.	10.0	279.9	2.0
12	01	01	1	06	-64.0	0.680	-9.000	-9.000	-999.	1344.	508.0	0.13	1.09	1.00	7.40	247.	10.0	278.8	2.0
12	01	01	1	07	-64.0	0.648	-9.000	-9.000	-999.	1254.	461.7	0.13	1.09	1.00	7.08	257.	10.0	278.1	2.0
12	01	01	1	08	-64.0	0.816	-9.000	-9.000	-999.	1765.	744.3	0.06	1.09	0.76	10.65	295.	10.0	275.9	2.0
12	01	01	1	09	-39.7	0.705	-9.000	-9.000	-999.	1440.	774.8	0.06	1.09	0.45	9.19	294.	10.0	275.4	2.0
12	01	01	1	10	16.9	0.759	0.503	0.006	264.	1584.	-2270.7	0.06	1.09	0.34	9.81	288.	10.0	275.9	2.0
12	01	01	1	11	31.1	0.826	0.739	0.005	457.	1797.	-1594.2	0.06	1.09	0.29	10.66	283.	10.0	277.0	2.0
12	01	01	1	12	37.9	0.927	0.837	0.005	546.	2133.	-1852.7	0.06	1.09	0.28	11.97	279.	10.0	275.9	2.0
12	01	01	1	13	13.8	0.928	0.608	0.005	572.	2146.	-5114.4	0.06	1.09	0.28	12.02	285.	10.0	274.2	2.0
12	01	01	1	14	28.5	0.825	0.797	0.005	625.	1820.	-1736.6	0.06	1.09	0.30	10.65	282.	10.0	273.1	2.0
12	01	01	1	15	1.4	0.791	0.293	0.006	628.	1696.	-8888.0	0.06	1.09	0.35	10.26	277.	10.0	273.8	2.0
12	01	01	1	16	-61.6	0.871	-9.000	-9.000	-999.	1944.	949.1	0.06	1.09	0.49	11.33	277.	10.0	273.8	2.0
12	01	01	1	17	-64.0	0.788	-9.000	-9.000	-999.	1692.	682.4	0.06	1.09	1.00	10.29	276.	10.0	273.8	2.0
12	01	01	1	18	-64.0	0.695	-9.000	-9.000	-999.	1406.	530.9	0.06	1.09	1.00	9.13	272.	10.0	273.1	2.0

```
 12 01 01   1 19  -64.0  0.714 -9.000 -9.000 -999. 1447.    560.9  0.06   1.09   1.00
9.37  278.   10.0  272.5    2.0
 12 01 01   1 20  -64.0  0.716 -9.000 -9.000 -999. 1453.    563.4  0.06   1.09   1.00
9.39  282.   10.0  272.5    2.0
 12 01 01   1 21  -64.0  0.714 -9.000 -9.000 -999. 1448.    560.9  0.06   1.09   1.00
9.37  281.   10.0  272.0    2.0
 12 01 01   1 22  -60.0  0.587 -9.000 -9.000 -999. 1099.    378.8  0.06   1.09   1.00
7.76  278.   10.0  272.5    2.0
 12 01 01   1 23  -59.7  0.583 -9.000 -9.000 -999. 1069.    373.7  0.06   1.09   1.00
7.71  276.   10.0  272.0    2.0
 12 01 01   1 24  -64.0  0.696 -9.000 -9.000 -999. 1392.    533.4  0.06   1.09   1.00
9.15  287.   10.0  272.0    2.0


 First hour of profile data
 YR MO DY HR HEIGHT F  WDIR    WSPD AMB_TMP sigmaA  sigmaW  sigmaV
 12 01 01 01   10.0 1  176.    6.86   278.8   99.0  -99.00  -99.00

 F indicates top of profile (=1) or below (=0)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454084.40	4615065.40	28.88268	(16100624)	454083.30	4615039.80	30.97750	(14100124)
454082.20	4615014.10	32.93913	(16112224)	454085.10	4614964.60	38.66659	(13103024)
454088.00	4614915.00	46.85625	(12082924)	454091.00	4614865.50	60.82542	(13111924)
454093.90	4614816.00	48.74326	(12110724)	454096.80	4614766.40	52.87457	(14020124)
454099.70	4614716.90	31.82330	(15012724)	454102.60	4614667.30	24.51720	(16112124)
454105.50	4614617.80	20.76432	(12120724)	454108.50	4614568.30	17.44339	(15060124)
454111.40	4614518.70	15.97848	(15092524)	454114.30	4614469.20	14.94534	(12100224)
454107.80	4614425.20	13.54116	(12012624)	454101.30	4614381.10	12.72633	(12100224)
454094.70	4614337.10	11.29615	(12050524)	454088.20	4614293.00	10.46669	(12050524)
454081.70	4614249.00	9.48279	(15050524)	454082.20	4614201.80	8.68190	(15050524)
454082.80	4614154.70	8.02416	(15050524)	454121.40	4614157.80	8.27007	(14030824)
454160.00	4614160.90	8.63642	(14030824)	454191.30	4614179.40	9.22203	(14120624)
454222.70	4614198.00	9.63171	(15060524)	454254.00	4614216.50	9.49461	(16040424)
454253.20	4614226.30	9.63455	(16040424)	454296.00	4614249.30	9.87366	(13031624)
454338.80	4614272.30	10.09324	(12032424)	454381.70	4614295.30	10.33260	(14120924)
454424.50	4614318.30	10.64459	(12122724)	454467.30	4614341.40	11.26200	(12020724)
454510.20	4614364.40	11.27377	(16102724)	454553.00	4614387.40	12.29808c	(14013124)

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        454595.80   4614410.40       13.97148  (16022524)              454595.80
4614459.20       16.15356  (16022524)
        454595.80   4614507.90       17.26847  (16021624)              454595.80
4614556.70       21.28589  (13032624)
        454595.80   4614605.50       23.99271  (12121724)              454595.80
4614654.30       25.15533  (13032124)
        454595.80   4614703.00       28.88524  (13032724)              454595.80
4614751.80       29.56676  (13032724)
        454595.80   4614800.60       28.74357  (12012424)              454595.80
4614849.30       31.05652  (12012524)
        454595.80   4614898.10       34.42994  (14010824)              454595.80
4614946.90       50.09859  (16102724)
        454595.80   4614995.60       81.93296  (13011524)              454595.80
4615044.40       99.46930  (13123024)
        454595.80   4615093.20       71.97321  (14121924)              454595.80
4615142.00       50.10920  (13122724)
        454595.80   4615190.70       40.14899  (14121924)              454595.80
4615239.50       32.04652  (12022224)
        454551.90   4615219.20       38.22156c (15020324)              454508.00
4615199.00       49.59307  (16012024)
        454484.50   4615239.50       36.21049  (12112124)              454461.10
4615279.90       32.34410  (15110324)
        454413.60   4615286.60       27.86652  (16110724)              454376.80
4615266.90       28.26370  (12111624)
        454340.00   4615247.20       28.83287  (15110324)              454303.10
4615227.50       27.60490  (12111424)
        454266.30   4615207.80       27.84581  (16010824)              454229.50
4615188.10       25.90290  (16101424)
        454251.00   4615155.90       30.58169  (16110724)              454209.30
4615133.30       29.82056  (14011024)
        454167.70   4615110.70       31.37156  (13112024)              454126.10
4615088.00       29.54108c (14010924)
        452000.00   4612100.00        0.80391  (14120524)              452100.00
4612100.00        0.78853  (15092524)
        452200.00   4612100.00        0.83455  (15092524)              452300.00
4612100.00        0.85700  (15092524)
        452400.00   4612100.00        1.02664c (12080124)              452500.00
4612100.00        1.06726  (16101924)
        452600.00   4612100.00        1.12653  (16021724)              452700.00
4612100.00        1.21774c (12060624)
        452800.00   4612100.00        1.26878c (12060624)              452900.00
4612100.00        1.23872  (14020424)
        453000.00   4612100.00        1.29110  (14020424)              453100.00
4612100.00        1.28065  (14101024)
        453200.00   4612100.00        1.33238  (16101924)              453300.00
4612100.00        1.28986  (16101924)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453400.00	4612100.00	1.34919	(14012024)	453500.00	4612100.00	1.30267	(15112824)
453600.00	4612100.00	1.21782	(15111024)	453700.00	4612100.00	1.47693	(14061024)
453800.00	4612100.00	1.60107	(15012124)	453900.00	4612100.00	1.41854	(15010324)
454000.00	4612100.00	1.48921	(15072624)	454100.00	4612100.00	1.57534	(12032424)
454200.00	4612100.00	1.38922	(12032424)	454300.00	4612100.00	1.31149	(13081824)
454400.00	4612100.00	1.24279	(14120424)	454500.00	4612100.00	1.12913	(12092824)
454600.00	4612100.00	1.12761	(13050524)	454700.00	4612100.00	1.18813	(15012124)
454800.00	4612100.00	1.15670	(14020424)	454900.00	4612100.00	1.35129	(14021524)
455000.00	4612100.00	1.38196	(14120924)	455100.00	4612100.00	1.27954	(16072624)
455200.00	4612100.00	1.12432	(14081824)	455300.00	4612100.00	1.23520m	(16010924)
455400.00	4612100.00	1.21949	(16100124)	455500.00	4612100.00	1.27252	(14080224)
455600.00	4612100.00	1.30602	(13020824)	455700.00	4612100.00	1.20819	(14080224)
455800.00	4612100.00	1.15635	(13111924)	455900.00	4612100.00	1.09204	(12121724)
456000.00	4612100.00	1.14012	(16121724)	456100.00	4612100.00	1.16633	(15011924)
456200.00	4612100.00	1.32774	(15011924)	456300.00	4612100.00	1.42972	(15011924)
456400.00	4612100.00	1.42856	(16102724)	456500.00	4612100.00	1.39300	(16102724)
456600.00	4612100.00	1.35610	(14112724)	452000.00	4612200.00	0.77919c	(14092724)

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        452100.00   4612200.00        0.83387c (14092724)              452200.00
4612200.00        0.84383  (15092524)
        452300.00   4612200.00        0.88147  (15092524)              452400.00
4612200.00        0.91762c (12080124)
        452500.00   4612200.00        1.11021  (13052524)              452600.00
4612200.00        1.13285  (16101924)
        452700.00   4612200.00        1.25864  (12120724)              452800.00
4612200.00        1.31256c (12060624)
        452900.00   4612200.00        1.30841c (12060624)              453000.00
4612200.00        1.33601  (14020424)
        453100.00   4612200.00        1.32200  (14101024)              453200.00
4612200.00        1.39975  (16101924)
        453300.00   4612200.00        1.39256  (13050424)              453400.00
4612200.00        1.38478  (13050424)
        453500.00   4612200.00        1.35453  (14061024)              453600.00
4612200.00        1.28155  (15112824)
        453700.00   4612200.00        1.54299  (12012024)              453800.00
4612200.00        1.62457  (16092224)
        453900.00   4612200.00        1.48177  (15021024)              454000.00
4612200.00        1.49047  (15072624)
        454100.00   4612200.00        1.64345  (12032424)              454200.00
4612200.00        1.48038  (12032424)
        454300.00   4612200.00        1.33778  (13081824)              454400.00
4612200.00        1.30335  (14120424)
        454500.00   4612200.00        1.17387  (12092824)              454600.00
4612200.00        1.15462  (13050524)
        454700.00   4612200.00        1.21354  (15012124)              454800.00
4612200.00        1.23617  (14020424)
        454900.00   4612200.00        1.42540  (14121924)              455000.00
4612200.00        1.43064  (14120924)
        455100.00   4612200.00        1.35287m (16010924)              455200.00
4612200.00        1.18645  (14121024)
        455300.00   4612200.00        1.28603  (16100124)              455400.00
4612200.00        1.26371  (16100124)
        455500.00   4612200.00        1.33216  (12020724)              455600.00
4612200.00        1.34020  (13020824)
        455700.00   4612200.00        1.26031  (13020824)              455800.00
4612200.00        1.18855  (13020824)
        455900.00   4612200.00        1.14236  (15012124)              456000.00
4612200.00        1.25869c (14013124)
        456100.00   4612200.00        1.36675  (16021624)              456200.00
4612200.00        1.41815  (13121624)
        456300.00   4612200.00        1.52008  (16102724)              456400.00
4612200.00        1.47870  (16102724)
        456500.00   4612200.00        1.42286  (14112724)              456600.00
4612200.00        1.33863  (15011924)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4612300.00	0.82701	(12113024)	452100.00	4612300.00	0.80813	(13052524)
452200.00	4612300.00	0.86695	(14120524)	452300.00	4612300.00	0.87778c	(14092724)
452400.00	4612300.00	0.93936	(15092524)	452500.00	4612300.00	1.01961	(16101924)
452600.00	4612300.00	1.15868	(16101924)	452700.00	4612300.00	1.19341	(16101924)
452800.00	4612300.00	1.33028	(12110224)	452900.00	4612300.00	1.39091c	(12060624)
453000.00	4612300.00	1.35731	(14062524)	453100.00	4612300.00	1.39734	(14020424)
453200.00	4612300.00	1.40924	(14101024)	453300.00	4612300.00	1.47277	(16101924)
453400.00	4612300.00	1.40866	(16101924)	453500.00	4612300.00	1.45946	(15050524)
453600.00	4612300.00	1.40928	(15112824)	453700.00	4612300.00	1.50349	(12012024)
453800.00	4612300.00	1.70433	(15090424)	453900.00	4612300.00	1.55173	(15021024)
454000.00	4612300.00	1.50670	(12032424)	454100.00	4612300.00	1.71233	(12032424)
454200.00	4612300.00	1.57730	(12032424)	454300.00	4612300.00	1.36448	(13081824)
454400.00	4612300.00	1.36535	(14120424)	454500.00	4612300.00	1.22201	(12092824)
454600.00	4612300.00	1.18966	(13050524)	454700.00	4612300.00	1.29449	(15012124)
454800.00	4612300.00	1.32874	(14021524)	454900.00	4612300.00	1.53998	(14121924)
455000.00	4612300.00	1.57635	(14122924)	455100.00	4612300.00	1.34106m	(16092324)
455200.00	4612300.00	1.31783	(13111924)	455300.00	4612300.00	1.35632	(16100124)

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        455400.00   4612300.00        1.33493  (14080224)              455500.00
4612300.00        1.43463  (14080224)
        455600.00   4612300.00        1.31857  (14080224)              455700.00
4612300.00        1.27346  (13082224)
        455800.00   4612300.00        1.22751  (13020824)              455900.00
4612300.00        1.31321  (16121724)
        456000.00   4612300.00        1.32413  (16021624)              456100.00
4612300.00        1.44087  (15011924)
        456200.00   4612300.00        1.56523  (15011924)              456300.00
4612300.00        1.57726  (16102724)
        456400.00   4612300.00        1.49885  (14112724)              456500.00
4612300.00        1.41641  (15011924)
        456600.00   4612300.00        1.37219  (13120724)              452000.00
4612400.00        0.93731  (15011324)
        452100.00   4612400.00        0.87443  (12113024)              452200.00
4612400.00        0.82298  (12113024)
        452300.00   4612400.00        0.87549  (14092624)              452400.00
4612400.00        0.94621  (14062524)
        452500.00   4612400.00        1.00277  (15092524)              452600.00
4612400.00        1.13390  (15100524)
        452700.00   4612400.00        1.24007  (16101924)              452800.00
4612400.00        1.34801  (12120724)
        452900.00   4612400.00        1.42654c (12060624)              453000.00
4612400.00        1.44736c (12060624)
        453100.00   4612400.00        1.45375  (15080824)              453200.00
4612400.00        1.46207  (14101024)
        453300.00   4612400.00        1.55553  (16101924)              453400.00
4612400.00        1.53071  (13050424)
        453500.00   4612400.00        1.55570  (16112124)              453600.00
4612400.00        1.55045  (15112824)
        453700.00   4612400.00        1.46582  (12020724)              453800.00
4612400.00        1.67860  (14061024)
        453900.00   4612400.00        1.66574  (12012024)              454000.00
4612400.00        1.63408  (15062024)
        454100.00   4612400.00        1.82321  (15090424)              454200.00
4612400.00        1.68972  (12020724)
        454300.00   4612400.00        1.39915  (13060724)              454400.00
4612400.00        1.40150  (13081824)
        454500.00   4612400.00        1.27384  (12092824)              454600.00
4612400.00        1.24782  (15020924)
        454700.00   4612400.00        1.29705  (15072624)              454800.00
4612400.00        1.45337  (13082324)
        454900.00   4612400.00        1.66073  (14121924)              455000.00
4612400.00        1.58793  (16072624)
        455100.00   4612400.00        1.32171  (12032224)              455200.00
4612400.00        1.42279  (14121924)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455300.00	4612400.00	1.41956	(16100124)	455400.00	4612400.00	1.47643	(12112624)
455500.00	4612400.00	1.45986	(14080224)	455600.00	4612400.00	1.43693	(13020824)
455700.00	4612400.00	1.28683	(13082224)	455800.00	4612400.00	1.26101	(13020824)
455900.00	4612400.00	1.34348c	(14013124)	456000.00	4612400.00	1.54531	(14121024)
456100.00	4612400.00	1.56823	(15011924)	456200.00	4612400.00	1.67588	(16102724)
456300.00	4612400.00	1.58850	(16102724)	456400.00	4612400.00	1.52979	(14112724)
456500.00	4612400.00	1.40487	(13120724)	456600.00	4612400.00	1.39631	(16021624)
452000.00	4612500.00	1.03273	(13020724)	452100.00	4612500.00	0.96536	(15011324)
452200.00	4612500.00	0.90643	(13020724)	452300.00	4612500.00	0.86620	(12113024)
452400.00	4612500.00	0.91938c	(14092724)	452500.00	4612500.00	1.02204	(15092524)
452600.00	4612500.00	1.07271	(15092524)	452700.00	4612500.00	1.22898	(16101924)
452800.00	4612500.00	1.28229	(16021724)	452900.00	4612500.00	1.54281	(12110224)
453000.00	4612500.00	1.57428	(12012624)	453100.00	4612500.00	1.54431	(14062524)
453200.00	4612500.00	1.53958	(16101924)	453300.00	4612500.00	1.61980	(15112824)
453400.00	4612500.00	1.63658	(16101924)	453500.00	4612500.00	1.60923	(14012024)
453600.00	4612500.00	1.60501	(14061024)	453700.00	4612500.00	1.52233	(15112824)
453800.00	4612500.00	1.79159	(14061024)	453900.00	4612500.00	1.81656	(12012024)

454000.00 4612500.00 1.62618 (15062024) 454100.00
4612500.00 2.01116 (15090424)
454200.00 4612500.00 1.83396 (12020724) 454300.00
4612500.00 1.47455 (13060724)
454400.00 4612500.00 1.45543 (13081824) 454500.00
4612500.00 1.32964 (12092824)
454600.00 4612500.00 1.31906 (12122524) 454700.00
4612500.00 1.36632 (12122524)
454800.00 4612500.00 1.49437 (14121924) 454900.00
4612500.00 1.77192 (14120924)
455000.00 4612500.00 1.57427 (14120924) 455100.00
4612500.00 1.43328 (14121024)
455200.00 4612500.00 1.51011 (16100124) 455300.00
4612500.00 1.49773 (14122924)
455400.00 4612500.00 1.54585 (14080224) 455500.00
4612500.00 1.47146 (16102124)
455600.00 4612500.00 1.40099 (13111924) 455700.00
4612500.00 1.39552 (13020824)
455800.00 4612500.00 1.53580 (16121724) 455900.00
4612500.00 1.53232 (16021624)
456000.00 4612500.00 1.67308 (12112624) 456100.00
4612500.00 1.74157 (15011924)
456200.00 4612500.00 1.70946 (16102724) 456300.00
4612500.00 1.60763 (14112724)
456400.00 4612500.00 1.47586 (15111024) 456500.00
4612500.00 1.48112 (13032624)
456600.00 4612500.00 1.39709 (14010824) 452000.00
4612600.00 0.99808 (16112124)
452100.00 4612600.00 1.09879 (13020724) 452200.00
4612600.00 1.02163 (15011324)
452300.00 4612600.00 0.94322 (13020724) 452400.00
4612600.00 0.95451c (14092724)
452500.00 4612600.00 1.02781c (14092724) 452600.00
4612600.00 1.12083 (15092524)
452700.00 4612600.00 1.16769 (16101924) 452800.00
4612600.00 1.32906 (14092624)
452900.00 4612600.00 1.44363 (12120724) 453000.00
4612600.00 1.55897c (12060624)
453100.00 4612600.00 1.61573 (15080824) 453200.00
4612600.00 1.63919 (16112124)
453300.00 4612600.00 1.62849 (14101024) 453400.00
4612600.00 1.73989 (16101924)
453500.00 4612600.00 1.68238 (16101924) 453600.00
4612600.00 1.63869 (12011624)
453700.00 4612600.00 1.69363 (15112824) 453800.00
4612600.00 1.90309 (12012024)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453900.00	4612600.00	1.97493	(12012024)	454000.00	4612600.00	1.64776	(15021024)
454100.00	4612600.00	2.13687	(15062024)	454200.00	4612600.00	1.97458	(12092824)
454300.00	4612600.00	1.55671	(13060724)	454400.00	4612600.00	1.49810	(13081824)
454500.00	4612600.00	1.40669	(13122024)	454600.00	4612600.00	1.39789	(12122524)
454700.00	4612600.00	1.46946	(12032224)	454800.00	4612600.00	1.63786	(14121924)
454900.00	4612600.00	1.86849	(14120924)	455000.00	4612600.00	1.66766m	(16092324)
455100.00	4612600.00	1.56326	(16100124)	455200.00	4612600.00	1.60417	(16100124)
455300.00	4612600.00	1.65405	(12112624)	455400.00	4612600.00	1.58690	(14080224)
455500.00	4612600.00	1.65407	(13020824)	455600.00	4612600.00	1.45235	(12121724)
455700.00	4612600.00	1.42721	(13020824)	455800.00	4612600.00	1.48798	(16021624)
455900.00	4612600.00	1.63691	(14121024)	456000.00	4612600.00	1.74976	(15011924)
456100.00	4612600.00	1.84804	(16102724)	456200.00	4612600.00	1.69995	(14112724)
456300.00	4612600.00	1.48250	(13120724)	456400.00	4612600.00	1.56341	(13032624)
456500.00	4612600.00	1.44548	(14121824)	456600.00	4612600.00	1.50851	(13121624)
452000.00	4612700.00	1.02175	(12113024)	452100.00	4612700.00	1.06341	(12113024)
452200.00	4612700.00	1.15705	(13020724)	452300.00	4612700.00	1.08302	(12113024)
452400.00	4612700.00	1.00600	(14120524)	452500.00	4612700.00	1.00609c	(14092724)

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        452600.00   4612700.00        1.07962c (14092724)              452700.00
4612700.00        1.22094  (15092524)
        452800.00   4612700.00        1.30546  (16101924)              452900.00
4612700.00        1.36255  (16021724)
        453000.00   4612700.00        1.69849  (12120724)              453100.00
4612700.00        1.77992  (15012724)
        453200.00   4612700.00        1.77021  (15080824)              453300.00
4612700.00        1.72524  (16101924)
        453400.00   4612700.00        1.83106  (16101924)              453500.00
4612700.00        1.82780  (16101924)
        453600.00   4612700.00        1.86605  (12011624)              453700.00
4612700.00        1.88604  (15112824)
        453800.00   4612700.00        1.88927  (12012024)              453900.00
4612700.00        2.13704  (12012024)
        454000.00   4612700.00        1.74662  (15021024)              454100.00
4612700.00        2.16444  (15062024)
        454200.00   4612700.00        2.05247  (12092824)              454300.00
4612700.00        1.64394  (12032424)
        454400.00   4612700.00        1.47974  (13081824)              454500.00
4612700.00        1.51003  (14120424)
        454600.00   4612700.00        1.52835  (12122524)              454700.00
4612700.00        1.56230  (12122524)
        454800.00   4612700.00        1.77614  (14121924)              454900.00
4612700.00        1.94079  (14122924)
        455000.00   4612700.00        1.63922m (16092324)              455100.00
4612700.00        1.69033  (16100124)
        455200.00   4612700.00        1.68437  (16100124)              455300.00
4612700.00        1.66629  (14080224)
        455400.00   4612700.00        1.67846  (16102124)              455500.00
4612700.00        1.58043  (16102124)
        455600.00   4612700.00        1.60065  (13020824)              455700.00
4612700.00        1.69525c (14013124)
        455800.00   4612700.00        1.77309  (16021624)              455900.00
4612700.00        1.82321  (12112624)
        456000.00   4612700.00        1.94466  (15011924)              456100.00
4612700.00        1.81762  (16102724)
        456200.00   4612700.00        1.56770  (15011924)              456300.00
4612700.00        1.64698  (13032624)
        456400.00   4612700.00        1.53733  (16021624)              456500.00
4612700.00        1.61290  (14010824)
        456600.00   4612700.00        1.52662  (13120624)              452000.00
4612800.00        0.88262  (15122524)
        452100.00   4612800.00        1.07885  (14012024)              452200.00
4612800.00        1.13599  (12113024)
        452300.00   4612800.00        1.21934  (13020724)              452400.00
4612800.00        1.15808  (12113024)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452500.00	4612800.00	1.07779	(14120524)	452600.00	4612800.00	1.10450	(12110224)
452700.00	4612800.00	1.16278	(14062524)	452800.00	4612800.00	1.28472	(15092524)
452900.00	4612800.00	1.44573	(14092624)	453000.00	4612800.00	1.54202	(16101924)
453100.00	4612800.00	1.78783	(12110224)	453200.00	4612800.00	1.81124	(15080824)
453300.00	4612800.00	1.83458	(16112124)	453400.00	4612800.00	1.87914	(15112824)
453500.00	4612800.00	1.96315	(16101924)	453600.00	4612800.00	1.97601	(13122024)
453700.00	4612800.00	1.94597	(14061024)	453800.00	4612800.00	1.84557	(12012024)
453900.00	4612800.00	2.17164	(15090424)	454000.00	4612800.00	1.89686	(12012024)
454100.00	4612800.00	2.17634	(15062024)	454200.00	4612800.00	2.14625	(12032424)
454300.00	4612800.00	1.78553	(12032424)	454400.00	4612800.00	1.59608	(13081824)
454500.00	4612800.00	1.59072	(15020924)	454600.00	4612800.00	1.61465	(13082324)
454700.00	4612800.00	1.78975m	(16092324)	454800.00	4612800.00	1.95854	(14121924)
454900.00	4612800.00	1.99478	(14120924)	455000.00	4612800.00	1.71942	(16100124)
455100.00	4612800.00	1.81385	(16100124)	455200.00	4612800.00	1.87524	(12112624)
455300.00	4612800.00	1.79381	(16102124)	455400.00	4612800.00	1.90219	(13111924)
455500.00	4612800.00	1.71981	(12121724)	455600.00	4612800.00	1.67265	(16121724)
455700.00	4612800.00	1.75414	(16021624)	455800.00	4612800.00	2.00316	(16021624)

455900.00	4612800.00	1.96262	(15011924)	456000.00	4612800.00	1.99988	(16102724)
456100.00	4612800.00	1.71095	(15011924)	456200.00	4612800.00	1.76063	(16121724)
456300.00	4612800.00	1.66204	(16021624)	456400.00	4612800.00	1.67935	(14010824)
456500.00	4612800.00	1.64251	(13120624)	456600.00	4612800.00	1.59095	(15111024)
452000.00	4612900.00	1.00573	(15122524)	452100.00	4612900.00	0.95250	(14012024)
452200.00	4612900.00	1.12135	(14012024)	452300.00	4612900.00	1.21652	(12113024)
452400.00	4612900.00	1.28773	(13020724)	452500.00	4612900.00	1.24052	(12113024)
452600.00	4612900.00	1.14432	(16112124)	452700.00	4612900.00	1.16632	(14120524)
452800.00	4612900.00	1.29648	(14062524)	452900.00	4612900.00	1.39816	(13052524)
453000.00	4612900.00	1.59086	(14092624)	453100.00	4612900.00	1.82510	(12120724)
453200.00	4612900.00	1.92684	(15012724)	453300.00	4612900.00	2.00934	(15080824)
453400.00	4612900.00	1.97612	(14020424)	453500.00	4612900.00	2.08242	(16101924)
453600.00	4612900.00	2.04800	(16101924)	453700.00	4612900.00	2.04601	(15100524)
453800.00	4612900.00	2.07891	(15112824)	453900.00	4612900.00	2.25572	(14061024)
454000.00	4612900.00	2.13667	(12012024)	454100.00	4612900.00	2.19351	(15062024)
454200.00	4612900.00	2.28044	(12032424)	454300.00	4612900.00	1.94400	(12032424)
454400.00	4612900.00	1.68905	(13060724)	454500.00	4612900.00	1.70791	(15020924)
454600.00	4612900.00	1.74427	(12122524)	454700.00	4612900.00	1.88766	(13082324)
454800.00	4612900.00	2.12084	(14121924)	454900.00	4612900.00	2.05716	(12032224)
455000.00	4612900.00	1.87715	(16100124)	455100.00	4612900.00	1.92767	(16100124)
455200.00	4612900.00	1.86586	(16102124)	455300.00	4612900.00	1.93733	(16102124)
455400.00	4612900.00	1.81425	(16102124)	455500.00	4612900.00	1.85428	(13020824)
455600.00	4612900.00	1.84869c	(14013124)	455700.00	4612900.00	2.02210	(13121624)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455800.00	4612900.00	1.98374	(12112624)	455900.00	4612900.00	2.10987	(16021624)
456000.00	4612900.00	1.87331	(15011924)	456100.00	4612900.00	1.92663	(15111024)
456200.00	4612900.00	1.80240	(16021624)	456300.00	4612900.00	1.82573	(12121724)
456400.00	4612900.00	1.74229	(14010824)	456500.00	4612900.00	1.63251	(15111024)
456600.00	4612900.00	1.55147m	(12121924)	452000.00	4613000.00	1.02812	(12113024)
452100.00	4613000.00	1.04163	(15011324)	452200.00	4613000.00	0.97379	(14012024)
452300.00	4613000.00	1.19145	(14012024)	452400.00	4613000.00	1.30947	(12113024)
452500.00	4613000.00	1.36496	(13020724)	452600.00	4613000.00	1.29171	(13020724)
452700.00	4613000.00	1.18163	(16112124)	452800.00	4613000.00	1.16663c	(14092724)
452900.00	4613000.00	1.43566	(14092624)	453000.00	4613000.00	1.57186	(15092524)
453100.00	4613000.00	1.66376	(16021724)	453200.00	4613000.00	2.09172	(12110224)
453300.00	4613000.00	2.16169	(12012624)	453400.00	4613000.00	2.07327	(16112124)
453500.00	4613000.00	2.18040	(16101924)	453600.00	4613000.00	2.22939	(16101924)
453700.00	4613000.00	2.20943	(15050524)	453800.00	4613000.00	2.32306	(15050524)
453900.00	4613000.00	2.43958	(14061024)	454000.00	4613000.00	2.40585	(12012024)
454100.00	4613000.00	2.32207	(15072624)	454200.00	4613000.00	2.44786	(12032424)
454300.00	4613000.00	2.11488	(12032424)	454400.00	4613000.00	1.82649	(16102024)

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        454500.00   4613000.00        1.83699  (15020924)              454600.00
4613000.00        1.88201  (13082324)
        454700.00   4613000.00        1.97227  (13082324)              454800.00
4613000.00        2.17338  (14122924)
        454900.00   4613000.00        2.08899m (16092324)              455000.00
4613000.00        2.04334  (16100124)
        455100.00   4613000.00        2.06081  (14122924)              455200.00
4613000.00        2.08092  (16102124)
        455300.00   4613000.00        2.14250  (13111924)              455400.00
4613000.00        2.06925  (12121724)
        455500.00   4613000.00        2.00564  (16121724)              455600.00
4613000.00        2.08312  (16021624)
        455700.00   4613000.00        2.21976  (12112624)              455800.00
4613000.00        2.17487  (15011924)
        455900.00   4613000.00        2.07970  (16102724)              456000.00
4613000.00        1.97988  (15111024)
        456100.00   4613000.00        1.96286  (16021624)              456200.00
4613000.00        1.99628  (12121724)
        456300.00   4613000.00        1.82135  (14010824)              456400.00
4613000.00        1.68895  (15111024)
        456500.00   4613000.00        1.63696m (12121924)              456600.00
4613000.00        1.54000m (12121924)
        452000.00   4613100.00        1.12316  (15122524)              452100.00
4613100.00        1.09256  (15012724)
        452200.00   4613100.00        1.08332  (12122424)              452300.00
4613100.00        1.11604  (13071524)
        452400.00   4613100.00        1.25976  (14012024)              452500.00
4613100.00        1.40762  (12113024)
        452600.00   4613100.00        1.44943  (12113024)              452700.00
4613100.00        1.34331  (13020724)
        452800.00   4613100.00        1.24970  (15092524)              452900.00
4613100.00        1.27017  (14062524)
        453000.00   4613100.00        1.55449  (14092624)              453100.00
4613100.00        1.71961  (14092624)
        453200.00   4613100.00        2.00853  (12120724)              453300.00
4613100.00        2.13236  (15012724)
        453400.00   4613100.00        2.28293  (15080824)              453500.00
4613100.00        2.32523  (14020424)
        453600.00   4613100.00        2.39364  (16101924)              453700.00
4613100.00        2.35306  (16112124)
        453800.00   4613100.00        2.43390  (14061024)              453900.00
4613100.00        2.47823  (12020724)
        454000.00   4613100.00        2.69703  (12012024)              454100.00
4613100.00        2.30173  (15072624)
        454200.00   4613100.00        2.61261  (12032424)              454300.00
4613100.00        2.30174  (12032424)
```

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454400.00	4613100.00	1.98929	(16102024)	454500.00	4613100.00	1.97909	(15020924)
454600.00	4613100.00	2.02580	(13082324)	454700.00	4613100.00	2.13013	(14121924)
454800.00	4613100.00	2.44833	(14121924)	454900.00	4613100.00	2.22045	(14120924)
455000.00	4613100.00	2.20705	(16100124)	455100.00	4613100.00	2.15678	(16102124)
455200.00	4613100.00	2.27107	(16102124)	455300.00	4613100.00	2.11168	(16102124)
455400.00	4613100.00	2.17249	(13020824)	455500.00	4613100.00	2.09861	(16021624)
455600.00	4613100.00	2.36718	(16021624)	455700.00	4613100.00	2.24643	(14112724)
455800.00	4613100.00	2.25073	(14112724)	455900.00	4613100.00	2.08245	(13032624)
456000.00	4613100.00	2.14907	(16021624)	456100.00	4613100.00	2.18950	(12121724)
456200.00	4613100.00	1.88715	(14010824)	456300.00	4613100.00	1.72206	(15111024)
456400.00	4613100.00	1.71368m	(12121924)	456500.00	4613100.00	1.61430	(16021324)
456600.00	4613100.00	1.64408	(14101124)	452000.00	4613200.00	1.17980	(14112624)
452100.00	4613200.00	1.23065	(12122424)	452200.00	4613200.00	1.19921	(15012724)
452300.00	4613200.00	1.19906	(12122424)	452400.00	4613200.00	1.25070	(15122524)
452500.00	4613200.00	1.33192	(14012024)	452600.00	4613200.00	1.51955	(12113024)
452700.00	4613200.00	1.57046	(12113024)	452800.00	4613200.00	1.41232c	(12022324)
452900.00	4613200.00	1.39129	(15092524)	453000.00	4613200.00	1.45222	(16010424)

453100.00 4613200.00 1.65357 (13052524) 453200.00
4613200.00 1.89104 (15092524)
453300.00 4613200.00 2.45394 (12120724) 453400.00
4613200.00 2.56611 (15012724)
453500.00 4613200.00 2.34468 (14020424) 453600.00
4613200.00 2.52385 (16101924)
453700.00 4613200.00 2.68886 (16112124) 453800.00
4613200.00 2.65949 (15100524)
453900.00 4613200.00 2.61929 (15112824) 454000.00
4613200.00 2.99308 (12012024)
454100.00 4613200.00 2.40060 (16040424) 454200.00
4613200.00 2.85470 (15090424)
454300.00 4613200.00 2.55695 (15062024) 454400.00
4613200.00 2.19263 (16102024)
454500.00 4613200.00 2.12578 (14101524) 454600.00
4613200.00 2.22354 (12032224)
454700.00 4613200.00 2.32020 (16072624) 454800.00
4613200.00 2.54073 (12032224)
454900.00 4613200.00 2.33431 (14121924) 455000.00
4613200.00 2.48376 (12112624)
455100.00 4613200.00 2.44639 (16102124) 455200.00
4613200.00 2.41579 (16102124)
455300.00 4613200.00 2.52343 (13020824) 455400.00
4613200.00 2.41750c (14013124)
455500.00 4613200.00 2.52255 (13121624) 455600.00
4613200.00 2.43224 (12112624)
455700.00 4613200.00 2.41099 (14112724) 455800.00
4613200.00 2.21684 (13032624)
455900.00 4613200.00 2.35115 (16021624) 456000.00
4613200.00 2.41963 (13121624)
456100.00 4613200.00 2.04149 (12121724) 456200.00
4613200.00 1.81309m (12121924)
456300.00 4613200.00 1.80766m (12121924) 456400.00
4613200.00 1.73197 (16021324)
456500.00 4613200.00 1.72936 (16112124) 456600.00
4613200.00 1.89968 (13120624)
452000.00 4613300.00 1.31704 (12032924) 452100.00
4613300.00 1.33334 (14112624)
452200.00 4613300.00 1.30085 (12122424) 452300.00
4613300.00 1.36978 (12122424)
452400.00 4613300.00 1.27133 (12113024) 452500.00
4613300.00 1.37835 (15122524)
452600.00 4613300.00 1.41198 (14012024) 452700.00
4613300.00 1.64699 (12113024)
452800.00 4613300.00 1.71011 (12113024) 452900.00
4613300.00 1.55831c (12022324)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453000.00	4613300.00	1.54614	(15092524)	453100.00	4613300.00	1.62145	(16010424)
453200.00	4613300.00	1.90580	(16101924)	453300.00	4613300.00	2.18644	(12120724)
453400.00	4613300.00	2.56064	(12110224)	453500.00	4613300.00	2.56279	(15080824)
453600.00	4613300.00	2.66940	(12011124)	453700.00	4613300.00	2.90426	(13122024)
453800.00	4613300.00	2.82306	(15050524)	453900.00	4613300.00	2.92312	(15050524)
454000.00	4613300.00	3.16868	(15012124)	454100.00	4613300.00	2.67011	(12012024)
454200.00	4613300.00	2.99939	(15062024)	454300.00	4613300.00	2.70078	(15062024)
454400.00	4613300.00	2.33686	(12092824)	454500.00	4613300.00	2.30755	(15020924)
454600.00	4613300.00	2.42093	(14101524)	454700.00	4613300.00	2.41700	(14122924)
454800.00	4613300.00	2.54888m	(16010924)	454900.00	4613300.00	2.48700	(12112624)
455000.00	4613300.00	2.52557	(16102124)	455100.00	4613300.00	2.70516	(16102124)
455200.00	4613300.00	2.52059	(12121724)	455300.00	4613300.00	2.58153	(13020824)
455400.00	4613300.00	2.63053	(16021624)	455500.00	4613300.00	2.72277	(16021624)
455600.00	4613300.00	2.58263	(14112724)	455700.00	4613300.00	2.36545	(13032624)
455800.00	4613300.00	2.53093	(15111024)	455900.00	4613300.00	2.60194	(14121824)
456000.00	4613300.00	2.27407	(12121724)	456100.00	4613300.00	1.97182	(12121724)
456200.00	4613300.00	1.90270m	(12121924)	456300.00	4613300.00	1.86321	(16021324)

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        456400.00   4613300.00        1.91115  (16112124)              456500.00
4613300.00        1.94683  (13120724)
        456600.00   4613300.00        1.81700  (12121724)              452000.00
4613400.00        1.37705  (14112624)
        452100.00   4613400.00        1.51894  (14112624)              452200.00
4613400.00        1.47632  (14112624)
        452300.00   4613400.00        1.40973  (12122424)              452400.00
4613400.00        1.48033  (12122424)
        452500.00   4613400.00        1.37828  (12032924)              452600.00
4613400.00        1.48360  (12113024)
        452700.00   4613400.00        1.50130  (14012024)              452800.00
4613400.00        1.79449  (12113024)
        452900.00   4613400.00        1.86463  (16112124)              453000.00
4613400.00        1.70051  (16112124)
        453100.00   4613400.00        1.65630  (13121924)              453200.00
4613400.00        1.75301  (13052524)
        453300.00   4613400.00        2.17871  (16101924)              453400.00
4613400.00        2.75242  (12120724)
        453500.00   4613400.00        3.05333  (15012724)              453600.00
4613400.00        2.76763  (14020424)
        453700.00   4613400.00        2.89395  (14020424)              453800.00
4613400.00        2.96772  (12011624)
        453900.00   4613400.00        3.18820  (14061024)              454000.00
4613400.00        3.33842  (14061024)
        454100.00   4613400.00        3.07256  (12012024)              454200.00
4613400.00        3.19240  (12032424)
        454300.00   4613400.00        3.06455  (12032424)              454400.00
4613400.00        2.54120  (15020924)
        454500.00   4613400.00        2.49779  (15020924)              454600.00
4613400.00        2.66907  (14101524)
        454700.00   4613400.00        2.82244  (14122924)              454800.00
4613400.00        2.76733m (16010924)
        454900.00   4613400.00        2.77988  (16100124)              455000.00
4613400.00        2.92754  (16102124)
        455100.00   4613400.00        2.90000  (16102124)              455200.00
4613400.00        3.00021c (14013124)
        455300.00   4613400.00        2.72632  (16021624)              455400.00
4613400.00        3.01729  (16021624)
        455500.00   4613400.00        2.75234  (14112724)              455600.00
4613400.00        2.64824  (14112724)
        455700.00   4613400.00        2.69918  (16121724)              455800.00
4613400.00        2.71333  (15111024)
        455900.00   4613400.00        2.37050  (15111024)              456000.00
4613400.00        2.18623  (12121724)
        456100.00   4613400.00        2.02322  (16100324)              456200.00
4613400.00        1.99512  (16021324)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 ,
V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 ,
VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456300.00	4613400.00	2.12357	(16112124)	456400.00	4613400.00	1.99389	(13120724)
456500.00	4613400.00	1.94311	(13112924)	456600.00	4613400.00	1.76995	(12121724)
452000.00	4613500.00	1.40524	(13052424)	452100.00	4613500.00	1.39605	(13052424)
452200.00	4613500.00	1.57634	(14112624)	452300.00	4613500.00	1.60805	(12032924)
452400.00	4613500.00	1.51297	(12122424)	452500.00	4613500.00	1.60891	(12122424)
452600.00	4613500.00	1.55011	(12020324)	452700.00	4613500.00	1.57774	(12113024)
452800.00	4613500.00	1.60161	(14012024)	452900.00	4613500.00	1.95287	(12113024)
453000.00	4613500.00	2.00829	(16112124)	453100.00	4613500.00	1.79160	(16112124)
453200.00	4613500.00	1.79165	(12113024)	453300.00	4613500.00	2.01458	(16101924)
453400.00	4613500.00	2.46314	(16101924)	453500.00	4613500.00	3.08443	(14062524)
453600.00	4613500.00	3.38267	(12012624)	453700.00	4613500.00	3.28620	(16112124)
453800.00	4613500.00	3.27677	(12011624)	453900.00	4613500.00	3.40503	(15050524)
454000.00	4613500.00	3.54493	(12012024)	454100.00	4613500.00	3.51401	(12012024)
454200.00	4613500.00	3.44878	(14012024)	454300.00	4613500.00	3.32075	(12092824)
454400.00	4613500.00	2.80067	(13051024)	454500.00	4613500.00	2.76620	(12122524)
454600.00	4613500.00	2.95579	(14101524)	454700.00	4613500.00	3.06534	(14121924)
454800.00	4613500.00	2.96905	(16100124)	454900.00	4613500.00	3.02450	(12020724)

455000.00 4613500.00 3.20911 (13111924) 455100.00
4613500.00 3.16263 (12121724)
455200.00 4613500.00 3.10669 (13020824) 455300.00
4613500.00 3.32327 (14121024)
455400.00 4613500.00 3.06218 (12112624) 455500.00
4613500.00 2.88250 (14112724)
455600.00 4613500.00 3.05491 (16121724) 455700.00
4613500.00 2.97210 (13120624)
455800.00 4613500.00 2.61930 (16021624) 455900.00
4613500.00 2.42660 (14010824)
456000.00 4613500.00 2.20920 (16100324) 456100.00
4613500.00 2.14248 (16021324)
456200.00 4613500.00 2.32286 (16112124) 456300.00
4613500.00 2.21886 (15101324)
456400.00 4613500.00 1.98909 (13032124) 456500.00
4613500.00 1.93031 (13032124)
456600.00 4613500.00 1.86677 (13032124) 452000.00
4613600.00 1.37340c (13022524)
452100.00 4613600.00 1.46293 (13052424) 452200.00
4613600.00 1.50500 (13052424)
452300.00 4613600.00 1.62350 (14112624) 452400.00
4613600.00 1.78119 (12011124)
452500.00 4613600.00 1.72803 (14112624) 452600.00
4613600.00 1.75237 (12122424)
452700.00 4613600.00 1.74256 (12020324) 452800.00
4613600.00 1.66984 (13083124)
452900.00 4613600.00 1.86299 (13071524) 453000.00
4613600.00 2.13374 (12113024)
453100.00 4613600.00 2.16784 (16112124) 453200.00
4613600.00 1.89269 (16112124)
453300.00 4613600.00 2.00804 (14052324) 453400.00
4613600.00 2.40096 (16101924)
453500.00 4613600.00 3.07560 (12120724) 453600.00
4613600.00 3.65307 (14062524)
453700.00 4613600.00 3.37327 (15080824) 453800.00
4613600.00 3.69975 (16112124)
453900.00 4613600.00 3.58733 (16092224) 454000.00
4613600.00 3.71177 (15050524)
454100.00 4613600.00 3.89673 (16092224) 454200.00
4613600.00 3.85122 (15072624)
454300.00 4613600.00 3.61592 (12092824) 454400.00
4613600.00 3.15019c (15011224)
454500.00 4613600.00 3.11616 (12122524) 454600.00
4613600.00 3.21643 (12122524)
454700.00 4613600.00 3.26303 (14121924) 454800.00
4613600.00 3.30491 (16100124)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454900.00	4613600.00	3.49371	(13111924)	455000.00	4613600.00	3.56270	(16102124)
455100.00	4613600.00	3.39838c	(14013124)	455200.00	4613600.00	3.65293	(16021624)
455300.00	4613600.00	3.57380	(12112624)	455400.00	4613600.00	3.17164	(14112724)
455500.00	4613600.00	3.40518	(16021624)	455600.00	4613600.00	3.23747	(13121624)
455700.00	4613600.00	2.98530	(16021624)	455800.00	4613600.00	2.68023	(14010824)
455900.00	4613600.00	2.40053	(12121724)	456000.00	4613600.00	2.35788	(13032124)
456100.00	4613600.00	2.52730	(13120724)	456200.00	4613600.00	2.25111	(13032124)
456300.00	4613600.00	2.18566	(13032124)	456400.00	4613600.00	2.11833	(13032124)
456500.00	4613600.00	2.04721	(13032124)	456600.00	4613600.00	1.97052	(14021524)
452000.00	4613700.00	1.44799	(15121224)	452100.00	4613700.00	1.50226c	(13022524)
452200.00	4613700.00	1.53928c	(13022524)	452300.00	4613700.00	1.63678	(13052424)
452400.00	4613700.00	1.68503c	(16012124)	452500.00	4613700.00	1.93317	(14112624)
452600.00	4613700.00	1.97117	(14112624)	452700.00	4613700.00	1.90951	(12122424)
452800.00	4613700.00	1.97825	(12020324)	452900.00	4613700.00	1.88245	(12032924)
453000.00	4613700.00	2.06083	(12113024)	453100.00	4613700.00	2.35032	(12113024)
453200.00	4613700.00	2.44597c	(12022324)	453300.00	4613700.00	2.12034	(15092524)
453400.00	4613700.00	2.39630c	(12022324)	453500.00	4613700.00	2.81429	(16101924)

453600.00 4613700.00 3.46215 (14062524) 453700.00
4613700.00 4.10371 (14062524)
453800.00 4613700.00 4.14004 (14020424) 453900.00
4613700.00 4.03951 (16101924)
454000.00 4613700.00 4.18717 (15050524) 454100.00
4613700.00 4.48359 (12012024)
454200.00 4613700.00 4.04023 (16040424) 454300.00
4613700.00 3.95452 (12092824)
454400.00 4613700.00 3.59916 (14120924) 454500.00
4613700.00 3.53546 (12122524)
454600.00 4613700.00 3.53826 (12122524) 454700.00
4613700.00 3.46455 (12020724)
454800.00 4613700.00 3.67887 (14122924) 454900.00
4613700.00 4.04755 (16102724)
455000.00 4613700.00 3.67568 (16102124) 455100.00
4613700.00 3.79275 (13020824)
455200.00 4613700.00 4.19336 (12112624) 455300.00
4613700.00 3.48859 (14112724)
455400.00 4613700.00 3.74591 (13032624) 455500.00
4613700.00 3.51198 (14121824)
455600.00 4613700.00 3.42492 (16021624) 455700.00
4613700.00 3.00600 (14010824)
455800.00 4613700.00 2.66655 (12121724) 455900.00
4613700.00 2.61039 (13032124)
456000.00 4613700.00 2.65833 (15101324) 456100.00
4613700.00 2.48952 (13120624)
456200.00 4613700.00 2.39598 (15020524) 456300.00
4613700.00 2.34783 (13032124)
456400.00 4613700.00 2.17266 (16112124) 456500.00
4613700.00 2.04815 (14021524)
456600.00 4613700.00 1.99868 (13011524) 452000.00
4613800.00 1.45979 (12020324)
452100.00 4613800.00 1.49717 (15121224) 452200.00
4613800.00 1.69985 (15022524)
452300.00 4613800.00 1.72363 (12011124) 452400.00
4613800.00 1.74205c (13022524)
452500.00 4613800.00 1.82167 (13052424) 452600.00
4613800.00 1.97893 (15012724)
452700.00 4613800.00 2.20468 (12032924) 452800.00
4613800.00 2.08501 (12122424)
452900.00 4613800.00 2.21742 (12122424) 453000.00
4613800.00 2.09030 (12122424)
453100.00 4613800.00 2.28576 (15122524) 453200.00
4613800.00 2.58651 (12113024)
453300.00 4613800.00 2.68846 (15011324) 453400.00
4613800.00 2.60194 (12110224)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453500.00	4613800.00	2.81665	(15100524)	453600.00	4613800.00	3.58670	(15092524)
453700.00	4613800.00	4.17090	(14062524)	453800.00	4613800.00	4.33223	(14062524)
453900.00	4613800.00	4.59313	(16101924)	454000.00	4613800.00	4.63284	(14061024)
454100.00	4613800.00	4.83379	(16092224)	454200.00	4613800.00	4.73529	(13031624)
454300.00	4613800.00	4.47100	(13052324)	454400.00	4613800.00	4.18258	(16102024)
454500.00	4613800.00	3.96426	(15072624)	454600.00	4613800.00	3.93085	(14121024)
454700.00	4613800.00	4.21150	(12112624)	454800.00	4613800.00	3.97549	(16102724)
454900.00	4613800.00	4.47144c	(14013124)	455000.00	4613800.00	3.92815c	(15020424)
455100.00	4613800.00	4.65496	(16102724)	455200.00	4613800.00	3.94800	(12112624)
455300.00	4613800.00	4.12593	(13032624)	455400.00	4613800.00	3.82284	(14121824)
455500.00	4613800.00	3.97630	(16021624)	455600.00	4613800.00	3.40132	(14010824)
455700.00	4613800.00	3.00972	(13032624)	455800.00	4613800.00	2.91417	(13032124)
455900.00	4613800.00	2.86018	(13032124)	456000.00	4613800.00	2.63019	(13120624)
456100.00	4613800.00	2.59748	(15020524)	456200.00	4613800.00	2.50393	(16112124)
456300.00	4613800.00	2.26038	(14021024)	456400.00	4613800.00	2.22074	(15020524)
456500.00	4613800.00	2.10010	(13123024)	456600.00	4613800.00	1.97230	(14021024)
452000.00	4613900.00	1.58252c	(12022324)	452100.00	4613900.00	1.59616	(16120624)

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        452200.00   4613900.00        1.60813  (15050624)              452300.00
4613900.00        1.72802  (15032324)
        452400.00   4613900.00        1.85292c (13022524)              452500.00
4613900.00        1.98196c (13022524)
        452600.00   4613900.00        1.99696c (13022524)              452700.00
4613900.00        2.03878  (14112624)
        452800.00   4613900.00        2.35989  (12032924)              452900.00
4613900.00        2.38577  (14112624)
        453000.00   4613900.00        2.49639  (15012724)              453100.00
4613900.00        2.43705  (12020324)
        453200.00   4613900.00        2.63391  (15122524)              453300.00
4613900.00        2.88517  (12113024)
        453400.00   4613900.00        2.98272  (15011324)              453500.00
4613900.00        2.90920  (12113024)
        453600.00   4613900.00        3.42081  (14062524)              453700.00
4613900.00        4.20021  (15092524)
        453800.00   4613900.00        4.96967  (14062524)              453900.00
4613900.00        5.36325  (12011124)
        454000.00   4613900.00        5.06462  (12120724)              454100.00
4613900.00        5.63733  (14061024)
        454200.00   4613900.00        5.28839  (16040424)              454300.00
4613900.00        5.27675  (13052324)
        454400.00   4613900.00        4.83968  (16102024)              454500.00
4613900.00        4.46182  (14101824)
        454600.00   4613900.00        4.60845m (16092324)              454700.00
4613900.00        4.67732  (13030124)
        454800.00   4613900.00        5.39177  (16102124)              454900.00
4613900.00        4.64194  (16102124)
        455000.00   4613900.00        5.22598  (16102724)              455100.00
4613900.00        4.75567  (12112624)
        455200.00   4613900.00        4.57614  (13032624)              455300.00
4613900.00        4.21207  (16121724)
        455400.00   4613900.00        4.62883  (16021624)              455500.00
4613900.00        3.96012  (16021624)
        455600.00   4613900.00        3.29618  (16100324)              455700.00
4613900.00        3.25529  (16112124)
        455800.00   4613900.00        3.19066  (13032124)              455900.00
4613900.00        2.83024  (15020524)
        456000.00   4613900.00        2.79176  (16112124)              456100.00
4613900.00        2.57652  (13110224)
        456200.00   4613900.00        2.48628  (15020524)              456300.00
4613900.00        2.35116  (14021024)
        456400.00   4613900.00        2.21415  (13123024)              456500.00
4613900.00        2.11153  (12082124)
        456600.00   4613900.00        2.04746c (14013124)              452000.00
4614000.00        1.79019c (12022324)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452100.00	4614000.00	1.87560c	(12022324)	452200.00	4614000.00	1.85329c	(12022324)
452300.00	4614000.00	1.85286m	(15022124)	452400.00	4614000.00	1.90200	(15032324)
452500.00	4614000.00	1.94408	(15032324)	452600.00	4614000.00	2.18215c	(13022524)
452700.00	4614000.00	2.32168c	(13022524)	452800.00	4614000.00	2.29415	(13071524)
452900.00	4614000.00	2.46856	(12032924)	453000.00	4614000.00	2.75432	(15012724)
453100.00	4614000.00	2.81725	(12122424)	453200.00	4614000.00	2.88647	(12020324)
453300.00	4614000.00	3.06883	(15122524)	453400.00	4614000.00	3.35014c	(12022324)
453500.00	4614000.00	3.32563	(15011324)	453600.00	4614000.00	3.42208	(16010424)
453700.00	4614000.00	4.15114	(14062524)	453800.00	4614000.00	5.55415	(12110224)
453900.00	4614000.00	6.31221	(15012724)	454000.00	4614000.00	5.83554	(16101924)
454100.00	4614000.00	6.44061	(14030824)	454200.00	4614000.00	6.31166	(15060524)
454300.00	4614000.00	6.23547	(15072624)	454400.00	4614000.00	5.97006	(14120924)
454500.00	4614000.00	5.29681	(16092824)	454600.00	4614000.00	5.48922	(14101524)
454700.00	4614000.00	5.51032	(16102724)	454800.00	4614000.00	5.80817	(12121724)
454900.00	4614000.00	6.03686	(16021624)	455000.00	4614000.00	5.78693	(12112624)
455100.00	4614000.00	5.24983	(16021624)	455200.00	4614000.00	4.86328	(16121724)
455300.00	4614000.00	5.21273	(13032624)	455400.00	4614000.00	4.53262	(14010824)

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        455500.00   4614000.00        3.78410  (16100324)              455600.00
4614000.00        3.71447  (13032124)
        455700.00   4614000.00        3.43412  (13120624)              455800.00
4614000.00        3.08947  (15020524)
        455900.00   4614000.00        2.96893  (13110224)              456000.00
4614000.00        2.75946  (15020524)
        456100.00   4614000.00        2.67542  (13032124)              456200.00
4614000.00        2.43875  (15101324)
        456300.00   4614000.00        2.38204  (12082124)              456400.00
4614000.00        2.26552c (14013124)
        456500.00   4614000.00        2.08214  (12020724)              456600.00
4614000.00        1.99557  (12020724)
        452000.00   4614100.00        1.90121  (16041624)              452100.00
4614100.00        1.99696  (16022224)
        452200.00   4614100.00        2.15776  (13121924)              452300.00
4614100.00        2.27548  (14010124)
        452400.00   4614100.00        2.14424c (12022324)              452500.00
4614100.00        2.10690  (15032324)
        452600.00   4614100.00        2.17107m (15022124)              452700.00
4614100.00        2.28059  (15022524)
        452800.00   4614100.00        2.58903  (16120624)              452900.00
4614100.00        2.74181c (13022524)
        453000.00   4614100.00        2.75353  (14010124)              453100.00
4614100.00        3.16982  (12032924)
        453200.00   4614100.00        3.17818  (12122424)              453300.00
4614100.00        3.40019  (13083124)
        453400.00   4614100.00        3.58775  (13083124)              453500.00
4614100.00        4.06475  (16110224)
        453600.00   4614100.00        3.79147  (15011324)              453700.00
4614100.00        4.32786  (15100524)
        453800.00   4614100.00        5.68676  (12120724)              453900.00
4614100.00        6.65170  (12100224)
        454000.00   4614100.00        7.24962  (12011624)              454100.00
4614100.00        7.29949  (14061024)
        454200.00   4614100.00        7.85603  (15060524)              454300.00
4614100.00        7.11456  (16040424)
        454400.00   4614100.00        7.15606  (14101524)              454500.00
4614100.00        6.44946  (12122524)
        454600.00   4614100.00        6.48965  (12020724)              454700.00
4614100.00        7.53461  (16102124)
        454800.00   4614100.00        6.37969  (16022524)              454900.00
4614100.00        6.82326  (16102724)
        455000.00   4614100.00        6.10286  (16021624)              455100.00
4614100.00        5.89617  (14010824)
        455200.00   4614100.00        5.85350  (13032624)              455300.00
4614100.00        5.39171  (13121624)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 , V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455400.00	4614100.00	4.43094	(15101324)	455500.00	4614100.00	4.32772	(13032124)
455600.00	4614100.00	3.68998	(16022224)	455700.00	4614100.00	3.50557	(13110224)
455800.00	4614100.00	3.17665	(14082324)	455900.00	4614100.00	3.13517	(13032124)
456000.00	4614100.00	2.91087	(15101324)	456100.00	4614100.00	2.71317c	(14013124)
456200.00	4614100.00	2.54484	(14021124)	456300.00	4614100.00	2.33361	(14111424)
456400.00	4614100.00	2.17081	(14021124)	456500.00	4614100.00	2.06615	(12020724)
456600.00	4614100.00	2.06578	(12082124)	452000.00	4614200.00	1.77225	(15050624)
452100.00	4614200.00	1.93012	(15050624)	452200.00	4614200.00	2.26820	(16110324)
452300.00	4614200.00	2.24870	(16022224)	452400.00	4614200.00	2.42517	(16022224)
452500.00	4614200.00	2.55637	(14080724)	452600.00	4614200.00	2.60807	(14080724)
452700.00	4614200.00	2.61541	(14080724)	452800.00	4614200.00	2.59893	(16120624)
452900.00	4614200.00	2.67990	(15022524)	453000.00	4614200.00	3.10215	(16120624)
453100.00	4614200.00	3.26927c	(13022524)	453200.00	4614200.00	3.35426	(14010124)
453300.00	4614200.00	3.61419	(15012724)	453400.00	4614200.00	4.00460	(12122424)
453500.00	4614200.00	4.32204	(15122524)	453600.00	4614200.00	4.78226	(12113024)
453700.00	4614200.00	4.74657	(16110224)	453800.00	4614200.00	5.32682	(15092524)
453900.00	4614200.00	7.38306	(15012724)	454000.00	4614200.00	8.29425	(12071024)

454300.00 4614200.00 8.69250 (12032424) 454400.00
4614200.00 8.98031 (14120924)
454500.00 4614200.00 7.82407 (16092824) 454600.00
4614200.00 7.82067c (14013124)
454700.00 4614200.00 8.48567 (16102124) 454800.00
4614200.00 8.94218 (12112624)
454900.00 4614200.00 7.45751 (16021624) 455000.00
4614200.00 6.63393 (16021624)
455100.00 4614200.00 6.64553 (13032624) 455200.00
4614200.00 6.24496 (14010824)
455300.00 4614200.00 5.39077 (12121724) 455400.00
4614200.00 4.76693 (16022224)
455500.00 4614200.00 4.26159 (14021124) 455600.00
4614200.00 4.06916 (14020424)
455700.00 4614200.00 3.83807 (14020424) 455800.00
4614200.00 3.51929 (14021024)
455900.00 4614200.00 3.20381c (14013124) 456000.00
4614200.00 2.88996c (14013124)
456100.00 4614200.00 2.62213 (12082124) 456200.00
4614200.00 2.43738 (14111324)
456300.00 4614200.00 2.34880 (12082124) 456400.00
4614200.00 2.13343 (12082124)
456500.00 4614200.00 2.03047 (16012024) 456600.00
4614200.00 2.04669 (16012024)
452000.00 4614300.00 1.76180 (13081724) 452100.00
4614300.00 1.78543 (12040624)
452200.00 4614300.00 2.03560 (14080724) 452300.00
4614300.00 2.25622 (14080724)
452400.00 4614300.00 2.33247 (15050624) 452500.00
4614300.00 2.69465 (16041624)
452600.00 4614300.00 2.85362 (15050624) 452700.00
4614300.00 3.01713 (16022224)
452800.00 4614300.00 3.21633 (16022224) 452900.00
4614300.00 3.26527 (16022224)
453000.00 4614300.00 3.31263 (14080724) 453100.00
4614300.00 3.38661 (16031224)
453200.00 4614300.00 3.87658 (16120624) 453300.00
4614300.00 3.98062c (13022524)
453400.00 4614300.00 4.50407 (14112624) 453500.00
4614300.00 4.74231 (15122524)
453600.00 4614300.00 5.25744 (13083124) 453700.00
4614300.00 5.95267 (12113024)
453800.00 4614300.00 6.28144 (16110224) 453900.00
4614300.00 7.29298 (12120724)
454000.00 4614300.00 9.34339 (12100224) 454400.00
4614300.00 10.72713 (13122024)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 ,
V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 ,
VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454500.00	4614300.00	9.94119	(12112624)	454600.00	4614300.00	10.53979c	(14013124)
454700.00	4614300.00	10.50419	(16121724)	454800.00	4614300.00	9.61179	(16021624)
454900.00	4614300.00	7.85211	(14121824)	455000.00	4614300.00	7.90918	(14121824)
455100.00	4614300.00	7.77829	(14010824)	455200.00	4614300.00	6.34491	(14020424)
455300.00	4614300.00	5.93256	(13032124)	455400.00	4614300.00	5.13071	(13112924)
455500.00	4614300.00	4.79296	(13110224)	455600.00	4614300.00	4.34926	(13110224)
455700.00	4614300.00	3.85190	(13110224)	455800.00	4614300.00	3.40672	(14111424)
455900.00	4614300.00	3.16018	(14111324)	456000.00	4614300.00	2.72215	(14021124)
456100.00	4614300.00	2.62130	(13080924)	456200.00	4614300.00	2.38969	(14111324)
456300.00	4614300.00	2.38677	(13080924)	456400.00	4614300.00	2.08295	(14020324)
456500.00	4614300.00	2.00439	(15072224)	456600.00	4614300.00	1.90652	(13080924)
452000.00	4614400.00	1.91958	(14092624)	452100.00	4614400.00	1.94323	(14092624)
452200.00	4614400.00	2.07001	(12040624)	452300.00	4614400.00	2.15001	(13081724)
452400.00	4614400.00	2.24870	(13081724)	452500.00	4614400.00	2.30887	(12020324)
452600.00	4614400.00	2.49299	(16041824)	452700.00	4614400.00	2.93458	(15112024)
452800.00	4614400.00	3.35309	(16041624)	452900.00	4614400.00	3.68053	(15050624)
453000.00	4614400.00	4.04273	(14010124)	453100.00	4614400.00	4.28873	(16080124)

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        453200.00   4614400.00        4.22696  (15032324)              453300.00
4614400.00        4.48020c (13022524)
        453400.00   4614400.00        5.05879c (13022524)              453500.00
4614400.00        5.27504  (14112624)
        453600.00   4614400.00        5.76753  (12122424)              453700.00
4614400.00        6.67064  (13071524)
        453800.00   4614400.00        7.55232  (12113024)              453900.00
4614400.00        8.53396  (15060124)
        454000.00   4614400.00       10.25033  (16042624)              454100.00
4614400.00       12.64091  (13050324)
        454600.00   4614400.00       13.51469  (16022524)              454700.00
4614400.00       12.34347c (15020424)
        454800.00   4614400.00       10.28290  (14121824)              454900.00
4614400.00        9.76342  (16020924)
        455000.00   4614400.00        9.33613  (13120624)              455100.00
4614400.00        7.24290  (16022224)
        455200.00   4614400.00        7.02142  (13032124)              455300.00
4614400.00        6.10375  (13110224)
        455400.00   4614400.00        5.41427  (15101324)              455500.00
4614400.00        4.70236  (13112924)
        455600.00   4614400.00        4.25015  (14111424)              455700.00
4614400.00        3.85134  (14111324)
        455800.00   4614400.00        3.35767  (15120224)              455900.00
4614400.00        2.97914  (13080924)
        456000.00   4614400.00        2.76147  (13080924)              456100.00
4614400.00        2.56573  (16102724)
        456200.00   4614400.00        2.35598  (13080924)              456300.00
4614400.00        2.24941  (15091024)
        456400.00   4614400.00        2.16359  (14111424)              456500.00
4614400.00        1.99955  (13102224)
        456600.00   4614400.00        2.00723  (16012024)              452000.00
4614500.00        1.94544  (16041624)
        452100.00   4614500.00        2.11874  (16041624)              452200.00
4614500.00        2.28553  (16041624)
        452300.00   4614500.00        2.34790  (15113024)              452400.00
4614500.00        2.48222  (16051124)
        452500.00   4614500.00        2.64348  (14092624)              452600.00
4614500.00        2.75003  (12011624)
        452700.00   4614500.00        2.81708  (12020324)              452800.00
4614500.00        2.98941  (12040624)
        452900.00   4614500.00        3.22594  (16041824)              453000.00
4614500.00        3.72926  (16031224)
        453100.00   4614500.00        4.53701  (16041624)              453200.00
4614500.00        4.90528  (15112024)
        453300.00   4614500.00        5.74435  (14080724)              453400.00
4614500.00        5.60823  (15032324)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 ,
V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 ,
VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453500.00	4614500.00	6.09437	(15032324)	453600.00	4614500.00	7.23830	(12080824)
453700.00	4614500.00	7.90919	(14010124)	453800.00	4614500.00	8.67407	(12032924)
453900.00	4614500.00	10.70450c	(12022324)	454000.00	4614500.00	12.43668	(16110224)
454100.00	4614500.00	15.00772	(15092524)	454600.00	4614500.00	17.10933	(12112624)
454700.00	4614500.00	14.55563	(13121624)	454800.00	4614500.00	12.84820	(16021324)
454900.00	4614500.00	11.78827	(12121724)	455000.00	4614500.00	9.58087	(13032124)
455100.00	4614500.00	8.29474	(15101324)	455200.00	4614500.00	7.00097	(14021124)
455300.00	4614500.00	6.12292	(15101324)	455400.00	4614500.00	5.47185	(14111424)
455500.00	4614500.00	4.81326	(14111324)	455600.00	4614500.00	4.16939	(14111324)
455700.00	4614500.00	3.63238	(15120224)	455800.00	4614500.00	3.38339	(16102724)
455900.00	4614500.00	2.97377	(13032724)	456000.00	4614500.00	2.82230	(15072224)
456100.00	4614500.00	2.57077	(13032724)	456200.00	4614500.00	2.44967	(15072224)
456300.00	4614500.00	2.26717	(13062724)	456400.00	4614500.00	2.12564	(12012424)
456500.00	4614500.00	2.03634	(12012424)	456600.00	4614500.00	1.94713	(12012424)
452000.00	4614600.00	1.77805	(16102424)	452100.00	4614600.00	1.84063	(16102424)
452200.00	4614600.00	1.94112	(15041424)	452300.00	4614600.00	2.03365	(13032924)
452400.00	4614600.00	2.16209c	(16012124)	452500.00	4614600.00	2.11479c	(16012124)

452600.00 4614600.00 2.70365 (13081724) 452700.00
4614600.00 3.17791 (16041624)
452800.00 4614600.00 3.53561 (16041624) 452900.00
4614600.00 3.81566 (15113024)
453000.00 4614600.00 3.98416 (16051124) 453100.00
4614600.00 4.24504 (14092624)
453200.00 4614600.00 4.89689 (16022324) 453300.00
4614600.00 5.35088 (16041824)
453400.00 4614600.00 6.57393 (15112024) 453500.00
4614600.00 7.66230 (16031224)
453600.00 4614600.00 7.92927 (16041624) 453700.00
4614600.00 9.27322 (16080124)
453800.00 4614600.00 10.77033 (16091424) 453900.00
4614600.00 12.45902 (15011324)
454000.00 4614600.00 14.90190 (15012724) 454100.00
4614600.00 19.74887 (12120724)
454600.00 4614600.00 23.61564 (12121724) 454700.00
4614600.00 18.48696 (16020924)
454800.00 4614600.00 15.35136 (14020324) 454900.00
4614600.00 12.26644 (13110224)
455000.00 4614600.00 10.13658 (14021124) 455100.00
4614600.00 8.69880 (15120224)
455200.00 4614600.00 7.12766 (14111424) 455300.00
4614600.00 6.05940 (14121724)
455400.00 4614600.00 5.33505 (16012024) 455500.00
4614600.00 4.65748 (16012024)
455600.00 4614600.00 4.01931 (13032724) 455700.00
4614600.00 3.66545 (16102724)
455800.00 4614600.00 3.35779 (12012524) 455900.00
4614600.00 3.17277 (12012424)
456000.00 4614600.00 2.98103 (12012424) 456100.00
4614600.00 2.78633 (12012424)
456200.00 4614600.00 2.63619 (15083124) 456300.00
4614600.00 2.50865 (16120924)
456400.00 4614600.00 2.37157 (15083124) 456500.00
4614600.00 2.20735 (12012424)
456600.00 4614600.00 2.09461 (15072024) 452000.00
4614700.00 2.11987 (13092624)
452100.00 4614700.00 2.12479 (16041724) 452200.00
4614700.00 2.11530 (16102424)
452300.00 4614700.00 2.03829 (14053124) 452400.00
4614700.00 2.12002 (14053124)
452500.00 4614700.00 2.42487 (16102424) 452600.00
4614700.00 2.90022 (13082924)
452700.00 4614700.00 3.12822 (16072624) 452800.00
4614700.00 3.25974 (16072624)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452900.00	4614700.00	3.42337	(16072624)	453000.00	4614700.00	3.82833	(16041624)
453100.00	4614700.00	4.42463	(16041624)	453200.00	4614700.00	5.20263	(16041624)
453300.00	4614700.00	6.04404	(16041624)	453400.00	4614700.00	6.71765	(14092624)
453500.00	4614700.00	7.37096	(12011624)	453600.00	4614700.00	8.40087	(15050624)
453700.00	4614700.00	11.01958	(15050624)	453800.00	4614700.00	13.38302	(12020324)
453900.00	4614700.00	18.20129	(14010124)	454000.00	4614700.00	20.98377	(15011324)
454100.00	4614700.00	27.66089	(15100524)	454600.00	4614700.00	28.33323	(13032724)
454700.00	4614700.00	21.74687	(14111324)	454800.00	4614700.00	16.43146	(14111324)
454900.00	4614700.00	12.14576	(13032724)	455000.00	4614700.00	10.34273	(14121724)
455100.00	4614700.00	8.42377	(13123024)	455200.00	4614700.00	7.19398	(13032724)
455300.00	4614700.00	6.14842	(15091024)	455400.00	4614700.00	5.48330	(15091024)
455500.00	4614700.00	4.90707	(15091024)	455600.00	4614700.00	4.39818	(15091024)
455700.00	4614700.00	3.96477	(15091024)	455800.00	4614700.00	3.58681	(15091024)
455900.00	4614700.00	3.31588	(15091024)	456000.00	4614700.00	3.07476	(15091024)
456100.00	4614700.00	2.81113	(15091024)	456200.00	4614700.00	2.64688	(15091024)
456300.00	4614700.00	2.48013	(12012424)	456400.00	4614700.00	2.29858	(15091024)
456500.00	4614700.00	2.14352	(12012424)	456600.00	4614700.00	2.04564	(13011524)

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        452000.00   4614800.00        2.24774  (14092624)              452100.00
4614800.00        2.38028  (14092624)
        452200.00   4614800.00        2.56619  (14092624)              452300.00
4614800.00        2.63637  (14092624)
        452400.00   4614800.00        2.80982  (16080324)              452500.00
4614800.00        3.01363  (16080324)
        452600.00   4614800.00        3.32795  (16072624)              452700.00
4614800.00        3.54645  (13092624)
        452800.00   4614800.00        3.92572  (16072624)              452900.00
4614800.00        4.25699  (16072624)
        453000.00   4614800.00        4.55920  (16072624)              453100.00
4614800.00        4.95855  (16072624)
        453200.00   4614800.00        5.52454  (16041724)              453300.00
4614800.00        6.30657  (16041724)
        453400.00   4614800.00        7.33477  (16080324)              453500.00
4614800.00        8.59499  (16041724)
        453600.00   4614800.00        9.82643  (16041724)              453700.00
4614800.00       11.20389  (16041724)
        453800.00   4614800.00       14.50700  (16020224)              453900.00
4614800.00       18.61350  (12101224)
        454000.00   4614800.00       32.33731  (15113024)              454600.00
4614800.00       28.34510  (12012424)
        454700.00   4614800.00       23.91472  (16112524)              454800.00
4614800.00       16.41264  (12012524)
        454900.00   4614800.00       13.39553  (12121724)              455000.00
4614800.00       11.58328  (13123024)
        455100.00   4614800.00        9.10134  (14020324)              455200.00
4614800.00        7.10992m (16120824)
        455300.00   4614800.00        6.08184  (14022424)              455400.00
4614800.00        5.32097  (14022424)
        455500.00   4614800.00        4.71085  (14022424)              455600.00
4614800.00        4.21008  (14022424)
        455700.00   4614800.00        3.79233  (14022424)              455800.00
4614800.00        3.43859  (14022424)
        455900.00   4614800.00        3.09916  (12012424)              456000.00
4614800.00        2.83644  (16050324)
        456100.00   4614800.00        2.63689  (14022424)              456200.00
4614800.00        2.43388  (14022424)
        456300.00   4614800.00        2.25747  (14022424)              456400.00
4614800.00        2.10470  (14022424)
        456500.00   4614800.00        1.99570  (12082024)              456600.00
4614800.00        1.95507  (16050324)
        452000.00   4614900.00        2.21637  (16041724)              452100.00
4614900.00        2.28976  (16041724)
        452200.00   4614900.00        2.38402  (16072624)              452300.00
4614900.00        2.54311  (16072624)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 ,
V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 ,
VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452400.00	4614900.00	2.71569	(16072624)	452500.00	4614900.00	2.90254	(16072624)
452600.00	4614900.00	3.12879	(16072624)	452700.00	4614900.00	3.36085	(16072624)
452800.00	4614900.00	3.66551	(13092624)	452900.00	4614900.00	4.06593	(13092624)
453000.00	4614900.00	4.44850	(15102724)	453100.00	4614900.00	5.04831	(15102724)
453200.00	4614900.00	5.66277	(15110924)	453300.00	4614900.00	6.27042	(15110924)
453400.00	4614900.00	6.98499	(15113024)	453500.00	4614900.00	8.15069	(12051724)
453600.00	4614900.00	10.65382	(12051724)	453700.00	4614900.00	13.33473	(13092624)
453800.00	4614900.00	16.57785	(13092624)	453900.00	4614900.00	21.67501	(13092624)
454000.00	4614900.00	29.80663	(12051724)	454600.00	4614900.00	35.24865	(14010824)
454700.00	4614900.00	26.25877	(14121824)	454800.00	4614900.00	18.94284	(16120624)
454900.00	4614900.00	13.84689	(16120924)	455000.00	4614900.00	10.52630	(16120324)
455100.00	4614900.00	8.55586	(13110124)	455200.00	4614900.00	6.81337	(12012424)
455300.00	4614900.00	5.65352	(14010824)	455400.00	4614900.00	5.02299	(16050324)
455500.00	4614900.00	4.50941	(14010824)	455600.00	4614900.00	4.04356	(13110124)
455700.00	4614900.00	3.63992	(14022424)	455800.00	4614900.00	3.30841	(14022424)
455900.00	4614900.00	3.02479	(12082824)	456000.00	4614900.00	2.80496	(16082224)
456100.00	4614900.00	2.68859	(16082224)	456200.00	4614900.00	2.54574	(16082224)

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        456300.00   4614900.00        2.38548  (16112524)              456400.00
4614900.00        2.21360  (16112524)
        456500.00   4614900.00        2.05824  (16112524)              456600.00
4614900.00        1.91987  (16112524)
        452000.00   4615000.00        2.18151  (15092624)              452100.00
4615000.00        2.29330  (15092624)
        452200.00   4615000.00        2.41684  (15102724)              452300.00
4615000.00        2.61199  (15102724)
        452400.00   4615000.00        2.83224  (15102724)              452500.00
4615000.00        3.08195  (15102724)
        452600.00   4615000.00        3.27247  (15110924)              452700.00
4615000.00        3.45112  (15110924)
        452800.00   4615000.00        3.72708  (16110324)              452900.00
4615000.00        4.17727  (12020124)
        453000.00   4615000.00        4.68436  (16110324)              453100.00
4615000.00        5.31306  (16110324)
        453200.00   4615000.00        5.99640  (16110324)              453300.00
4615000.00        6.64996  (16110324)
        453400.00   4615000.00        7.76043  (16032924)              453500.00
4615000.00        9.27860  (15102724)
        453600.00   4615000.00       10.74239  (13120224)              453700.00
4615000.00       12.71146  (13111924)
        453800.00   4615000.00       15.55465  (12011124)              453900.00
4615000.00       21.87379  (12082924)
        454000.00   4615000.00       26.19158  (16112224)              454600.00
4615000.00       82.88427c (14013124)
        454700.00   4615000.00       30.36477  (14020324)              454800.00
4615000.00       17.01304  (14102924)
        454900.00   4615000.00       12.19991  (16050324)              455000.00
4615000.00        9.32791  (16120124)
        455100.00   4615000.00        7.72485  (15012224)              455200.00
4615000.00        6.48029  (12082824)
        455300.00   4615000.00        5.94846  (15012224)              455400.00
4615000.00        5.29425  (15012224)
        455500.00   4615000.00        4.65063  (16120324)              455600.00
4615000.00        4.10086  (16120324)
        455700.00   4615000.00        3.65324  (16120324)              455800.00
4615000.00        3.37279  (13110124)
        455900.00   4615000.00        3.12271  (13032824)              456000.00
4615000.00        2.89729  (13032824)
        456100.00   4615000.00        2.68598  (13032824)              456200.00
4615000.00        2.50125  (13032824)
        456300.00   4615000.00        2.31436  (13032824)              456400.00
4615000.00        2.16504  (13032824)
        456500.00   4615000.00        2.02275  (13032824)              456600.00
4615000.00        1.89036  (13032824)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4615100.00	2.28924	(12051724)	452100.00	4615100.00	2.42867	(12051724)
452200.00	4615100.00	2.57391	(12051724)	452300.00	4615100.00	2.78580	(12020124)
452400.00	4615100.00	2.89791	(12020124)	452500.00	4615100.00	3.00799	(12020124)
452600.00	4615100.00	3.22260	(15102724)	452700.00	4615100.00	3.46795	(15102724)
452800.00	4615100.00	3.77461c	(13101024)	452900.00	4615100.00	4.16484	(16110324)
453000.00	4615100.00	4.34021	(15102724)	453100.00	4615100.00	5.03640	(13120224)
453200.00	4615100.00	5.88742	(12011124)	453300.00	4615100.00	7.00353	(13120224)
453400.00	4615100.00	7.01506	(16080324)	453500.00	4615100.00	8.59357	(12082924)
453600.00	4615100.00	11.25391	(12082924)	453700.00	4615100.00	13.79665	(12011124)
453800.00	4615100.00	15.06112	(16112224)	453900.00	4615100.00	18.94133	(16112224)
454000.00	4615100.00	20.91135	(16102524)	454100.00	4615100.00	27.51107	(16102524)
454600.00	4615100.00	66.43263	(14121924)	454700.00	4615100.00	24.55261	(13011524)
454800.00	4615100.00	16.44537	(14012824)	454900.00	4615100.00	11.33087	(13022324)
455000.00	4615100.00	8.91807	(15012224)	455100.00	4615100.00	7.22857	(14011724)
455200.00	4615100.00	5.89326	(15123024)	455300.00	4615100.00	5.19403	(12020224)
455400.00	4615100.00	4.56019	(14020624)	455500.00	4615100.00	4.00677	(13110124)
455600.00	4615100.00	3.70831	(13032824)	455700.00	4615100.00	3.47730	(15072324)

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        455800.00   4615100.00        3.14301  (15072324)              455900.00
4615100.00        2.87576  (12020224)
        456000.00   4615100.00        2.66054  (12020224)              456100.00
4615100.00        2.46962  (12020224)
        456200.00   4615100.00        2.37799  (16082224)              456300.00
4615100.00        2.28873  (16082224)
        456400.00   4615100.00        2.18995  (16082224)              456500.00
4615100.00        2.10403  (16082224)
        456600.00   4615100.00        2.02700  (16082224)              452000.00
4615200.00        2.15884  (15070424)
        452100.00   4615200.00        2.34740c (13101024)              452200.00
4615200.00        2.58893c (13101024)
        452300.00   4615200.00        2.68839  (16110324)              452400.00
4615200.00        2.84088  (15070424)
        452500.00   4615200.00        3.02503  (15070424)              452600.00
4615200.00        3.17451  (12051724)
        452700.00   4615200.00        3.30393  (15070424)              452800.00
4615200.00        3.75788  (13120224)
        452900.00   4615200.00        4.23852  (13120224)              453000.00
4615200.00        4.56068  (16080324)
        453100.00   4615200.00        4.98241  (12082924)              453200.00
4615200.00        5.13026  (13011024)
        453300.00   4615200.00        6.52287  (13120224)              453400.00
4615200.00        7.53628  (13120224)
        453500.00   4615200.00        8.15660  (13082924)              453600.00
4615200.00        9.82020  (12110724)
        453700.00   4615200.00       11.18245  (12082924)              453800.00
4615200.00       12.78471  (13120224)
        453900.00   4615200.00       14.14346  (13012624)              454000.00
4615200.00       16.39279  (16102524)
        454100.00   4615200.00       21.34303  (12121424)              454200.00
4615200.00       22.96981  (12110924)
        454600.00   4615200.00       38.33444  (14121924)              454700.00
4615200.00       24.54257  (12010924)
        454800.00   4615200.00       17.26776  (16020124)              454900.00
4615200.00       10.99476  (15123024)
        455000.00   4615200.00        8.60072  (12020924)              455100.00
4615200.00        7.07895  (12020624)
        455200.00   4615200.00        5.76592  (15010224)              455300.00
4615200.00        4.87132  (13022324)
        455400.00   4615200.00        4.47376  (15123024)              455500.00
4615200.00        3.77997  (15123024)
        455600.00   4615200.00        3.52241  (16072724)              455700.00
4615200.00        3.24161  (16072724)
        455800.00   4615200.00        3.05059  (15012224)              455900.00
4615200.00        2.83314  (16071924)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456000.00	4615200.00	2.57420	(13032824)	456100.00	4615200.00	2.43608	(12020224)
456200.00	4615200.00	2.32714	(12020224)	456300.00	4615200.00	2.22049	(12020224)
456400.00	4615200.00	2.13980	(12020224)	456500.00	4615200.00	1.98847	(15072324)
456600.00	4615200.00	1.88921	(14010824)	452000.00	4615300.00	2.17727	(15070424)
452100.00	4615300.00	2.27885	(15070424)	452200.00	4615300.00	2.40076	(15070424)
452300.00	4615300.00	2.49049	(15070424)	452400.00	4615300.00	2.57317	(15070424)
452500.00	4615300.00	2.80447	(13120224)	452600.00	4615300.00	3.03693	(13120224)
452700.00	4615300.00	3.31256	(13120224)	452800.00	4615300.00	3.57797	(13120224)
452900.00	4615300.00	3.83672	(16083024)	453000.00	4615300.00	4.30706	(13120224)
453100.00	4615300.00	4.88629	(13120224)	453200.00	4615300.00	5.16583	(12050724)
453300.00	4615300.00	6.44988	(13082924)	453400.00	4615300.00	6.33377	(16112224)
453500.00	4615300.00	7.53700	(12050724)	453600.00	4615300.00	8.51131	(12110724)
453700.00	4615300.00	8.90274	(12110724)	453800.00	4615300.00	9.77531	(14122224)
453900.00	4615300.00	11.60142	(12122824)	454000.00	4615300.00	14.13628c	(14010924)
454100.00	4615300.00	15.39006	(13103024)	454200.00	4615300.00	17.61192	(16110724)
454300.00	4615300.00	23.18322	(14021224)	454400.00	4615300.00	26.66845	(12111624)
454500.00	4615300.00	29.74071	(12112124)	454600.00	4615300.00	26.08368	(12022224)

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        454700.00   4615300.00       21.00022  (13122724)              454800.00
4615300.00       15.65301c (13123124)
        454900.00   4615300.00       12.51319  (13101724)              455000.00
4615300.00        8.26702  (15010224)
        455100.00   4615300.00        6.47957  (14031024)              455200.00
4615300.00        5.51577  (15010224)
        455300.00   4615300.00        4.82412  (12020624)              455400.00
4615300.00        4.13770  (14012824)
        455500.00   4615300.00        3.64335  (13022324)              455600.00
4615300.00        3.25281  (15072324)
        455700.00   4615300.00        2.99834  (13011524)              455800.00
4615300.00        2.72488  (16072724)
        455900.00   4615300.00        2.61426  (16072724)              456000.00
4615300.00        2.46336  (16072724)
        456100.00   4615300.00        2.28897  (16072724)              456200.00
4615300.00        2.10494  (16072724)
        456300.00   4615300.00        1.96946  (15012224)              456400.00
4615300.00        1.93000  (15012224)
        456500.00   4615300.00        1.87361  (15012224)              456600.00
4615300.00        1.83448  (15012224)
        452000.00   4615400.00        1.99809  (15070424)              452100.00
4615400.00        2.04050  (13120224)
        452200.00   4615400.00        2.18392  (13120224)              452300.00
4615400.00        2.32779  (13120224)
        452400.00   4615400.00        2.65665  (12082924)              452500.00
4615400.00        2.75923c (13101024)
        452600.00   4615400.00        2.80994  (12110724)              452700.00
4615400.00        3.22112  (13011024)
        452800.00   4615400.00        3.41270  (13120224)              452900.00
4615400.00        3.61456  (15050824)
        453000.00   4615400.00        4.40879  (12050724)              453100.00
4615400.00        5.02952  (13120224)
        453200.00   4615400.00        4.89500m (16010724)              453300.00
4615400.00        5.67951  (16112224)
        453400.00   4615400.00        6.23716  (16112224)              453500.00
4615400.00        6.29620  (16112224)
        453600.00   4615400.00        7.23792  (14100124)              453700.00
4615400.00        7.17180  (14122224)
        453800.00   4615400.00        8.49125  (14100124)              453900.00
4615400.00       10.25793c (14010924)
        454000.00   4615400.00       10.79449  (13030824)              454100.00
4615400.00       11.86504  (12012524)
        454200.00   4615400.00       13.91138  (12122824)              454300.00
4615400.00       16.90456  (16010624)
        454400.00   4615400.00       19.64306  (16010624)              454500.00
4615400.00       22.83580  (12011024)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 ,
V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 ,
VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454600.00	4615400.00	20.46080	(16012024)	454700.00	4615400.00	18.23764	(13122724)
454800.00	4615400.00	11.77484	(12011024)	454900.00	4615400.00	10.35372	(12021424)
455000.00	4615400.00	9.78146	(15010224)	455100.00	4615400.00	7.81514	(14121324)
455200.00	4615400.00	5.92765	(14012824)	455300.00	4615400.00	4.49522	(14090224)
455400.00	4615400.00	3.88507	(13010424)	455500.00	4615400.00	3.51259	(14020324)
455600.00	4615400.00	3.21120	(14020624)	455700.00	4615400.00	3.00940	(13081624)
455800.00	4615400.00	2.76170	(13081624)	455900.00	4615400.00	2.51260	(13081624)
456000.00	4615400.00	2.28292	(15123024)	456100.00	4615400.00	2.07641	(16072724)
456200.00	4615400.00	1.98291	(14020624)	456300.00	4615400.00	1.93411	(16072724)
456400.00	4615400.00	1.88272	(16072724)	456500.00	4615400.00	1.82052	(16072724)
456600.00	4615400.00	1.72269	(16072724)	452000.00	4615500.00	1.93183	(12082924)
452100.00	4615500.00	2.19794	(12082924)	452200.00	4615500.00	2.15356	(12110724)
452300.00	4615500.00	2.27736	(13011024)	452400.00	4615500.00	2.57972	(13011024)
452500.00	4615500.00	2.80378	(12011124)	452600.00	4615500.00	2.81286	(12011124)
452700.00	4615500.00	3.12655	(15050824)	452800.00	4615500.00	3.61142	(13120224)
452900.00	4615500.00	4.09779	(13120224)	453000.00	4615500.00	4.13021m	(16010724)
453100.00	4615500.00	4.58575c	(15021624)	453200.00	4615500.00	4.94274b	(16071824)

453300.00 4615500.00 5.25566 (14122224) 453400.00
4615500.00 5.29250 (13092624)
453500.00 4615500.00 5.94545 (14122224) 453600.00
4615500.00 5.75181 (13103024)
453700.00 4615500.00 6.58396 (13103024) 453800.00
4615500.00 7.34496 (13103024)
453900.00 4615500.00 8.64490 (13121324) 454000.00
4615500.00 8.33689 (15111624)
454100.00 4615500.00 9.39967 (15111624) 454200.00
4615500.00 11.80616 (12122824)
454300.00 4615500.00 13.93690 (12121424) 454400.00
4615500.00 16.13578 (16010624)
454500.00 4615500.00 16.70617 (16012024) 454600.00
4615500.00 15.96864 (16012024)
454700.00 4615500.00 15.38835c (14013124) 454800.00
4615500.00 11.21403 (12010524)
454900.00 4615500.00 8.33968 (16012024) 455000.00
4615500.00 7.97564 (12021424)
455100.00 4615500.00 7.99928 (15010224) 455200.00
4615500.00 6.37872 (15010224)
455300.00 4615500.00 5.03855 (16020124) 455400.00
4615500.00 4.08157 (14121324)
455500.00 4615500.00 3.36971m (13090424) 455600.00
4615500.00 2.97080 (13081924)
455700.00 4615500.00 2.77740 (13081624) 455800.00
4615500.00 2.50823 (15010224)
455900.00 4615500.00 2.38007 (14020624) 456000.00
4615500.00 2.25421 (15010224)
456100.00 4615500.00 2.13441 (14020624) 456200.00
4615500.00 1.96358 (15123024)
456300.00 4615500.00 1.81278 (15072324) 456400.00
4615500.00 1.70315 (14020624)
456500.00 4615500.00 1.57724 (14020624) 456600.00
4615500.00 1.51659 (14101424)
452000.00 4615600.00 1.97264 (13011024) 452100.00
4615600.00 2.17779 (13011024)
452200.00 4615600.00 2.37422 (12011124) 452300.00
4615600.00 2.34905 (12011124)
452400.00 4615600.00 2.42775 (13120224) 452500.00
4615600.00 2.71475 (13120224)
452600.00 4615600.00 3.05796 (13120224) 452700.00
4615600.00 3.35608m (16010724)
452800.00 4615600.00 3.57691m (16010724) 452900.00
4615600.00 3.96223 (12050724)
453000.00 4615600.00 4.13907b (16071824) 453100.00
4615600.00 4.20859 (16112224)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453200.00	4615600.00	4.57069	(14122224)	453300.00	4615600.00	4.73664b	(16071824)
453400.00	4615600.00	4.82486	(14122224)	453500.00	4615600.00	4.67265	(16010824)
453600.00	4615600.00	4.91579	(13012624)	453700.00	4615600.00	5.15363	(13103024)
453800.00	4615600.00	6.54988	(15111724)	453900.00	4615600.00	7.10113	(13112024)
454000.00	4615600.00	6.77057	(14011024)	454100.00	4615600.00	7.58896	(15111624)
454200.00	4615600.00	10.00121	(16012524)	454300.00	4615600.00	11.01681	(14090824)
454400.00	4615600.00	13.68515	(16010624)	454500.00	4615600.00	13.53526	(12111624)
454600.00	4615600.00	13.01281	(12111524)	454700.00	4615600.00	12.24490	(14021724)
454800.00	4615600.00	11.92290	(12111524)	454900.00	4615600.00	8.31896	(12010524)
455000.00	4615600.00	6.13597	(15101024)	455100.00	4615600.00	6.48979	(16110124)
455200.00	4615600.00	6.48425	(15010224)	455300.00	4615600.00	5.39122	(13101724)
455400.00	4615600.00	4.57428	(14121324)	455500.00	4615600.00	3.69902	(14012824)
455600.00	4615600.00	3.16220m	(13090424)	455700.00	4615600.00	2.63763m	(13090424)
455800.00	4615600.00	2.39812	(14080324)	455900.00	4615600.00	2.38609	(13081624)
456000.00	4615600.00	2.06075	(12010624)	456100.00	4615600.00	1.90794	(14012824)
456200.00	4615600.00	1.84607	(14020624)	456300.00	4615600.00	1.78086	(15010224)
456400.00	4615600.00	1.70592	(15010224)	456500.00	4615600.00	1.57927	(14020624)

456600.00 4615600.00 1.47439 (14020624) 452000.00
4615700.00 2.05601c (13050924)
452100.00 4615700.00 2.02455 (12011124) 452200.00
4615700.00 2.23356c (13050924)
452300.00 4615700.00 2.49201 (15050824) 452400.00
4615700.00 2.71637 (15050824)
452500.00 4615700.00 2.94981 (13120224) 452600.00
4615700.00 3.13127m (16010724)
452700.00 4615700.00 3.39608 (12050724) 452800.00
4615700.00 3.45343b (16071824)
452900.00 4615700.00 3.56467 (13120224) 453000.00
4615700.00 3.64703 (14122224)
453100.00 4615700.00 3.97799 (14122224) 453200.00
4615700.00 4.11385 (14122224)
453300.00 4615700.00 4.01725 (14122224) 453400.00
4615700.00 4.00269 (13112024)
453500.00 4615700.00 4.09392 (16010824) 453600.00
4615700.00 4.28704 (13020724)
453700.00 4615700.00 5.16700 (13121324) 453800.00
4615700.00 5.78763 (12121424)
453900.00 4615700.00 5.62643 (13030824) 454000.00
4615700.00 5.86531 (12121424)
454100.00 4615700.00 6.60669 (12110924) 454200.00
4615700.00 8.51695 (12110624)
454300.00 4615700.00 9.16145 (14090824) 454400.00
4615700.00 10.99732 (15092824)
454500.00 4615700.00 11.41718 (12111524) 454600.00
4615700.00 10.01114 (15030924)
454700.00 4615700.00 10.55853c (15020324) 454800.00
4615700.00 10.96335c (14013124)
454900.00 4615700.00 8.63262 (12111524) 455000.00
4615700.00 6.21655 (14121924)
455100.00 4615700.00 5.06194 (14102424) 455200.00
4615700.00 5.43247 (12021424)
455300.00 4615700.00 5.33299 (12010624) 455400.00
4615700.00 4.87654 (13101724)
455500.00 4615700.00 3.96294 (15010224) 455600.00
4615700.00 3.56421 (12010924)
455700.00 4615700.00 2.94729m (13090424) 455800.00
4615700.00 2.52111 (12010924)
455900.00 4615700.00 2.18452 (12041224) 456000.00
4615700.00 2.11262 (14080324)
456100.00 4615700.00 2.08063 (12041224) 456200.00
4615700.00 1.90232 (14012824)
456300.00 4615700.00 1.76735 (16071924) 456400.00
4615700.00 1.59113 (14020324)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456500.00	4615700.00	1.49501	(15010224)	456600.00	4615700.00	1.45546	(15010224)
452000.00	4615800.00	2.06240	(15050824)	452100.00	4615800.00	2.26401	(15050824)
452200.00	4615800.00	2.49826m	(16010724)	452300.00	4615800.00	2.59071	(13120224)
452400.00	4615800.00	2.80379m	(16010724)	452500.00	4615800.00	3.04239	(12050724)
452600.00	4615800.00	2.95619b	(16071824)	452700.00	4615800.00	3.17168	(13120224)
452800.00	4615800.00	3.27138	(12082924)	452900.00	4615800.00	3.27778	(14122224)
453000.00	4615800.00	3.48174	(14122224)	453100.00	4615800.00	3.58213	(13092624)
453200.00	4615800.00	3.40199	(14092424)	453300.00	4615800.00	3.39889	(16010824)
453400.00	4615800.00	3.48298	(16010824)	453500.00	4615800.00	3.58247	(15111724)
453600.00	4615800.00	4.36918	(15010224)	453700.00	4615800.00	4.93501	(13121324)
453800.00	4615800.00	4.72961	(13112024)	453900.00	4615800.00	4.83159	(13020624)
454000.00	4615800.00	5.47142	(15111624)	454100.00	4615800.00	6.12433	(16111524)
454200.00	4615800.00	7.48940	(12110624)	454300.00	4615800.00	7.78740	(14090824)
454400.00	4615800.00	9.39055	(12111924)	454500.00	4615800.00	9.93718	(15110424)
454600.00	4615800.00	8.68350	(15030924)	454700.00	4615800.00	8.50274	(12022224)
454800.00	4615800.00	8.80164	(14021724)	454900.00	4615800.00	8.53120	(12112124)
455000.00	4615800.00	6.25997	(12010524)	455100.00	4615800.00	4.82909	(12011024)

455200.00 4615800.00 4.27893 (12110824) 455300.00
4615800.00 4.67964 (12021424)
455400.00 4615800.00 4.21847 (12010624) 455500.00
4615800.00 4.38157 (14121324)
455600.00 4615800.00 3.65545 (14121324) 455700.00
4615800.00 3.15855 (12010924)
455800.00 4615800.00 2.84024 (12010924) 455900.00
4615800.00 2.42672 (14020324)
456000.00 4615800.00 2.05631 (12010924) 456100.00
4615800.00 1.91213 (12020924)
456200.00 4615800.00 1.87640 (14080324) 456300.00
4615800.00 1.84346 (13081624)
456400.00 4615800.00 1.64144 (14012824) 456500.00
4615800.00 1.49436 (16071924)
456600.00 4615800.00 1.45064 (14020324) 452000.00
4615900.00 2.20809 (15050824)
452100.00 4615900.00 2.32548 (13120224) 452200.00
4615900.00 2.51125m (16010724)
452300.00 4615900.00 2.71696 (12050724) 452400.00
4615900.00 2.52410b (16071824)
452500.00 4615900.00 2.86510b (16071824) 452600.00
4615900.00 2.96406 (12082924)
452700.00 4615900.00 2.71080 (14122224) 452800.00
4615900.00 2.94407 (14122224)
452900.00 4615900.00 3.11886b (16071824) 453000.00
4615900.00 3.18014 (16100624)
453100.00 4615900.00 3.00481 (14092424) 453200.00
4615900.00 2.94037 (16010824)
453300.00 4615900.00 3.06877c (14010924) 453400.00
4615900.00 3.08434 (12122824)
453500.00 4615900.00 3.70610 (15111724) 453600.00
4615900.00 4.24640 (13121324)
453700.00 4615900.00 4.39277 (12121424) 453800.00
4615900.00 4.23342m (16010724)
453900.00 4615900.00 4.35441 (14011024) 454000.00
4615900.00 4.62422 (15111624)
454100.00 4615900.00 5.49470 (15110924) 454200.00
4615900.00 6.70520 (12110624)
454300.00 4615900.00 6.80326 (14090824) 454400.00
4615900.00 8.00516 (15092824)
454500.00 4615900.00 8.56955c (15020324) 454600.00
4615900.00 7.85829 (12111624)
454700.00 4615900.00 7.73251 (14021724) 454800.00
4615900.00 7.42964 (12022224)
454900.00 4615900.00 8.06643c (14013124) 455000.00
4615900.00 6.73306 (16012024)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 ,
V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 ,
VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455100.00	4615900.00	4.84863	(12111524)	455200.00	4615900.00	3.94733	(16082724)
455300.00	4615900.00	3.67862	(12110824)	455400.00	4615900.00	3.96394c	(13123124)
455500.00	4615900.00	3.69900	(16110124)	455600.00	4615900.00	3.91328	(14121324)
455700.00	4615900.00	3.26821	(13101724)	455800.00	4615900.00	2.78166	(12010924)
455900.00	4615900.00	2.58473	(12010924)	456000.00	4615900.00	2.29409	(12052324)
456100.00	4615900.00	2.04173	(15031824)	456200.00	4615900.00	1.82744	(12041224)
456300.00	4615900.00	1.71604	(14080324)	456400.00	4615900.00	1.67871	(14080324)
456500.00	4615900.00	1.60965	(14012824)	456600.00	4615900.00	1.44689	(12010624)
452000.00	4616000.00	2.26468m	(16010724)	452100.00	4616000.00	2.45030	(12050724)
452200.00	4616000.00	2.27568	(13092624)	452300.00	4616000.00	2.55351	(13092624)
452400.00	4616000.00	2.69163b	(16071824)	452500.00	4616000.00	2.48220	(12110724)
452600.00	4616000.00	2.51608	(12110724)	452700.00	4616000.00	2.71575	(16100624)
452800.00	4616000.00	2.71300	(14092424)	452900.00	4616000.00	2.74662	(14092424)
453000.00	4616000.00	2.60990	(14092424)	453100.00	4616000.00	2.58667	(16121624)
453200.00	4616000.00	2.65623	(16010824)	453300.00	4616000.00	2.65486	(16100424)
453400.00	4616000.00	3.13390	(15111724)	453500.00	4616000.00	3.56851	(13020624)
453600.00	4616000.00	3.90713	(12022024)	453700.00	4616000.00	3.69449m	(16010724)

453800.00 4616000.00 3.79247m (16010724) 453900.00
4616000.00 4.02359 (14011024)
454000.00 4616000.00 4.26392 (16012524) 454100.00
4616000.00 5.08491 (12111424)
454200.00 4616000.00 6.08701 (12110624) 454300.00
4616000.00 6.05301 (12110624)
454400.00 4616000.00 6.85632 (12111624) 454500.00
4616000.00 7.12773 (15092824)
454600.00 4616000.00 7.21168 (12111624) 454700.00
4616000.00 6.30866 (15030924)
454800.00 4616000.00 6.58540 (16012024) 454900.00
4616000.00 6.48417 (14021724)
455000.00 4616000.00 6.43025 (13122724) 455100.00
4616000.00 4.98735 (12010524)
455200.00 4616000.00 3.91639 (16110524) 455300.00
4616000.00 3.52481 (16082724)
455400.00 4616000.00 3.23930 (12110824) 455500.00
4616000.00 3.37683c (13123124)
455600.00 4616000.00 3.33023 (16110124) 455700.00
4616000.00 3.43954 (12010624)
455800.00 4616000.00 3.02222 (14121324) 455900.00
4616000.00 2.70540 (12020924)
456000.00 4616000.00 2.32904 (12010924) 456100.00
4616000.00 2.18437 (15101024)
456200.00 4616000.00 2.01791 (15011924) 456300.00
4616000.00 1.81899 (12020924)
456400.00 4616000.00 1.60285 (15031824) 456500.00
4616000.00 1.56002 (13081624)
456600.00 4616000.00 1.53272 (14080324) 452000.00
4616100.00 2.06337 (13092624)
452100.00 4616100.00 2.31109 (13092624) 452200.00
4616100.00 2.35605b (16071824)
452300.00 4616100.00 2.22669 (12110724) 452400.00
4616100.00 2.35790 (12110724)
452500.00 4616100.00 2.35398 (16100624) 452600.00
4616100.00 2.39547b (16071824)
452700.00 4616100.00 2.45840 (14100124) 452800.00
4616100.00 2.47699 (14092424)
452900.00 4616100.00 2.33035b (16071824) 453000.00
4616100.00 2.31493c (14010924)
453100.00 4616100.00 2.36472 (16010824) 453200.00
4616100.00 2.36176c (14010924)
453300.00 4616100.00 2.74546 (15010224) 453400.00
4616100.00 3.00082 (15111724)
453500.00 4616100.00 3.53961 (15010224) 453600.00
4616100.00 3.31796 (13112024)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 ,
V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 ,
VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453700.00	4616100.00	3.40586	(16121624)	453800.00	4616100.00	3.32810m	(16010724)
453900.00	4616100.00	3.63221	(14011024)	454000.00	4616100.00	3.94688	(12111924)
454100.00	4616100.00	4.79759	(12111424)	454200.00	4616100.00	5.57361	(12110624)
454300.00	4616100.00	5.46917	(12110624)	454400.00	4616100.00	6.06178	(15092824)
454500.00	4616100.00	6.38050	(15092824)	454600.00	4616100.00	6.57808	(14020824)
454700.00	4616100.00	5.72255	(16110124)	454800.00	4616100.00	5.85152	(12022224)
454900.00	4616100.00	6.00734	(12022224)	455000.00	4616100.00	6.13184c	(14013124)
455100.00	4616100.00	5.44061	(16012024)	455200.00	4616100.00	4.26524	(12010524)
455300.00	4616100.00	3.35440	(16110524)	455400.00	4616100.00	3.13306	(16082724)
455500.00	4616100.00	2.88727	(14102424)	455600.00	4616100.00	2.91089c	(13123124)
455700.00	4616100.00	3.01627	(16110124)	455800.00	4616100.00	2.92641	(15010224)
455900.00	4616100.00	2.77161	(14121324)	456000.00	4616100.00	2.41241	(13101724)
456100.00	4616100.00	2.13569	(15010224)	456200.00	4616100.00	2.01140	(12052324)
456300.00	4616100.00	1.93568	(16020124)	456400.00	4616100.00	1.79258	(14020324)
456500.00	4616100.00	1.61561	(15011924)	456600.00	4616100.00	1.42882	(14080324)
452000.00	4616200.00	2.14586	(13120224)	452100.00	4616200.00	2.07079	(13120224)
452200.00	4616200.00	2.17954	(12110724)	452300.00	4616200.00	2.20766	(12110724)

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        452400.00   4616200.00        2.19099b (16071824)              452500.00
4616200.00        2.27148  (13011024)
        452600.00   4616200.00        2.25439c (14010924)              452700.00
4616200.00        2.19670  (14092424)
        452800.00   4616200.00        2.10982b (16071824)              452900.00
4616200.00        2.06823b (16071824)
        453000.00   4616200.00        2.12557  (16010824)              453100.00
4616200.00        2.09812c (14010924)
        453200.00   4616200.00        2.34328  (12121424)              453300.00
4616200.00        2.62573  (15111724)
        453400.00   4616200.00        3.26626  (15010224)              453500.00
4616200.00        3.19732  (13112024)
        453600.00   4616200.00        3.06863m (16010724)              453700.00
4616200.00        3.01410  (12022024)
        453800.00   4616200.00        3.04437  (14011024)              453900.00
4616200.00        3.24964  (14011024)
        454000.00   4616200.00        3.80747  (14020824)              454100.00
4616200.00        4.52337  (12110624)
        454200.00   4616200.00        5.21333  (16010624)              454300.00
4616200.00        4.97648  (12110624)
        454400.00   4616200.00        5.35568  (15092824)              454500.00
4616200.00        5.73588  (15092824)
        454600.00   4616200.00        6.00562  (14020824)              454700.00
4616200.00        5.33419  (16110124)
        454800.00   4616200.00        5.20798  (16121924)              454900.00
4616200.00        5.30527  (14122024)
        455000.00   4616200.00        5.22283  (16111424)              455100.00
4616200.00        5.23120  (13122724)
        455200.00   4616200.00        4.11953  (12010524)              455300.00
4616200.00        3.66531  (12010524)
        455400.00   4616200.00        2.93663  (16122124)              455500.00
4616200.00        2.78612  (16082724)
        455600.00   4616200.00        2.58269  (14102424)              455700.00
4616200.00        2.59338  (14102424)
        455800.00   4616200.00        2.69520  (15120924)              455900.00
4616200.00        2.58809  (13121624)
        456000.00   4616200.00        2.59773c (13123124)              456100.00
4616200.00        2.34600  (13101724)
        456200.00   4616200.00        2.10081  (12020924)              456300.00
4616200.00        1.86823m (13090424)
        456400.00   4616200.00        1.85307  (12020924)              456500.00
4616200.00        1.67963  (12020924)
        456600.00   4616200.00        1.61977  (15101024)              452000.00
4616300.00        1.98748  (12110724)
        452100.00   4616300.00        2.03920b (16071824)              452200.00
4616300.00        2.02847  (12110724)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452300.00	4616300.00	2.05176	(14092424)	452400.00	4616300.00	1.94842	(14122224)
452500.00	4616300.00	2.01956	(14082324)	452600.00	4616300.00	1.93350	(14092424)
452700.00	4616300.00	1.91833b	(16071824)	452800.00	4616300.00	1.88083b	(16071824)
452900.00	4616300.00	1.92696	(13020724)	453000.00	4616300.00	1.95847	(16010824)
453100.00	4616300.00	1.99617	(12121424)	453200.00	4616300.00	2.30789	(15111724)
453300.00	4616300.00	2.87085	(13020624)	453400.00	4616300.00	3.03284	(13112024)
453500.00	4616300.00	2.70060m	(16010724)	453600.00	4616300.00	2.78973	(12110924)
453700.00	4616300.00	2.62411	(12022024)	453800.00	4616300.00	2.89738	(15111624)
453900.00	4616300.00	3.08066	(16012524)	454000.00	4616300.00	3.51618	(15110924)
454100.00	4616300.00	4.29067	(12110624)	454200.00	4616300.00	4.88536	(14090824)
454300.00	4616300.00	4.55521	(12110624)	454400.00	4616300.00	4.76810	(15092824)
454500.00	4616300.00	5.17649	(15092824)	454600.00	4616300.00	5.45589	(14021224)
454700.00	4616300.00	4.99132	(15030924)	454800.00	4616300.00	4.60412	(16110124)
454900.00	4616300.00	4.74420	(16111424)	455000.00	4616300.00	4.98167	(16111424)
455100.00	4616300.00	4.81916c	(14013124)	455200.00	4616300.00	4.52263	(16012024)
455300.00	4616300.00	3.61496	(12010524)	455400.00	4616300.00	2.96180	(12111524)
455500.00	4616300.00	2.59829	(14122024)	455600.00	4616300.00	2.48691	(16082724)

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        455700.00   4616300.00        2.32849  (14102424)              455800.00
4616300.00        2.33464  (14102424)
        455900.00   4616300.00        2.39906  (15120924)              456000.00
4616300.00        2.37090  (13121624)
        456100.00   4616300.00        2.46786  (12010624)              456200.00
4616300.00        2.28276  (13101724)
        456300.00   4616300.00        1.89508  (12020924)              456400.00
4616300.00        1.74573  (15010224)
        456500.00   4616300.00        1.70672  (15101024)              456600.00
4616300.00        1.68251  (15011924)
        452000.00   4616400.00        1.82925b (16071824)              452100.00
4616400.00        1.84861  (12110724)
        452200.00   4616400.00        1.81566  (13011024)              452300.00
4616400.00        1.80624  (13092624)
        452400.00   4616400.00        1.78893c (14010924)              452500.00
4616400.00        1.71469b (16071824)
        452600.00   4616400.00        1.75581b (16071824)              452700.00
4616400.00        1.72246b (16071824)
        452800.00   4616400.00        1.77273  (13020724)              452900.00
4616400.00        1.78292  (13012624)
        453000.00   4616400.00        1.77444  (16100424)              453100.00
4616400.00        2.07846  (13020724)
        453200.00   4616400.00        2.46218  (13020624)              453300.00
4616400.00        2.83661  (13112024)
        453400.00   4616400.00        2.63086  (15010224)              453500.00
4616400.00        2.55361  (13030824)
        453600.00   4616400.00        2.51897  (13030824)              453700.00
4616400.00        2.45426  (13120324)
        453800.00   4616400.00        2.67875  (13120324)              453900.00
4616400.00        2.93204  (13100924)
        454000.00   4616400.00        3.22107  (16111524)              454100.00
4616400.00        4.06908  (12110624)
        454200.00   4616400.00        4.54033  (14090824)              454300.00
4616400.00        4.19159  (12110624)
        454400.00   4616400.00        4.41805  (12111524)              454500.00
4616400.00        4.68704  (15092824)
        454600.00   4616400.00        4.97058c (15020324)              454700.00
4616400.00        4.68902  (12121424)
        454800.00   4616400.00        4.13962  (15072424)              454900.00
4616400.00        4.34910  (15072424)
        455000.00   4616400.00        4.39706  (14021724)              455100.00
4616400.00        4.38696  (16111424)
        455200.00   4616400.00        4.38504  (13122724)              455300.00
4616400.00        3.51855  (16012024)
        455400.00   4616400.00        3.18237  (12010524)              455500.00
4616400.00        2.54678  (16110524)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455600.00	4616400.00	2.30640	(12010524)	455700.00	4616400.00	2.23142	(16082724)
455800.00	4616400.00	2.11357	(14102424)	455900.00	4616400.00	2.11647	(14102424)
456000.00	4616400.00	2.14911	(15120924)	456100.00	4616400.00	2.17392	(13121624)
456200.00	4616400.00	2.18907	(14121324)	456300.00	4616400.00	2.12581	(12091624)
456400.00	4616400.00	1.82448	(13101724)	456500.00	4616400.00	1.70414	(12020924)
456600.00	4616400.00	1.58111	(12052324)	452000.00	4616500.00	1.75445	(13011024)
452100.00	4616500.00	1.60714	(14122224)	452200.00	4616500.00	1.65811c	(14010924)
452300.00	4616500.00	1.61386c	(14010924)	452400.00	4616500.00	1.56942c	(14010924)
452500.00	4616500.00	1.61645b	(16071824)	452600.00	4616500.00	1.61165	(16090324)
452700.00	4616500.00	1.63763	(13020724)	452800.00	4616500.00	1.60700	(13012624)
452900.00	4616500.00	1.63025	(16010824)	453000.00	4616500.00	1.94927	(13020724)
453100.00	4616500.00	2.08590	(13020624)	453200.00	4616500.00	2.63354	(13112024)
453300.00	4616500.00	2.50131	(12022024)	453400.00	4616500.00	2.33601m	(16010724)
453500.00	4616500.00	2.36371	(12110924)	453600.00	4616500.00	2.30472	(13030824)
453700.00	4616500.00	2.36993	(15111624)	453800.00	4616500.00	2.46642	(13120324)
453900.00	4616500.00	2.87053	(12110924)	454000.00	4616500.00	3.16014	(12110624)
454100.00	4616500.00	3.80967	(12110624)	454200.00	4616500.00	4.23208	(14090824)

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        454300.00   4616500.00        3.87576  (12110624)              454400.00
4616500.00        4.20638  (12111524)
        454500.00   4616500.00        4.33743  (12111624)              454600.00
4616500.00        4.33161c (15020324)
        454700.00   4616500.00        4.47848  (12121424)              454800.00
4616500.00        4.04605  (15030924)
        454900.00   4616500.00        3.98416  (15072424)              455000.00
4616500.00        3.84309  (16121924)
        455100.00   4616500.00        4.25000  (16111424)              455200.00
4616500.00        3.95316  (13122724)
        455300.00   4616500.00        3.82583  (16012024)              455400.00
4616500.00        3.10825  (12010524)
        455500.00   4616500.00        2.81308  (12010524)              455600.00
4616500.00        2.29058  (16122124)
        455700.00   4616500.00        2.08755  (15101024)              455800.00
4616500.00        2.01357  (16082724)
        455900.00   4616500.00        1.92990  (14102424)              456000.00
4616500.00        1.93046  (14102424)
        456100.00   4616500.00        1.98069  (12021424)              456200.00
4616500.00        1.98445  (16110124)
        456300.00   4616500.00        1.98941  (15010224)              456400.00
4616500.00        1.97216c (13123124)
        456500.00   4616500.00        1.78763  (13101724)              456600.00
4616500.00        1.55549  (12020924)
        452000.00   4616600.00        1.51008  (13012624)              452100.00
4616600.00        1.54557c (15021624)
        452200.00   4616600.00        1.46921c (14010924)              452300.00
4616600.00        1.44574  (13073124)
        452400.00   4616600.00        1.48617b (16071824)              452500.00
4616600.00        1.49802  (14100124)
        452600.00   4616600.00        1.51736  (13020724)              452700.00
4616600.00        1.45771  (13012624)
        452800.00   4616600.00        1.50535  (16010824)              452900.00
4616600.00        1.82709  (13020724)
        453000.00   4616600.00        1.78012  (15111724)              453100.00
4616600.00        2.40322  (13020624)
        453200.00   4616600.00        2.32357  (13112024)              453300.00
4616600.00        2.20732  (15010224)
        453400.00   4616600.00        2.18173  (12121424)              453500.00
4616600.00        2.21156  (12022024)
        453600.00   4616600.00        2.09180  (13030824)              453700.00
4616600.00        2.24853  (13120324)
        453800.00   4616600.00        2.32820  (16012524)              453900.00
4616600.00        2.78840  (16012524)
        454000.00   4616600.00        3.02071  (16012524)              454100.00
4616600.00        3.60282  (12110624)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 , V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454200.00	4616600.00	3.82780	(14090824)	454300.00	4616600.00	3.59541	(12110624)
454400.00	4616600.00	4.00046	(12111924)	454500.00	4616600.00	4.11496	(12111524)
454600.00	4616600.00	3.97569	(15092824)	454700.00	4616600.00	4.28377	(12121424)
454800.00	4616600.00	3.90790	(16110124)	454900.00	4616600.00	3.62414	(16110124)
455000.00	4616600.00	3.72092	(16111424)	455100.00	4616600.00	3.59394	(16012024)
455200.00	4616600.00	3.75951	(12022224)	455300.00	4616600.00	3.75313	(13122724)
455400.00	4616600.00	3.15249	(14020324)	455500.00	4616600.00	2.78271	(12010524)
455600.00	4616600.00	2.45669	(12111524)	455700.00	4616600.00	2.05454	(12110824)
455800.00	4616600.00	1.90812	(16122124)	455900.00	4616600.00	1.82576	(16082724)
456000.00	4616600.00	1.77147	(14102424)	456100.00	4616600.00	1.77032	(14102424)
456200.00	4616600.00	1.84412	(12021424)	456300.00	4616600.00	1.83778	(13121624)
456400.00	4616600.00	1.86128	(16012024)	456500.00	4616600.00	1.89273	(12010624)
456600.00	4616600.00	1.75421	(15120924)	452000.00	4616700.00	1.36552c	(14010924)
452100.00	4616700.00	1.34899c	(14010924)	452200.00	4616700.00	1.34494b	(16071824)
452300.00	4616700.00	1.37700b	(16071824)	452400.00	4616700.00	1.41424	(13030824)
452500.00	4616700.00	1.41048	(13020724)	452600.00	4616700.00	1.32795	(13012624)
452700.00	4616700.00	1.39556	(16010824)	452800.00	4616700.00	1.66328	(12121424)

452900.00 4616700.00 1.62049 (15111724) 453000.00
4616700.00 2.07192 (13020624)
453100.00 4616700.00 2.19616 (13112024) 453200.00
4616700.00 2.19555 (12022024)
453300.00 4616700.00 2.04237m (16010724) 453400.00
4616700.00 2.03094 (12110924)
453500.00 4616700.00 1.95909 (15111624) 453600.00
4616700.00 1.97013 (15111624)
453700.00 4616700.00 2.09970 (13120324) 453800.00
4616700.00 2.29951 (16012524)
453900.00 4616700.00 2.65312 (16012524) 454000.00
4616700.00 2.85955 (12111424)
454100.00 4616700.00 3.46444 (12110624) 454200.00
4616700.00 3.69280 (14090824)
454300.00 4616700.00 3.28662 (12110624) 454400.00
4616700.00 3.63773 (12111924)
454500.00 4616700.00 3.77402 (15110324) 454600.00
4616700.00 3.69161 (15092824)
454700.00 4616700.00 3.90628 (14021224) 454800.00
4616700.00 3.70269 (15030924)
454900.00 4616700.00 3.24083 (12112124) 455000.00
4616700.00 3.38908 (12022224)
455100.00 4616700.00 3.19317 (15072424) 455200.00
4616700.00 3.67897 (16111424)
455300.00 4616700.00 3.38598 (13122724) 455400.00
4616700.00 3.29001 (16012024)
455500.00 4616700.00 2.89967 (14020324) 455600.00
4616700.00 2.49585 (12010524)
455700.00 4616700.00 2.02576 (12111524) 455800.00
4616700.00 1.91454 (14122024)
455900.00 4616700.00 1.78173 (14121324) 456000.00
4616700.00 1.68318 (12112724)
456100.00 4616700.00 1.64586 (13102724) 456200.00
4616700.00 1.63127 (14102424)
456300.00 4616700.00 1.72311 (12021424) 456400.00
4616700.00 1.72632 (14121924)
456500.00 4616700.00 1.76465 (16020124) 456600.00
4616700.00 1.70283 (16012024)
452000.00 4616800.00 1.24411c (14010924) 452100.00
4616800.00 1.25234b (16071824)
452200.00 4616800.00 1.30540 (13030824) 452300.00
4616800.00 1.34630 (13030824)
452400.00 4616800.00 1.31499 (13020724) 452500.00
4616800.00 1.23657 (12012524)
452600.00 4616800.00 1.29660 (16010824) 452700.00
4616800.00 1.46272 (12121424)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452800.00	4616800.00	1.52190	(13020724)	452900.00	4616800.00	1.76787	(13020624)
453000.00	4616800.00	2.06381	(13112024)	453100.00	4616800.00	1.98015	(12022024)
453200.00	4616800.00	1.90287	(13030824)	453300.00	4616800.00	1.82383	(12121424)
453400.00	4616800.00	1.91583m	(16010724)	453500.00	4616800.00	1.81281	(15111624)
453600.00	4616800.00	1.91658	(13120324)	453700.00	4616800.00	1.94719	(13120324)
453800.00	4616800.00	2.23570	(16012524)	453900.00	4616800.00	2.51142	(16012524)
454000.00	4616800.00	2.78604	(12111424)	454100.00	4616800.00	3.28108	(12110624)
454200.00	4616800.00	3.45436	(14090824)	454300.00	4616800.00	3.12472	(12110624)
454400.00	4616800.00	3.41020	(12111924)	454500.00	4616800.00	3.36608	(15110324)
454600.00	4616800.00	3.52067	(12111524)	454700.00	4616800.00	3.69296	(14020824)
454800.00	4616800.00	3.51765	(15030924)	454900.00	4616800.00	3.11525	(15030924)
455000.00	4616800.00	3.14051	(15072424)	455100.00	4616800.00	3.06091c	(15020324)
455200.00	4616800.00	3.11022	(12111524)	455300.00	4616800.00	3.27964	(12022224)
455400.00	4616800.00	3.26351	(13122724)	455500.00	4616800.00	2.99304	(14020324)
455600.00	4616800.00	2.62171	(14020324)	455700.00	4616800.00	2.24734	(12010524)
455800.00	4616800.00	1.83766	(16122124)	455900.00	4616800.00	1.71283	(12011024)
456000.00	4616800.00	1.64723	(16082724)	456100.00	4616800.00	1.57736	(13102724)

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        456200.00   4616800.00        1.57073  (13102724)              456300.00
4616800.00        1.50964  (14102424)
        456400.00   4616800.00        1.61470  (12021424)              456500.00
4616800.00        1.60933  (15120924)
        456600.00   4616800.00        1.62645  (13121624)              452000.00
4616900.00        1.17299b (16071824)
        452100.00   4616900.00        1.22132  (14100124)              452200.00
4616900.00        1.28221  (13030824)
        452300.00   4616900.00        1.24726  (14082324)              452400.00
4616900.00        1.16752  (12012524)
        452500.00   4616900.00        1.20736  (16010824)              452600.00
4616900.00        1.29113  (12121424)
        452700.00   4616900.00        1.44809  (13020724)              452800.00
4616900.00        1.49012  (13020624)
        452900.00   4616900.00        1.93348  (13112024)              453000.00
4616900.00        1.84850  (13112024)
        453100.00   4616900.00        1.90828  (15010224)              453200.00
4616900.00        1.80143  (12121424)
        453300.00   4616900.00        1.76660  (12110924)              453400.00
4616900.00        1.71292  (12022024)
        453500.00   4616900.00        1.70202  (13100924)              453600.00
4616900.00        1.81320  (13120324)
        453700.00   4616900.00        1.86966  (12113024)              453800.00
4616900.00        2.16268  (16012524)
        453900.00   4616900.00        2.36778  (16012524)              454000.00
4616900.00        2.71909  (12111424)
        454100.00   4616900.00        3.10750  (12110624)              454200.00
4616900.00        3.23195  (14090824)
        454300.00   4616900.00        2.93594  (12111524)              454400.00
4616900.00        3.17612  (12111924)
        454500.00   4616900.00        3.13167  (12121424)              454600.00
4616900.00        3.32584  (12111524)
        454700.00   4616900.00        3.38873c (13101024)              454800.00
4616900.00        3.35510  (12121424)
        454900.00   4616900.00        3.06027  (15030924)              455000.00
4616900.00        2.90369  (15072424)
        455100.00   4616900.00        3.01505  (16111424)              455200.00
4616900.00        2.70599  (15072424)
        455300.00   4616900.00        3.22054  (16111424)              455400.00
4616900.00        2.94390  (13122724)
        455500.00   4616900.00        2.87949  (16012024)              455600.00
4616900.00        2.65368  (12011024)
        455700.00   4616900.00        2.34502  (14020324)              455800.00
4616900.00        2.02996  (12010524)
        455900.00   4616900.00        1.71260  (16122124)              456000.00
4616900.00        1.57225  (12111324)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456100.00	4616900.00	1.52078	(16082724)	456200.00	4616900.00	1.50123	(13102724)
456300.00	4616900.00	1.48567	(13102724)	456400.00	4616900.00	1.40642	(14102424)
456500.00	4616900.00	1.52110	(12021424)	456600.00	4616900.00	1.48274	(15120924)
452000.00	4617000.00	1.17425	(13112024)	452100.00	4617000.00	1.22287	(13030824)
452200.00	4617000.00	1.15840	(12012524)	452300.00	4617000.00	1.10492	(12012524)
452400.00	4617000.00	1.12673	(16010824)	452500.00	4617000.00	1.19852	(13061524)
452600.00	4617000.00	1.37960	(13020724)	452700.00	4617000.00	1.30964	(15111724)
452800.00	4617000.00	1.77966	(13020624)	452900.00	4617000.00	1.76292	(13112024)
453000.00	4617000.00	1.77735	(12022024)	453100.00	4617000.00	1.65502m	(16010724)
453200.00	4617000.00	1.61419	(16101424)	453300.00	4617000.00	1.67679m	(16010724)
453400.00	4617000.00	1.56757	(12120124)	453500.00	4617000.00	1.65134	(13120324)
453600.00	4617000.00	1.70001	(13120324)	453700.00	4617000.00	1.88649	(12113024)
453800.00	4617000.00	2.13939	(12113024)	453900.00	4617000.00	2.24702	(12110624)
454000.00	4617000.00	2.65489	(12111424)	454100.00	4617000.00	2.93583	(16110724)
454200.00	4617000.00	3.02484	(14090824)	454300.00	4617000.00	2.81622	(12111524)
454400.00	4617000.00	2.94619	(12111924)	454500.00	4617000.00	2.98989	(12121424)
454600.00	4617000.00	3.18222	(12111524)	454700.00	4617000.00	3.23866c	(13101024)

454800.00	4617000.00	3.25482	(12121424)	454900.00	4617000.00	3.03235	(16110124)
455000.00	4617000.00	2.66535	(13100824)	455100.00	4617000.00	2.72125	(12022224)
455200.00	4617000.00	2.60315	(15072424)	455300.00	4617000.00	2.82883	(12111524)
455400.00	4617000.00	2.87082	(16111424)	455500.00	4617000.00	2.84581	(16012024)
455600.00	4617000.00	2.63988	(12011024)	455700.00	4617000.00	2.38839	(12011024)
455800.00	4617000.00	2.08330	(14020324)	455900.00	4617000.00	1.77618	(12111524)
456000.00	4617000.00	1.59297	(16122124)	456100.00	4617000.00	1.45923	(16082724)
456200.00	4617000.00	1.41696	(15050224)	456300.00	4617000.00	1.43832	(13102724)
456400.00	4617000.00	1.41599	(13102724)	456500.00	4617000.00	1.31440	(14102424)
456600.00	4617000.00	1.42082c	(13123124)	452000.00	4617100.00	1.14734	(13112024)
452100.00	4617100.00	1.09178	(13012624)	452200.00	4617100.00	1.04722	(12012524)
452300.00	4617100.00	1.05362	(16010824)	452400.00	4617100.00	1.12983	(15010224)
452500.00	4617100.00	1.31578	(13020724)	452600.00	4617100.00	1.20750	(13020724)
452700.00	4617100.00	1.52688	(13020624)	452800.00	4617100.00	1.67271	(13112024)
452900.00	4617100.00	1.61292	(12022024)	453000.00	4617100.00	1.58897	(16090924)
453100.00	4617100.00	1.55015	(16101424)	453200.00	4617100.00	1.56019	(12120124)
453300.00	4617100.00	1.51705	(12022024)	453400.00	4617100.00	1.48887	(13100924)
453500.00	4617100.00	1.58136	(13120324)	453600.00	4617100.00	1.58668	(12100124)
453700.00	4617100.00	1.88167	(12113024)	453800.00	4617100.00	2.08196	(12113024)
453900.00	4617100.00	2.21324	(12110624)	454000.00	4617100.00	2.59245	(12111424)
454100.00	4617100.00	2.73973	(16110724)	454200.00	4617100.00	2.82448	(16110724)
454300.00	4617100.00	2.69853	(12111524)	454400.00	4617100.00	2.76134	(12111924)
454500.00	4617100.00	2.79818	(15110424)	454600.00	4617100.00	3.09249	(12111524)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454700.00	4617100.00	3.07973c	(13101024)	454800.00	4617100.00	3.15993	(12121424)
454900.00	4617100.00	2.88923	(15030924)	455000.00	4617100.00	2.46072	(15072424)
455100.00	4617100.00	2.54630	(15072424)	455200.00	4617100.00	2.58353c	(15020324)
455300.00	4617100.00	2.41733	(16012024)	455400.00	4617100.00	2.81956	(14122024)
455500.00	4617100.00	2.59330	(13122724)	455600.00	4617100.00	2.63995	(14020324)
455700.00	4617100.00	2.28494	(12011024)	455800.00	4617100.00	2.21501	(12011024)
455900.00	4617100.00	1.84931	(12010524)	456000.00	4617100.00	1.50812	(16122124)
456100.00	4617100.00	1.46981	(12010524)	456200.00	4617100.00	1.36311	(16122124)
456300.00	4617100.00	1.34339	(16082724)	456400.00	4617100.00	1.38542	(13102724)
456500.00	4617100.00	1.35138	(13102724)	456600.00	4617100.00	1.23618	(16012024)
452000.00	4617200.00	1.02398	(13020724)	452100.00	4617200.00	0.98160	(16010824)
452200.00	4617200.00	0.98465	(13061524)	452300.00	4617200.00	1.06953	(16090324)
452400.00	4617200.00	1.25615	(13020724)	452500.00	4617200.00	1.16089	(13020724)
452600.00	4617200.00	1.34039	(13121324)	452700.00	4617200.00	1.58203	(13112024)
452800.00	4617200.00	1.53677	(13121324)	452900.00	4617200.00	1.55677	(16121624)
453000.00	4617200.00	1.49979m	(16010724)	453100.00	4617200.00	1.48645	(12120124)
453200.00	4617200.00	1.48741	(12120124)	453300.00	4617200.00	1.38255	(16111524)

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        453400.00   4617200.00        1.44045  (13120324)              453500.00
4617200.00        1.49805  (13120324)
        453600.00   4617200.00        1.60473  (12113024)              453700.00
4617200.00        1.73277  (16012524)
        453800.00   4617200.00        2.01794  (12113024)              453900.00
4617200.00        2.12855  (12113024)
        454000.00   4617200.00        2.49298  (12110624)              454100.00
4617200.00        2.56804  (16010624)
        454200.00   4617200.00        2.61753  (16110724)              454300.00
4617200.00        2.56243  (12111524)
        454400.00   4617200.00        2.58197  (12111924)              454500.00
4617200.00        2.58282  (15110424)
        454600.00   4617200.00        2.91690  (15110324)              454700.00
4617200.00        2.93083c (13101024)
        454800.00   4617200.00        2.89426c (15020324)              454900.00
4617200.00        2.78594  (15030924)
        455000.00   4617200.00        2.55106  (13100824)              455100.00
4617200.00        2.38094  (15072424)
        455200.00   4617200.00        2.50007  (16111424)              455300.00
4617200.00        2.26359  (16121924)
        455400.00   4617200.00        2.51934  (14122024)              455500.00
4617200.00        2.54376  (16111424)
        455600.00   4617200.00        2.51378  (16012024)              455700.00
4617200.00        2.31874  (12011024)
        455800.00   4617200.00        2.05450  (12011024)              455900.00
4617200.00        2.04608  (13122724)
        456000.00   4617200.00        1.69154  (12010524)              456100.00
4617200.00        1.42424  (16122124)
        456200.00   4617200.00        1.43935  (16122124)              456300.00
4617200.00        1.27388  (15101024)
        456400.00   4617200.00        1.30134  (13102724)              456500.00
4617200.00        1.30942  (13102724)
        456600.00   4617200.00        1.29691  (13102724)              452000.00
4617300.00        0.92090  (16010824)
        452100.00   4617300.00        0.92584  (16010824)              452200.00
4617300.00        1.02969  (16090324)
        452300.00   4617300.00        1.13809  (12121424)              452400.00
4617300.00        1.11701  (13020724)
        452500.00   4617300.00        1.21395  (13121324)              452600.00
4617300.00        1.49349  (13112024)
        452700.00   4617300.00        1.50133  (13121324)              452800.00
4617300.00        1.47128  (12022024)
        452900.00   4617300.00        1.42667  (16090924)              453000.00
4617300.00        1.42618  (16101424)
        453100.00   4617300.00        1.43856  (12120124)              453200.00
4617300.00        1.35407  (12022024)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453300.00	4617300.00	1.31259	(13100924)	453400.00	4617300.00	1.39482	(13120324)
453500.00	4617300.00	1.47014	(12100124)	453600.00	4617300.00	1.62477	(12113024)
453700.00	4617300.00	1.70125	(12111924)	453800.00	4617300.00	1.94978	(16111524)
453900.00	4617300.00	2.03117	(12113024)	454000.00	4617300.00	2.40852	(12110624)
454100.00	4617300.00	2.50636	(12110624)	454200.00	4617300.00	2.48193	(16110724)
454300.00	4617300.00	2.50253	(12111524)	454400.00	4617300.00	2.43567	(12111924)
454500.00	4617300.00	2.42336	(15110424)	454600.00	4617300.00	2.69155	(15110324)
454700.00	4617300.00	2.79178c	(13101024)	454800.00	4617300.00	2.79108	(14020824)
454900.00	4617300.00	2.67573	(15030924)	455000.00	4617300.00	2.45893	(13100824)
455100.00	4617300.00	2.22075	(15072424)	455200.00	4617300.00	2.25947	(16121924)
455300.00	4617300.00	2.20927	(14031124)	455400.00	4617300.00	2.19521	(12111524)
455500.00	4617300.00	2.49309	(14122024)	455600.00	4617300.00	2.30719	(13122724)
455700.00	4617300.00	2.42460	(14020324)	455800.00	4617300.00	1.99884	(12011024)
455900.00	4617300.00	1.90255	(12011024)	456000.00	4617300.00	1.83891	(13122724)
456100.00	4617300.00	1.51771	(12111524)	456200.00	4617300.00	1.32119	(13122724)
456300.00	4617300.00	1.27963	(16122124)	456400.00	4617300.00	1.20800	(14121924)
456500.00	4617300.00	1.25799	(13102724)	456600.00	4617300.00	1.28195	(13102724)

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        449000.00   4609000.00        0.35348  (16112124)              449500.00
4609000.00        0.32069  (14120524)
        450000.00   4609000.00        0.36890c (12080124)              450500.00
4609000.00        0.44038  (14062524)
        451000.00   4609000.00        0.48009  (14020424)              451500.00
4609000.00        0.53905  (12011124)
        452000.00   4609000.00        0.49262  (15010324)              452500.00
4609000.00        0.48876  (16110224)
        453000.00   4609000.00        0.59593  (14061024)              453500.00
4609000.00        0.55429  (15062024)
        454000.00   4609000.00        0.44151  (12032424)              454500.00
4609000.00        0.48856  (12092824)
        455000.00   4609000.00        0.43729  (13050524)              455500.00
4609000.00        0.48160  (14121924)
        456000.00   4609000.00        0.41876m (16010924)              456500.00
4609000.00        0.46932  (16031124)
        457000.00   4609000.00        0.44807  (12010824)              457500.00
4609000.00        0.47756  (14052524)
        458000.00   4609000.00        0.48784  (14052524)              458500.00
4609000.00        0.41555  (16102724)
        459000.00   4609000.00        0.54704  (16102724)              459500.00
4609000.00        0.42878  (12020124)
        460000.00   4609000.00        0.44546  (13032624)              449000.00
4609500.00        0.36988  (12012624)
        449500.00   4609500.00        0.38387  (16112124)              450000.00
4609500.00        0.35729c (14092724)
        450500.00   4609500.00        0.39751c (12080124)              451000.00
4609500.00        0.49430  (16041824)
        451500.00   4609500.00        0.49281c (12060624)              452000.00
4609500.00        0.53310  (16101924)
        452500.00   4609500.00        0.49752  (15112824)              453000.00
4609500.00        0.56966  (12020724)
        453500.00   4609500.00        0.67348  (15021024)              454000.00
4609500.00        0.55003  (12032424)
        454500.00   4609500.00        0.54132  (12092824)              455000.00
4609500.00        0.47243  (13050524)
        455500.00   4609500.00        0.62037  (14121924)              456000.00
4609500.00        0.43971  (13022124)
        456500.00   4609500.00        0.54391  (16031124)              457000.00
4609500.00        0.47697  (14052524)
        457500.00   4609500.00        0.53299  (12012524)              458000.00
4609500.00        0.50641  (12112624)
        458500.00   4609500.00        0.58376  (16102724)              459000.00
4609500.00        0.52617  (15011924)
        459500.00   4609500.00        0.50208  (14101024)              460000.00
4609500.00        0.49776  (13081124)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
449000.00	4610000.00	0.28842	(12113024)	449500.00	4610000.00	0.42396	(16112124)
450000.00	4610000.00	0.39144	(13020724)	450500.00	4610000.00	0.39239	(12110224)
451000.00	4610000.00	0.48506	(16101924)	451500.00	4610000.00	0.60533	(12120724)
452000.00	4610000.00	0.66081	(12011124)	452500.00	4610000.00	0.61120	(15112824)
453000.00	4610000.00	0.61833	(15050524)	453500.00	4610000.00	0.85482	(15010324)
454000.00	4610000.00	0.68903	(12032424)	454500.00	4610000.00	0.61851	(14062524)
455000.00	4610000.00	0.51877	(14062224)	455500.00	4610000.00	0.66920m	(16092324)
456000.00	4610000.00	0.60030	(14121924)	456500.00	4610000.00	0.57727	(12020724)
457000.00	4610000.00	0.57882	(14052524)	457500.00	4610000.00	0.63607	(12112624)
458000.00	4610000.00	0.61624	(16102724)	458500.00	4610000.00	0.60227	(16121724)
459000.00	4610000.00	0.56669	(13121624)	459500.00	4610000.00	0.56892	(13081124)
460000.00	4610000.00	0.51549	(14060624)	449000.00	4610500.00	0.30773	(16110224)
449500.00	4610500.00	0.34289	(12113024)	450000.00	4610500.00	0.48623	(16112124)
450500.00	4610500.00	0.44113	(14120524)	451000.00	4610500.00	0.48995c	(14092724)
451500.00	4610500.00	0.67518	(14062524)	452000.00	4610500.00	0.68520c	(12060624)
452500.00	4610500.00	0.70501	(16101924)	453000.00	4610500.00	0.71755	(15050524)
453500.00	4610500.00	0.93864	(15021024)	454000.00	4610500.00	0.86168	(12032424)

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        454500.00   4610500.00        0.72104  (14120424)              455000.00
4610500.00        0.62952  (14020424)
        455500.00   4610500.00        0.70229c (15011224)              456000.00
4610500.00        0.63934  (16100124)
        456500.00   4610500.00        0.63675  (13082224)              457000.00
4610500.00        0.69678  (15011924)
        457500.00   4610500.00        0.68835  (16102724)              458000.00
4610500.00        0.73373  (14112724)
        458500.00   4610500.00        0.66245  (14091624)              459000.00
4610500.00        0.63234  (13081124)
        459500.00   4610500.00        0.58717m (12121924)              460000.00
4610500.00        0.64623  (16112124)
        449000.00   4611000.00        0.39074  (16020224)              449500.00
4611000.00        0.37309  (15122524)
        450000.00   4611000.00        0.39960  (14012024)              450500.00
4611000.00        0.57101  (16112124)
        451000.00   4611000.00        0.52721  (15121224)              451500.00
4611000.00        0.58047c (12080124)
        452000.00   4611000.00        0.82526c (12060624)              452500.00
4611000.00        0.85017  (12011124)
        453000.00   4611000.00        0.77870  (15100524)              453500.00
4611000.00        0.96034  (14061024)
        454000.00   4611000.00        1.06389  (12032424)              454500.00
4611000.00        0.84960  (14120424)
        455000.00   4611000.00        0.80872  (14021524)              455500.00
4611000.00        0.71546c (15011224)
        456000.00   4611000.00        0.84824  (13020824)              456500.00
4611000.00        0.76264  (15012124)
        457000.00   4611000.00        0.82568  (12112624)              457500.00
4611000.00        0.89076  (14112724)
        458000.00   4611000.00        0.75654  (14091624)              458500.00
4611000.00        0.74175  (13032624)
        459000.00   4611000.00        0.64580  (16100324)              459500.00
4611000.00        0.68625  (12121724)
        460000.00   4611000.00        0.64728  (12121724)              449000.00
4611500.00        0.50556  (13071524)
        449500.00   4611500.00        0.48026  (16020224)              450000.00
4611500.00        0.47500  (12113024)
        450500.00   4611500.00        0.43384  (15122524)              451000.00
4611500.00        0.68820  (16112124)
        451500.00   4611500.00        0.63866  (14120524)              452000.00
4611500.00        0.73547  (13052524)
        452500.00   4611500.00        0.97514  (14062524)              453000.00
4611500.00        1.02343  (12120724)
        453500.00   4611500.00        1.05071  (12012024)              454000.00
4611500.00        1.26967  (12032424)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454500.00	4611500.00	1.00453	(14120424)	455000.00	4611500.00	1.04835	(14020424)
455500.00	4611500.00	0.96704m	(16010924)	456000.00	4611500.00	0.88221	(16102724)
456500.00	4611500.00	1.05338	(15011924)	457000.00	4611500.00	1.06915	(16102724)
457500.00	4611500.00	0.95255	(13032624)	458000.00	4611500.00	0.88682	(13032624)
458500.00	4611500.00	0.81881	(13120624)	459000.00	4611500.00	0.80532	(14020324)
459500.00	4611500.00	0.74459	(16100324)	460000.00	4611500.00	0.72106	(16112124)
449000.00	4612000.00	0.53091	(15121224)	449500.00	4612000.00	0.50807	(12032224)
450000.00	4612000.00	0.66506	(14112624)	450500.00	4612000.00	0.55502	(12032924)
451000.00	4612000.00	0.57448	(15122524)	451500.00	4612000.00	0.84309	(13020724)
452000.00	4612000.00	0.73752	(14120524)	452500.00	4612000.00	1.07228	(16021724)
453000.00	4612000.00	1.21859	(14101024)	453500.00	4612000.00	1.19472	(15112824)
454000.00	4612000.00	1.48527	(15072624)	454500.00	4612000.00	1.11477	(13081824)
455000.00	4612000.00	1.33320	(14120924)	455500.00	4612000.00	1.15416	(14080224)
456000.00	4612000.00	1.06620	(15012124)	456500.00	4612000.00	1.34805	(16102724)
457000.00	4612000.00	1.18884	(13032624)	457500.00	4612000.00	1.07624	(15111024)
458000.00	4612000.00	0.97547	(16112124)	458500.00	4612000.00	0.95901	(12121724)
459000.00	4612000.00	0.86162	(13011524)	459500.00	4612000.00	0.75942	(13030324)

460000.00 4612000.00 0.68287 (14020424) 449000.00
4612500.00 0.48963 (15050624)
449500.00 4612500.00 0.56132 (15022524) 450000.00
4612500.00 0.65840 (14040724)
450500.00 4612500.00 0.76985c (16012124) 451000.00
4612500.00 0.75821 (12032924)
451500.00 4612500.00 0.76332 (12122424) 457000.00
4612500.00 1.29450m (12121924)
457500.00 4612500.00 1.32097 (14101124) 458000.00
4612500.00 1.07846 (12121724)
458500.00 4612500.00 0.98430 (13030324) 459000.00
4612500.00 0.81365 (15020524)
459500.00 4612500.00 0.85131 (13112924) 460000.00
4612500.00 0.79822 (12020724)
449000.00 4613000.00 0.60884 (16022224) 449500.00
4613000.00 0.72557 (16022224)
450000.00 4613000.00 0.68960c (12022324) 450500.00
4613000.00 0.74771 (15042824)
451000.00 4613000.00 0.86004 (13052424) 451500.00
4613000.00 1.13592 (14112624)
457000.00 4613000.00 1.47641 (13112924) 457500.00
4613000.00 1.44034 (13011524)
458000.00 4613000.00 1.10613 (15020524) 458500.00
4613000.00 1.11220c (14013124)
459000.00 4613000.00 0.88845 (14020424) 459500.00
4613000.00 0.76993 (13080924)
460000.00 4613000.00 0.68717 (12082024) 449000.00
4613500.00 0.63349 (12020324)
449500.00 4613500.00 0.64593 (16080124) 450000.00
4613500.00 0.76796 (16090924)
450500.00 4613500.00 0.98291 (16022224) 451000.00
4613500.00 1.03143 (14010124)
451500.00 4613500.00 1.12919 (15022524) 457000.00
4613500.00 1.67241 (13123024)
457500.00 4613500.00 1.44173 (14020424) 458000.00
4613500.00 1.14084 (12022724)
458500.00 4613500.00 0.99177 (14010824) 459000.00
4613500.00 0.78551 (12082024)
459500.00 4613500.00 0.70319 (13072524) 460000.00
4613500.00 0.61704 (13102224)
449000.00 4614000.00 0.73250 (14092624) 449500.00
4614000.00 0.77200 (13082424)
450000.00 4614000.00 0.89526 (12102324) 450500.00
4614000.00 0.97993 (12020324)
451000.00 4614000.00 1.10219 (12102324) 451500.00
4614000.00 1.40506 (15112024)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 , V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
457000.00	4614000.00	1.63741	(13072524)	457500.00	4614000.00	1.28932	(13072524)
458000.00	4614000.00	1.08397	(13102224)	458500.00	4614000.00	0.94458	(15072224)
459000.00	4614000.00	0.79326	(13102224)	459500.00	4614000.00	0.74595	(13011524)
460000.00	4614000.00	0.63586	(16082224)	449000.00	4614500.00	0.71384	(15113024)
449500.00	4614500.00	0.85997	(15113024)	450000.00	4614500.00	0.88249	(14053124)
450500.00	4614500.00	1.00421	(13082924)	451000.00	4614500.00	1.14281	(13092624)
451500.00	4614500.00	1.47552	(13032924)	457000.00	4614500.00	1.63761	(12012424)
457500.00	4614500.00	1.35439	(12012424)	458000.00	4614500.00	1.12118	(12012424)
458500.00	4614500.00	0.95340	(16112524)	459000.00	4614500.00	0.81052	(16050324)
459500.00	4614500.00	0.72021	(16070224)	460000.00	4614500.00	0.62203	(16070224)
449000.00	4615000.00	0.85290	(15110924)	449500.00	4615000.00	0.97508	(15110924)
450000.00	4615000.00	1.13450	(13082924)	450500.00	4615000.00	1.32775	(15110924)
451000.00	4615000.00	1.42864	(16041724)	451500.00	4615000.00	1.71039	(15092624)
457000.00	4615000.00	1.45692	(13032824)	457500.00	4615000.00	1.17668	(15012224)
458000.00	4615000.00	0.96721	(13011524)	458500.00	4615000.00	0.79170	(12092924)
459000.00	4615000.00	0.66848	(12041224)	459500.00	4615000.00	0.61542	(12041224)
460000.00	4615000.00	0.54910	(16020524)	449000.00	4615500.00	0.78581	(12020124)

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        449500.00   4615500.00        0.89880  (13082924)              450000.00
4615500.00        1.09365  (13082924)
        450500.00   4615500.00        1.28600c (13101024)              451000.00
4615500.00        1.55266  (16080324)
        451500.00   4615500.00        1.57660  (12011124)              457000.00
4615500.00        1.29493  (12020224)
        457500.00   4615500.00        1.16029  (14021524)              458000.00
4615500.00        1.06847  (14021524)
        458500.00   4615500.00        0.87935  (15012224)              459000.00
4615500.00        0.73091  (13090324)
        459500.00   4615500.00        0.69359  (15012224)              460000.00
4615500.00        0.61464  (15012224)
        449000.00   4616000.00        0.70599  (12012624)              449500.00
4616000.00        0.82154  (12012624)
        450000.00   4616000.00        0.87190  (13103024)              450500.00
4616000.00        0.96468  (14071024)
        451000.00   4616000.00        1.38839  (12011124)              451500.00
4616000.00        1.59243  (15050824)
        457000.00   4616000.00        1.17123  (16071924)              457500.00
4616000.00        0.92493  (12010824)
        458000.00   4616000.00        0.79176  (12010824)              458500.00
4616000.00        0.69491  (13081624)
        459000.00   4616000.00        0.62683  (12020224)              459500.00
4616000.00        0.60374  (13011524)
        460000.00   4616000.00        0.58486  (13081924)              449000.00
4616500.00        0.69323c (13050924)
        449500.00   4616500.00        0.83846  (16083024)              450000.00
4616500.00        0.93519  (13011024)
        450500.00   4616500.00        1.21583c (13050924)              451000.00
4616500.00        1.49129  (13120224)
        451500.00   4616500.00        1.69702  (13120224)              457000.00
4616500.00        1.30501  (14020324)
        457500.00   4616500.00        0.92706  (14012824)              458000.00
4616500.00        0.70084  (14080324)
        458500.00   4616500.00        0.60017  (15041724)              459000.00
4616500.00        0.55324  (15041724)
        459500.00   4616500.00        0.48963  (13081624)              460000.00
4616500.00        0.46126  (12010824)
        449000.00   4617000.00        0.69964  (13011024)              449500.00
4617000.00        0.93008  (15050824)
        450000.00   4617000.00        1.07508  (13120224)              450500.00
4617000.00        1.18876  (12082924)
        451000.00   4617000.00        1.17732  (12112024)              451500.00
4617000.00        1.12108  (14100124)
        457000.00   4617000.00        1.42671  (12091624)              457500.00
4617000.00        1.00353  (15103024)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 ,
V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 ,
V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
458000.00	4617000.00	0.94473	(15101024)	458500.00	4617000.00	0.60660	(14012824)
459000.00	4617000.00	0.49305	(12010624)	459500.00	4617000.00	0.46367	(12010824)
460000.00	4617000.00	0.40165	(13011524)	449000.00	4617500.00	0.82545	(13120224)
449500.00	4617500.00	0.89753	(13092624)	450000.00	4617500.00	0.96397	(13092624)
450500.00	4617500.00	0.85342	(15031824)	451000.00	4617500.00	0.82765	(14092424)
451500.00	4617500.00	0.88278	(12012524)	452000.00	4617500.00	0.87191	(12122824)
452500.00	4617500.00	1.40594	(13121324)	453000.00	4617500.00	1.29251m	(16010724)
453500.00	4617500.00	1.39992	(12113024)	454000.00	4617500.00	2.15168	(16110724)
454500.00	4617500.00	2.16402	(12111424)	455000.00	4617500.00	2.31908	(15030924)
455500.00	4617500.00	2.02750	(14122024)	456000.00	4617500.00	1.64204	(12011024)
456500.00	4617500.00	1.10717	(16122124)	457000.00	4617500.00	1.01430	(16012024)
457500.00	4617500.00	1.05203	(16020124)	458000.00	4617500.00	0.78592	(15103024)
458500.00	4617500.00	0.81530	(16020124)	459000.00	4617500.00	0.69951	(15011924)
459500.00	4617500.00	0.46889	(13072524)	460000.00	4617500.00	0.40715	(14080324)
449000.00	4618000.00	0.72853	(13092624)	449500.00	4618000.00	0.75276c	(14010924)
450000.00	4618000.00	0.65697	(12110724)	450500.00	4618000.00	0.70029c	(13033024)
451000.00	4618000.00	0.71443	(12012524)	451500.00	4618000.00	0.68410	(12122824)

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        452000.00   4618000.00        0.98460  (13121324)             452500.00
4618000.00        1.08350  (16101424)
        453000.00   4618000.00        0.95975  (13100924)             453500.00
4618000.00        1.15914  (14020824)
        454000.00   4618000.00        1.62989  (16010624)             454500.00
4618000.00        1.75547  (12121424)
        455000.00   4618000.00        2.00620  (12121424)             455500.00
4618000.00        1.73545c (15020324)
        456000.00   4618000.00        1.65297  (16012024)             456500.00
4618000.00        1.22664  (13122724)
        457000.00   4618000.00        0.84391  (16110124)             457500.00
4618000.00        0.83044  (16012024)
        458000.00   4618000.00        0.78412  (14121324)             458500.00
4618000.00        0.71912  (13101724)
        459000.00   4618000.00        0.61042  (15103024)             459500.00
4618000.00        0.60644  (14020324)
        460000.00   4618000.00        0.49648  (12091624)             449000.00
4618500.00        0.54967  (15031824)
        449500.00   4618500.00        0.51548  (14120224)             450000.00
4618500.00        0.62411c (14010924)
        450500.00   4618500.00        0.59032  (14082324)             451000.00
4618500.00        0.54111  (12122824)
        451500.00   4618500.00        0.67208  (16092224)             452000.00
4618500.00        0.89257  (16090924)
        452500.00   4618500.00        0.86225  (12022024)             453000.00
4618500.00        0.96145  (13100924)
        453500.00   4618500.00        1.13831  (12111924)             454000.00
4618500.00        1.46930  (12110624)
        454500.00   4618500.00        1.46283  (14092524)             455000.00
4618500.00        1.71076  (14020824)
        455500.00   4618500.00        1.34052  (13121924)             456000.00
4618500.00        1.35391  (16012024)
        456500.00   4618500.00        1.12574  (12012524)             457000.00
4618500.00        0.83117  (12010524)
        457500.00   4618500.00        0.72433  (12111324)             458000.00
4618500.00        0.68923  (16110124)
        458500.00   4618500.00        0.65585  (15120924)             459000.00
4618500.00        0.71524  (13101724)
        459500.00   4618500.00        0.48116  (14112124)             460000.00
4618500.00        0.56940  (15011924)
        449000.00   4619000.00        0.44253  (15121124)             449500.00
4619000.00        0.53402  (13073124)
        450000.00   4619000.00        0.47475  (13012624)             450500.00
4619000.00        0.47322  (15051124)
        451000.00   4619000.00        0.60117  (13112024)             451500.00
4619000.00        0.79720  (16121624)
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*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 6TH HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , DC1 , V1 , V2 , V3 , V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4619000.00	0.79799	(12120124)	452500.00	4619000.00	0.68734	(16101424)
453000.00	4619000.00	0.83497	(13100924)	453500.00	4619000.00	0.95893	(16111524)
454000.00	4619000.00	1.21533	(12110624)	454500.00	4619000.00	1.25667	(14092524)
455000.00	4619000.00	1.49018	(15110424)	455500.00	4619000.00	1.19432	(12111624)
456000.00	4619000.00	1.28523	(14031124)	456500.00	4619000.00	1.08125	(14020324)
457000.00	4619000.00	0.82019	(12010524)	457500.00	4619000.00	0.65143	(12010824)
458000.00	4619000.00	0.61757	(16020124)	458500.00	4619000.00	0.56572	(16110124)
459000.00	4619000.00	0.55756	(12011424)	459500.00	4619000.00	0.60727	(16020124)
460000.00	4619000.00	0.43157	(15091024)	449000.00	4619500.00	0.46462	(16100624)
449500.00	4619500.00	0.40298b	(16071824)	450000.00	4619500.00	0.41236	(13061524)
450500.00	4619500.00	0.48145	(12022824)	451000.00	4619500.00	0.57073	(13112024)
451500.00	4619500.00	0.65397	(16101424)	452000.00	4619500.00	0.61667c	(13050924)
452500.00	4619500.00	0.63535	(13100924)	453000.00	4619500.00	0.65971	(12102224)
453500.00	4619500.00	0.91113	(12110624)	454000.00	4619500.00	1.08824	(14071924)
454500.00	4619500.00	1.09652	(14092524)	455000.00	4619500.00	1.27296	(12111524)
455500.00	4619500.00	1.11445	(16110124)	456000.00	4619500.00	1.07777	(15042424)
456500.00	4619500.00	0.95940	(16012024)	457000.00	4619500.00	1.08099	(13122724)

```
        457500.00   4619500.00        0.70577  (13122724)              458000.00
4619500.00        0.56233  (12111324)
        458500.00   4619500.00        0.53195  (16110124)              459000.00
4619500.00        0.47330  (16110124)
        459500.00   4619500.00        0.47876  (15091024)              460000.00
4619500.00        0.47875  (15091024)
        449000.00   4620000.00        0.33379  (16121624)              449500.00
4620000.00        0.35925  (13042724)
        450000.00   4620000.00        0.40772  (15010224)              450500.00
4620000.00        0.47730  (13112024)
        451000.00   4620000.00        0.62346c (13050924)              451500.00
4620000.00        0.61919  (16101424)
        452000.00   4620000.00        0.50507  (13020624)              452500.00
4620000.00        0.59683  (13100924)
        453000.00   4620000.00        0.62290  (14020824)              453500.00
4620000.00        0.77095  (12111624)
        454000.00   4620000.00        0.92022  (14020824)              454500.00
4620000.00        0.96647  (12111424)
        455000.00   4620000.00        1.04774  (15110424)              455500.00
4620000.00        0.98360  (15030924)
        456000.00   4620000.00        0.84094  (13121924)              456500.00
4620000.00        0.85527  (14031124)
        457000.00   4620000.00        0.78269  (14020324)              457500.00
4620000.00        0.65791  (12012524)
        458000.00   4620000.00        0.57281  (12111524)              458500.00
4620000.00        0.49218  (12112124)
        459000.00   4620000.00        0.46051  (16110124)              459500.00
4620000.00        0.40574  (12110824)
        460000.00   4620000.00        0.41488  (16012024)              449000.00
4620500.00        0.32220  (13042724)
        449500.00   4620500.00        0.34935c (14010924)              450000.00
4620500.00        0.40630  (13112024)
        450500.00   4620500.00        0.47407  (16121624)              451000.00
4620500.00        0.51031  (12022024)
        451500.00   4620500.00        0.48094c (13022524)              452000.00
4620500.00        0.45479  (13100924)
        452500.00   4620500.00        0.53773  (12110924)              453000.00
4620500.00        0.64406  (14020824)
        453500.00   4620500.00        0.68330  (12111424)              454000.00
4620500.00        0.77158  (14020824)
        454500.00   4620500.00        0.85548  (12111424)              455000.00
4620500.00        0.88593  (15110424)
        455500.00   4620500.00        0.92682  (12121424)              456000.00
4620500.00        0.77709  (14031124)
        456500.00   4620500.00        0.78860  (16111424)              457000.00
4620500.00        0.73361  (14121924)
```

 *** AERMOD - VERSION 19191 ***   *** PM10 Modeling
***   06/15/20
 *** AERMET - VERSION 18081 ***   ***
***   08:21:15

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 *** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

                              *** THE   6TH HIGHEST 24-HR AVERAGE CONCENTRATION
VALUES FOR SOURCE GROUP: ALL   ***
                                   INCLUDING SOURCE(S):   RTO   , DC1   ,
V1   , V2   , V3   ,
                V4   , V5   , V6   , V7   , V8   ,
V9   , V10   , V11   ,
                V12   , V13   , VN1   , VN2   , VN3   ,
VN4   , VN5   , VN6   ,
                AB_0001   , AB_0002   , AB_0003   , AB_0004   , AB_0005   ,
AB_0006   , AB_0007   , . . .   ,

                                        *** DISCRETE CARTESIAN RECEPTOR POINTS ***

                                      ** CONC OF PM10   IN MICROGRAMS/M**3
**

      X-COORD (M) Y-COORD (M)   CONC   (YYMMDDHH)   X-COORD (M) Y-
COORD (M)   CONC   (YYMMDDHH)
 -
- -
        457500.00   4620500.00   0.84909 (13122724)   458000.00
4620500.00   0.55201 (15011424)
        458500.00   4620500.00   0.48732 (14110224)   459000.00
4620500.00   0.42246 (15050224)
        459500.00   4620500.00   0.40148 (16110124)   460000.00
4620500.00   0.35640 (12110824)

*** AERMOD - VERSION 19191 *** *** PM10 Modeling
*** 06/15/20
*** AERMET - VERSION 18081 *** ***
*** 08:21:15

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE SUMMARY OF HIGHEST 24-HR RESULTS ***

** CONC OF PM10 IN MICROGRAMS/M**3 **

NETWORK GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG)	OF TYPE	GRID-ID
ALL	HIGH 6TH HIGH VALUE IS	99.46930	ON 13123024: AT (454595.80, 4615044.40, 178.19, 178.19, 0.00)	DC	

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR

```
 *** AERMOD - VERSION  19191 ***   *** PM10 Modeling
***        06/15/20
 *** AERMET - VERSION  18081 ***   ***
***        08:21:15

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 *** MODELOPTs:    RegDFAULT  CONC  ELEV  NODRYDPLT  NOWETDPLT  RURAL  ADJ_U*

 *** Message Summary : AERMOD Model Execution ***

  --------- Summary of Total Messages --------

 A Total of            0 Fatal Error Message(s)
 A Total of            2 Warning Message(s)
 A Total of          352 Informational Message(s)

 A Total of        43848 Hours Were Processed

 A Total of           86 Calm Hours Identified

 A Total of          266 Missing Hours Identified (  0.61 Percent)


    ******** FATAL ERROR MESSAGES ********
               ***  NONE  ***


    ********   WARNING MESSAGES   ********
 ME W186    3535       MEOPEN: THRESH_1MIN 1-min ASOS wind speed threshold used
0.50
 ME W187    3535       MEOPEN: ADJ_U* Option for Stable Low Winds used in AERMET

    ***********************************
    *** AERMOD Finishes Successfully ***
    ***********************************
```

NO ECHO

*** Message Summary For AERMOD Model Setup ***

--------- Summary of Total Messages --------

A Total of 0 Fatal Error Message(s)
A Total of 2 Warning Message(s)
A Total of 0 Informational Message(s)

******** FATAL ERROR MESSAGES ********
*** NONE ***

******** WARNING MESSAGES ********
ME W186 3634 MEOPEN: THRESH_1MIN 1-min ASOS wind speed threshold used
0.50
ME W187 3634 MEOPEN: ADJ_U* Option for Stable Low Winds used in AERMET

****
*** SETUP Finishes Successfully ***
****

```
 *** AERMOD - VERSION  19191 ***   *** IEPA Audit Run2 - General III HAP (Mn) Emissions
***        05/23/20
 *** AERMET - VERSION  18081 ***   ***
***        12:35:28

PAGE   1
 *** MODELOPTs:    RegDFAULT  CONC  ELEV  NODRYDPLT  NOWETDPLT  RURAL  ADJ_U*

                                            ***     MODEL SETUP OPTIONS SUMMARY
***
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - -

 **Model Is Setup For Calculation of Average CONCentration Values.

   --  DEPOSITION LOGIC  --
 **NO GAS DEPOSITION Data Provided.
 **NO PARTICLE DEPOSITION Data Provided.
 **Model Uses NO DRY DEPLETION.  DRYDPLT  =  F
 **Model Uses NO WET DEPLETION.  WETDPLT  =  F

 **Model Uses RURAL Dispersion Only.

 **Model Uses Regulatory DEFAULT Options:
        1. Stack-tip Downwash.
        2. Model Accounts for ELEVated Terrain Effects.
        3. Use Calms Processing Routine.
        4. Use Missing Data Processing Routine.
        5. No Exponential Decay.

 **Other Options Specified:
        ADJ_U*   - Use ADJ_U* option for SBL in AERMET
        CCVR_Sub - Meteorological data includes CCVR substitutions
        TEMP_Sub - Meteorological data includes TEMP substitutions

 **Model Assumes No FLAGPOLE Receptor Heights.

 **The User Specified a Pollutant Type of:  OTHER

 **Model Calculates  2 Short Term Average(s) of:   8-HR  24-HR
    and Calculates ANNUAL Averages

 **This Run Includes:    157 Source(s);       1 Source Group(s); and    2966
Receptor(s)

                with:     47 POINT(s), including
                           0 POINTCAP(s) and      0 POINTHOR(s)
                 and:    110 VOLUME source(s)
                 and:      0 AREA type source(s)
                 and:      0 LINE source(s)
                 and:      0 RLINE/RLINEXT source(s)
                 and:      0 OPENPIT source(s)
                 and:      0 BUOYANT LINE source(s) with      0 line(s)


 **Model Set To Continue RUNning After the Setup Testing.

 **The AERMET Input Meteorological Data Version Date:  18081

 **Output Options Selected:
         Model Outputs Tables of ANNUAL Averages by Receptor
```

```
          Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE
Keyword)
          Model Outputs External File(s) of High Values for Plotting (PLOTFILE Keyword)
          Model Outputs Separate Summary File of High Ranked Values (SUMMFILE Keyword)

 **NOTE:  The Following Flags May Appear Following CONC Values:  c for Calm Hours
                                                                 m for Missing Hours
                                                                 b for Both Calm and
Missing Hours

 **Misc. Inputs:  Base Elev. for Pot. Temp. Profile (m MSL) =   175.00 ;  Decay Coef. =
0.000     ;  Rot. Angle =     0.0
                  Emission Units = GRAMS/SEC                                    ;  Emission
Rate Unit Factor =   0.10000E+07
                  Output Units   = MICROGRAMS/M**3

 **Approximate Storage Requirements of Model =      4.3 MB of RAM.

 **Input Runstream File:          aermod.inp
 **Output Print File:             aermod.out

 **File for Summary of Results:   Manganese_2012-2016_OTHER.SUM
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER EMIS CATS.	EMISSION RATE / URBAN SOURCE	CAP/ PART.	EMIS RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BLDG EXISTS	HOR SCALAR VARY BY
RTO	0			0.25074E-03	454280.6	4614874.6	178.2	12.50	314.26	12.91	1.83	YES	NO NO HRDOW
DC1	0			0.11405E-03	454378.4	4614823.0	178.2	14.33	295.37	19.40	0.61	YES	NO NO
031036AAA1	0			0.19152E-06	454809.0	4610011.0	178.2	7.62	422.04	4.45	0.61	NO	NO NO
031036AAA2	0			0.74213E-07	454809.0	4610011.0	178.2	7.62	422.04	4.45	0.61	NO	NO NO
031036AAA3	0			0.74213E-07	454809.0	4610011.0	178.2	28.96	377.59	1.37	1.07	NO	NO NO
031600AAR4	0			0.12927E-06	453419.0	4612420.0	178.7	25.91	455.93	8.19	1.13	NO	NO NO
031600AAR5	0			0.32079E-06	453419.0	4612420.0	178.7	11.28	500.93	6.26	0.54	NO	NO NO
031600AAR6	0			0.12927E-06	453419.0	4612420.0	178.7	11.28	494.26	6.30	0.56	NO	NO NO
031600AAR7	0			0.33515E-07	453419.0	4612420.0	178.7	11.28	494.26	6.30	0.56	NO	NO NO
031600AAR8	0			0.50369E-05	453419.0	4612420.0	178.7	11.89	398.71	8.53	0.59	NO	NO NO
031600AAR9	0			0.93950E-06	453419.0	4612420.0	178.7	10.97	639.82	20.54	0.62	NO	NO NO
031600AFV1	0			0.82877E-02	453769.8	4615223.5	178.3	31.09	355.93	0.35	2.64	NO	NO NO
031600ALC	0			0.11683E-05	454085.0	4613531.0	178.2	34.14	516.48	9.85	0.76	NO	NO NO
031600AOL	0			0.37346E-06	450256.0	4617392.0	179.8	9.14	435.37	14.20	1.04	NO	NO NO
031600BIY1	0			0.22024E-06	451612.0	4613129.0	178.4	27.43	569.26	2.06	1.52	NO	NO NO
031600BIY2	0			0.26334E-06	451612.0	4613129.0	178.4	8.53	474.82	7.98	0.61	NO	NO NO
031600BRA	0			0.21546E-06	454528.0	4618594.0	179.4	10.67	449.82	0.72	0.76	NO	NO NO
031600DPK	0			0.63629E-04	454722.0	4619060.0	180.7	9.75	318.15	16.60	0.67	NO	NO NO
031600DQO	0			0.17466E-06	450146.0	4613049.0	179.5	14.02	505.37	3.96	0.56	NO	NO NO
031600FDK	0			0.18673E-06	453577.0	4617978.0	183.4	10.36	477.59	0.00	0.79	NO	NO NO
031600FGT1	0			0.23861E-02	451809.0	4617532.0	180.1	10.97	299.82	8.47	0.85	NO	NO NO

031600FGT2	0	0.46266E-02	451809.0	4617532.0	180.1	9.75	299.82	
7.86	0.88	NO	NO	NO				
031600FGT3	0	0.43091E-06	451809.0	4617532.0	180.1	15.24	444.82	
7.86	0.82	NO	NO	NO				
031600FHQ1	0	0.12726E-04	452496.4	4612239.7	178.1	61.77	294.26	
3.81	0.69	NO	NO	NO				
031600FHQ2	0	0.76355E-04	452461.0	4612136.0	180.8	36.58	294.26	
0.95	1.38	NO	NO	NO				
031600FHQ5	0	0.14747E-05	452468.0	4612141.0	180.2	47.85	357.04	
17.01	1.62	NO	NO	NO				
031600FLD1	0	0.83789E-09	454330.0	4617602.0	178.2	27.43	369.26	
26.73	0.67	NO	NO	NO				
031600FLD2	0	0.21067E-09	454330.0	4617602.0	178.2	27.43	369.26	
4.46	0.67	NO	NO	NO				
031600FWM	0	0.73734E-06	453740.0	4613979.0	179.3	17.68	497.59	
8.43	1.04	NO	NO	NO				
031600GFX	0	0.78043E-06	450418.0	4617336.0	179.8	14.94	439.26	
9.80	0.75	NO	NO	NO				
031600GHA1	0	0.13440E-01	453654.0	4614792.0	178.4	27.43	809.26	
26.81	6.10	NO	NO	NO				
031600GHA3	0	0.12631E-01	453697.0	4614792.0	178.5	27.43	809.26	
26.81	6.10	NO	NO	NO				
031600GHV1	0	0.68467E-06	452774.0	4612395.0	178.5	10.67	438.71	
13.51	0.46	NO	NO	NO				
031600GHV2	0	0.59370E-06	452774.0	4612395.0	178.5	10.67	438.71	
13.51	0.46	NO	NO	NO				
031600GKE1	0	0.54112E-02	454621.0	4618643.0	179.1	25.60	838.71	
26.81	3.70	NO	NO	NO				
031600GKE2	0	0.19705E-02	454708.0	4618584.0	178.4	3.66	752.59	
11.64	0.91	NO	NO	NO				
031600GKE3	0	0.19705E-02	454708.0	4618571.0	178.4	3.66	752.59	
11.64	0.91	NO	NO	NO				
031600GKE4	0	0.19705E-02	454708.0	4618559.0	178.4	3.66	752.59	
11.64	0.91	NO	NO	NO				
031600GKE5	0	0.53486E-02	454621.0	4618616.0	179.0	25.60	838.71	
26.81	3.70	NO	NO	NO				
031600GKE6	0	0.53890E-02	454621.0	4618590.0	179.1	25.60	838.71	
26.81	3.70	NO	NO	NO				

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER EMIS PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BLDG EXISTS	URBAN SOURCE	CAP/ HOR	EMIS RATE SCALAR VARY BY
031600GKE7	0	0.54699E-02	454621.0	4618564.0	179.2	25.60	838.71	26.81	3.70	NO	NO	NO	
031600GKE8	0	0.52890E-02	454672.0	4618643.0	178.7	25.60	838.71	26.81	3.70	NO	NO	NO	
031600GKE9	0	0.52950E-02	454672.0	4618617.0	178.6	25.60	838.71	26.81	3.70	NO	NO	NO	
031600GKE10	0	0.53183E-02	454672.0	4618590.0	178.6	25.60	838.71	26.81	3.70	NO	NO	NO	
031600GKE11	0	0.53011E-02	454672.0	4618564.0	178.6	25.60	838.71	26.81	3.70	NO	NO	NO	
031600GKU	0	0.62243E-06	451623.0	4617728.0	180.4	9.14	449.82	3.70	0.91	NO	NO	NO	
031600GWV	0	0.16109E-04	454218.0	4613685.0	178.2	22.56	486.48	8.94	1.15	NO	NO	NO	

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** VOLUME SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	INIT. SY (METERS)	INIT. SZ (METERS)	URBAN SOURCE	EMISSION RATE SCALAR VARY BY
V1	0	0.10664E-03	454297.7	4614928.0	178.2	0.61	0.71	0.57	NO	HRDOW
V2	0	0.12864E-04	454259.7	4614907.5	178.2	9.14	5.95	8.51	NO	HRDOW
V3	0	0.38984E-04	454235.9	4614892.4	178.2	0.61	0.43	0.57	NO	HRDOW
V4	0	0.33415E-05	454227.0	4614887.1	178.2	3.81	3.54	3.54	NO	HRDOW
V5	0	0.52377E-04	454218.1	4614878.5	178.2	3.81	1.42	3.54	NO	HRDOW
V6	0	0.46279E-04	454225.9	4614867.5	178.2	5.33	4.25	4.96	NO	HRDOW
V7	0	0.40597E-04	454197.1	4614871.1	178.2	4.57	1.42	4.25	NO	HRDOW
V8	0	0.67938E-05	454193.5	4614874.6	178.2	4.57	1.42	4.25	NO	HRDOW
V9	0	0.91147E-05	454213.5	4614885.7	178.2	3.81	1.77	3.54	NO	HRDOW
V10	0	0.67169E-04	454173.4	4614858.0	178.2	0.91	1.42	0.85	NO	HRDOW
V11	0	0.55578E-04	454170.9	4614872.8	178.2	5.33	8.51	4.96	NO	HRDOW
V12	0	0.55578E-04	454179.6	4614840.6	178.2	5.33	8.51	4.96	NO	HRDOW
V13	0	0.15800E-03	454094.6	4614815.9	177.7	0.91	1.42	0.85	NO	HRDOW
VN1	0	0.43091E-03	454294.9	4614781.5	178.2	6.10	7.09	5.67	NO	HRDOW
VN2	0	0.11965E-03	454328.5	4614797.6	178.2	6.10	7.09	5.67	NO	HRDOW
VN3	0	0.24507E-03	454345.4	4614834.4	178.2	3.81	7.09	3.54	NO	HRDOW
VN4	0	0.10556E-04	454300.5	4614814.4	178.2	3.81	7.09	3.54	NO	HRDOW
VN5	0	0.69412E-05	454338.2	4614842.4	178.2	3.81	7.09	3.54	NO	HRDOW
VN6	0	0.97711E-04	454383.0	4614853.6	178.2	3.81	2.84	3.54	NO	HRDOW
AB_0001	0	0.16449E-04	454569.7	4615033.8	178.2	2.59	5.58	2.41	NO	HRDOW
AB_0002	0	0.16449E-04	454557.7	4615033.8	178.2	2.59	5.58	2.41	NO	HRDOW

AB_0003		0	0.16449E-04	454545.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0004		0	0.16449E-04	454533.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0005		0	0.16449E-04	454521.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0006		0	0.16449E-04	454509.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0007		0	0.16449E-04	454497.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0008		0	0.16449E-04	454485.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0009		0	0.16449E-04	454473.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
AB_0010		0	0.16449E-04	454461.7	4615033.8	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0001		0	0.34352E-05	454450.0	4615030.0	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0002		0	0.34352E-05	454440.1	4615023.2	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0003		0	0.34352E-05	454430.3	4615016.3	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0004		0	0.34352E-05	454420.7	4615009.2	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0005		0	0.34352E-05	454411.5	4615001.5	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0006		0	0.34352E-05	454402.3	4614993.8	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0007		0	0.34352E-05	454394.4	4614984.7	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0008		0	0.34352E-05	454386.6	4614975.6	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0009		0	0.34352E-05	454380.9	4614965.1	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0010		0	0.34352E-05	454375.7	4614954.3	178.2	2.59	5.58	2.41	NO
HRDOW										
CDE_0011		0	0.34352E-05	454370.5	4614943.5	178.2	2.59	5.58	2.41	NO
HRDOW										

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** VOLUME SOURCE DATA ***

SOURCE ID	NUMBER EMISSION RATE PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	INIT. SY (METERS)	INIT. SZ (METERS)	URBAN SOURCE	EMISSION RATE SCALAR VARY BY
CDE_0012	0	0.34352E-05	454366.6	4614932.3	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0013	0	0.34352E-05	454364.9	4614920.4	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0014	0	0.34352E-05	454361.7	4614909.6	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0015	0	0.34352E-05	454351.2	4614903.8	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0016	0	0.34352E-05	454340.6	4614898.1	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0017	0	0.34352E-05	454330.1	4614892.3	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0018	0	0.48536E-05	454319.6	4614886.5	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0019	0	0.48536E-05	454309.1	4614880.8	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0020	0	0.48536E-05	454298.6	4614875.0	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0021	0	0.48536E-05	454288.0	4614869.2	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0022	0	0.48536E-05	454277.5	4614863.4	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0023	0	0.48536E-05	454267.0	4614857.7	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0024	0	0.48536E-05	454256.5	4614851.9	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0025	0	0.48536E-05	454246.0	4614846.1	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0026	0	0.48536E-05	454235.4	4614840.3	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0027	0	0.48536E-05	454224.9	4614834.6	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0028	0	0.48536E-05	454214.4	4614828.8	178.2	2.59	5.58	2.41	NO	HRDOW
CDE_0029	0	0.48536E-05	454203.9	4614823.0	178.2	2.59	5.58	2.41	NO	HRDOW
I_0001	0	0.74627E-06	454452.7	4615028.5	178.2	2.59	5.58	2.41	NO	HRDOW
I_0002	0	0.74627E-06	454447.6	4615017.6	178.2	2.59	5.58	2.41	NO	HRDOW
I_0003	0	0.74627E-06	454442.5	4615006.8	178.2	2.59	5.58	2.41	NO	HRDOW

I_0004		0	0.74627E-06	454437.4	4614995.9	178.2	2.59	5.58	2.41	NO	HRDOW
I_0005		0	0.74627E-06	454432.2	4614985.0	178.2	2.59	5.58	2.41	NO	HRDOW
I_0006		0	0.74627E-06	454427.1	4614974.2	178.2	2.59	5.58	2.41	NO	HRDOW
I_0007		0	0.74627E-06	454422.0	4614963.4	178.2	2.59	5.58	2.41	NO	HRDOW
I_0008		0	0.74627E-06	454416.8	4614952.5	178.2	2.59	5.58	2.41	NO	HRDOW
I_0009		0	0.74627E-06	454411.7	4614941.7	178.2	2.59	5.58	2.41	NO	HRDOW
I_0010		0	0.74627E-06	454406.6	4614930.8	178.2	2.59	5.58	2.41	NO	HRDOW
I_0011		0	0.74627E-06	454401.5	4614920.0	178.2	2.59	5.58	2.41	NO	HRDOW
I_0012		0	0.74627E-06	454396.3	4614909.1	178.2	2.59	5.58	2.41	NO	HRDOW
I_0013		0	0.74627E-06	454391.2	4614898.3	178.2	2.59	5.58	2.41	NO	HRDOW
I_0014		0	0.74627E-06	454386.1	4614887.4	178.2	2.59	5.58	2.41	NO	HRDOW
I_0015		0	0.74627E-06	454380.9	4614876.6	178.2	2.59	5.58	2.41	NO	HRDOW
I_0016		0	0.74627E-06	454375.8	4614865.7	178.2	2.59	5.58	2.41	NO	HRDOW
I_0017		0	0.74627E-06	454370.7	4614854.9	178.2	2.59	5.58	2.41	NO	HRDOW
H_0001		0	0.48000E-05	454569.7	4615048.6	178.2	2.59	5.58	2.41	NO	HRDOW
H_0002		0	0.48000E-05	454557.7	4615048.6	178.2	2.59	5.58	2.41	NO	HRDOW
H_0003		0	0.48000E-05	454545.7	4615048.5	178.2	2.59	5.58	2.41	NO	HRDOW
H_0004		0	0.48000E-05	454533.7	4615048.5	178.2	2.59	5.58	2.41	NO	HRDOW
H_0005		0	0.48000E-05	454521.7	4615048.5	178.2	2.59	5.58	2.41	NO	HRDOW

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** VOLUME SOURCE DATA ***

SOURCE ID	NUMBER EMISSION RATE PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	INIT. SY (METERS)	INIT. SZ (METERS)	URBAN SOURCE	EMISSION RATE SCALAR VARY BY
H_0006	0	0.48000E-05	454509.7	4615048.5	178.2	2.59	5.58	2.41	NO	HRDOW
H_0007	0	0.48000E-05	454497.7	4615048.4	178.2	2.59	5.58	2.41	NO	HRDOW
H_0008	0	0.48000E-05	454485.7	4615048.4	178.2	2.59	5.58	2.41	NO	HRDOW
H_0009	0	0.48000E-05	454473.8	4615049.5	178.2	2.59	5.58	2.41	NO	HRDOW
H_0010	0	0.48000E-05	454462.4	4615053.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0001	0	0.32604E-05	454450.4	4615031.4	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0002	0	0.32604E-05	454439.8	4615025.7	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0003	0	0.32604E-05	454429.3	4615020.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0004	0	0.32604E-05	454418.8	4615014.2	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0005	0	0.32604E-05	454408.2	4615008.5	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0006	0	0.32604E-05	454397.7	4615002.7	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0007	0	0.32604E-05	454387.2	4614997.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0008	0	0.32604E-05	454376.6	4614991.2	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0009	0	0.32604E-05	454366.1	4614985.5	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0010	0	0.32604E-05	454355.5	4614979.8	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0011	0	0.32604E-05	454345.0	4614974.0	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0012	0	0.32604E-05	454334.5	4614968.3	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0013	0	0.32604E-05	454323.9	4614962.5	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0014	0	0.32604E-05	454313.4	4614956.8	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0015	0	0.42936E-05	454301.7	4614955.4	178.2	2.59	5.58	2.41	NO	HRDOW
FG_0016	0	0.42936E-05	454289.7	4614955.1	178.2	2.59	5.58	2.41	NO	HRDOW

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 FG_0017          0   0.42936E-05  454277.7 4614954.8   178.2     2.59     5.58
2.41     NO    HRDOW
 FG_0018          0   0.42936E-05  454267.0 4614950.0   178.2     2.59     5.58
2.41     NO    HRDOW
 FG_0019          0   0.42936E-05  454256.5 4614944.1   178.2     2.59     5.58
2.41     NO    HRDOW
 FG_0020          0   0.42936E-05  454246.1 4614938.1   178.2     2.59     5.58
2.41     NO    HRDOW
 FG_0021          0   0.42936E-05  454235.6 4614932.2   178.2     2.59     5.58
2.41     NO    HRDOW
 FG_0022          0   0.42936E-05  454225.2 4614926.3   178.2     2.59     5.58
2.41     NO    HRDOW
 FG_0023          0   0.42936E-05  454214.8 4614920.4   178.2     2.59     5.58
2.41     NO    HRDOW
 FG_0024          0   0.42936E-05  454204.3 4614914.5   178.2     2.59     5.58
2.41     NO    HRDOW
 FG_0025          0   0.42936E-05  454193.9 4614908.6   178.2     2.59     5.58
2.41     NO    HRDOW
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 *** MODELOPTs:    RegDFAULT  CONC  ELEV  NODRYDPLT  NOWETDPLT  RURAL  ADJ_U*


                                          *** SOURCE IDs DEFINING SOURCE GROUPS ***

 SRCGROUP ID                                                SOURCE IDs
 -----------                                                ----------


  ALL        RTO         , V1          , V2          , V3          , V4          , V5
, V6          , V7          ,

             V8          , V9          , V10         , V11         , V12         , V13
, VN1         , VN2         ,

             VN3         , VN4         , VN5         , VN6         , DC1         ,
AB_0001     , AB_0002     , AB_0003     ,

             AB_0004     , AB_0005     , AB_0006     , AB_0007     , AB_0008     ,
AB_0009     , AB_0010     , CDE_0001    ,

             CDE_0002    , CDE_0003    , CDE_0004    , CDE_0005    , CDE_0006    ,
CDE_0007    , CDE_0008    , CDE_0009    ,

             CDE_0010    , CDE_0011    , CDE_0012    , CDE_0013    , CDE_0014    ,
CDE_0015    , CDE_0016    , CDE_0017    ,

             CDE_0018    , CDE_0019    , CDE_0020    , CDE_0021    , CDE_0022    ,
CDE_0023    , CDE_0024    , CDE_0025    ,

             CDE_0026    , CDE_0027    , CDE_0028    , CDE_0029    , I_0001      ,
I_0002      , I_0003      , I_0004      ,

             I_0005      , I_0006      , I_0007      , I_0008      , I_0009      ,
I_0010      , I_0011      , I_0012      ,

             I_0013      , I_0014      , I_0015      , I_0016      , I_0017      ,
H_0001      , H_0002      , H_0003      ,

             H_0004      , H_0005      , H_0006      , H_0007      , H_0008      ,
H_0009      , H_0010      , FG_0001     ,

             FG_0002     , FG_0003     , FG_0004     , FG_0005     , FG_0006     ,
FG_0007     , FG_0008     , FG_0009     ,

             FG_0010     , FG_0011     , FG_0012     , FG_0013     , FG_0014     ,
FG_0015     , FG_0016     , FG_0017     ,

             FG_0018     , FG_0019     , FG_0020     , FG_0021     , FG_0022     ,
FG_0023     , FG_0024     , FG_0025     ,

             031036AAA1  , 031036AAA2  , 031036AAA3  , 031600AAR4  , 031600AAR5  ,
031600AAR6  , 031600AAR7  , 031600AAR8  ,

             031600AAR9  , 031600AFV1  , 031600ALC   , 031600AOL   , 031600BIY1  ,
031600BIY2  , 031600BRA   , 031600DPK   ,
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031600DQO , 031600FDK , 031600FGT1 , 031600FGT2 , 031600FGT3 , 031600FHQ1 , 031600FHQ2 , 031600FHQ5 ,

031600FLD1 , 031600FLD2 , 031600FWM , 031600GFX , 031600GHA1 , 031600GHA3 , 031600GHV1 , 031600GHV2 ,

031600GKE1 , 031600GKE2 , 031600GKE3 , 031600GKE4 , 031600GKE5 , 031600GKE6 , 031600GKE7 , 031600GKE8 ,

031600GKE9 , 031600GKE10 , 031600GKE11 , 031600GKU , 031600GWV ,

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DIRECTION SPECIFIC BUILDING DIMENSIONS ***

SOURCE ID: RTO

IFV	BH	BW	BL	XADJ	YADJ	IFV	BH	BW	BL	XADJ	YADJ
1	18.3,	39.0,	36.0,	6.9,	21.1,	2	18.3,	39.8,	34.8,	3.9,	24.8,
3	18.3,	39.3,	32.6,	0.7,	27.7,	4	0.0,	0.0,	0.0,	0.0,	0.0,
5	0.0,	0.0,	0.0,	0.0,	0.0,	6	0.0,	0.0,	0.0,	0.0,	0.0,
7	0.0,	0.0,	0.0,	0.0,	0.0,	8	0.0,	0.0,	0.0,	0.0,	0.0,
9	0.0,	0.0,	0.0,	0.0,	0.0,	10	18.3,	36.0,	39.0,	-40.6,	24.9,
11	18.3,	34.8,	39.8,	-44.7,	21.3,	12	18.3,	32.6,	39.3,	-47.4,	17.0,
13	18.3,	29.7,	37.7,	-48.6,	12.1,	14	18.3,	28.3,	34.9,	-48.4,	5.5,
15	18.3,	26.1,	31.1,	-46.7,	-1.2,	16	18.3,	29.9,	33.0,	-47.4,	-6.8,
17	18.3,	34.0,	35.1,	-47.4,	-12.0,	18	18.3,	37.0,	36.1,	-45.8,	-16.8,
19	18.3,	39.0,	36.0,	-42.9,	-21.1,	20	18.3,	39.8,	34.8,	-38.7,	-24.8,
21	18.3,	39.3,	32.6,	-33.3,	-27.7,	22	0.0,	0.0,	0.0,	0.0,	0.0,
23	0.0,	0.0,	0.0,	0.0,	0.0,	24	0.0,	0.0,	0.0,	0.0,	0.0,
25	0.0,	0.0,	0.0,	0.0,	0.0,	26	0.0,	0.0,	0.0,	0.0,	0.0,
27	0.0,	0.0,	0.0,	0.0,	0.0,	28	18.3,	36.0,	39.0,	1.6,	-24.9,
29	18.3,	34.8,	39.8,	4.9,	-21.3,	30	18.3,	32.6,	39.3,	8.0,	-17.0,
31	18.3,	29.7,	37.7,	10.9,	-12.1,	32	18.3,	28.3,	34.9,	13.5,	-5.5,
33	18.3,	26.1,	31.1,	15.6,	1.2,	34	18.3,	29.9,	33.0,	14.4,	6.8,
35	18.3,	34.0,	35.1,	12.2,	12.0,	36	18.3,	37.0,	36.1,	9.7,	16.8,

SOURCE ID: DC1

IFV	BH	BW	BL	XADJ	YADJ	IFV	BH	BW	BL	XADJ	YADJ
1	13.7,	66.6,	68.8,	-55.4,	12.1,	2	13.7,	68.6,	67.4,	-56.5,	8.2,
3	13.7,	68.5,	64.0,	-55.9,	4.2,	4	13.7,	66.3,	58.7,	-53.5,	-0.0,
5	13.7,	62.1,	51.6,	-49.6,	-4.2,	6	13.7,	56.0,	42.9,	-44.2,	-8.3,

```
    7   13.7,   60.4,   49.1,  -45.5,  -12.1,      8   13.7,   65.2,   56.8,  -46.9,  -
15.6,
    9   13.7,   68.0,   62.6,  -46.9,  -18.6,     10   13.7,   68.8,   66.6,  -45.4,  -
21.0,
   11   13.7,   67.4,   68.6,  -42.5,  -22.8,     12   13.7,   64.0,   68.5,  -38.4,  -
23.8,
   13   13.7,   58.7,   66.3,  -33.1,  -24.2,     14   13.7,   51.6,   62.1,  -26.8,  -
23.8,
   15   13.7,   42.9,   56.0,  -19.7,  -22.7,     16   13.7,   49.1,   60.4,  -18.1,  -
20.9,
   17   13.7,   56.8,   65.2,  -17.0,  -18.5,     18   13.7,   62.6,   68.0,  -15.5,  -
15.5,
   19   13.7,   66.6,   68.8,  -13.4,  -12.1,     20   13.7,   68.6,   67.4,  -11.0,
-8.2,
   21   13.7,   68.5,   64.0,   -8.2,   -4.2,     22   13.7,   66.3,   58.7,   -5.1,
0.0,
   23   13.7,   62.1,   51.6,   -2.0,    4.2,     24   13.7,   56.0,   42.9,    1.3,
8.3,
   25   13.7,   60.4,   49.1,   -3.6,   12.1,     26   13.7,   65.2,   56.8,   -9.9,
15.6,
   27   13.7,   68.0,   62.6,  -15.8,   18.6,     28   13.7,   68.8,   66.6,  -21.2,
21.0,
   29   13.7,   67.4,   68.6,  -26.1,   22.8,     30   13.7,   64.0,   68.5,  -30.1,
23.8,
   31   13.7,   58.7,   66.3,  -33.2,   24.2,     32   13.7,   51.6,   62.1,  -35.3,
23.8,
   33   13.7,   42.9,   56.0,  -36.3,   22.7,     34   13.7,   49.1,   60.4,  -42.4,
20.9,
   35   13.7,   56.8,   65.2,  -48.2,   18.5,     36   13.7,   62.6,   68.0,  -52.6,
15.5,
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = RTO ; SOURCE TYPE = POINT :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V1 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.6840E-01	2	.6840E-01	3	.6840E-01	4	.6840E-01	5	.6840E-01	6	.6840E-01	7	.6840E-01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.6840E-01	21	.6840E-01	22	.6840E-01	23	.6840E-01	24	.6840E-01

DAY OF WEEK = SATURDAY

1	.6840E-01	2	.6840E-01	3	.6840E-01	4	.6840E-01	5	.6840E-01	6	.6840E-01	7	.6840E-01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.6840E-01	19	.6840E-01	20	.6840E-01	21	.6840E-01	22	.6840E-01	23	.6840E-01	24	.6840E-01

DAY OF WEEK = SUNDAY

1	.6840E-01	2	.6840E-01	3	.6840E-01	4	.6840E-01	5	.6840E-01	6	.6840E-01	7	.6840E-01	8	.6840E-01
9	.6840E-01	10	.6840E-01	11	.6840E-01	12	.6840E-01	13	.6840E-01	14	.6840E-01	15	.6840E-01	16	.6840E-01
17	.6840E-01	18	.6840E-01	19	.6840E-01	20	.6840E-01	21	.6840E-01	22	.6840E-01	23	.6840E-01	24	.6840E-01

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V2 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V3 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V4 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.1000E+00	2	.1000E+00	3	.1000E+00	4	.1000E+00	5	.1000E+00	6	.1000E+00	7	.1000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+00	21	.1000E+00	22	.1000E+00	23	.1000E+00	24	.1000E+00

DAY OF WEEK = SATURDAY

1	.1000E+00	2	.1000E+00	3	.1000E+00	4	.1000E+00	5	.1000E+00	6	.1000E+00	7	.1000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+00	19	.1000E+00	20	.1000E+00	21	.1000E+00	22	.1000E+00	23	.1000E+00	24	.1000E+00

DAY OF WEEK = SUNDAY

1	.1000E+00	2	.1000E+00	3	.1000E+00	4	.1000E+00	5	.1000E+00	6	.1000E+00	7	.1000E+00	8	.1000E+00
9	.1000E+00	10	.1000E+00	11	.1000E+00	12	.1000E+00	13	.1000E+00	14	.1000E+00	15	.1000E+00	16	.1000E+00
17	.1000E+00	18	.1000E+00	19	.1000E+00	20	.1000E+00	21	.1000E+00	22	.1000E+00	23	.1000E+00	24	.1000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V5 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V6 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.1778E+00	2	.1778E+00	3	.1778E+00	4	.1778E+00	5	.1778E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1778E+00

DAY OF WEEK = SATURDAY

1	.1778E+00	2	.1778E+00	3	.1778E+00	4	.1778E+00	5	.1778E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1778E+00

DAY OF WEEK = SUNDAY

1	.1778E+00	2	.1778E+00	3	.1778E+00	4	.1778E+00	5	.1778E+00	6	.1778E+00	7	.1778E+00	8	.1778E+00
9	.1778E+00	10	.1778E+00	11	.1778E+00	12	.1778E+00	13	.1778E+00	14	.1778E+00	15	.1778E+00	16	.1778E+00
17	.1778E+00	18	.1778E+00	19	.1778E+00	20	.1778E+00	21	.1778E+00	22	.1778E+00	23	.1778E+00	24	.1778E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V7 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V8 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V9 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.1950E-01	2	.1950E-01	3	.1950E-01	4	.1950E-01	5	.1950E-01	6	.1950E-01	7	.1950E-01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1950E-01	21	.1950E-01	22	.1950E-01	23	.1950E-01	24	.1950E-01
DAY OF WEEK = SATURDAY															
1	.1950E-01	2	.1950E-01	3	.1950E-01	4	.1950E-01	5	.1950E-01	6	.1950E-01	7	.1950E-01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1950E-01	19	.1950E-01	20	.1950E-01	21	.1950E-01	22	.1950E-01	23	.1950E-01	24	.1950E-01
DAY OF WEEK = SUNDAY															
1	.1950E-01	2	.1950E-01	3	.1950E-01	4	.1950E-01	5	.1950E-01	6	.1950E-01	7	.1950E-01	8	.1950E-01
9	.1950E-01	10	.1950E-01	11	.1950E-01	12	.1950E-01	13	.1950E-01	14	.1950E-01	15	.1950E-01	16	.1950E-01
17	.1950E-01	18	.1950E-01	19	.1950E-01	20	.1950E-01	21	.1950E-01	22	.1950E-01	23	.1950E-01	24	.1950E-01

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V10 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1746E+01
17	.1746E+01	18	.1746E+01	19	.1746E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1746E+01
17	.1746E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V11 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.2164E+01
17	.2164E+01	18	.2164E+01	19	.2164E+01	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00
DAY OF WEEK = SATURDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.2164E+01
17	.2164E+01	18	.2650E+00	19	.2650E+00	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00
DAY OF WEEK = SUNDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.2650E+00
9	.2650E+00	10	.2650E+00	11	.2650E+00	12	.2650E+00	13	.2650E+00	14	.2650E+00	15	.2650E+00	16	.2650E+00
17	.2650E+00	18	.2650E+00	19	.2650E+00	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V12 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.2164E+01
17	.2164E+01	18	.2164E+01	19	.2164E+01	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00
DAY OF WEEK = SATURDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.2164E+01
17	.2164E+01	18	.2650E+00	19	.2650E+00	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00
DAY OF WEEK = SUNDAY															
1	.2650E+00	2	.2650E+00	3	.2650E+00	4	.2650E+00	5	.2650E+00	6	.2650E+00	7	.2650E+00	8	.2650E+00
9	.2650E+00	10	.2650E+00	11	.2650E+00	12	.2650E+00	13	.2650E+00	14	.2650E+00	15	.2650E+00	16	.2650E+00
17	.2650E+00	18	.2650E+00	19	.2650E+00	20	.2650E+00	21	.2650E+00	22	.2650E+00	23	.2650E+00	24	.2650E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = V13 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN1 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.1030E-03	2	.1030E-03	3	.1030E-03	4	.1030E-03	5	.1030E-03	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1030E-03
DAY OF WEEK = SATURDAY															
1	.1030E-03	2	.1030E-03	3	.1030E-03	4	.1030E-03	5	.1030E-03	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1030E-03
DAY OF WEEK = SUNDAY															
1	.1030E-03	2	.1030E-03	3	.1030E-03	4	.1030E-03	5	.1030E-03	6	.1030E-03	7	.1030E-03	8	.1030E-03
9	.1030E-03	10	.1030E-03	11	.1030E-03	12	.1030E-03	13	.1030E-03	14	.1030E-03	15	.1030E-03	16	.1030E-03
17	.1030E-03	18	.1030E-03	19	.1030E-03	20	.1030E-03	21	.1030E-03	22	.1030E-03	23	.1030E-03	24	.1030E-03

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN2 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN3 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN4 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.5670E-01	2	.5670E-01	3	.5670E-01	4	.5670E-01	5	.5670E-01	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.5670E-01
DAY OF WEEK = SATURDAY															
1	.5670E-01	2	.5670E-01	3	.5670E-01	4	.5670E-01	5	.5670E-01	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.5670E-01
DAY OF WEEK = SUNDAY															
1	.5670E-01	2	.5670E-01	3	.5670E-01	4	.5670E-01	5	.5670E-01	6	.5670E-01	7	.5670E-01	8	.5670E-01
9	.5670E-01	10	.5670E-01	11	.5670E-01	12	.5670E-01	13	.5670E-01	14	.5670E-01	15	.5670E-01	16	.5670E-01
17	.5670E-01	18	.5670E-01	19	.5670E-01	20	.5670E-01	21	.5670E-01	22	.5670E-01	23	.5670E-01	24	.5670E-01

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN5 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.1438E+00	2	.1438E+00	3	.1438E+00	4	.1438E+00	5	.1438E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1438E+00
DAY OF WEEK = SATURDAY															
1	.1438E+00	2	.1438E+00	3	.1438E+00	4	.1438E+00	5	.1438E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.1438E+00
DAY OF WEEK = SUNDAY															
1	.1438E+00	2	.1438E+00	3	.1438E+00	4	.1438E+00	5	.1438E+00	6	.1438E+00	7	.1438E+00	8	.1438E+00
9	.1438E+00	10	.1438E+00	11	.1438E+00	12	.1438E+00	13	.1438E+00	14	.1438E+00	15	.1438E+00	16	.1438E+00
17	.1438E+00	18	.1438E+00	19	.1438E+00	20	.1438E+00	21	.1438E+00	22	.1438E+00	23	.1438E+00	24	.1438E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = VN6 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.9500E-02	2	.9500E-02	3	.9500E-02	4	.9500E-02	5	.9500E-02	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.9500E-02
DAY OF WEEK = SATURDAY															
1	.9500E-02	2	.9500E-02	3	.9500E-02	4	.9500E-02	5	.9500E-02	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.1000E+01	21	.1000E+01	22	.1000E+01	23	.1000E+01	24	.9500E-02
DAY OF WEEK = SUNDAY															
1	.9500E-02	2	.9500E-02	3	.9500E-02	4	.9500E-02	5	.9500E-02	6	.9500E-02	7	.9500E-02	8	.9500E-02
9	.9500E-02	10	.9500E-02	11	.9500E-02	12	.9500E-02	13	.9500E-02	14	.9500E-02	15	.9500E-02	16	.9500E-02
17	.9500E-02	18	.9500E-02	19	.9500E-02	20	.9500E-02	21	.9500E-02	22	.9500E-02	23	.9500E-02	24	.9500E-02

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

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* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = AB_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
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*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0011 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0012 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0013 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0014 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0015 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0016 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0017 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0018 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0019 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0020 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0021 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0022 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0023 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0024 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0025 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0026 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0027 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0028 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = CDE_0029 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0011 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0012 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0013 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0014 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0015 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0016 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = I_0017 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
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*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = H_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0001 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0002 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0003 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0004 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0005 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0006 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0007 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0008 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0009 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0010 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0011 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0012 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0013 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0014 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0015 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0016 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0017 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0018 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0019 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0020 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0021 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0022 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0023 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR

DAY OF WEEK = WEEKDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SATURDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

DAY OF WEEK = SUNDAY

1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0024 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE EMISSION RATE SCALARS WHICH VARY DIURNALLY AND BY DAY OF WEEK (HRDOW) *

SOURCE ID = FG_0025 ; SOURCE TYPE = VOLUME :

HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR	HOUR	SCALAR
DAY OF WEEK = WEEKDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.1000E+01	19	.1000E+01	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SATURDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.1000E+01	7	.1000E+01	8	.1000E+01
9	.1000E+01	10	.1000E+01	11	.1000E+01	12	.1000E+01	13	.1000E+01	14	.1000E+01	15	.1000E+01	16	.1000E+01
17	.1000E+01	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00
DAY OF WEEK = SUNDAY															
1	.0000E+00	2	.0000E+00	3	.0000E+00	4	.0000E+00	5	.0000E+00	6	.0000E+00	7	.0000E+00	8	.0000E+00
9	.0000E+00	10	.0000E+00	11	.0000E+00	12	.0000E+00	13	.0000E+00	14	.0000E+00	15	.0000E+00	16	.0000E+00
17	.0000E+00	18	.0000E+00	19	.0000E+00	20	.0000E+00	21	.0000E+00	22	.0000E+00	23	.0000E+00	24	.0000E+00

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454084.4, 4615065.4, 176.2, 178.2, 0.0); (454083.3, 4615039.8, 176.1, 178.2, 0.0);
(454082.2, 4615014.1, 175.9, 178.2, 0.0); (454085.1, 4614964.6, 176.4, 178.2, 0.0);
(454088.0, 4614915.0, 176.8, 176.8, 0.0); (454091.0, 4614865.5, 177.2, 177.2, 0.0);
(454093.9, 4614816.0, 177.6, 177.6, 0.0); (454096.8, 4614766.4, 178.0, 178.0, 0.0);
(454099.7, 4614716.9, 178.2, 178.2, 0.0); (454102.6, 4614667.3, 176.8, 176.8, 0.0);
(454105.5, 4614617.8, 176.3, 178.2, 0.0); (454108.5, 4614568.3, 176.7, 178.2, 0.0);
(454111.4, 4614518.7, 177.1, 177.1, 0.0); (454114.3, 4614469.2, 177.6, 178.2, 0.0);
(454107.8, 4614425.2, 176.8, 176.8, 0.0); (454101.3, 4614381.1, 178.1, 178.1, 0.0);
(454094.7, 4614337.1, 177.9, 177.9, 0.0); (454088.2, 4614293.0, 177.6, 178.6, 0.0);
(454081.7, 4614249.0, 176.5, 178.2, 0.0); (454082.2, 4614201.8, 177.2, 177.2, 0.0);
(454082.8, 4614154.7, 177.4, 177.4, 0.0); (454121.4, 4614157.8, 178.2, 178.2, 0.0);
(454160.0, 4614160.9, 178.2, 178.2, 0.0); (454191.3, 4614179.4, 178.2, 178.2, 0.0);
(454222.7, 4614198.0, 178.2, 178.2, 0.0); (454254.0, 4614216.5, 178.2, 178.2, 0.0);
(454253.2, 4614226.3, 178.2, 178.2, 0.0); (454296.0, 4614249.3, 178.2, 178.2, 0.0);
(454338.8, 4614272.3, 178.2, 178.2, 0.0); (454381.7, 4614295.3, 178.2, 178.2, 0.0);
(454424.5, 4614318.3, 178.2, 178.2, 0.0); (454467.3, 4614341.4, 178.2, 178.2, 0.0);
(454510.2, 4614364.4, 178.2, 178.2, 0.0); (454553.0, 4614387.4, 178.2, 178.2, 0.0);
(454595.8, 4614410.4, 178.2, 178.2, 0.0); (454595.8, 4614459.2, 178.2, 178.2, 0.0);
(454595.8, 4614507.9, 178.2, 178.2, 0.0); (454595.8, 4614556.7, 178.2, 178.2, 0.0);
(454595.8, 4614605.5, 178.2, 178.2, 0.0); (454595.8, 4614654.3, 178.2, 178.2, 0.0);
(454595.8, 4614703.0, 178.2, 178.2, 0.0); (454595.8, 4614751.8, 178.2, 178.2, 0.0);
(454595.8, 4614800.6, 178.2, 178.2, 0.0); (454595.8, 4614849.3, 178.2, 178.2, 0.0);
(454595.8, 4614898.1, 178.2, 178.2, 0.0); (454595.8, 4614946.9, 178.2, 178.2, 0.0);
(454595.8, 4614995.6, 178.2, 178.2, 0.0); (454595.8, 4615044.4, 178.2, 178.2, 0.0);
(454595.8, 4615093.2, 178.2, 178.2, 0.0); (454595.8, 4615142.0, 178.2, 178.2, 0.0);

```
     ( 454595.8, 4615190.7,     178.2,     178.2,       0.0);         ( 454595.8,
4615239.5,     178.2,     178.2,       0.0);
     ( 454551.9, 4615219.2,     178.2,     178.2,       0.0);         ( 454508.0,
4615199.0,     178.2,     178.2,       0.0);
     ( 454484.5, 4615239.5,     178.2,     178.2,       0.0);         ( 454461.1,
4615279.9,     178.2,     178.2,       0.0);
     ( 454413.6, 4615286.6,     178.2,     178.2,       0.0);         ( 454376.8,
4615266.9,     178.2,     178.2,       0.0);
     ( 454340.0, 4615247.2,     178.2,     178.2,       0.0);         ( 454303.1,
4615227.5,     178.2,     178.2,       0.0);
     ( 454266.3, 4615207.8,     178.2,     178.2,       0.0);         ( 454229.5,
4615188.1,     178.2,     178.2,       0.0);
     ( 454251.0, 4615155.9,     178.2,     178.2,       0.0);         ( 454209.3,
4615133.3,     178.2,     178.2,       0.0);
     ( 454167.7, 4615110.7,     178.2,     178.2,       0.0);         ( 454126.1,
4615088.0,     178.2,     178.2,       0.0);
     ( 452000.0, 4612100.0,     178.9,     225.3,       0.0);         ( 452100.0,
4612100.0,     179.7,     225.2,       0.0);
     ( 452200.0, 4612100.0,     183.3,     183.3,       0.0);         ( 452300.0,
4612100.0,     175.2,     186.7,       0.0);
     ( 452400.0, 4612100.0,     185.7,     185.7,       0.0);         ( 452500.0,
4612100.0,     181.9,     181.9,       0.0);
     ( 452600.0, 4612100.0,     179.4,     179.4,       0.0);         ( 452700.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 452800.0, 4612100.0,     178.4,     178.4,       0.0);         ( 452900.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 453000.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453100.0,
4612100.0,     178.6,     178.6,       0.0);
     ( 453200.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453300.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 453400.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453500.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 453600.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453700.0,
4612100.0,     178.4,     178.4,       0.0);
     ( 453800.0, 4612100.0,     178.4,     178.4,       0.0);         ( 453900.0,
4612100.0,     178.5,     178.5,       0.0);
     ( 454000.0, 4612100.0,     180.1,     180.1,       0.0);         ( 454100.0,
4612100.0,     179.1,     179.1,       0.0);
     ( 454200.0, 4612100.0,     178.2,     178.2,       0.0);         ( 454300.0,
4612100.0,     178.2,     178.2,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454400.0, 4612100.0, 178.2, 178.2, 0.0); (454500.0, 4612100.0, 178.2, 178.2, 0.0);
(454600.0, 4612100.0, 178.2, 178.2, 0.0); (454700.0, 4612100.0, 181.1, 181.1, 0.0);
(454800.0, 4612100.0, 183.5, 183.5, 0.0); (454900.0, 4612100.0, 178.4, 178.4, 0.0);
(455000.0, 4612100.0, 178.2, 178.2, 0.0); (455100.0, 4612100.0, 178.2, 178.2, 0.0);
(455200.0, 4612100.0, 178.2, 178.2, 0.0); (455300.0, 4612100.0, 177.9, 177.9, 0.0);
(455400.0, 4612100.0, 177.6, 177.6, 0.0); (455500.0, 4612100.0, 177.7, 177.7, 0.0);
(455600.0, 4612100.0, 178.3, 178.3, 0.0); (455700.0, 4612100.0, 177.6, 177.6, 0.0);
(455800.0, 4612100.0, 177.6, 177.6, 0.0); (455900.0, 4612100.0, 177.7, 177.7, 0.0);
(456000.0, 4612100.0, 178.2, 178.2, 0.0); (456100.0, 4612100.0, 177.2, 177.2, 0.0);
(456200.0, 4612100.0, 177.2, 177.2, 0.0); (456300.0, 4612100.0, 178.0, 178.0, 0.0);
(456400.0, 4612100.0, 178.6, 178.6, 0.0); (456500.0, 4612100.0, 178.7, 178.7, 0.0);
(456600.0, 4612100.0, 178.4, 178.4, 0.0); (452000.0, 4612200.0, 179.6, 179.6, 0.0);
(452100.0, 4612200.0, 180.1, 180.1, 0.0); (452200.0, 4612200.0, 180.0, 180.0, 0.0);
(452300.0, 4612200.0, 175.2, 185.8, 0.0); (452400.0, 4612200.0, 175.2, 186.7, 0.0);
(452500.0, 4612200.0, 178.4, 178.4, 0.0); (452600.0, 4612200.0, 178.7, 178.7, 0.0);
(452700.0, 4612200.0, 178.7, 178.7, 0.0); (452800.0, 4612200.0, 178.5, 178.5, 0.0);
(452900.0, 4612200.0, 178.4, 178.4, 0.0); (453000.0, 4612200.0, 178.4, 178.4, 0.0);
(453100.0, 4612200.0, 178.4, 178.4, 0.0); (453200.0, 4612200.0, 178.4, 178.4, 0.0);
(453300.0, 4612200.0, 178.4, 178.4, 0.0); (453400.0, 4612200.0, 178.4, 178.4, 0.0);
(453500.0, 4612200.0, 178.4, 178.4, 0.0); (453600.0, 4612200.0, 178.4, 178.4, 0.0);
(453700.0, 4612200.0, 178.4, 178.4, 0.0); (453800.0, 4612200.0, 178.4, 178.4, 0.0);
(453900.0, 4612200.0, 178.7, 178.7, 0.0); (454000.0, 4612200.0, 179.3, 179.3, 0.0);
(454100.0, 4612200.0, 179.1, 179.1, 0.0); (454200.0, 4612200.0, 178.5, 178.5, 0.0);
(454300.0, 4612200.0, 178.2, 178.2, 0.0); (454400.0, 4612200.0, 178.2, 178.2, 0.0);
(454500.0, 4612200.0, 178.2, 178.2, 0.0); (454600.0, 4612200.0, 182.1, 182.1, 0.0);

```
     ( 454700.0, 4612200.0,     183.9,     183.9,       0.0);         ( 454800.0,
4612200.0,     184.3,     184.3,       0.0);
     ( 454900.0, 4612200.0,     181.0,     181.0,       0.0);         ( 455000.0,
4612200.0,     178.3,     178.3,       0.0);
     ( 455100.0, 4612200.0,     178.2,     178.2,       0.0);         ( 455200.0,
4612200.0,     177.9,     177.9,       0.0);
     ( 455300.0, 4612200.0,     177.7,     177.7,       0.0);         ( 455400.0,
4612200.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4612200.0,     177.6,     177.6,       0.0);         ( 455600.0,
4612200.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4612200.0,     177.6,     177.6,       0.0);         ( 455800.0,
4612200.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4612200.0,     177.6,     177.6,       0.0);         ( 456000.0,
4612200.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4612200.0,     177.1,     177.1,       0.0);         ( 456200.0,
4612200.0,     177.4,     177.4,       0.0);
     ( 456300.0, 4612200.0,     178.2,     178.2,       0.0);         ( 456400.0,
4612200.0,     178.1,     178.1,       0.0);
     ( 456500.0, 4612200.0,     178.4,     178.4,       0.0);         ( 456600.0,
4612200.0,     178.5,     178.5,       0.0);
     ( 452000.0, 4612300.0,     179.2,     179.2,       0.0);         ( 452100.0,
4612300.0,     179.1,     179.1,       0.0);
     ( 452200.0, 4612300.0,     178.7,     178.7,       0.0);         ( 452300.0,
4612300.0,     175.2,     175.2,       0.0);
     ( 452400.0, 4612300.0,     175.2,     175.2,       0.0);         ( 452500.0,
4612300.0,     176.0,     176.0,       0.0);
     ( 452600.0, 4612300.0,     178.3,     178.3,       0.0);         ( 452700.0,
4612300.0,     178.6,     178.6,       0.0);
     ( 452800.0, 4612300.0,     178.7,     178.7,       0.0);         ( 452900.0,
4612300.0,     178.4,     178.4,       0.0);
     ( 453000.0, 4612300.0,     178.4,     178.4,       0.0);         ( 453100.0,
4612300.0,     178.4,     178.4,       0.0);
     ( 453200.0, 4612300.0,     178.4,     178.4,       0.0);         ( 453300.0,
4612300.0,     178.4,     178.4,       0.0);
     ( 453400.0, 4612300.0,     178.6,     178.6,       0.0);         ( 453500.0,
4612300.0,     178.5,     178.5,       0.0);
     ( 453600.0, 4612300.0,     178.4,     178.4,       0.0);         ( 453700.0,
4612300.0,     178.4,     178.4,       0.0);
     ( 453800.0, 4612300.0,     178.7,     178.7,       0.0);         ( 453900.0,
4612300.0,     178.9,     178.9,       0.0);
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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454000.0, 4612300.0, 179.0, 179.0, 0.0); (454100.0, 4612300.0, 178.9, 178.9, 0.0);
(454200.0, 4612300.0, 178.4, 178.4, 0.0); (454300.0, 4612300.0, 178.2, 178.2, 0.0);
(454400.0, 4612300.0, 177.9, 177.9, 0.0); (454500.0, 4612300.0, 178.2, 178.2, 0.0);
(454600.0, 4612300.0, 184.2, 184.2, 0.0); (454700.0, 4612300.0, 182.4, 182.4, 0.0);
(454800.0, 4612300.0, 184.2, 184.2, 0.0); (454900.0, 4612300.0, 182.4, 182.4, 0.0);
(455000.0, 4612300.0, 178.2, 178.2, 0.0); (455100.0, 4612300.0, 178.2, 178.2, 0.0);
(455200.0, 4612300.0, 177.6, 177.6, 0.0); (455300.0, 4612300.0, 177.6, 177.6, 0.0);
(455400.0, 4612300.0, 177.6, 177.6, 0.0); (455500.0, 4612300.0, 177.6, 177.6, 0.0);
(455600.0, 4612300.0, 177.6, 177.6, 0.0); (455700.0, 4612300.0, 177.6, 177.6, 0.0);
(455800.0, 4612300.0, 177.6, 177.6, 0.0); (455900.0, 4612300.0, 177.6, 177.6, 0.0);
(456000.0, 4612300.0, 177.6, 177.6, 0.0); (456100.0, 4612300.0, 177.1, 177.1, 0.0);
(456200.0, 4612300.0, 177.1, 177.1, 0.0); (456300.0, 4612300.0, 178.2, 178.2, 0.0);
(456400.0, 4612300.0, 182.9, 182.9, 0.0); (456500.0, 4612300.0, 182.2, 182.2, 0.0);
(456600.0, 4612300.0, 177.7, 177.7, 0.0); (452000.0, 4612400.0, 178.5, 178.5, 0.0);
(452100.0, 4612400.0, 177.9, 177.9, 0.0); (452200.0, 4612400.0, 175.3, 175.3, 0.0);
(452300.0, 4612400.0, 175.2, 175.2, 0.0); (452400.0, 4612400.0, 175.2, 175.2, 0.0);
(452500.0, 4612400.0, 175.2, 175.2, 0.0); (452600.0, 4612400.0, 176.8, 178.8, 0.0);
(452700.0, 4612400.0, 178.3, 178.3, 0.0); (452800.0, 4612400.0, 178.6, 178.6, 0.0);
(452900.0, 4612400.0, 178.7, 178.7, 0.0); (453000.0, 4612400.0, 178.4, 178.4, 0.0);
(453100.0, 4612400.0, 178.4, 178.4, 0.0); (453200.0, 4612400.0, 178.5, 178.5, 0.0);
(453300.0, 4612400.0, 178.7, 178.7, 0.0); (453400.0, 4612400.0, 178.7, 178.7, 0.0);
(453500.0, 4612400.0, 178.7, 178.7, 0.0); (453600.0, 4612400.0, 178.6, 178.6, 0.0);
(453700.0, 4612400.0, 178.5, 178.5, 0.0); (453800.0, 4612400.0, 178.8, 178.8, 0.0);
(453900.0, 4612400.0, 178.9, 178.9, 0.0); (454000.0, 4612400.0, 178.9, 178.9, 0.0);
(454100.0, 4612400.0, 178.8, 178.8, 0.0); (454200.0, 4612400.0, 178.2, 178.2, 0.0);

```
     ( 454300.0, 4612400.0,     178.2,     178.2,       0.0);         ( 454400.0,
4612400.0,     176.9,     176.9,       0.0);
     ( 454500.0, 4612400.0,     178.2,     178.2,       0.0);         ( 454600.0,
4612400.0,     184.3,     184.3,       0.0);
     ( 454700.0, 4612400.0,     182.4,     182.4,       0.0);         ( 454800.0,
4612400.0,     182.9,     182.9,       0.0);
     ( 454900.0, 4612400.0,     182.4,     182.4,       0.0);         ( 455000.0,
4612400.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4612400.0,     178.2,     178.2,       0.0);         ( 455200.0,
4612400.0,     177.6,     177.6,       0.0);
     ( 455300.0, 4612400.0,     177.6,     177.6,       0.0);         ( 455400.0,
4612400.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4612400.0,     177.6,     177.6,       0.0);         ( 455600.0,
4612400.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4612400.0,     177.6,     177.6,       0.0);         ( 455800.0,
4612400.0,     178.0,     178.0,       0.0);
     ( 455900.0, 4612400.0,     177.6,     177.6,       0.0);         ( 456000.0,
4612400.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4612400.0,     177.1,     177.1,       0.0);         ( 456200.0,
4612400.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4612400.0,     177.2,     177.2,       0.0);         ( 456400.0,
4612400.0,     179.1,     179.1,       0.0);
     ( 456500.0, 4612400.0,     177.1,     184.9,       0.0);         ( 456600.0,
4612400.0,     177.1,     177.1,       0.0);
     ( 452000.0, 4612500.0,     175.2,     175.2,       0.0);         ( 452100.0,
4612500.0,     175.2,     175.2,       0.0);
     ( 452200.0, 4612500.0,     175.2,     175.2,       0.0);         ( 452300.0,
4612500.0,     175.2,     175.2,       0.0);
     ( 452400.0, 4612500.0,     175.2,     175.2,       0.0);         ( 452500.0,
4612500.0,     175.2,     175.2,       0.0);
     ( 452600.0, 4612500.0,     175.2,     175.2,       0.0);         ( 452700.0,
4612500.0,     175.2,     175.2,       0.0);
     ( 452800.0, 4612500.0,     176.4,     176.4,       0.0);         ( 452900.0,
4612500.0,     178.8,     178.8,       0.0);
     ( 453000.0, 4612500.0,     178.4,     178.4,       0.0);         ( 453100.0,
4612500.0,     178.4,     178.4,       0.0);
     ( 453200.0, 4612500.0,     178.8,     178.8,       0.0);         ( 453300.0,
4612500.0,     178.9,     178.9,       0.0);
     ( 453400.0, 4612500.0,     178.9,     178.9,       0.0);         ( 453500.0,
4612500.0,     178.9,     178.9,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453600.0, 4612500.0, 178.8, 178.8, 0.0); (453700.0, 4612500.0, 178.9, 178.9, 0.0);
(453800.0, 4612500.0, 178.9, 178.9, 0.0); (453900.0, 4612500.0, 178.8, 178.8, 0.0);
(454000.0, 4612500.0, 179.1, 179.1, 0.0); (454100.0, 4612500.0, 179.7, 179.7, 0.0);
(454200.0, 4612500.0, 178.4, 178.4, 0.0); (454300.0, 4612500.0, 178.2, 178.2, 0.0);
(454400.0, 4612500.0, 177.4, 177.4, 0.0); (454500.0, 4612500.0, 178.2, 178.2, 0.0);
(454600.0, 4612500.0, 184.5, 184.5, 0.0); (454700.0, 4612500.0, 182.1, 182.1, 0.0);
(454800.0, 4612500.0, 183.0, 183.0, 0.0); (454900.0, 4612500.0, 182.3, 182.3, 0.0);
(455000.0, 4612500.0, 178.2, 178.2, 0.0); (455100.0, 4612500.0, 178.3, 178.3, 0.0);
(455200.0, 4612500.0, 177.6, 177.6, 0.0); (455300.0, 4612500.0, 178.1, 178.1, 0.0);
(455400.0, 4612500.0, 177.6, 177.6, 0.0); (455500.0, 4612500.0, 177.6, 177.6, 0.0);
(455600.0, 4612500.0, 177.6, 177.6, 0.0); (455700.0, 4612500.0, 177.6, 177.6, 0.0);
(455800.0, 4612500.0, 177.6, 177.6, 0.0); (455900.0, 4612500.0, 177.6, 177.6, 0.0);
(456000.0, 4612500.0, 177.6, 177.6, 0.0); (456100.0, 4612500.0, 177.1, 177.1, 0.0);
(456200.0, 4612500.0, 177.1, 177.1, 0.0); (456300.0, 4612500.0, 177.2, 177.2, 0.0);
(456400.0, 4612500.0, 178.4, 178.4, 0.0); (456500.0, 4612500.0, 177.1, 177.1, 0.0);
(456600.0, 4612500.0, 177.1, 177.1, 0.0); (452000.0, 4612600.0, 177.1, 177.8, 0.0);
(452100.0, 4612600.0, 177.9, 177.9, 0.0); (452200.0, 4612600.0, 178.0, 178.0, 0.0);
(452300.0, 4612600.0, 178.2, 178.2, 0.0); (452400.0, 4612600.0, 178.2, 178.2, 0.0);
(452500.0, 4612600.0, 178.2, 178.2, 0.0); (452600.0, 4612600.0, 177.2, 177.2, 0.0);
(452700.0, 4612600.0, 175.2, 175.2, 0.0); (452800.0, 4612600.0, 175.2, 175.2, 0.0);
(452900.0, 4612600.0, 178.7, 178.7, 0.0); (453000.0, 4612600.0, 179.5, 179.5, 0.0);
(453100.0, 4612600.0, 179.3, 179.3, 0.0); (453200.0, 4612600.0, 179.2, 179.2, 0.0);
(453300.0, 4612600.0, 179.2, 179.2, 0.0); (453400.0, 4612600.0, 179.1, 179.1, 0.0);
(453500.0, 4612600.0, 179.1, 179.1, 0.0); (453600.0, 4612600.0, 179.0, 179.0, 0.0);
(453700.0, 4612600.0, 179.1, 179.1, 0.0); (453800.0, 4612600.0, 179.1, 179.1, 0.0);

```
     ( 453900.0, 4612600.0,     178.8,     178.8,       0.0);         ( 454000.0,
4612600.0,     179.6,     179.6,       0.0);
     ( 454100.0, 4612600.0,     178.6,     178.6,       0.0);         ( 454200.0,
4612600.0,     178.4,     178.4,       0.0);
     ( 454300.0, 4612600.0,     178.2,     178.2,       0.0);         ( 454400.0,
4612600.0,     177.5,     177.5,       0.0);
     ( 454500.0, 4612600.0,     178.2,     178.2,       0.0);         ( 454600.0,
4612600.0,     182.0,     182.0,       0.0);
     ( 454700.0, 4612600.0,     182.2,     194.0,       0.0);         ( 454800.0,
4612600.0,     183.9,     194.0,       0.0);
     ( 454900.0, 4612600.0,     183.7,     183.7,       0.0);         ( 455000.0,
4612600.0,     178.4,     178.4,       0.0);
     ( 455100.0, 4612600.0,     178.2,     178.2,       0.0);         ( 455200.0,
4612600.0,     178.1,     178.1,       0.0);
     ( 455300.0, 4612600.0,     177.6,     177.6,       0.0);         ( 455400.0,
4612600.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4612600.0,     177.9,     177.9,       0.0);         ( 455600.0,
4612600.0,     178.0,     178.0,       0.0);
     ( 455700.0, 4612600.0,     177.6,     177.6,       0.0);         ( 455800.0,
4612600.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4612600.0,     177.6,     177.6,       0.0);         ( 456000.0,
4612600.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4612600.0,     177.1,     177.1,       0.0);         ( 456200.0,
4612600.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4612600.0,     177.2,     177.2,       0.0);         ( 456400.0,
4612600.0,     177.6,     177.6,       0.0);
     ( 456500.0, 4612600.0,     177.1,     177.1,       0.0);         ( 456600.0,
4612600.0,     177.1,     177.1,       0.0);
     ( 452000.0, 4612700.0,     178.3,     178.3,       0.0);         ( 452100.0,
4612700.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4612700.0,     178.3,     178.3,       0.0);         ( 452300.0,
4612700.0,     178.5,     178.5,       0.0);
     ( 452400.0, 4612700.0,     178.3,     178.3,       0.0);         ( 452500.0,
4612700.0,     178.3,     178.3,       0.0);
     ( 452600.0, 4612700.0,     178.3,     178.3,       0.0);         ( 452700.0,
4612700.0,     178.3,     178.3,       0.0);
     ( 452800.0, 4612700.0,     175.2,     175.2,       0.0);         ( 452900.0,
4612700.0,     175.9,     175.9,       0.0);
     ( 453000.0, 4612700.0,     179.1,     179.1,       0.0);         ( 453100.0,
4612700.0,     179.5,     179.5,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 124
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453200.0, 4612700.0, 179.4, 179.4, 0.0); (453300.0, 4612700.0, 179.4, 179.4, 0.0);
(453400.0, 4612700.0, 179.1, 179.1, 0.0); (453500.0, 4612700.0, 179.0, 179.0, 0.0);
(453600.0, 4612700.0, 179.0, 179.0, 0.0); (453700.0, 4612700.0, 179.3, 179.3, 0.0);
(453800.0, 4612700.0, 179.4, 179.4, 0.0); (453900.0, 4612700.0, 179.4, 179.4, 0.0);
(454000.0, 4612700.0, 179.3, 179.3, 0.0); (454100.0, 4612700.0, 177.9, 177.9, 0.0);
(454200.0, 4612700.0, 178.4, 178.4, 0.0); (454300.0, 4612700.0, 177.7, 177.7, 0.0);
(454400.0, 4612700.0, 176.1, 176.1, 0.0); (454500.0, 4612700.0, 178.2, 192.9, 0.0);
(454600.0, 4612700.0, 187.7, 192.9, 0.0); (454700.0, 4612700.0, 192.8, 192.8, 0.0);
(454800.0, 4612700.0, 188.7, 194.0, 0.0); (454900.0, 4612700.0, 184.3, 185.7, 0.0);
(455000.0, 4612700.0, 178.4, 178.4, 0.0); (455100.0, 4612700.0, 178.2, 178.2, 0.0);
(455200.0, 4612700.0, 178.4, 178.4, 0.0); (455300.0, 4612700.0, 177.6, 177.6, 0.0);
(455400.0, 4612700.0, 177.6, 177.6, 0.0); (455500.0, 4612700.0, 177.6, 177.6, 0.0);
(455600.0, 4612700.0, 177.6, 177.6, 0.0); (455700.0, 4612700.0, 177.6, 177.6, 0.0);
(455800.0, 4612700.0, 177.6, 177.6, 0.0); (455900.0, 4612700.0, 177.6, 177.6, 0.0);
(456000.0, 4612700.0, 177.6, 177.6, 0.0); (456100.0, 4612700.0, 177.1, 177.1, 0.0);
(456200.0, 4612700.0, 177.1, 177.1, 0.0); (456300.0, 4612700.0, 177.2, 177.2, 0.0);
(456400.0, 4612700.0, 177.5, 177.5, 0.0); (456500.0, 4612700.0, 177.1, 177.1, 0.0);
(456600.0, 4612700.0, 177.1, 177.1, 0.0); (452000.0, 4612800.0, 178.3, 178.3, 0.0);
(452100.0, 4612800.0, 178.3, 178.3, 0.0); (452200.0, 4612800.0, 178.0, 178.0, 0.0);
(452300.0, 4612800.0, 178.3, 178.3, 0.0); (452400.0, 4612800.0, 178.6, 178.6, 0.0);
(452500.0, 4612800.0, 178.5, 178.5, 0.0); (452600.0, 4612800.0, 178.3, 178.3, 0.0);
(452700.0, 4612800.0, 178.9, 178.9, 0.0); (452800.0, 4612800.0, 175.2, 178.9, 0.0);
(452900.0, 4612800.0, 175.2, 175.2, 0.0); (453000.0, 4612800.0, 175.5, 178.8, 0.0);
(453100.0, 4612800.0, 179.7, 179.7, 0.0); (453200.0, 4612800.0, 179.5, 179.5, 0.0);
(453300.0, 4612800.0, 179.2, 179.2, 0.0); (453400.0, 4612800.0, 179.0, 179.0, 0.0);

```
     ( 453500.0, 4612800.0,     179.0,     179.0,       0.0);         ( 453600.0,
4612800.0,     179.0,     179.0,       0.0);
     ( 453700.0, 4612800.0,     179.2,     179.2,       0.0);         ( 453800.0,
4612800.0,     179.5,     179.5,       0.0);
     ( 453900.0, 4612800.0,     179.8,     179.8,       0.0);         ( 454000.0,
4612800.0,     178.3,     178.3,       0.0);
     ( 454100.0, 4612800.0,     177.2,     177.2,       0.0);         ( 454200.0,
4612800.0,     178.1,     178.1,       0.0);
     ( 454300.0, 4612800.0,     177.9,     177.9,       0.0);         ( 454400.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 454500.0, 4612800.0,     178.1,     178.1,       0.0);         ( 454600.0,
4612800.0,     178.3,     193.1,       0.0);
     ( 454700.0, 4612800.0,     178.6,     194.0,       0.0);         ( 454800.0,
4612800.0,     179.2,     194.0,       0.0);
     ( 454900.0, 4612800.0,     179.2,     179.2,       0.0);         ( 455000.0,
4612800.0,     178.9,     178.9,       0.0);
     ( 455100.0, 4612800.0,     178.2,     178.2,       0.0);         ( 455200.0,
4612800.0,     178.4,     178.4,       0.0);
     ( 455300.0, 4612800.0,     177.6,     177.6,       0.0);         ( 455400.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4612800.0,     177.6,     177.6,       0.0);         ( 455600.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4612800.0,     177.6,     177.6,       0.0);         ( 455800.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4612800.0,     177.6,     177.6,       0.0);         ( 456000.0,
4612800.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4612800.0,     177.1,     177.1,       0.0);         ( 456200.0,
4612800.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4612800.0,     177.3,     177.3,       0.0);         ( 456400.0,
4612800.0,     177.8,     177.8,       0.0);
     ( 456500.0, 4612800.0,     177.1,     177.1,       0.0);         ( 456600.0,
4612800.0,     177.1,     177.1,       0.0);
     ( 452000.0, 4612900.0,     178.3,     178.3,       0.0);         ( 452100.0,
4612900.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4612900.0,     176.1,     176.1,       0.0);         ( 452300.0,
4612900.0,     177.9,     177.9,       0.0);
     ( 452400.0, 4612900.0,     178.6,     178.6,       0.0);         ( 452500.0,
4612900.0,     179.0,     179.0,       0.0);
     ( 452600.0, 4612900.0,     179.1,     179.1,       0.0);         ( 452700.0,
4612900.0,     179.7,     179.7,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 125
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452800.0, 4612900.0, 179.7, 179.7, 0.0); (452900.0, 4612900.0, 175.5, 179.7, 0.0);
(453000.0, 4612900.0, 178.2, 178.9, 0.0); (453100.0, 4612900.0, 175.2, 175.2, 0.0);
(453200.0, 4612900.0, 175.7, 179.6, 0.0); (453300.0, 4612900.0, 179.5, 179.5, 0.0);
(453400.0, 4612900.0, 179.0, 179.0, 0.0); (453500.0, 4612900.0, 179.0, 179.0, 0.0);
(453600.0, 4612900.0, 179.0, 179.0, 0.0); (453700.0, 4612900.0, 179.2, 179.2, 0.0);
(453800.0, 4612900.0, 179.6, 179.6, 0.0); (453900.0, 4612900.0, 178.7, 178.7, 0.0);
(454000.0, 4612900.0, 178.2, 178.2, 0.0); (454100.0, 4612900.0, 177.1, 177.1, 0.0);
(454200.0, 4612900.0, 178.2, 178.2, 0.0); (454300.0, 4612900.0, 178.2, 178.2, 0.0);
(454400.0, 4612900.0, 178.3, 178.3, 0.0); (454500.0, 4612900.0, 178.2, 178.2, 0.0);
(454600.0, 4612900.0, 178.3, 178.3, 0.0); (454700.0, 4612900.0, 179.2, 179.2, 0.0);
(454800.0, 4612900.0, 180.0, 180.0, 0.0); (454900.0, 4612900.0, 180.4, 180.4, 0.0);
(455000.0, 4612900.0, 180.4, 180.4, 0.0); (455100.0, 4612900.0, 178.2, 178.2, 0.0);
(455200.0, 4612900.0, 178.2, 178.2, 0.0); (455300.0, 4612900.0, 177.6, 177.6, 0.0);
(455400.0, 4612900.0, 177.6, 177.6, 0.0); (455500.0, 4612900.0, 177.6, 177.6, 0.0);
(455600.0, 4612900.0, 177.6, 177.6, 0.0); (455700.0, 4612900.0, 177.6, 177.6, 0.0);
(455800.0, 4612900.0, 177.6, 177.6, 0.0); (455900.0, 4612900.0, 177.9, 177.9, 0.0);
(456000.0, 4612900.0, 177.6, 177.6, 0.0); (456100.0, 4612900.0, 177.1, 177.1, 0.0);
(456200.0, 4612900.0, 177.1, 177.1, 0.0); (456300.0, 4612900.0, 177.2, 177.2, 0.0);
(456400.0, 4612900.0, 177.1, 177.1, 0.0); (456500.0, 4612900.0, 177.1, 177.1, 0.0);
(456600.0, 4612900.0, 177.1, 177.1, 0.0); (452000.0, 4613000.0, 178.3, 178.3, 0.0);
(452100.0, 4613000.0, 178.3, 178.3, 0.0); (452200.0, 4613000.0, 176.1, 176.1, 0.0);
(452300.0, 4613000.0, 177.9, 177.9, 0.0); (452400.0, 4613000.0, 178.9, 178.9, 0.0);
(452500.0, 4613000.0, 179.2, 179.2, 0.0); (452600.0, 4613000.0, 179.7, 179.7, 0.0);
(452700.0, 4613000.0, 179.7, 179.7, 0.0); (452800.0, 4613000.0, 179.7, 179.7, 0.0);
(452900.0, 4613000.0, 179.7, 179.7, 0.0); (453000.0, 4613000.0, 178.5, 178.5, 0.0);

```
     ( 453100.0, 4613000.0,     176.9,     176.9,       0.0);         ( 453200.0,
4613000.0,     175.2,     175.2,       0.0);
     ( 453300.0, 4613000.0,     176.4,     179.6,       0.0);         ( 453400.0,
4613000.0,     179.0,     179.0,       0.0);
     ( 453500.0, 4613000.0,     179.0,     179.0,       0.0);         ( 453600.0,
4613000.0,     179.0,     179.0,       0.0);
     ( 453700.0, 4613000.0,     179.3,     179.3,       0.0);         ( 453800.0,
4613000.0,     179.8,     179.8,       0.0);
     ( 453900.0, 4613000.0,     178.6,     178.6,       0.0);         ( 454000.0,
4613000.0,     178.4,     178.4,       0.0);
     ( 454100.0, 4613000.0,     177.3,     177.3,       0.0);         ( 454200.0,
4613000.0,     178.2,     178.2,       0.0);
     ( 454300.0, 4613000.0,     178.4,     178.4,       0.0);         ( 454400.0,
4613000.0,     178.8,     178.8,       0.0);
     ( 454500.0, 4613000.0,     178.2,     178.2,       0.0);         ( 454600.0,
4613000.0,     178.3,     178.3,       0.0);
     ( 454700.0, 4613000.0,     179.1,     179.1,       0.0);         ( 454800.0,
4613000.0,     179.6,     179.6,       0.0);
     ( 454900.0, 4613000.0,     179.9,     179.9,       0.0);         ( 455000.0,
4613000.0,     180.3,     180.3,       0.0);
     ( 455100.0, 4613000.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613000.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4613000.0,     178.5,     178.5,       0.0);         ( 455400.0,
4613000.0,     177.6,     177.6,       0.0);
     ( 455500.0, 4613000.0,     177.6,     177.6,       0.0);         ( 455600.0,
4613000.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4613000.0,     177.6,     177.6,       0.0);         ( 455800.0,
4613000.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4613000.0,     179.1,     179.1,       0.0);         ( 456000.0,
4613000.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4613000.0,     177.1,     177.1,       0.0);         ( 456200.0,
4613000.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4613000.0,     177.7,     177.7,       0.0);         ( 456400.0,
4613000.0,     177.8,     177.8,       0.0);
     ( 456500.0, 4613000.0,     177.9,     177.9,       0.0);         ( 456600.0,
4613000.0,     177.9,     177.9,       0.0);
     ( 452000.0, 4613100.0,     178.3,     178.3,       0.0);         ( 452100.0,
4613100.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4613100.0,     176.1,     176.1,       0.0);         ( 452300.0,
4613100.0,     178.6,     178.6,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 126
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452400.0, 4613100.0, 179.7, 179.7, 0.0); (452500.0, 4613100.0, 179.5, 179.5, 0.0);
(452600.0, 4613100.0, 179.7, 179.7, 0.0); (452700.0, 4613100.0, 179.7, 179.7, 0.0);
(452800.0, 4613100.0, 179.7, 179.7, 0.0); (452900.0, 4613100.0, 179.7, 179.7, 0.0);
(453000.0, 4613100.0, 178.5, 178.5, 0.0); (453100.0, 4613100.0, 179.1, 179.1, 0.0);
(453200.0, 4613100.0, 177.4, 177.4, 0.0); (453300.0, 4613100.0, 175.2, 175.2, 0.0);
(453400.0, 4613100.0, 178.9, 183.4, 0.0); (453500.0, 4613100.0, 179.0, 179.0, 0.0);
(453600.0, 4613100.0, 179.2, 179.2, 0.0); (453700.0, 4613100.0, 179.6, 179.6, 0.0);
(453800.0, 4613100.0, 179.6, 179.6, 0.0); (453900.0, 4613100.0, 179.0, 179.0, 0.0);
(454000.0, 4613100.0, 178.3, 178.3, 0.0); (454100.0, 4613100.0, 178.6, 178.6, 0.0);
(454200.0, 4613100.0, 178.2, 178.2, 0.0); (454300.0, 4613100.0, 178.2, 189.2, 0.0);
(454400.0, 4613100.0, 178.8, 178.8, 0.0); (454500.0, 4613100.0, 178.2, 178.2, 0.0);
(454600.0, 4613100.0, 178.3, 178.3, 0.0); (454700.0, 4613100.0, 179.0, 179.0, 0.0);
(454800.0, 4613100.0, 179.3, 179.3, 0.0); (454900.0, 4613100.0, 179.7, 179.7, 0.0);
(455000.0, 4613100.0, 179.7, 179.7, 0.0); (455100.0, 4613100.0, 178.2, 178.2, 0.0);
(455200.0, 4613100.0, 178.3, 178.3, 0.0); (455300.0, 4613100.0, 178.5, 178.5, 0.0);
(455400.0, 4613100.0, 177.6, 177.6, 0.0); (455500.0, 4613100.0, 177.6, 177.6, 0.0);
(455600.0, 4613100.0, 177.6, 177.6, 0.0); (455700.0, 4613100.0, 179.4, 179.4, 0.0);
(455800.0, 4613100.0, 177.7, 177.7, 0.0); (455900.0, 4613100.0, 177.6, 177.6, 0.0);
(456000.0, 4613100.0, 177.6, 177.6, 0.0); (456100.0, 4613100.0, 177.1, 177.1, 0.0);
(456200.0, 4613100.0, 177.1, 177.1, 0.0); (456300.0, 4613100.0, 177.4, 177.4, 0.0);
(456400.0, 4613100.0, 177.1, 177.1, 0.0); (456500.0, 4613100.0, 177.1, 177.1, 0.0);
(456600.0, 4613100.0, 177.1, 177.1, 0.0); (452000.0, 4613200.0, 178.3, 178.3, 0.0);
(452100.0, 4613200.0, 178.3, 178.3, 0.0); (452200.0, 4613200.0, 176.1, 176.1, 0.0);
(452300.0, 4613200.0, 178.5, 178.5, 0.0); (452400.0, 4613200.0, 179.4, 179.4, 0.0);
(452500.0, 4613200.0, 179.7, 179.7, 0.0); (452600.0, 4613200.0, 179.7, 179.7, 0.0);

```
     ( 452700.0, 4613200.0,     179.7,     179.7,       0.0);         ( 452800.0,
4613200.0,     179.7,     179.7,       0.0);
     ( 452900.0, 4613200.0,     179.2,     179.2,       0.0);         ( 453000.0,
4613200.0,     178.5,     178.5,       0.0);
     ( 453100.0, 4613200.0,     179.1,     179.1,       0.0);         ( 453200.0,
4613200.0,     179.1,     179.1,       0.0);
     ( 453300.0, 4613200.0,     177.6,     179.1,       0.0);         ( 453400.0,
4613200.0,     175.2,     183.8,       0.0);
     ( 453500.0, 4613200.0,     175.3,     183.8,       0.0);         ( 453600.0,
4613200.0,     179.5,     179.5,       0.0);
     ( 453700.0, 4613200.0,     178.9,     178.9,       0.0);         ( 453800.0,
4613200.0,     179.3,     179.3,       0.0);
     ( 453900.0, 4613200.0,     178.8,     178.8,       0.0);         ( 454000.0,
4613200.0,     178.3,     178.3,       0.0);
     ( 454100.0, 4613200.0,     179.7,     179.7,       0.0);         ( 454200.0,
4613200.0,     178.2,     191.5,       0.0);
     ( 454300.0, 4613200.0,     186.3,     191.5,       0.0);         ( 454400.0,
4613200.0,     183.9,     183.9,       0.0);
     ( 454500.0, 4613200.0,     178.4,     178.4,       0.0);         ( 454600.0,
4613200.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4613200.0,     179.3,     179.3,       0.0);         ( 454800.0,
4613200.0,     180.6,     180.6,       0.0);
     ( 454900.0, 4613200.0,     179.5,     179.5,       0.0);         ( 455000.0,
4613200.0,     178.6,     178.6,       0.0);
     ( 455100.0, 4613200.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613200.0,     178.3,     178.3,       0.0);
     ( 455300.0, 4613200.0,     178.6,     178.6,       0.0);         ( 455400.0,
4613200.0,     178.1,     178.1,       0.0);
     ( 455500.0, 4613200.0,     177.6,     177.6,       0.0);         ( 455600.0,
4613200.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4613200.0,     177.6,     177.6,       0.0);         ( 455800.0,
4613200.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4613200.0,     177.6,     177.6,       0.0);         ( 456000.0,
4613200.0,     178.3,     178.3,       0.0);
     ( 456100.0, 4613200.0,     177.1,     177.1,       0.0);         ( 456200.0,
4613200.0,     177.1,     177.1,       0.0);
     ( 456300.0, 4613200.0,     177.4,     177.4,       0.0);         ( 456400.0,
4613200.0,     177.1,     177.1,       0.0);
     ( 456500.0, 4613200.0,     177.1,     177.1,       0.0);         ( 456600.0,
4613200.0,     177.1,     177.1,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452000.0, 4613300.0, 178.3, 178.3, 0.0); (452100.0, 4613300.0, 178.3, 178.3, 0.0);
(452200.0, 4613300.0, 176.1, 176.1, 0.0); (452300.0, 4613300.0, 178.6, 178.6, 0.0);
(452400.0, 4613300.0, 179.6, 179.6, 0.0); (452500.0, 4613300.0, 179.7, 179.7, 0.0);
(452600.0, 4613300.0, 179.7, 179.7, 0.0); (452700.0, 4613300.0, 179.7, 179.7, 0.0);
(452800.0, 4613300.0, 179.4, 179.4, 0.0); (452900.0, 4613300.0, 178.9, 178.9, 0.0);
(453000.0, 4613300.0, 179.6, 179.6, 0.0); (453100.0, 4613300.0, 179.1, 179.1, 0.0);
(453200.0, 4613300.0, 179.1, 179.1, 0.0); (453300.0, 4613300.0, 179.1, 179.1, 0.0);
(453400.0, 4613300.0, 180.5, 180.5, 0.0); (453500.0, 4613300.0, 176.4, 183.0, 0.0);
(453600.0, 4613300.0, 175.2, 175.2, 0.0); (453700.0, 4613300.0, 178.9, 178.9, 0.0);
(453800.0, 4613300.0, 178.5, 178.5, 0.0); (453900.0, 4613300.0, 178.7, 178.7, 0.0);
(454000.0, 4613300.0, 178.2, 178.2, 0.0); (454100.0, 4613300.0, 178.6, 178.6, 0.0);
(454200.0, 4613300.0, 178.2, 191.7, 0.0); (454300.0, 4613300.0, 191.0, 191.0, 0.0);
(454400.0, 4613300.0, 185.1, 191.1, 0.0); (454500.0, 4613300.0, 178.6, 178.6, 0.0);
(454600.0, 4613300.0, 178.2, 178.2, 0.0); (454700.0, 4613300.0, 179.4, 179.4, 0.0);
(454800.0, 4613300.0, 180.0, 180.0, 0.0); (454900.0, 4613300.0, 178.6, 178.6, 0.0);
(455000.0, 4613300.0, 178.2, 178.2, 0.0); (455100.0, 4613300.0, 178.2, 178.2, 0.0);
(455200.0, 4613300.0, 178.4, 178.4, 0.0); (455300.0, 4613300.0, 178.6, 178.6, 0.0);
(455400.0, 4613300.0, 179.1, 179.1, 0.0); (455500.0, 4613300.0, 177.6, 177.6, 0.0);
(455600.0, 4613300.0, 177.6, 177.6, 0.0); (455700.0, 4613300.0, 177.6, 177.6, 0.0);
(455800.0, 4613300.0, 177.6, 177.6, 0.0); (455900.0, 4613300.0, 177.6, 177.6, 0.0);
(456000.0, 4613300.0, 178.2, 178.2, 0.0); (456100.0, 4613300.0, 177.1, 177.1, 0.0);
(456200.0, 4613300.0, 177.1, 177.1, 0.0); (456300.0, 4613300.0, 177.4, 177.4, 0.0);
(456400.0, 4613300.0, 177.1, 177.1, 0.0); (456500.0, 4613300.0, 177.1, 177.1, 0.0);
(456600.0, 4613300.0, 177.1, 181.5, 0.0); (452000.0, 4613400.0, 178.4, 178.4, 0.0);
(452100.0, 4613400.0, 178.3, 178.3, 0.0); (452200.0, 4613400.0, 176.1, 176.1, 0.0);

```
     ( 452300.0, 4613400.0,     178.6,     178.6,       0.0);         ( 452400.0,
4613400.0,     179.8,     179.8,       0.0);
     ( 452500.0, 4613400.0,     179.8,     179.8,       0.0);         ( 452600.0,
4613400.0,     179.9,     179.9,       0.0);
     ( 452700.0, 4613400.0,     179.7,     179.7,       0.0);         ( 452800.0,
4613400.0,     179.3,     179.3,       0.0);
     ( 452900.0, 4613400.0,     179.3,     179.3,       0.0);         ( 453000.0,
4613400.0,     179.7,     179.7,       0.0);
     ( 453100.0, 4613400.0,     179.4,     179.4,       0.0);         ( 453200.0,
4613400.0,     179.2,     179.2,       0.0);
     ( 453300.0, 4613400.0,     179.2,     179.2,       0.0);         ( 453400.0,
4613400.0,     178.6,     178.6,       0.0);
     ( 453500.0, 4613400.0,     178.3,     178.3,       0.0);         ( 453600.0,
4613400.0,     175.4,     175.4,       0.0);
     ( 453700.0, 4613400.0,     175.2,     175.2,       0.0);         ( 453800.0,
4613400.0,     178.1,     178.1,       0.0);
     ( 453900.0, 4613400.0,     178.2,     178.2,       0.0);         ( 454000.0,
4613400.0,     178.2,     178.2,       0.0);
     ( 454100.0, 4613400.0,     178.3,     178.3,       0.0);         ( 454200.0,
4613400.0,     178.2,     190.9,       0.0);
     ( 454300.0, 4613400.0,     183.3,     191.4,       0.0);         ( 454400.0,
4613400.0,     186.9,     188.6,       0.0);
     ( 454500.0, 4613400.0,     178.8,     189.9,       0.0);         ( 454600.0,
4613400.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4613400.0,     178.2,     178.2,       0.0);         ( 454800.0,
4613400.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4613400.0,     178.2,     178.2,       0.0);         ( 455000.0,
4613400.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4613400.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613400.0,     178.3,     178.3,       0.0);
     ( 455300.0, 4613400.0,     178.8,     178.8,       0.0);         ( 455400.0,
4613400.0,     179.2,     179.2,       0.0);
     ( 455500.0, 4613400.0,     177.6,     177.6,       0.0);         ( 455600.0,
4613400.0,     177.6,     177.6,       0.0);
     ( 455700.0, 4613400.0,     177.6,     177.6,       0.0);         ( 455800.0,
4613400.0,     177.6,     177.6,       0.0);
     ( 455900.0, 4613400.0,     177.6,     177.6,       0.0);         ( 456000.0,
4613400.0,     177.6,     177.6,       0.0);
     ( 456100.0, 4613400.0,     177.1,     177.1,       0.0);         ( 456200.0,
4613400.0,     177.1,     177.1,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(456300.0, 4613400.0, 177.5, 177.5, 0.0); (456400.0, 4613400.0, 177.1, 177.1, 0.0);
(456500.0, 4613400.0, 177.1, 177.1, 0.0); (456600.0, 4613400.0, 179.7, 181.7, 0.0);
(452000.0, 4613500.0, 178.8, 178.8, 0.0); (452100.0, 4613500.0, 178.3, 178.3, 0.0);
(452200.0, 4613500.0, 176.1, 176.1, 0.0); (452300.0, 4613500.0, 178.5, 178.5, 0.0);
(452400.0, 4613500.0, 179.4, 179.4, 0.0); (452500.0, 4613500.0, 179.7, 179.7, 0.0);
(452600.0, 4613500.0, 179.7, 179.7, 0.0); (452700.0, 4613500.0, 179.6, 179.6, 0.0);
(452800.0, 4613500.0, 179.7, 179.7, 0.0); (452900.0, 4613500.0, 179.7, 179.7, 0.0);
(453000.0, 4613500.0, 179.7, 179.7, 0.0); (453100.0, 4613500.0, 179.4, 179.4, 0.0);
(453200.0, 4613500.0, 179.1, 179.1, 0.0); (453300.0, 4613500.0, 178.8, 178.8, 0.0);
(453400.0, 4613500.0, 178.5, 178.5, 0.0); (453500.0, 4613500.0, 178.3, 178.3, 0.0);
(453600.0, 4613500.0, 178.6, 178.6, 0.0); (453700.0, 4613500.0, 176.7, 178.8, 0.0);
(453800.0, 4613500.0, 175.2, 175.2, 0.0); (453900.0, 4613500.0, 175.2, 179.6, 0.0);
(454000.0, 4613500.0, 178.7, 178.7, 0.0); (454100.0, 4613500.0, 178.2, 178.2, 0.0);
(454200.0, 4613500.0, 178.2, 178.2, 0.0); (454300.0, 4613500.0, 179.6, 190.1, 0.0);
(454400.0, 4613500.0, 179.7, 190.1, 0.0); (454500.0, 4613500.0, 178.8, 189.9, 0.0);
(454600.0, 4613500.0, 178.2, 178.2, 0.0); (454700.0, 4613500.0, 178.2, 178.2, 0.0);
(454800.0, 4613500.0, 178.2, 178.2, 0.0); (454900.0, 4613500.0, 178.2, 178.2, 0.0);
(455000.0, 4613500.0, 178.2, 178.2, 0.0); (455100.0, 4613500.0, 178.2, 178.2, 0.0);
(455200.0, 4613500.0, 178.2, 178.2, 0.0); (455300.0, 4613500.0, 178.7, 178.7, 0.0);
(455400.0, 4613500.0, 179.2, 179.2, 0.0); (455500.0, 4613500.0, 177.6, 177.6, 0.0);
(455600.0, 4613500.0, 177.6, 177.6, 0.0); (455700.0, 4613500.0, 177.6, 177.6, 0.0);
(455800.0, 4613500.0, 177.6, 177.6, 0.0); (455900.0, 4613500.0, 177.6, 177.6, 0.0);
(456000.0, 4613500.0, 177.6, 177.6, 0.0); (456100.0, 4613500.0, 177.3, 177.3, 0.0);
(456200.0, 4613500.0, 177.1, 177.1, 0.0); (456300.0, 4613500.0, 177.2, 177.2, 0.0);
(456400.0, 4613500.0, 177.1, 177.1, 0.0); (456500.0, 4613500.0, 177.1, 177.1, 0.0);

```
     ( 456600.0, 4613500.0,     182.0,     182.0,       0.0);         ( 452000.0,
4613600.0,     179.2,     179.2,       0.0);
     ( 452100.0, 4613600.0,     178.3,     178.3,       0.0);         ( 452200.0,
4613600.0,     176.1,     176.1,       0.0);
     ( 452300.0, 4613600.0,     176.4,     176.4,       0.0);         ( 452400.0,
4613600.0,     179.7,     179.7,       0.0);
     ( 452500.0, 4613600.0,     179.8,     179.8,       0.0);         ( 452600.0,
4613600.0,     179.7,     179.7,       0.0);
     ( 452700.0, 4613600.0,     179.9,     179.9,       0.0);         ( 452800.0,
4613600.0,     179.8,     179.8,       0.0);
     ( 452900.0, 4613600.0,     179.7,     179.7,       0.0);         ( 453000.0,
4613600.0,     179.9,     179.9,       0.0);
     ( 453100.0, 4613600.0,     179.4,     179.4,       0.0);         ( 453200.0,
4613600.0,     178.5,     178.5,       0.0);
     ( 453300.0, 4613600.0,     178.5,     178.5,       0.0);         ( 453400.0,
4613600.0,     178.6,     178.6,       0.0);
     ( 453500.0, 4613600.0,     178.3,     178.3,       0.0);         ( 453600.0,
4613600.0,     178.7,     178.7,       0.0);
     ( 453700.0, 4613600.0,     178.6,     178.6,       0.0);         ( 453800.0,
4613600.0,     178.4,     178.4,       0.0);
     ( 453900.0, 4613600.0,     175.2,     175.2,       0.0);         ( 454000.0,
4613600.0,     175.2,     175.2,       0.0);
     ( 454100.0, 4613600.0,     178.2,     178.2,       0.0);         ( 454200.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 454300.0, 4613600.0,     178.3,     178.3,       0.0);         ( 454400.0,
4613600.0,     178.6,     178.6,       0.0);
     ( 454500.0, 4613600.0,     178.2,     178.2,       0.0);         ( 454600.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4613600.0,     178.2,     178.2,       0.0);         ( 454800.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4613600.0,     178.2,     178.2,       0.0);         ( 455000.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4613600.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613600.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4613600.0,     178.4,     178.4,       0.0);         ( 455400.0,
4613600.0,     178.9,     178.9,       0.0);
     ( 455500.0, 4613600.0,     179.5,     179.5,       0.0);         ( 455600.0,
4613600.0,     177.7,     177.7,       0.0);
     ( 455700.0, 4613600.0,     177.6,     177.6,       0.0);         ( 455800.0,
4613600.0,     177.6,     177.6,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455900.0, 4613600.0, 177.6, 177.6, 0.0); (456000.0, 4613600.0, 177.6, 177.6, 0.0);
(456100.0, 4613600.0, 177.1, 177.1, 0.0); (456200.0, 4613600.0, 177.1, 177.1, 0.0);
(456300.0, 4613600.0, 177.1, 177.1, 0.0); (456400.0, 4613600.0, 177.1, 177.1, 0.0);
(456500.0, 4613600.0, 177.1, 177.1, 0.0); (456600.0, 4613600.0, 179.3, 182.0, 0.0);
(452000.0, 4613700.0, 179.3, 179.3, 0.0); (452100.0, 4613700.0, 179.5, 179.5, 0.0);
(452200.0, 4613700.0, 178.2, 196.2, 0.0); (452300.0, 4613700.0, 178.5, 195.0, 0.0);
(452400.0, 4613700.0, 178.7, 178.7, 0.0); (452500.0, 4613700.0, 179.8, 179.8, 0.0);
(452600.0, 4613700.0, 179.8, 179.8, 0.0); (452700.0, 4613700.0, 180.2, 180.2, 0.0);
(452800.0, 4613700.0, 180.3, 180.3, 0.0); (452900.0, 4613700.0, 180.1, 180.1, 0.0);
(453000.0, 4613700.0, 180.0, 180.0, 0.0); (453100.0, 4613700.0, 179.4, 179.4, 0.0);
(453200.0, 4613700.0, 179.6, 179.6, 0.0); (453300.0, 4613700.0, 179.7, 179.7, 0.0);
(453400.0, 4613700.0, 179.7, 179.7, 0.0); (453500.0, 4613700.0, 179.0, 179.0, 0.0);
(453600.0, 4613700.0, 179.0, 179.0, 0.0); (453700.0, 4613700.0, 178.8, 178.8, 0.0);
(453800.0, 4613700.0, 179.8, 179.8, 0.0); (453900.0, 4613700.0, 178.6, 178.6, 0.0);
(454000.0, 4613700.0, 175.2, 175.2, 0.0); (454100.0, 4613700.0, 178.2, 178.2, 0.0);
(454200.0, 4613700.0, 178.2, 178.2, 0.0); (454300.0, 4613700.0, 178.2, 178.2, 0.0);
(454400.0, 4613700.0, 178.2, 178.2, 0.0); (454500.0, 4613700.0, 178.2, 178.2, 0.0);
(454600.0, 4613700.0, 178.2, 178.2, 0.0); (454700.0, 4613700.0, 178.2, 178.2, 0.0);
(454800.0, 4613700.0, 178.2, 178.2, 0.0); (454900.0, 4613700.0, 178.2, 178.2, 0.0);
(455000.0, 4613700.0, 178.2, 178.2, 0.0); (455100.0, 4613700.0, 178.2, 178.2, 0.0);
(455200.0, 4613700.0, 178.2, 178.2, 0.0); (455300.0, 4613700.0, 178.2, 178.2, 0.0);
(455400.0, 4613700.0, 178.4, 178.4, 0.0); (455500.0, 4613700.0, 178.9, 178.9, 0.0);
(455600.0, 4613700.0, 179.8, 179.8, 0.0); (455700.0, 4613700.0, 177.6, 177.6, 0.0);
(455800.0, 4613700.0, 177.6, 177.6, 0.0); (455900.0, 4613700.0, 177.6, 177.6, 0.0);
(456000.0, 4613700.0, 177.6, 177.6, 0.0); (456100.0, 4613700.0, 177.1, 177.1, 0.0);

```
     ( 456200.0, 4613700.0,     177.5,     177.5,       0.0);         ( 456300.0,
4613700.0,     178.5,     178.5,       0.0);
     ( 456400.0, 4613700.0,     178.4,     178.4,       0.0);         ( 456500.0,
4613700.0,     177.3,     177.3,       0.0);
     ( 456600.0, 4613700.0,     178.3,     178.3,       0.0);         ( 452000.0,
4613800.0,     179.2,     179.2,       0.0);
     ( 452100.0, 4613800.0,     179.6,     197.6,       0.0);         ( 452200.0,
4613800.0,     192.7,     193.5,       0.0);
     ( 452300.0, 4613800.0,     182.3,     197.6,       0.0);         ( 452400.0,
4613800.0,     178.8,     196.3,       0.0);
     ( 452500.0, 4613800.0,     179.8,     179.8,       0.0);         ( 452600.0,
4613800.0,     180.3,     180.3,       0.0);
     ( 452700.0, 4613800.0,     180.7,     180.7,       0.0);         ( 452800.0,
4613800.0,     180.8,     180.8,       0.0);
     ( 452900.0, 4613800.0,     180.4,     180.4,       0.0);         ( 453000.0,
4613800.0,     180.0,     180.0,       0.0);
     ( 453100.0, 4613800.0,     179.4,     179.4,       0.0);         ( 453200.0,
4613800.0,     179.4,     179.4,       0.0);
     ( 453300.0, 4613800.0,     179.4,     179.4,       0.0);         ( 453400.0,
4613800.0,     178.8,     178.8,       0.0);
     ( 453500.0, 4613800.0,     179.1,     179.1,       0.0);         ( 453600.0,
4613800.0,     179.3,     179.3,       0.0);
     ( 453700.0, 4613800.0,     179.0,     179.0,       0.0);         ( 453800.0,
4613800.0,     179.7,     179.7,       0.0);
     ( 453900.0, 4613800.0,     180.6,     180.6,       0.0);         ( 454000.0,
4613800.0,     175.2,     180.1,       0.0);
     ( 454100.0, 4613800.0,     175.2,     179.6,       0.0);         ( 454200.0,
4613800.0,     177.8,     177.8,       0.0);
     ( 454300.0, 4613800.0,     178.2,     178.2,       0.0);         ( 454400.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4613800.0,     178.2,     178.2,       0.0);         ( 454600.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4613800.0,     178.2,     178.2,       0.0);         ( 454800.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4613800.0,     178.2,     178.2,       0.0);         ( 455000.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4613800.0,     178.2,     178.2,       0.0);         ( 455200.0,
4613800.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4613800.0,     178.2,     178.2,       0.0);         ( 455400.0,
4613800.0,     178.2,     178.2,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 130
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455500.0, 4613800.0, 178.8, 178.8, 0.0); (455600.0, 4613800.0, 180.1, 180.1, 0.0);
(455700.0, 4613800.0, 178.8, 180.8, 0.0); (455800.0, 4613800.0, 179.5, 181.1, 0.0);
(455900.0, 4613800.0, 179.6, 181.1, 0.0); (456000.0, 4613800.0, 178.7, 178.7, 0.0);
(456100.0, 4613800.0, 177.2, 177.2, 0.0); (456200.0, 4613800.0, 178.3, 178.3, 0.0);
(456300.0, 4613800.0, 178.7, 178.7, 0.0); (456400.0, 4613800.0, 178.0, 178.0, 0.0);
(456500.0, 4613800.0, 177.9, 181.4, 0.0); (456600.0, 4613800.0, 179.0, 179.0, 0.0);
(452000.0, 4613900.0, 179.2, 179.2, 0.0); (452100.0, 4613900.0, 179.6, 198.9, 0.0);
(452200.0, 4613900.0, 196.7, 196.7, 0.0); (452300.0, 4613900.0, 192.0, 196.3, 0.0);
(452400.0, 4613900.0, 179.1, 198.9, 0.0); (452500.0, 4613900.0, 179.9, 179.9, 0.0);
(452600.0, 4613900.0, 180.6, 180.6, 0.0); (452700.0, 4613900.0, 183.1, 183.1, 0.0);
(452800.0, 4613900.0, 181.1, 181.1, 0.0); (452900.0, 4613900.0, 180.6, 180.6, 0.0);
(453000.0, 4613900.0, 180.0, 180.0, 0.0); (453100.0, 4613900.0, 178.8, 178.8, 0.0);
(453200.0, 4613900.0, 179.1, 179.1, 0.0); (453300.0, 4613900.0, 179.1, 179.1, 0.0);
(453400.0, 4613900.0, 178.5, 178.5, 0.0); (453500.0, 4613900.0, 179.8, 179.8, 0.0);
(453600.0, 4613900.0, 179.4, 179.4, 0.0); (453700.0, 4613900.0, 179.2, 179.2, 0.0);
(453800.0, 4613900.0, 179.7, 179.7, 0.0); (453900.0, 4613900.0, 179.5, 179.5, 0.0);
(454000.0, 4613900.0, 175.2, 179.3, 0.0); (454100.0, 4613900.0, 175.2, 175.2, 0.0);
(454200.0, 4613900.0, 175.2, 175.2, 0.0); (454300.0, 4613900.0, 178.2, 178.2, 0.0);
(454400.0, 4613900.0, 178.2, 178.2, 0.0); (454500.0, 4613900.0, 178.2, 178.2, 0.0);
(454600.0, 4613900.0, 178.2, 178.2, 0.0); (454700.0, 4613900.0, 178.2, 178.2, 0.0);
(454800.0, 4613900.0, 178.2, 178.2, 0.0); (454900.0, 4613900.0, 178.2, 178.2, 0.0);
(455000.0, 4613900.0, 178.2, 178.2, 0.0); (455100.0, 4613900.0, 178.2, 178.2, 0.0);
(455200.0, 4613900.0, 178.2, 178.2, 0.0); (455300.0, 4613900.0, 178.2, 178.2, 0.0);
(455400.0, 4613900.0, 178.2, 178.2, 0.0); (455500.0, 4613900.0, 178.4, 178.4, 0.0);
(455600.0, 4613900.0, 179.7, 179.7, 0.0); (455700.0, 4613900.0, 181.3, 181.3, 0.0);

```
     ( 455800.0, 4613900.0,     181.3,     181.3,       0.0);         ( 455900.0,
4613900.0,     181.3,     181.3,       0.0);
     ( 456000.0, 4613900.0,     181.3,     181.3,       0.0);         ( 456100.0,
4613900.0,     180.2,     180.2,       0.0);
     ( 456200.0, 4613900.0,     178.8,     178.8,       0.0);         ( 456300.0,
4613900.0,     178.4,     178.4,       0.0);
     ( 456400.0, 4613900.0,     178.0,     178.0,       0.0);         ( 456500.0,
4613900.0,     181.2,     181.2,       0.0);
     ( 456600.0, 4613900.0,     178.7,     178.7,       0.0);         ( 452000.0,
4614000.0,     179.2,     179.2,       0.0);
     ( 452100.0, 4614000.0,     179.6,     198.9,       0.0);         ( 452200.0,
4614000.0,     196.9,     196.9,       0.0);
     ( 452300.0, 4614000.0,     194.2,     198.9,       0.0);         ( 452400.0,
4614000.0,     179.1,     198.9,       0.0);
     ( 452500.0, 4614000.0,     180.1,     180.1,       0.0);         ( 452600.0,
4614000.0,     180.8,     180.8,       0.0);
     ( 452700.0, 4614000.0,     182.5,     182.5,       0.0);         ( 452800.0,
4614000.0,     181.5,     181.5,       0.0);
     ( 452900.0, 4614000.0,     181.0,     181.0,       0.0);         ( 453000.0,
4614000.0,     180.2,     180.2,       0.0);
     ( 453100.0, 4614000.0,     178.4,     178.4,       0.0);         ( 453200.0,
4614000.0,     179.1,     179.1,       0.0);
     ( 453300.0, 4614000.0,     178.9,     178.9,       0.0);         ( 453400.0,
4614000.0,     178.5,     178.5,       0.0);
     ( 453500.0, 4614000.0,     179.8,     179.8,       0.0);         ( 453600.0,
4614000.0,     179.4,     179.4,       0.0);
     ( 453700.0, 4614000.0,     179.2,     179.2,       0.0);         ( 453800.0,
4614000.0,     179.7,     179.7,       0.0);
     ( 453900.0, 4614000.0,     179.1,     179.1,       0.0);         ( 454000.0,
4614000.0,     175.3,     179.1,       0.0);
     ( 454100.0, 4614000.0,     175.3,     175.3,       0.0);         ( 454200.0,
4614000.0,     178.3,     178.3,       0.0);
     ( 454300.0, 4614000.0,     178.2,     178.2,       0.0);         ( 454400.0,
4614000.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4614000.0,     178.2,     178.2,       0.0);         ( 454600.0,
4614000.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4614000.0,     178.2,     178.2,       0.0);         ( 454800.0,
4614000.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4614000.0,     178.2,     178.2,       0.0);         ( 455000.0,
4614000.0,     178.2,     178.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455100.0, 4614000.0, 178.2, 178.2, 0.0); (455200.0, 4614000.0, 178.2, 178.2, 0.0);
(455300.0, 4614000.0, 178.2, 178.2, 0.0); (455400.0, 4614000.0, 178.2, 178.2, 0.0);
(455500.0, 4614000.0, 178.9, 178.9, 0.0); (455600.0, 4614000.0, 180.2, 180.2, 0.0);
(455700.0, 4614000.0, 181.2, 181.2, 0.0); (455800.0, 4614000.0, 181.5, 181.5, 0.0);
(455900.0, 4614000.0, 181.4, 181.4, 0.0); (456000.0, 4614000.0, 181.4, 181.4, 0.0);
(456100.0, 4614000.0, 181.3, 181.3, 0.0); (456200.0, 4614000.0, 180.7, 180.7, 0.0);
(456300.0, 4614000.0, 178.4, 178.4, 0.0); (456400.0, 4614000.0, 178.3, 178.3, 0.0);
(456500.0, 4614000.0, 182.4, 182.4, 0.0); (456600.0, 4614000.0, 178.7, 178.7, 0.0);
(452000.0, 4614100.0, 179.1, 179.1, 0.0); (452100.0, 4614100.0, 179.6, 198.8, 0.0);
(452200.0, 4614100.0, 197.1, 197.1, 0.0); (452300.0, 4614100.0, 195.2, 198.2, 0.0);
(452400.0, 4614100.0, 179.1, 198.9, 0.0); (452500.0, 4614100.0, 180.4, 180.4, 0.0);
(452600.0, 4614100.0, 181.7, 181.7, 0.0); (452700.0, 4614100.0, 180.9, 180.9, 0.0);
(452800.0, 4614100.0, 181.0, 181.0, 0.0); (452900.0, 4614100.0, 182.9, 182.9, 0.0);
(453000.0, 4614100.0, 180.4, 180.4, 0.0); (453100.0, 4614100.0, 178.3, 178.3, 0.0);
(453200.0, 4614100.0, 178.9, 178.9, 0.0); (453300.0, 4614100.0, 178.8, 178.8, 0.0);
(453400.0, 4614100.0, 178.5, 178.5, 0.0); (453500.0, 4614100.0, 179.7, 179.7, 0.0);
(453600.0, 4614100.0, 179.4, 179.4, 0.0); (453700.0, 4614100.0, 179.0, 179.0, 0.0);
(453800.0, 4614100.0, 179.7, 179.7, 0.0); (453900.0, 4614100.0, 179.1, 179.1, 0.0);
(454000.0, 4614100.0, 175.2, 175.2, 0.0); (454100.0, 4614100.0, 178.2, 178.2, 0.0);
(454200.0, 4614100.0, 178.2, 178.2, 0.0); (454300.0, 4614100.0, 178.2, 178.2, 0.0);
(454400.0, 4614100.0, 178.2, 178.2, 0.0); (454500.0, 4614100.0, 178.2, 178.2, 0.0);
(454600.0, 4614100.0, 178.2, 178.2, 0.0); (454700.0, 4614100.0, 178.2, 178.2, 0.0);
(454800.0, 4614100.0, 178.2, 178.2, 0.0); (454900.0, 4614100.0, 178.2, 178.2, 0.0);
(455000.0, 4614100.0, 178.2, 178.2, 0.0); (455100.0, 4614100.0, 178.2, 178.2, 0.0);
(455200.0, 4614100.0, 178.2, 178.2, 0.0); (455300.0, 4614100.0, 178.2, 178.2, 0.0);

```
     ( 455400.0, 4614100.0,     178.2,     178.2,       0.0);         ( 455500.0,
4614100.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4614100.0,     179.6,     179.6,       0.0);         ( 455700.0,
4614100.0,     180.6,     180.6,       0.0);
     ( 455800.0, 4614100.0,     181.1,     181.1,       0.0);         ( 455900.0,
4614100.0,     181.1,     181.1,       0.0);
     ( 456000.0, 4614100.0,     181.0,     181.0,       0.0);         ( 456100.0,
4614100.0,     181.0,     181.0,       0.0);
     ( 456200.0, 4614100.0,     180.2,     180.2,       0.0);         ( 456300.0,
4614100.0,     178.8,     178.8,       0.0);
     ( 456400.0, 4614100.0,     178.5,     178.5,       0.0);         ( 456500.0,
4614100.0,     184.0,     184.0,       0.0);
     ( 456600.0, 4614100.0,     179.0,     179.0,       0.0);         ( 452000.0,
4614200.0,     178.9,     178.9,       0.0);
     ( 452100.0, 4614200.0,     179.5,     198.1,       0.0);         ( 452200.0,
4614200.0,     197.1,     197.1,       0.0);
     ( 452300.0, 4614200.0,     190.9,     197.9,       0.0);         ( 452400.0,
4614200.0,     179.4,     198.5,       0.0);
     ( 452500.0, 4614200.0,     183.2,     183.2,       0.0);         ( 452600.0,
4614200.0,     181.2,     181.2,       0.0);
     ( 452700.0, 4614200.0,     180.8,     180.8,       0.0);         ( 452800.0,
4614200.0,     180.6,     180.6,       0.0);
     ( 452900.0, 4614200.0,     180.8,     180.8,       0.0);         ( 453000.0,
4614200.0,     180.1,     180.1,       0.0);
     ( 453100.0, 4614200.0,     178.3,     178.3,       0.0);         ( 453200.0,
4614200.0,     178.7,     178.7,       0.0);
     ( 453300.0, 4614200.0,     178.8,     178.8,       0.0);         ( 453400.0,
4614200.0,     178.4,     178.4,       0.0);
     ( 453500.0, 4614200.0,     179.6,     179.6,       0.0);         ( 453600.0,
4614200.0,     178.7,     178.7,       0.0);
     ( 453700.0, 4614200.0,     179.0,     179.0,       0.0);         ( 453800.0,
4614200.0,     179.7,     179.7,       0.0);
     ( 453900.0, 4614200.0,     179.1,     179.1,       0.0);         ( 454000.0,
4614200.0,     175.4,     178.0,       0.0);
     ( 454300.0, 4614200.0,     178.2,     178.2,       0.0);         ( 454400.0,
4614200.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4614200.0,     178.2,     178.2,       0.0);         ( 454600.0,
4614200.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4614200.0,     178.2,     178.2,       0.0);         ( 454800.0,
4614200.0,     178.2,     178.2,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 132
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454900.0, 4614200.0, 178.2, 178.2, 0.0); (455000.0, 4614200.0, 178.2, 178.2, 0.0);
(455100.0, 4614200.0, 178.2, 178.2, 0.0); (455200.0, 4614200.0, 178.2, 178.2, 0.0);
(455300.0, 4614200.0, 178.2, 178.2, 0.0); (455400.0, 4614200.0, 178.2, 178.2, 0.0);
(455500.0, 4614200.0, 178.2, 178.2, 0.0); (455600.0, 4614200.0, 178.6, 178.6, 0.0);
(455700.0, 4614200.0, 180.0, 180.0, 0.0); (455800.0, 4614200.0, 180.5, 180.5, 0.0);
(455900.0, 4614200.0, 180.7, 180.7, 0.0); (456000.0, 4614200.0, 180.8, 180.8, 0.0);
(456100.0, 4614200.0, 180.8, 180.8, 0.0); (456200.0, 4614200.0, 179.8, 179.8, 0.0);
(456300.0, 4614200.0, 179.2, 179.2, 0.0); (456400.0, 4614200.0, 178.4, 178.4, 0.0);
(456500.0, 4614200.0, 185.7, 185.7, 0.0); (456600.0, 4614200.0, 178.9, 178.9, 0.0);
(452000.0, 4614300.0, 178.8, 178.8, 0.0); (452100.0, 4614300.0, 179.5, 198.4, 0.0);
(452200.0, 4614300.0, 197.0, 197.0, 0.0); (452300.0, 4614300.0, 195.3, 198.0, 0.0);
(452400.0, 4614300.0, 179.9, 207.7, 0.0); (452500.0, 4614300.0, 180.6, 180.6, 0.0);
(452600.0, 4614300.0, 181.2, 181.2, 0.0); (452700.0, 4614300.0, 180.9, 180.9, 0.0);
(452800.0, 4614300.0, 180.7, 180.7, 0.0); (452900.0, 4614300.0, 180.3, 180.3, 0.0);
(453000.0, 4614300.0, 179.9, 179.9, 0.0); (453100.0, 4614300.0, 178.3, 178.3, 0.0);
(453200.0, 4614300.0, 178.6, 178.6, 0.0); (453300.0, 4614300.0, 178.7, 178.7, 0.0);
(453400.0, 4614300.0, 178.4, 178.4, 0.0); (453500.0, 4614300.0, 179.6, 179.6, 0.0);
(453600.0, 4614300.0, 178.6, 178.6, 0.0); (453700.0, 4614300.0, 179.4, 179.4, 0.0);
(453800.0, 4614300.0, 179.1, 179.1, 0.0); (453900.0, 4614300.0, 179.1, 179.1, 0.0);
(454000.0, 4614300.0, 175.6, 179.4, 0.0); (454400.0, 4614300.0, 178.2, 178.2, 0.0);
(454500.0, 4614300.0, 178.2, 178.2, 0.0); (454600.0, 4614300.0, 178.2, 178.2, 0.0);
(454700.0, 4614300.0, 178.2, 178.2, 0.0); (454800.0, 4614300.0, 178.2, 178.2, 0.0);
(454900.0, 4614300.0, 178.2, 178.2, 0.0); (455000.0, 4614300.0, 178.2, 178.2, 0.0);
(455100.0, 4614300.0, 178.2, 178.2, 0.0); (455200.0, 4614300.0, 178.2, 178.2, 0.0);
(455300.0, 4614300.0, 178.2, 178.2, 0.0); (455400.0, 4614300.0, 178.2, 178.2, 0.0);

```
     ( 455500.0, 4614300.0,     178.2,     178.2,       0.0);         ( 455600.0,
4614300.0,     178.2,     178.2,       0.0);
     ( 455700.0, 4614300.0,     179.2,     179.2,       0.0);         ( 455800.0,
4614300.0,     180.1,     180.1,       0.0);
     ( 455900.0, 4614300.0,     180.4,     180.4,       0.0);         ( 456000.0,
4614300.0,     180.5,     180.5,       0.0);
     ( 456100.0, 4614300.0,     180.8,     180.8,       0.0);         ( 456200.0,
4614300.0,     180.5,     180.5,       0.0);
     ( 456300.0, 4614300.0,     179.7,     179.7,       0.0);         ( 456400.0,
4614300.0,     178.8,     178.8,       0.0);
     ( 456500.0, 4614300.0,     186.7,     186.7,       0.0);         ( 456600.0,
4614300.0,     178.5,     178.5,       0.0);
     ( 452000.0, 4614400.0,     178.9,     178.9,       0.0);         ( 452100.0,
4614400.0,     179.6,     209.4,       0.0);
     ( 452200.0, 4614400.0,     189.9,     198.0,       0.0);         ( 452300.0,
4614400.0,     182.1,     209.9,       0.0);
     ( 452400.0, 4614400.0,     180.8,     209.9,       0.0);         ( 452500.0,
4614400.0,     181.5,     209.7,       0.0);
     ( 452600.0, 4614400.0,     182.6,     209.7,       0.0);         ( 452700.0,
4614400.0,     183.2,     207.9,       0.0);
     ( 452800.0, 4614400.0,     180.9,     180.9,       0.0);         ( 452900.0,
4614400.0,     180.4,     180.4,       0.0);
     ( 453000.0, 4614400.0,     179.9,     179.9,       0.0);         ( 453100.0,
4614400.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4614400.0,     178.6,     178.6,       0.0);         ( 453300.0,
4614400.0,     178.6,     178.6,       0.0);
     ( 453400.0, 4614400.0,     178.4,     178.4,       0.0);         ( 453500.0,
4614400.0,     179.5,     179.5,       0.0);
     ( 453600.0, 4614400.0,     178.4,     178.4,       0.0);         ( 453700.0,
4614400.0,     178.3,     178.3,       0.0);
     ( 453800.0, 4614400.0,     179.2,     179.2,       0.0);         ( 453900.0,
4614400.0,     179.1,     179.1,       0.0);
     ( 454000.0, 4614400.0,     175.7,     179.4,       0.0);         ( 454100.0,
4614400.0,     176.6,     176.6,       0.0);
     ( 454600.0, 4614400.0,     178.2,     178.2,       0.0);         ( 454700.0,
4614400.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4614400.0,     178.2,     178.2,       0.0);         ( 454900.0,
4614400.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4614400.0,     178.2,     178.2,       0.0);         ( 455100.0,
4614400.0,     178.2,     178.2,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 133
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455200.0, 4614400.0, 178.2, 178.2, 0.0); (455300.0, 4614400.0, 178.2, 178.2, 0.0);
(455400.0, 4614400.0, 178.2, 178.2, 0.0); (455500.0, 4614400.0, 178.2, 178.2, 0.0);
(455600.0, 4614400.0, 178.2, 178.2, 0.0); (455700.0, 4614400.0, 178.5, 178.5, 0.0);
(455800.0, 4614400.0, 179.8, 179.8, 0.0); (455900.0, 4614400.0, 180.0, 180.0, 0.0);
(456000.0, 4614400.0, 180.1, 180.1, 0.0); (456100.0, 4614400.0, 180.3, 180.3, 0.0);
(456200.0, 4614400.0, 180.1, 180.1, 0.0); (456300.0, 4614400.0, 180.1, 180.1, 0.0);
(456400.0, 4614400.0, 179.2, 179.2, 0.0); (456500.0, 4614400.0, 184.0, 187.3, 0.0);
(456600.0, 4614400.0, 178.1, 187.3, 0.0); (452000.0, 4614500.0, 178.9, 209.3, 0.0);
(452100.0, 4614500.0, 179.6, 209.7, 0.0); (452200.0, 4614500.0, 181.9, 209.9, 0.0);
(452300.0, 4614500.0, 184.6, 209.9, 0.0); (452400.0, 4614500.0, 186.0, 209.9, 0.0);
(452500.0, 4614500.0, 186.2, 209.9, 0.0); (452600.0, 4614500.0, 187.9, 209.7, 0.0);
(452700.0, 4614500.0, 183.1, 209.7, 0.0); (452800.0, 4614500.0, 181.1, 207.9, 0.0);
(452900.0, 4614500.0, 180.8, 180.8, 0.0); (453000.0, 4614500.0, 180.0, 180.0, 0.0);
(453100.0, 4614500.0, 177.1, 177.1, 0.0); (453200.0, 4614500.0, 178.5, 178.5, 0.0);
(453300.0, 4614500.0, 178.6, 178.6, 0.0); (453400.0, 4614500.0, 178.4, 178.4, 0.0);
(453500.0, 4614500.0, 178.3, 178.3, 0.0); (453600.0, 4614500.0, 178.5, 178.5, 0.0);
(453700.0, 4614500.0, 178.3, 178.3, 0.0); (453800.0, 4614500.0, 178.7, 178.7, 0.0);
(453900.0, 4614500.0, 179.0, 179.0, 0.0); (454000.0, 4614500.0, 175.9, 179.4, 0.0);
(454100.0, 4614500.0, 175.7, 178.2, 0.0); (454600.0, 4614500.0, 178.2, 178.2, 0.0);
(454700.0, 4614500.0, 178.2, 178.2, 0.0); (454800.0, 4614500.0, 178.2, 178.2, 0.0);
(454900.0, 4614500.0, 178.2, 178.2, 0.0); (455000.0, 4614500.0, 178.2, 178.2, 0.0);
(455100.0, 4614500.0, 178.2, 178.2, 0.0); (455200.0, 4614500.0, 178.2, 178.2, 0.0);
(455300.0, 4614500.0, 178.2, 178.2, 0.0); (455400.0, 4614500.0, 178.2, 178.2, 0.0);
(455500.0, 4614500.0, 178.2, 178.2, 0.0); (455600.0, 4614500.0, 178.2, 178.2, 0.0);
(455700.0, 4614500.0, 178.2, 178.2, 0.0); (455800.0, 4614500.0, 178.3, 178.3, 0.0);

```
     ( 455900.0, 4614500.0,     179.0,     179.0,       0.0);         ( 456000.0,
4614500.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4614500.0,     177.8,     177.8,       0.0);         ( 456200.0,
4614500.0,     178.0,     178.0,       0.0);
     ( 456300.0, 4614500.0,     177.9,     177.9,       0.0);         ( 456400.0,
4614500.0,     179.7,     179.7,       0.0);
     ( 456500.0, 4614500.0,     178.6,     186.5,       0.0);         ( 456600.0,
4614500.0,     178.4,     178.4,       0.0);
     ( 452000.0, 4614600.0,     178.9,     209.6,       0.0);         ( 452100.0,
4614600.0,     180.3,     209.9,       0.0);
     ( 452200.0, 4614600.0,     203.8,     208.9,       0.0);         ( 452300.0,
4614600.0,     208.7,     208.7,       0.0);
     ( 452400.0, 4614600.0,     209.1,     209.1,       0.0);         ( 452500.0,
4614600.0,     209.2,     209.2,       0.0);
     ( 452600.0, 4614600.0,     196.4,     209.7,       0.0);         ( 452700.0,
4614600.0,     183.5,     209.7,       0.0);
     ( 452800.0, 4614600.0,     182.2,     207.9,       0.0);         ( 452900.0,
4614600.0,     181.4,     181.4,       0.0);
     ( 453000.0, 4614600.0,     180.2,     180.2,       0.0);         ( 453100.0,
4614600.0,     177.2,     177.2,       0.0);
     ( 453200.0, 4614600.0,     177.0,     177.0,       0.0);         ( 453300.0,
4614600.0,     178.5,     178.5,       0.0);
     ( 453400.0, 4614600.0,     178.4,     178.4,       0.0);         ( 453500.0,
4614600.0,     178.3,     178.3,       0.0);
     ( 453600.0, 4614600.0,     178.3,     178.3,       0.0);         ( 453700.0,
4614600.0,     178.4,     178.4,       0.0);
     ( 453800.0, 4614600.0,     178.6,     178.6,       0.0);         ( 453900.0,
4614600.0,     178.9,     178.9,       0.0);
     ( 454000.0, 4614600.0,     176.0,     179.4,       0.0);         ( 454100.0,
4614600.0,     175.6,     178.2,       0.0);
     ( 454600.0, 4614600.0,     178.2,     178.2,       0.0);         ( 454700.0,
4614600.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4614600.0,     178.2,     178.2,       0.0);         ( 454900.0,
4614600.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4614600.0,     178.2,     178.2,       0.0);         ( 455100.0,
4614600.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4614600.0,     178.2,     178.2,       0.0);         ( 455300.0,
4614600.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4614600.0,     178.2,     178.2,       0.0);         ( 455500.0,
4614600.0,     178.2,     178.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455600.0, 4614600.0, 178.2, 178.2, 0.0); (455700.0, 4614600.0, 178.2, 178.2, 0.0);
(455800.0, 4614600.0, 178.2, 178.2, 0.0); (455900.0, 4614600.0, 178.7, 178.7, 0.0);
(456000.0, 4614600.0, 178.2, 178.2, 0.0); (456100.0, 4614600.0, 177.6, 177.6, 0.0);
(456200.0, 4614600.0, 177.8, 177.8, 0.0); (456300.0, 4614600.0, 178.0, 178.0, 0.0);
(456400.0, 4614600.0, 180.3, 180.3, 0.0); (456500.0, 4614600.0, 182.2, 184.3, 0.0);
(456600.0, 4614600.0, 178.2, 178.2, 0.0); (452000.0, 4614700.0, 178.6, 209.6, 0.0);
(452100.0, 4614700.0, 182.1, 209.9, 0.0); (452200.0, 4614700.0, 205.0, 205.3, 0.0);
(452300.0, 4614700.0, 209.0, 209.0, 0.0); (452400.0, 4614700.0, 209.7, 209.7, 0.0);
(452500.0, 4614700.0, 206.4, 206.7, 0.0); (452600.0, 4614700.0, 189.8, 209.7, 0.0);
(452700.0, 4614700.0, 181.7, 209.7, 0.0); (452800.0, 4614700.0, 181.8, 181.8, 0.0);
(452900.0, 4614700.0, 179.7, 179.7, 0.0); (453000.0, 4614700.0, 179.5, 179.5, 0.0);
(453100.0, 4614700.0, 177.2, 177.2, 0.0); (453200.0, 4614700.0, 178.4, 178.4, 0.0);
(453300.0, 4614700.0, 178.4, 178.4, 0.0); (453400.0, 4614700.0, 178.3, 178.3, 0.0);
(453500.0, 4614700.0, 178.3, 178.3, 0.0); (453600.0, 4614700.0, 178.3, 178.3, 0.0);
(453700.0, 4614700.0, 178.5, 178.5, 0.0); (453800.0, 4614700.0, 178.5, 178.5, 0.0);
(453900.0, 4614700.0, 178.7, 178.7, 0.0); (454000.0, 4614700.0, 175.7, 175.7, 0.0);
(454100.0, 4614700.0, 178.5, 178.5, 0.0); (454600.0, 4614700.0, 178.2, 178.2, 0.0);
(454700.0, 4614700.0, 178.2, 178.2, 0.0); (454800.0, 4614700.0, 178.2, 178.2, 0.0);
(454900.0, 4614700.0, 178.2, 178.2, 0.0); (455000.0, 4614700.0, 178.2, 178.2, 0.0);
(455100.0, 4614700.0, 178.2, 178.2, 0.0); (455200.0, 4614700.0, 178.2, 178.2, 0.0);
(455300.0, 4614700.0, 178.2, 178.2, 0.0); (455400.0, 4614700.0, 178.2, 178.2, 0.0);
(455500.0, 4614700.0, 178.2, 178.2, 0.0); (455600.0, 4614700.0, 178.2, 178.2, 0.0);
(455700.0, 4614700.0, 178.2, 178.2, 0.0); (455800.0, 4614700.0, 178.2, 178.2, 0.0);
(455900.0, 4614700.0, 178.3, 178.3, 0.0); (456000.0, 4614700.0, 178.2, 178.2, 0.0);
(456100.0, 4614700.0, 177.5, 177.5, 0.0); (456200.0, 4614700.0, 177.7, 177.7, 0.0);

```
     ( 456300.0, 4614700.0,     177.8,     177.8,       0.0);         ( 456400.0,
4614700.0,     180.2,     180.2,       0.0);
     ( 456500.0, 4614700.0,     182.0,     186.8,       0.0);         ( 456600.0,
4614700.0,     178.4,     186.8,       0.0);
     ( 452000.0, 4614800.0,     178.3,     209.0,       0.0);         ( 452100.0,
4614800.0,     180.9,     209.9,       0.0);
     ( 452200.0, 4614800.0,     183.2,     209.9,       0.0);         ( 452300.0,
4614800.0,     200.6,     209.8,       0.0);
     ( 452400.0, 4614800.0,     201.0,     209.9,       0.0);         ( 452500.0,
4614800.0,     200.5,     206.7,       0.0);
     ( 452600.0, 4614800.0,     187.8,     209.8,       0.0);         ( 452700.0,
4614800.0,     179.3,     209.8,       0.0);
     ( 452800.0, 4614800.0,     183.4,     183.4,       0.0);         ( 452900.0,
4614800.0,     180.0,     180.0,       0.0);
     ( 453000.0, 4614800.0,     178.3,     178.3,       0.0);         ( 453100.0,
4614800.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4614800.0,     178.3,     178.3,       0.0);         ( 453300.0,
4614800.0,     178.3,     178.3,       0.0);
     ( 453400.0, 4614800.0,     178.3,     178.3,       0.0);         ( 453500.0,
4614800.0,     178.3,     178.3,       0.0);
     ( 453600.0, 4614800.0,     178.3,     178.3,       0.0);         ( 453700.0,
4614800.0,     178.5,     178.5,       0.0);
     ( 453800.0, 4614800.0,     178.5,     178.5,       0.0);         ( 453900.0,
4614800.0,     178.7,     178.7,       0.0);
     ( 454000.0, 4614800.0,     175.4,     175.4,       0.0);         ( 454600.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4614800.0,     178.2,     178.2,       0.0);         ( 454800.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455000.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455200.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455400.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455500.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455600.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455700.0, 4614800.0,     178.2,     178.2,       0.0);         ( 455800.0,
4614800.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4614800.0,     178.2,     178.2,       0.0);         ( 456000.0,
4614800.0,     178.2,     178.2,       0.0);
```

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(456100.0, 4614800.0, 177.6, 177.6, 0.0); (456200.0, 4614800.0, 177.4, 177.4, 0.0);
(456300.0, 4614800.0, 177.7, 177.7, 0.0); (456400.0, 4614800.0, 180.1, 180.1, 0.0);
(456500.0, 4614800.0, 180.3, 186.1, 0.0); (456600.0, 4614800.0, 178.8, 186.0, 0.0);
(452000.0, 4614900.0, 178.3, 178.3, 0.0); (452100.0, 4614900.0, 178.3, 209.8, 0.0);
(452200.0, 4614900.0, 178.3, 209.9, 0.0); (452300.0, 4614900.0, 178.3, 209.9, 0.0);
(452400.0, 4614900.0, 178.4, 209.9, 0.0); (452500.0, 4614900.0, 178.4, 209.9, 0.0);
(452600.0, 4614900.0, 178.5, 209.9, 0.0); (452700.0, 4614900.0, 178.3, 206.7, 0.0);
(452800.0, 4614900.0, 178.3, 178.3, 0.0); (452900.0, 4614900.0, 178.3, 178.3, 0.0);
(453000.0, 4614900.0, 178.3, 178.3, 0.0); (453100.0, 4614900.0, 178.3, 178.3, 0.0);
(453200.0, 4614900.0, 178.3, 178.3, 0.0); (453300.0, 4614900.0, 178.3, 178.3, 0.0);
(453400.0, 4614900.0, 178.3, 178.3, 0.0); (453500.0, 4614900.0, 178.3, 178.3, 0.0);
(453600.0, 4614900.0, 178.3, 178.3, 0.0); (453700.0, 4614900.0, 178.5, 178.5, 0.0);
(453800.0, 4614900.0, 178.5, 178.5, 0.0); (453900.0, 4614900.0, 178.3, 178.3, 0.0);
(454000.0, 4614900.0, 175.2, 175.2, 0.0); (454600.0, 4614900.0, 178.2, 178.2, 0.0);
(454700.0, 4614900.0, 178.2, 178.2, 0.0); (454800.0, 4614900.0, 178.2, 178.2, 0.0);
(454900.0, 4614900.0, 178.2, 178.2, 0.0); (455000.0, 4614900.0, 178.2, 178.2, 0.0);
(455100.0, 4614900.0, 178.2, 178.2, 0.0); (455200.0, 4614900.0, 178.2, 178.2, 0.0);
(455300.0, 4614900.0, 178.2, 178.2, 0.0); (455400.0, 4614900.0, 178.2, 178.2, 0.0);
(455500.0, 4614900.0, 178.2, 178.2, 0.0); (455600.0, 4614900.0, 178.2, 178.2, 0.0);
(455700.0, 4614900.0, 178.2, 178.2, 0.0); (455800.0, 4614900.0, 178.2, 178.2, 0.0);
(455900.0, 4614900.0, 178.2, 178.2, 0.0); (456000.0, 4614900.0, 178.2, 178.2, 0.0);
(456100.0, 4614900.0, 178.7, 178.7, 0.0); (456200.0, 4614900.0, 177.4, 177.4, 0.0);
(456300.0, 4614900.0, 177.7, 177.7, 0.0); (456400.0, 4614900.0, 179.6, 179.6, 0.0);
(456500.0, 4614900.0, 179.7, 184.8, 0.0); (456600.0, 4614900.0, 179.0, 184.2, 0.0);
(452000.0, 4615000.0, 178.3, 178.3, 0.0); (452100.0, 4615000.0, 178.3, 178.3, 0.0);

```
     ( 452200.0, 4615000.0,     178.3,     209.8,       0.0);         ( 452300.0,
4615000.0,     178.3,     209.9,       0.0);
     ( 452400.0, 4615000.0,     178.3,     209.9,       0.0);         ( 452500.0,
4615000.0,     178.3,     209.9,       0.0);
     ( 452600.0, 4615000.0,     178.3,     209.8,       0.0);         ( 452700.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 452800.0, 4615000.0,     178.3,     178.3,       0.0);         ( 452900.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4615000.0,     178.3,     178.3,       0.0);         ( 453100.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4615000.0,     178.3,     178.3,       0.0);         ( 453300.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 453400.0, 4615000.0,     178.3,     178.3,       0.0);         ( 453500.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 453600.0, 4615000.0,     178.3,     178.3,       0.0);         ( 453700.0,
4615000.0,     178.4,     178.4,       0.0);
     ( 453800.0, 4615000.0,     178.4,     178.4,       0.0);         ( 453900.0,
4615000.0,     178.4,     178.4,       0.0);
     ( 454000.0, 4615000.0,     175.2,     175.2,       0.0);         ( 454600.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 454700.0, 4615000.0,     178.2,     178.2,       0.0);         ( 454800.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 454900.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455000.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455200.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455400.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455500.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455600.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455700.0, 4615000.0,     178.2,     178.2,       0.0);         ( 455800.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4615000.0,     178.2,     178.2,       0.0);         ( 456000.0,
4615000.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4615000.0,     178.1,     178.1,       0.0);         ( 456200.0,
4615000.0,     178.3,     178.3,       0.0);
     ( 456300.0, 4615000.0,     177.6,     177.6,       0.0);         ( 456400.0,
4615000.0,     179.5,     179.5,       0.0);
     ( 456500.0, 4615000.0,     179.3,     182.7,       0.0);         ( 456600.0,
4615000.0,     179.4,     182.4,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 136
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452000.0, 4615100.0, 178.3, 178.3, 0.0); (452100.0, 4615100.0, 178.0, 178.0, 0.0);
(452200.0, 4615100.0, 177.6, 177.6, 0.0); (452300.0, 4615100.0, 178.3, 178.3, 0.0);
(452400.0, 4615100.0, 178.3, 178.3, 0.0); (452500.0, 4615100.0, 178.3, 178.3, 0.0);
(452600.0, 4615100.0, 178.3, 178.3, 0.0); (452700.0, 4615100.0, 178.3, 178.3, 0.0);
(452800.0, 4615100.0, 178.3, 178.3, 0.0); (452900.0, 4615100.0, 178.3, 178.3, 0.0);
(453000.0, 4615100.0, 178.3, 178.3, 0.0); (453100.0, 4615100.0, 178.3, 178.3, 0.0);
(453200.0, 4615100.0, 178.4, 178.4, 0.0); (453300.0, 4615100.0, 178.3, 178.3, 0.0);
(453400.0, 4615100.0, 178.3, 178.3, 0.0); (453500.0, 4615100.0, 178.3, 178.3, 0.0);
(453600.0, 4615100.0, 178.3, 178.3, 0.0); (453700.0, 4615100.0, 178.3, 178.3, 0.0);
(453800.0, 4615100.0, 178.3, 178.3, 0.0); (453900.0, 4615100.0, 175.2, 175.2, 0.0);
(454000.0, 4615100.0, 178.2, 178.2, 0.0); (454100.0, 4615100.0, 178.2, 178.2, 0.0);
(454600.0, 4615100.0, 178.2, 178.2, 0.0); (454700.0, 4615100.0, 178.2, 178.2, 0.0);
(454800.0, 4615100.0, 178.2, 178.2, 0.0); (454900.0, 4615100.0, 178.2, 178.2, 0.0);
(455000.0, 4615100.0, 178.2, 178.2, 0.0); (455100.0, 4615100.0, 178.2, 178.2, 0.0);
(455200.0, 4615100.0, 178.2, 178.2, 0.0); (455300.0, 4615100.0, 178.2, 178.2, 0.0);
(455400.0, 4615100.0, 178.2, 178.2, 0.0); (455500.0, 4615100.0, 178.2, 178.2, 0.0);
(455600.0, 4615100.0, 178.2, 178.2, 0.0); (455700.0, 4615100.0, 178.2, 178.2, 0.0);
(455800.0, 4615100.0, 178.2, 178.2, 0.0); (455900.0, 4615100.0, 178.2, 178.2, 0.0);
(456000.0, 4615100.0, 178.2, 178.2, 0.0); (456100.0, 4615100.0, 177.8, 177.8, 0.0);
(456200.0, 4615100.0, 177.9, 177.9, 0.0); (456300.0, 4615100.0, 177.9, 177.9, 0.0);
(456400.0, 4615100.0, 179.7, 179.7, 0.0); (456500.0, 4615100.0, 180.0, 180.0, 0.0);
(456600.0, 4615100.0, 180.0, 180.0, 0.0); (452000.0, 4615200.0, 178.3, 178.3, 0.0);
(452100.0, 4615200.0, 177.6, 177.6, 0.0); (452200.0, 4615200.0, 178.3, 178.3, 0.0);
(452300.0, 4615200.0, 178.3, 178.3, 0.0); (452400.0, 4615200.0, 178.3, 178.3, 0.0);
(452500.0, 4615200.0, 178.3, 178.3, 0.0); (452600.0, 4615200.0, 178.3, 178.3, 0.0);

```
     ( 452700.0, 4615200.0,     178.3,     178.3,       0.0);         ( 452800.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 452900.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453000.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 453100.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453200.0,
4615200.0,     178.5,     178.5,       0.0);
     ( 453300.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453400.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 453500.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453600.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 453700.0, 4615200.0,     178.3,     178.3,       0.0);         ( 453800.0,
4615200.0,     178.3,     178.3,       0.0);
     ( 453900.0, 4615200.0,     178.3,     178.3,       0.0);         ( 454000.0,
4615200.0,     175.5,     175.5,       0.0);
     ( 454100.0, 4615200.0,     178.1,     178.1,       0.0);         ( 454200.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4615200.0,     178.2,     178.2,       0.0);         ( 454700.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4615200.0,     178.2,     178.2,       0.0);         ( 454900.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455100.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455300.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455500.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455700.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 455800.0, 4615200.0,     178.2,     178.2,       0.0);         ( 455900.0,
4615200.0,     178.2,     178.2,       0.0);
     ( 456000.0, 4615200.0,     178.2,     178.2,       0.0);         ( 456100.0,
4615200.0,     178.1,     178.1,       0.0);
     ( 456200.0, 4615200.0,     178.2,     178.2,       0.0);         ( 456300.0,
4615200.0,     177.9,     177.9,       0.0);
     ( 456400.0, 4615200.0,     179.3,     179.3,       0.0);         ( 456500.0,
4615200.0,     181.3,     181.3,       0.0);
     ( 456600.0, 4615200.0,     181.4,     181.4,       0.0);         ( 452000.0,
4615300.0,     178.3,     178.3,       0.0);
     ( 452100.0, 4615300.0,     177.3,     177.3,       0.0);         ( 452200.0,
4615300.0,     178.3,     178.3,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 137
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452300.0, 4615300.0, 177.7, 177.7, 0.0); (452400.0, 4615300.0, 177.7, 177.7, 0.0);
(452500.0, 4615300.0, 177.7, 177.7, 0.0); (452600.0, 4615300.0, 177.8, 177.8, 0.0);
(452700.0, 4615300.0, 178.3, 178.3, 0.0); (452800.0, 4615300.0, 178.3, 178.3, 0.0);
(452900.0, 4615300.0, 178.3, 178.3, 0.0); (453000.0, 4615300.0, 178.3, 178.3, 0.0);
(453100.0, 4615300.0, 178.4, 178.4, 0.0); (453200.0, 4615300.0, 178.6, 178.6, 0.0);
(453300.0, 4615300.0, 178.5, 178.5, 0.0); (453400.0, 4615300.0, 178.3, 178.3, 0.0);
(453500.0, 4615300.0, 178.3, 178.3, 0.0); (453600.0, 4615300.0, 178.3, 178.3, 0.0);
(453700.0, 4615300.0, 178.3, 178.3, 0.0); (453800.0, 4615300.0, 178.3, 178.3, 0.0);
(453900.0, 4615300.0, 178.4, 178.4, 0.0); (454000.0, 4615300.0, 175.5, 175.5, 0.0);
(454100.0, 4615300.0, 178.4, 178.4, 0.0); (454200.0, 4615300.0, 178.2, 178.2, 0.0);
(454300.0, 4615300.0, 178.2, 178.2, 0.0); (454400.0, 4615300.0, 178.2, 178.2, 0.0);
(454500.0, 4615300.0, 178.2, 178.2, 0.0); (454600.0, 4615300.0, 178.2, 178.2, 0.0);
(454700.0, 4615300.0, 178.2, 178.2, 0.0); (454800.0, 4615300.0, 178.2, 178.2, 0.0);
(454900.0, 4615300.0, 178.2, 178.2, 0.0); (455000.0, 4615300.0, 178.2, 178.2, 0.0);
(455100.0, 4615300.0, 178.2, 178.2, 0.0); (455200.0, 4615300.0, 178.2, 178.2, 0.0);
(455300.0, 4615300.0, 178.2, 178.2, 0.0); (455400.0, 4615300.0, 178.2, 178.2, 0.0);
(455500.0, 4615300.0, 178.2, 178.2, 0.0); (455600.0, 4615300.0, 178.2, 178.2, 0.0);
(455700.0, 4615300.0, 178.2, 178.2, 0.0); (455800.0, 4615300.0, 178.2, 178.2, 0.0);
(455900.0, 4615300.0, 178.2, 178.2, 0.0); (456000.0, 4615300.0, 178.2, 178.2, 0.0);
(456100.0, 4615300.0, 178.3, 178.3, 0.0); (456200.0, 4615300.0, 178.2, 178.2, 0.0);
(456300.0, 4615300.0, 177.9, 177.9, 0.0); (456400.0, 4615300.0, 179.6, 179.6, 0.0);
(456500.0, 4615300.0, 182.3, 182.3, 0.0); (456600.0, 4615300.0, 181.8, 181.8, 0.0);
(452000.0, 4615400.0, 178.3, 178.3, 0.0); (452100.0, 4615400.0, 178.2, 178.2, 0.0);
(452200.0, 4615400.0, 178.0, 178.0, 0.0); (452300.0, 4615400.0, 177.0, 177.0, 0.0);
(452400.0, 4615400.0, 177.0, 177.0, 0.0); (452500.0, 4615400.0, 177.0, 177.0, 0.0);

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     ( 452600.0, 4615400.0,     177.0,     177.0,       0.0);         ( 452700.0,
4615400.0,     177.1,     177.1,       0.0);
     ( 452800.0, 4615400.0,     177.0,     177.0,       0.0);         ( 452900.0,
4615400.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4615400.0,     178.3,     178.3,       0.0);         ( 453100.0,
4615400.0,     178.4,     178.4,       0.0);
     ( 453200.0, 4615400.0,     178.5,     178.5,       0.0);         ( 453300.0,
4615400.0,     178.6,     178.6,       0.0);
     ( 453400.0, 4615400.0,     178.3,     178.3,       0.0);         ( 453500.0,
4615400.0,     178.3,     178.3,       0.0);
     ( 453600.0, 4615400.0,     178.3,     178.3,       0.0);         ( 453700.0,
4615400.0,     178.3,     178.3,       0.0);
     ( 453800.0, 4615400.0,     178.4,     178.4,       0.0);         ( 453900.0,
4615400.0,     178.4,     178.4,       0.0);
     ( 454000.0, 4615400.0,     175.4,     175.4,       0.0);         ( 454100.0,
4615400.0,     178.6,     178.6,       0.0);
     ( 454200.0, 4615400.0,     178.2,     178.2,       0.0);         ( 454300.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4615400.0,     178.2,     178.2,       0.0);         ( 454500.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4615400.0,     178.2,     178.2,       0.0);         ( 454700.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4615400.0,     178.2,     178.2,       0.0);         ( 454900.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455100.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455300.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455500.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455700.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 455800.0, 4615400.0,     178.2,     178.2,       0.0);         ( 455900.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 456000.0, 4615400.0,     178.2,     178.2,       0.0);         ( 456100.0,
4615400.0,     178.2,     178.2,       0.0);
     ( 456200.0, 4615400.0,     178.2,     178.2,       0.0);         ( 456300.0,
4615400.0,     177.8,     177.8,       0.0);
     ( 456400.0, 4615400.0,     179.6,     179.6,       0.0);         ( 456500.0,
4615400.0,     181.1,     181.1,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 138
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(456600.0, 4615400.0, 182.3, 182.3, 0.0); (452000.0, 4615500.0, 178.3, 178.3, 0.0);
(452100.0, 4615500.0, 178.3, 178.3, 0.0); (452200.0, 4615500.0, 178.3, 178.3, 0.0);
(452300.0, 4615500.0, 177.0, 177.0, 0.0); (452400.0, 4615500.0, 177.0, 177.0, 0.0);
(452500.0, 4615500.0, 177.0, 177.0, 0.0); (452600.0, 4615500.0, 178.3, 178.3, 0.0);
(452700.0, 4615500.0, 177.0, 177.0, 0.0); (452800.0, 4615500.0, 177.0, 177.0, 0.0);
(452900.0, 4615500.0, 178.3, 178.3, 0.0); (453000.0, 4615500.0, 178.3, 178.3, 0.0);
(453100.0, 4615500.0, 178.4, 178.4, 0.0); (453200.0, 4615500.0, 178.6, 178.6, 0.0);
(453300.0, 4615500.0, 178.7, 178.7, 0.0); (453400.0, 4615500.0, 178.4, 178.4, 0.0);
(453500.0, 4615500.0, 178.3, 178.3, 0.0); (453600.0, 4615500.0, 178.6, 178.6, 0.0);
(453700.0, 4615500.0, 178.4, 178.4, 0.0); (453800.0, 4615500.0, 178.6, 178.6, 0.0);
(453900.0, 4615500.0, 178.3, 178.3, 0.0); (454000.0, 4615500.0, 175.6, 178.3, 0.0);
(454100.0, 4615500.0, 176.8, 176.8, 0.0); (454200.0, 4615500.0, 178.2, 178.2, 0.0);
(454300.0, 4615500.0, 178.2, 178.2, 0.0); (454400.0, 4615500.0, 178.2, 178.2, 0.0);
(454500.0, 4615500.0, 178.2, 178.2, 0.0); (454600.0, 4615500.0, 178.2, 178.2, 0.0);
(454700.0, 4615500.0, 178.2, 178.2, 0.0); (454800.0, 4615500.0, 178.2, 178.2, 0.0);
(454900.0, 4615500.0, 178.2, 178.2, 0.0); (455000.0, 4615500.0, 178.2, 178.2, 0.0);
(455100.0, 4615500.0, 178.2, 178.2, 0.0); (455200.0, 4615500.0, 178.2, 178.2, 0.0);
(455300.0, 4615500.0, 178.2, 178.2, 0.0); (455400.0, 4615500.0, 178.2, 178.2, 0.0);
(455500.0, 4615500.0, 178.2, 178.2, 0.0); (455600.0, 4615500.0, 178.2, 178.2, 0.0);
(455700.0, 4615500.0, 178.2, 178.2, 0.0); (455800.0, 4615500.0, 178.2, 178.2, 0.0);
(455900.0, 4615500.0, 178.2, 178.2, 0.0); (456000.0, 4615500.0, 178.2, 178.2, 0.0);
(456100.0, 4615500.0, 177.9, 177.9, 0.0); (456200.0, 4615500.0, 178.2, 178.2, 0.0);
(456300.0, 4615500.0, 177.5, 177.5, 0.0); (456400.0, 4615500.0, 178.8, 178.8, 0.0);
(456500.0, 4615500.0, 179.9, 183.2, 0.0); (456600.0, 4615500.0, 179.8, 183.3, 0.0);
(452000.0, 4615600.0, 178.3, 178.3, 0.0); (452100.0, 4615600.0, 178.3, 178.3, 0.0);

```
     ( 452200.0, 4615600.0,     178.3,     178.3,       0.0);         ( 452300.0,
4615600.0,     177.0,     177.0,       0.0);
     ( 452400.0, 4615600.0,     177.8,     177.8,       0.0);         ( 452500.0,
4615600.0,     177.0,     177.0,       0.0);
     ( 452600.0, 4615600.0,     177.0,     177.0,       0.0);         ( 452700.0,
4615600.0,     178.0,     178.0,       0.0);
     ( 452800.0, 4615600.0,     177.9,     177.9,       0.0);         ( 452900.0,
4615600.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4615600.0,     178.3,     178.3,       0.0);         ( 453100.0,
4615600.0,     178.5,     178.5,       0.0);
     ( 453200.0, 4615600.0,     178.7,     178.7,       0.0);         ( 453300.0,
4615600.0,     178.8,     178.8,       0.0);
     ( 453400.0, 4615600.0,     178.9,     178.9,       0.0);         ( 453500.0,
4615600.0,     178.7,     178.7,       0.0);
     ( 453600.0, 4615600.0,     178.8,     178.8,       0.0);         ( 453700.0,
4615600.0,     178.8,     178.8,       0.0);
     ( 453800.0, 4615600.0,     178.7,     178.7,       0.0);         ( 453900.0,
4615600.0,     178.5,     178.5,       0.0);
     ( 454000.0, 4615600.0,     176.6,     176.6,       0.0);         ( 454100.0,
4615600.0,     177.2,     177.2,       0.0);
     ( 454200.0, 4615600.0,     178.2,     178.2,       0.0);         ( 454300.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4615600.0,     178.2,     178.2,       0.0);         ( 454500.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4615600.0,     178.2,     178.2,       0.0);         ( 454700.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4615600.0,     178.2,     178.2,       0.0);         ( 454900.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455100.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455300.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455500.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455700.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 455800.0, 4615600.0,     178.2,     178.2,       0.0);         ( 455900.0,
4615600.0,     178.2,     178.2,       0.0);
     ( 456000.0, 4615600.0,     178.2,     178.2,       0.0);         ( 456100.0,
4615600.0,     177.5,     177.5,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 139
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(456200.0, 4615600.0, 178.0, 178.0, 0.0); (456300.0, 4615600.0, 178.4, 178.4, 0.0);
(456400.0, 4615600.0, 178.8, 178.8, 0.0); (456500.0, 4615600.0, 179.0, 183.5, 0.0);
(456600.0, 4615600.0, 178.9, 183.7, 0.0); (452000.0, 4615700.0, 178.3, 178.3, 0.0);
(452100.0, 4615700.0, 178.3, 178.3, 0.0); (452200.0, 4615700.0, 178.3, 178.3, 0.0);
(452300.0, 4615700.0, 177.6, 177.6, 0.0); (452400.0, 4615700.0, 177.7, 177.7, 0.0);
(452500.0, 4615700.0, 177.0, 177.0, 0.0); (452600.0, 4615700.0, 177.0, 177.0, 0.0);
(452700.0, 4615700.0, 177.0, 177.0, 0.0); (452800.0, 4615700.0, 177.2, 177.2, 0.0);
(452900.0, 4615700.0, 177.0, 177.0, 0.0); (453000.0, 4615700.0, 178.3, 178.3, 0.0);
(453100.0, 4615700.0, 178.5, 178.5, 0.0); (453200.0, 4615700.0, 178.8, 178.8, 0.0);
(453300.0, 4615700.0, 179.0, 179.0, 0.0); (453400.0, 4615700.0, 179.2, 179.2, 0.0);
(453500.0, 4615700.0, 179.2, 179.2, 0.0); (453600.0, 4615700.0, 179.1, 179.1, 0.0);
(453700.0, 4615700.0, 179.1, 179.1, 0.0); (453800.0, 4615700.0, 178.8, 178.8, 0.0);
(453900.0, 4615700.0, 178.4, 178.4, 0.0); (454000.0, 4615700.0, 177.6, 177.6, 0.0);
(454100.0, 4615700.0, 175.2, 178.4, 0.0); (454200.0, 4615700.0, 178.2, 178.2, 0.0);
(454300.0, 4615700.0, 178.2, 178.2, 0.0); (454400.0, 4615700.0, 178.2, 178.2, 0.0);
(454500.0, 4615700.0, 178.2, 178.2, 0.0); (454600.0, 4615700.0, 178.2, 178.2, 0.0);
(454700.0, 4615700.0, 178.2, 178.2, 0.0); (454800.0, 4615700.0, 178.2, 178.2, 0.0);
(454900.0, 4615700.0, 178.2, 178.2, 0.0); (455000.0, 4615700.0, 178.2, 178.2, 0.0);
(455100.0, 4615700.0, 178.2, 178.2, 0.0); (455200.0, 4615700.0, 178.2, 178.2, 0.0);
(455300.0, 4615700.0, 178.2, 178.2, 0.0); (455400.0, 4615700.0, 178.2, 178.2, 0.0);
(455500.0, 4615700.0, 178.2, 178.2, 0.0); (455600.0, 4615700.0, 178.2, 178.2, 0.0);
(455700.0, 4615700.0, 178.2, 178.2, 0.0); (455800.0, 4615700.0, 178.2, 178.2, 0.0);
(455900.0, 4615700.0, 178.2, 178.2, 0.0); (456000.0, 4615700.0, 178.2, 178.2, 0.0);
(456100.0, 4615700.0, 178.5, 178.5, 0.0); (456200.0, 4615700.0, 178.6, 178.6, 0.0);
(456300.0, 4615700.0, 178.6, 178.6, 0.0); (456400.0, 4615700.0, 178.5, 178.5, 0.0);

```
     ( 456500.0, 4615700.0,     178.3,     183.6,       0.0);         ( 456600.0,
4615700.0,     178.8,     183.7,       0.0);
     ( 452000.0, 4615800.0,     178.3,     178.3,       0.0);         ( 452100.0,
4615800.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4615800.0,     178.3,     178.3,       0.0);         ( 452300.0,
4615800.0,     177.0,     177.0,       0.0);
     ( 452400.0, 4615800.0,     178.3,     178.3,       0.0);         ( 452500.0,
4615800.0,     178.3,     178.3,       0.0);
     ( 452600.0, 4615800.0,     178.3,     178.3,       0.0);         ( 452700.0,
4615800.0,     177.0,     177.0,       0.0);
     ( 452800.0, 4615800.0,     177.7,     177.7,       0.0);         ( 452900.0,
4615800.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4615800.0,     178.3,     178.3,       0.0);         ( 453100.0,
4615800.0,     178.5,     178.5,       0.0);
     ( 453200.0, 4615800.0,     178.8,     178.8,       0.0);         ( 453300.0,
4615800.0,     179.0,     179.0,       0.0);
     ( 453400.0, 4615800.0,     179.0,     179.0,       0.0);         ( 453500.0,
4615800.0,     179.4,     179.4,       0.0);
     ( 453600.0, 4615800.0,     179.4,     179.4,       0.0);         ( 453700.0,
4615800.0,     179.2,     179.2,       0.0);
     ( 453800.0, 4615800.0,     178.6,     178.6,       0.0);         ( 453900.0,
4615800.0,     178.4,     178.4,       0.0);
     ( 454000.0, 4615800.0,     176.8,     178.3,       0.0);         ( 454100.0,
4615800.0,     175.2,     178.1,       0.0);
     ( 454200.0, 4615800.0,     178.2,     178.2,       0.0);         ( 454300.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4615800.0,     178.2,     178.2,       0.0);         ( 454500.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4615800.0,     178.2,     178.2,       0.0);         ( 454700.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4615800.0,     178.2,     178.2,       0.0);         ( 454900.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4615800.0,     178.2,     178.2,       0.0);         ( 455100.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4615800.0,     178.2,     178.2,       0.0);         ( 455300.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 455400.0, 4615800.0,     178.2,     178.2,       0.0);         ( 455500.0,
4615800.0,     178.2,     178.2,       0.0);
     ( 455600.0, 4615800.0,     178.2,     178.2,       0.0);         ( 455700.0,
4615800.0,     178.2,     178.2,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 140
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455800.0, 4615800.0, 178.2, 178.2, 0.0); (455900.0, 4615800.0, 178.2, 178.2, 0.0);
(456000.0, 4615800.0, 178.2, 178.2, 0.0); (456100.0, 4615800.0, 178.0, 178.0, 0.0);
(456200.0, 4615800.0, 178.3, 178.3, 0.0); (456300.0, 4615800.0, 178.4, 178.4, 0.0);
(456400.0, 4615800.0, 178.5, 178.5, 0.0); (456500.0, 4615800.0, 178.4, 183.4, 0.0);
(456600.0, 4615800.0, 179.3, 183.7, 0.0); (452000.0, 4615900.0, 178.3, 178.3, 0.0);
(452100.0, 4615900.0, 178.3, 178.3, 0.0); (452200.0, 4615900.0, 178.3, 178.3, 0.0);
(452300.0, 4615900.0, 178.3, 178.3, 0.0); (452400.0, 4615900.0, 178.3, 178.3, 0.0);
(452500.0, 4615900.0, 178.3, 178.3, 0.0); (452600.0, 4615900.0, 177.9, 177.9, 0.0);
(452700.0, 4615900.0, 177.0, 177.0, 0.0); (452800.0, 4615900.0, 178.2, 178.2, 0.0);
(452900.0, 4615900.0, 178.3, 178.3, 0.0); (453000.0, 4615900.0, 178.3, 178.3, 0.0);
(453100.0, 4615900.0, 178.5, 178.5, 0.0); (453200.0, 4615900.0, 178.8, 178.8, 0.0);
(453300.0, 4615900.0, 179.1, 179.1, 0.0); (453400.0, 4615900.0, 179.0, 179.0, 0.0);
(453500.0, 4615900.0, 179.3, 179.3, 0.0); (453600.0, 4615900.0, 179.6, 179.6, 0.0);
(453700.0, 4615900.0, 177.9, 177.9, 0.0); (453800.0, 4615900.0, 177.8, 177.8, 0.0);
(453900.0, 4615900.0, 177.8, 177.8, 0.0); (454000.0, 4615900.0, 175.4, 175.4, 0.0);
(454100.0, 4615900.0, 175.2, 178.7, 0.0); (454200.0, 4615900.0, 178.2, 178.2, 0.0);
(454300.0, 4615900.0, 178.2, 178.2, 0.0); (454400.0, 4615900.0, 178.2, 178.2, 0.0);
(454500.0, 4615900.0, 178.2, 178.2, 0.0); (454600.0, 4615900.0, 178.2, 178.2, 0.0);
(454700.0, 4615900.0, 178.2, 178.2, 0.0); (454800.0, 4615900.0, 178.2, 178.2, 0.0);
(454900.0, 4615900.0, 178.2, 178.2, 0.0); (455000.0, 4615900.0, 178.2, 178.2, 0.0);
(455100.0, 4615900.0, 178.2, 178.2, 0.0); (455200.0, 4615900.0, 178.2, 178.2, 0.0);
(455300.0, 4615900.0, 178.2, 178.2, 0.0); (455400.0, 4615900.0, 178.2, 178.2, 0.0);
(455500.0, 4615900.0, 178.2, 178.2, 0.0); (455600.0, 4615900.0, 178.2, 178.2, 0.0);
(455700.0, 4615900.0, 178.2, 178.2, 0.0); (455800.0, 4615900.0, 178.2, 178.2, 0.0);
(455900.0, 4615900.0, 178.2, 178.2, 0.0); (456000.0, 4615900.0, 178.2, 178.2, 0.0);

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     ( 456100.0, 4615900.0,     178.0,     178.0,       0.0);         ( 456200.0,
4615900.0,     178.2,     178.2,       0.0);
     ( 456300.0, 4615900.0,     178.3,     178.3,       0.0);         ( 456400.0,
4615900.0,     178.3,     178.3,       0.0);
     ( 456500.0, 4615900.0,     179.9,     179.9,       0.0);         ( 456600.0,
4615900.0,     179.2,     183.2,       0.0);
     ( 452000.0, 4616000.0,     178.4,     178.4,       0.0);         ( 452100.0,
4616000.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4616000.0,     178.3,     178.3,       0.0);         ( 452300.0,
4616000.0,     178.3,     178.3,       0.0);
     ( 452400.0, 4616000.0,     178.3,     178.3,       0.0);         ( 452500.0,
4616000.0,     178.3,     178.3,       0.0);
     ( 452600.0, 4616000.0,     177.0,     177.0,       0.0);         ( 452700.0,
4616000.0,     177.0,     177.0,       0.0);
     ( 452800.0, 4616000.0,     178.0,     178.0,       0.0);         ( 452900.0,
4616000.0,     177.2,     177.2,       0.0);
     ( 453000.0, 4616000.0,     178.3,     178.3,       0.0);         ( 453100.0,
4616000.0,     178.5,     178.5,       0.0);
     ( 453200.0, 4616000.0,     178.8,     178.8,       0.0);         ( 453300.0,
4616000.0,     179.1,     179.1,       0.0);
     ( 453400.0, 4616000.0,     179.4,     179.4,       0.0);         ( 453500.0,
4616000.0,     179.7,     179.7,       0.0);
     ( 453600.0, 4616000.0,     180.0,     180.0,       0.0);         ( 453700.0,
4616000.0,     178.8,     178.8,       0.0);
     ( 453800.0, 4616000.0,     178.8,     178.8,       0.0);         ( 453900.0,
4616000.0,     178.8,     178.8,       0.0);
     ( 454000.0, 4616000.0,     175.2,     175.2,       0.0);         ( 454100.0,
4616000.0,     177.7,     177.7,       0.0);
     ( 454200.0, 4616000.0,     178.2,     178.2,       0.0);         ( 454300.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4616000.0,     178.2,     178.2,       0.0);         ( 454500.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4616000.0,     178.2,     178.2,       0.0);         ( 454700.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4616000.0,     178.2,     178.2,       0.0);         ( 454900.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4616000.0,     178.2,     178.2,       0.0);         ( 455100.0,
4616000.0,     178.2,     178.2,       0.0);
     ( 455200.0, 4616000.0,     178.2,     178.2,       0.0);         ( 455300.0,
4616000.0,     178.2,     178.2,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 141
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455400.0, 4616000.0, 178.2, 178.2, 0.0); (455500.0, 4616000.0, 178.2, 178.2, 0.0);
(455600.0, 4616000.0, 178.2, 178.2, 0.0); (455700.0, 4616000.0, 178.2, 178.2, 0.0);
(455800.0, 4616000.0, 178.2, 178.2, 0.0); (455900.0, 4616000.0, 178.2, 178.2, 0.0);
(456000.0, 4616000.0, 178.2, 178.2, 0.0); (456100.0, 4616000.0, 178.0, 178.0, 0.0);
(456200.0, 4616000.0, 178.2, 178.2, 0.0); (456300.0, 4616000.0, 178.6, 178.6, 0.0);
(456400.0, 4616000.0, 178.2, 178.2, 0.0); (456500.0, 4616000.0, 179.4, 179.4, 0.0);
(456600.0, 4616000.0, 179.8, 182.4, 0.0); (452000.0, 4616100.0, 179.4, 179.4, 0.0);
(452100.0, 4616100.0, 178.3, 178.3, 0.0); (452200.0, 4616100.0, 178.3, 178.3, 0.0);
(452300.0, 4616100.0, 178.3, 178.3, 0.0); (452400.0, 4616100.0, 177.7, 177.7, 0.0);
(452500.0, 4616100.0, 177.7, 177.7, 0.0); (452600.0, 4616100.0, 177.0, 177.0, 0.0);
(452700.0, 4616100.0, 177.6, 177.6, 0.0); (452800.0, 4616100.0, 177.9, 177.9, 0.0);
(452900.0, 4616100.0, 178.1, 178.1, 0.0); (453000.0, 4616100.0, 178.3, 178.3, 0.0);
(453100.0, 4616100.0, 178.4, 178.4, 0.0); (453200.0, 4616100.0, 178.4, 178.4, 0.0);
(453300.0, 4616100.0, 178.5, 178.5, 0.0); (453400.0, 4616100.0, 178.6, 178.6, 0.0);
(453500.0, 4616100.0, 179.7, 179.7, 0.0); (453600.0, 4616100.0, 180.2, 180.2, 0.0);
(453700.0, 4616100.0, 180.5, 180.5, 0.0); (453800.0, 4616100.0, 180.3, 180.3, 0.0);
(453900.0, 4616100.0, 180.2, 180.2, 0.0); (454000.0, 4616100.0, 175.2, 175.2, 0.0);
(454100.0, 4616100.0, 178.2, 178.2, 0.0); (454200.0, 4616100.0, 178.2, 178.2, 0.0);
(454300.0, 4616100.0, 178.3, 178.3, 0.0); (454400.0, 4616100.0, 178.2, 178.2, 0.0);
(454500.0, 4616100.0, 178.2, 178.2, 0.0); (454600.0, 4616100.0, 178.2, 178.2, 0.0);
(454700.0, 4616100.0, 178.2, 178.2, 0.0); (454800.0, 4616100.0, 178.2, 178.2, 0.0);
(454900.0, 4616100.0, 178.2, 178.2, 0.0); (455000.0, 4616100.0, 178.2, 178.2, 0.0);
(455100.0, 4616100.0, 178.2, 178.2, 0.0); (455200.0, 4616100.0, 178.2, 178.2, 0.0);
(455300.0, 4616100.0, 178.2, 178.2, 0.0); (455400.0, 4616100.0, 178.4, 178.4, 0.0);
(455500.0, 4616100.0, 178.2, 178.2, 0.0); (455600.0, 4616100.0, 178.2, 178.2, 0.0);

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     ( 455700.0, 4616100.0,     178.2,     178.2,       0.0);         ( 455800.0,
4616100.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4616100.0,     178.2,     178.2,       0.0);         ( 456000.0,
4616100.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4616100.0,     178.1,     178.1,       0.0);         ( 456200.0,
4616100.0,     178.3,     178.3,       0.0);
     ( 456300.0, 4616100.0,     178.5,     178.5,       0.0);         ( 456400.0,
4616100.0,     178.4,     178.4,       0.0);
     ( 456500.0, 4616100.0,     179.0,     179.0,       0.0);         ( 456600.0,
4616100.0,     180.7,     180.7,       0.0);
     ( 452000.0, 4616200.0,     179.6,     179.6,       0.0);         ( 452100.0,
4616200.0,     178.6,     178.6,       0.0);
     ( 452200.0, 4616200.0,     178.4,     178.4,       0.0);         ( 452300.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 452400.0, 4616200.0,     178.3,     178.3,       0.0);         ( 452500.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 452600.0, 4616200.0,     178.4,     178.4,       0.0);         ( 452700.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 452800.0, 4616200.0,     178.3,     178.3,       0.0);         ( 452900.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 453000.0, 4616200.0,     178.3,     178.3,       0.0);         ( 453100.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4616200.0,     178.3,     178.3,       0.0);         ( 453300.0,
4616200.0,     178.3,     178.3,       0.0);
     ( 453400.0, 4616200.0,     178.3,     178.3,       0.0);         ( 453500.0,
4616200.0,     179.7,     179.7,       0.0);
     ( 453600.0, 4616200.0,     180.2,     180.2,       0.0);         ( 453700.0,
4616200.0,     180.1,     180.1,       0.0);
     ( 453800.0, 4616200.0,     178.5,     178.5,       0.0);         ( 453900.0,
4616200.0,     177.6,     177.6,       0.0);
     ( 454000.0, 4616200.0,     176.1,     177.7,       0.0);         ( 454100.0,
4616200.0,     178.2,     178.2,       0.0);
     ( 454200.0, 4616200.0,     178.2,     178.2,       0.0);         ( 454300.0,
4616200.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4616200.0,     178.3,     178.3,       0.0);         ( 454500.0,
4616200.0,     178.2,     178.2,       0.0);
     ( 454600.0, 4616200.0,     178.2,     178.2,       0.0);         ( 454700.0,
4616200.0,     178.2,     178.2,       0.0);
     ( 454800.0, 4616200.0,     178.2,     178.2,       0.0);         ( 454900.0,
4616200.0,     178.2,     178.2,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 142
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(455000.0, 4616200.0, 178.2, 178.2, 0.0); (455100.0, 4616200.0, 178.2, 178.2, 0.0);
(455200.0, 4616200.0, 178.2, 178.2, 0.0); (455300.0, 4616200.0, 178.2, 178.2, 0.0);
(455400.0, 4616200.0, 178.3, 178.3, 0.0); (455500.0, 4616200.0, 178.3, 178.3, 0.0);
(455600.0, 4616200.0, 178.2, 178.2, 0.0); (455700.0, 4616200.0, 178.2, 178.2, 0.0);
(455800.0, 4616200.0, 178.2, 178.2, 0.0); (455900.0, 4616200.0, 178.2, 178.2, 0.0);
(456000.0, 4616200.0, 178.2, 178.2, 0.0); (456100.0, 4616200.0, 178.1, 178.1, 0.0);
(456200.0, 4616200.0, 178.3, 178.3, 0.0); (456300.0, 4616200.0, 178.5, 178.5, 0.0);
(456400.0, 4616200.0, 178.2, 178.2, 0.0); (456500.0, 4616200.0, 178.9, 178.9, 0.0);
(456600.0, 4616200.0, 180.6, 180.6, 0.0); (452000.0, 4616300.0, 179.4, 179.4, 0.0);
(452100.0, 4616300.0, 178.9, 178.9, 0.0); (452200.0, 4616300.0, 178.5, 178.5, 0.0);
(452300.0, 4616300.0, 178.3, 178.3, 0.0); (452400.0, 4616300.0, 178.5, 178.5, 0.0);
(452500.0, 4616300.0, 178.6, 178.6, 0.0); (452600.0, 4616300.0, 178.7, 178.7, 0.0);
(452700.0, 4616300.0, 178.5, 178.5, 0.0); (452800.0, 4616300.0, 178.5, 178.5, 0.0);
(452900.0, 4616300.0, 178.5, 178.5, 0.0); (453000.0, 4616300.0, 178.3, 178.3, 0.0);
(453100.0, 4616300.0, 178.3, 178.3, 0.0); (453200.0, 4616300.0, 178.3, 178.3, 0.0);
(453300.0, 4616300.0, 178.3, 178.3, 0.0); (453400.0, 4616300.0, 178.3, 178.3, 0.0);
(453500.0, 4616300.0, 179.8, 179.8, 0.0); (453600.0, 4616300.0, 178.5, 178.5, 0.0);
(453700.0, 4616300.0, 178.4, 178.4, 0.0); (453800.0, 4616300.0, 178.4, 178.4, 0.0);
(453900.0, 4616300.0, 178.4, 178.4, 0.0); (454000.0, 4616300.0, 176.3, 178.5, 0.0);
(454100.0, 4616300.0, 178.2, 178.2, 0.0); (454200.0, 4616300.0, 178.2, 178.2, 0.0);
(454300.0, 4616300.0, 178.2, 178.2, 0.0); (454400.0, 4616300.0, 178.4, 178.4, 0.0);
(454500.0, 4616300.0, 178.2, 178.2, 0.0); (454600.0, 4616300.0, 178.2, 178.2, 0.0);
(454700.0, 4616300.0, 178.2, 178.2, 0.0); (454800.0, 4616300.0, 178.2, 178.2, 0.0);
(454900.0, 4616300.0, 178.2, 178.2, 0.0); (455000.0, 4616300.0, 178.2, 178.2, 0.0);
(455100.0, 4616300.0, 178.2, 178.2, 0.0); (455200.0, 4616300.0, 178.2, 178.2, 0.0);

```
     ( 455300.0, 4616300.0,     178.2,     178.2,       0.0);         ( 455400.0,
4616300.0,     178.4,     178.4,       0.0);
     ( 455500.0, 4616300.0,     178.5,     178.5,       0.0);         ( 455600.0,
4616300.0,     178.3,     178.3,       0.0);
     ( 455700.0, 4616300.0,     178.2,     178.2,       0.0);         ( 455800.0,
4616300.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4616300.0,     178.2,     178.2,       0.0);         ( 456000.0,
4616300.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4616300.0,     178.3,     178.3,       0.0);         ( 456200.0,
4616300.0,     178.3,     178.3,       0.0);
     ( 456300.0, 4616300.0,     178.4,     178.4,       0.0);         ( 456400.0,
4616300.0,     178.2,     178.2,       0.0);
     ( 456500.0, 4616300.0,     179.5,     179.5,       0.0);         ( 456600.0,
4616300.0,     178.6,     183.1,       0.0);
     ( 452000.0, 4616400.0,     179.2,     179.2,       0.0);         ( 452100.0,
4616400.0,     178.9,     178.9,       0.0);
     ( 452200.0, 4616400.0,     178.5,     178.5,       0.0);         ( 452300.0,
4616400.0,     178.3,     178.3,       0.0);
     ( 452400.0, 4616400.0,     178.6,     178.6,       0.0);         ( 452500.0,
4616400.0,     178.8,     178.8,       0.0);
     ( 452600.0, 4616400.0,     178.8,     178.8,       0.0);         ( 452700.0,
4616400.0,     178.9,     178.9,       0.0);
     ( 452800.0, 4616400.0,     178.9,     178.9,       0.0);         ( 452900.0,
4616400.0,     178.6,     178.6,       0.0);
     ( 453000.0, 4616400.0,     178.3,     178.3,       0.0);         ( 453100.0,
4616400.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4616400.0,     178.5,     178.5,       0.0);         ( 453300.0,
4616400.0,     178.8,     178.8,       0.0);
     ( 453400.0, 4616400.0,     179.2,     179.2,       0.0);         ( 453500.0,
4616400.0,     179.8,     179.8,       0.0);
     ( 453600.0, 4616400.0,     179.9,     179.9,       0.0);         ( 453700.0,
4616400.0,     179.5,     179.5,       0.0);
     ( 453800.0, 4616400.0,     179.4,     179.4,       0.0);         ( 453900.0,
4616400.0,     179.2,     179.2,       0.0);
     ( 454000.0, 4616400.0,     175.2,     175.2,       0.0);         ( 454100.0,
4616400.0,     178.2,     178.2,       0.0);
     ( 454200.0, 4616400.0,     178.2,     178.2,       0.0);         ( 454300.0,
4616400.0,     178.2,     178.2,       0.0);
     ( 454400.0, 4616400.0,     178.5,     178.5,       0.0);         ( 454500.0,
4616400.0,     178.4,     178.4,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 143
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454600.0, 4616400.0, 178.2, 178.2, 0.0); (454700.0, 4616400.0, 178.2, 178.2, 0.0);
(454800.0, 4616400.0, 178.2, 178.2, 0.0); (454900.0, 4616400.0, 178.2, 178.2, 0.0);
(455000.0, 4616400.0, 178.2, 178.2, 0.0); (455100.0, 4616400.0, 178.2, 178.2, 0.0);
(455200.0, 4616400.0, 178.2, 178.2, 0.0); (455300.0, 4616400.0, 178.2, 178.2, 0.0);
(455400.0, 4616400.0, 178.4, 178.4, 0.0); (455500.0, 4616400.0, 178.6, 178.6, 0.0);
(455600.0, 4616400.0, 178.6, 178.6, 0.0); (455700.0, 4616400.0, 178.3, 178.3, 0.0);
(455800.0, 4616400.0, 178.2, 178.2, 0.0); (455900.0, 4616400.0, 178.2, 178.2, 0.0);
(456000.0, 4616400.0, 178.2, 178.2, 0.0); (456100.0, 4616400.0, 178.5, 178.5, 0.0);
(456200.0, 4616400.0, 178.3, 178.3, 0.0); (456300.0, 4616400.0, 178.4, 178.4, 0.0);
(456400.0, 4616400.0, 178.6, 178.6, 0.0); (456500.0, 4616400.0, 180.0, 180.0, 0.0);
(456600.0, 4616400.0, 179.9, 183.7, 0.0); (452000.0, 4616500.0, 178.6, 178.6, 0.0);
(452100.0, 4616500.0, 178.8, 178.8, 0.0); (452200.0, 4616500.0, 178.4, 178.4, 0.0);
(452300.0, 4616500.0, 178.4, 178.4, 0.0); (452400.0, 4616500.0, 178.6, 178.6, 0.0);
(452500.0, 4616500.0, 179.0, 179.0, 0.0); (452600.0, 4616500.0, 179.0, 179.0, 0.0);
(452700.0, 4616500.0, 179.2, 179.2, 0.0); (452800.0, 4616500.0, 179.3, 179.3, 0.0);
(452900.0, 4616500.0, 179.1, 179.1, 0.0); (453000.0, 4616500.0, 178.5, 178.5, 0.0);
(453100.0, 4616500.0, 178.3, 178.3, 0.0); (453200.0, 4616500.0, 178.5, 178.5, 0.0);
(453300.0, 4616500.0, 178.9, 178.9, 0.0); (453400.0, 4616500.0, 179.3, 179.3, 0.0);
(453500.0, 4616500.0, 179.8, 179.8, 0.0); (453600.0, 4616500.0, 180.1, 180.1, 0.0);
(453700.0, 4616500.0, 180.2, 180.2, 0.0); (453800.0, 4616500.0, 180.1, 180.1, 0.0);
(453900.0, 4616500.0, 180.2, 180.2, 0.0); (454000.0, 4616500.0, 178.8, 179.8, 0.0);
(454100.0, 4616500.0, 176.0, 176.0, 0.0); (454200.0, 4616500.0, 178.2, 178.2, 0.0);
(454300.0, 4616500.0, 178.2, 178.2, 0.0); (454400.0, 4616500.0, 178.5, 178.5, 0.0);
(454500.0, 4616500.0, 178.5, 178.5, 0.0); (454600.0, 4616500.0, 178.2, 178.2, 0.0);
(454700.0, 4616500.0, 178.2, 178.2, 0.0); (454800.0, 4616500.0, 178.2, 178.2, 0.0);

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     ( 454900.0, 4616500.0,     178.2,     178.2,       0.0);         ( 455000.0,
4616500.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4616500.0,     178.2,     178.2,       0.0);         ( 455200.0,
4616500.0,     178.4,     178.4,       0.0);
     ( 455300.0, 4616500.0,     178.3,     178.3,       0.0);         ( 455400.0,
4616500.0,     178.5,     178.5,       0.0);
     ( 455500.0, 4616500.0,     178.8,     178.8,       0.0);         ( 455600.0,
4616500.0,     178.8,     178.8,       0.0);
     ( 455700.0, 4616500.0,     178.5,     178.5,       0.0);         ( 455800.0,
4616500.0,     178.2,     178.2,       0.0);
     ( 455900.0, 4616500.0,     178.2,     178.2,       0.0);         ( 456000.0,
4616500.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4616500.0,     178.3,     178.3,       0.0);         ( 456200.0,
4616500.0,     178.2,     178.2,       0.0);
     ( 456300.0, 4616500.0,     178.1,     178.1,       0.0);         ( 456400.0,
4616500.0,     178.0,     178.0,       0.0);
     ( 456500.0, 4616500.0,     180.5,     183.1,       0.0);         ( 456600.0,
4616500.0,     179.3,     183.6,       0.0);
     ( 452000.0, 4616600.0,     178.2,     178.2,       0.0);         ( 452100.0,
4616600.0,     178.7,     178.7,       0.0);
     ( 452200.0, 4616600.0,     178.3,     178.3,       0.0);         ( 452300.0,
4616600.0,     178.4,     178.4,       0.0);
     ( 452400.0, 4616600.0,     178.7,     178.7,       0.0);         ( 452500.0,
4616600.0,     179.0,     179.0,       0.0);
     ( 452600.0, 4616600.0,     179.2,     179.2,       0.0);         ( 452700.0,
4616600.0,     179.4,     179.4,       0.0);
     ( 452800.0, 4616600.0,     179.6,     179.6,       0.0);         ( 452900.0,
4616600.0,     179.6,     179.6,       0.0);
     ( 453000.0, 4616600.0,     178.8,     178.8,       0.0);         ( 453100.0,
4616600.0,     178.3,     178.3,       0.0);
     ( 453200.0, 4616600.0,     178.5,     178.5,       0.0);         ( 453300.0,
4616600.0,     178.8,     178.8,       0.0);
     ( 453400.0, 4616600.0,     179.3,     179.3,       0.0);         ( 453500.0,
4616600.0,     179.8,     179.8,       0.0);
     ( 453600.0, 4616600.0,     180.0,     180.0,       0.0);         ( 453700.0,
4616600.0,     180.3,     180.3,       0.0);
     ( 453800.0, 4616600.0,     180.0,     180.0,       0.0);         ( 453900.0,
4616600.0,     178.5,     178.5,       0.0);
     ( 454000.0, 4616600.0,     178.3,     178.3,       0.0);         ( 454100.0,
4616600.0,     175.5,     175.5,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(454200.0, 4616600.0, 175.2, 175.2, 0.0); (454300.0, 4616600.0, 178.1, 178.1, 0.0);
(454400.0, 4616600.0, 178.2, 178.2, 0.0); (454500.0, 4616600.0, 178.6, 178.6, 0.0);
(454600.0, 4616600.0, 178.4, 178.4, 0.0); (454700.0, 4616600.0, 178.2, 178.2, 0.0);
(454800.0, 4616600.0, 178.2, 178.2, 0.0); (454900.0, 4616600.0, 178.2, 178.2, 0.0);
(455000.0, 4616600.0, 178.2, 178.2, 0.0); (455100.0, 4616600.0, 178.2, 178.2, 0.0);
(455200.0, 4616600.0, 178.3, 178.3, 0.0); (455300.0, 4616600.0, 178.6, 178.6, 0.0);
(455400.0, 4616600.0, 178.7, 178.7, 0.0); (455500.0, 4616600.0, 178.8, 178.8, 0.0);
(455600.0, 4616600.0, 179.0, 179.0, 0.0); (455700.0, 4616600.0, 178.7, 178.7, 0.0);
(455800.0, 4616600.0, 178.5, 178.5, 0.0); (455900.0, 4616600.0, 178.4, 178.4, 0.0);
(456000.0, 4616600.0, 178.2, 178.2, 0.0); (456100.0, 4616600.0, 178.3, 178.3, 0.0);
(456200.0, 4616600.0, 178.4, 178.4, 0.0); (456300.0, 4616600.0, 178.3, 178.3, 0.0);
(456400.0, 4616600.0, 178.0, 178.0, 0.0); (456500.0, 4616600.0, 180.6, 184.7, 0.0);
(456600.0, 4616600.0, 178.2, 184.9, 0.0); (452000.0, 4616700.0, 179.0, 179.0, 0.0);
(452100.0, 4616700.0, 178.7, 178.7, 0.0); (452200.0, 4616700.0, 178.3, 178.3, 0.0);
(452300.0, 4616700.0, 178.5, 178.5, 0.0); (452400.0, 4616700.0, 178.8, 178.8, 0.0);
(452500.0, 4616700.0, 179.0, 179.0, 0.0); (452600.0, 4616700.0, 179.3, 179.3, 0.0);
(452700.0, 4616700.0, 179.5, 179.5, 0.0); (452800.0, 4616700.0, 179.7, 179.7, 0.0);
(452900.0, 4616700.0, 179.4, 179.4, 0.0); (453000.0, 4616700.0, 178.8, 178.8, 0.0);
(453100.0, 4616700.0, 178.3, 178.3, 0.0); (453200.0, 4616700.0, 178.4, 178.4, 0.0);
(453300.0, 4616700.0, 178.6, 178.6, 0.0); (453400.0, 4616700.0, 179.1, 179.1, 0.0);
(453500.0, 4616700.0, 179.6, 179.6, 0.0); (453600.0, 4616700.0, 179.9, 179.9, 0.0);
(453700.0, 4616700.0, 180.3, 180.3, 0.0); (453800.0, 4616700.0, 180.0, 180.0, 0.0);
(453900.0, 4616700.0, 178.2, 178.2, 0.0); (454000.0, 4616700.0, 178.2, 178.2, 0.0);
(454100.0, 4616700.0, 178.3, 178.3, 0.0); (454200.0, 4616700.0, 178.7, 178.7, 0.0);
(454300.0, 4616700.0, 175.6, 175.6, 0.0); (454400.0, 4616700.0, 175.2, 175.2, 0.0);

```
     ( 454500.0, 4616700.0,     178.3,     178.3,       0.0);         ( 454600.0,
4616700.0,     178.5,     178.5,       0.0);
     ( 454700.0, 4616700.0,     178.3,     178.3,       0.0);         ( 454800.0,
4616700.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4616700.0,     178.4,     178.4,       0.0);         ( 455000.0,
4616700.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4616700.0,     178.2,     178.2,       0.0);         ( 455200.0,
4616700.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4616700.0,     178.7,     178.7,       0.0);         ( 455400.0,
4616700.0,     178.8,     178.8,       0.0);
     ( 455500.0, 4616700.0,     179.0,     179.0,       0.0);         ( 455600.0,
4616700.0,     179.2,     179.2,       0.0);
     ( 455700.0, 4616700.0,     178.9,     178.9,       0.0);         ( 455800.0,
4616700.0,     178.7,     178.7,       0.0);
     ( 455900.0, 4616700.0,     178.3,     178.3,       0.0);         ( 456000.0,
4616700.0,     178.2,     178.2,       0.0);
     ( 456100.0, 4616700.0,     178.2,     178.2,       0.0);         ( 456200.0,
4616700.0,     178.4,     178.4,       0.0);
     ( 456300.0, 4616700.0,     178.2,     178.2,       0.0);         ( 456400.0,
4616700.0,     177.9,     177.9,       0.0);
     ( 456500.0, 4616700.0,     178.4,     178.4,       0.0);         ( 456600.0,
4616700.0,     178.7,     178.7,       0.0);
     ( 452000.0, 4616800.0,     179.1,     179.1,       0.0);         ( 452100.0,
4616800.0,     178.6,     178.6,       0.0);
     ( 452200.0, 4616800.0,     178.3,     178.3,       0.0);         ( 452300.0,
4616800.0,     178.6,     178.6,       0.0);
     ( 452400.0, 4616800.0,     178.9,     178.9,       0.0);         ( 452500.0,
4616800.0,     179.2,     179.2,       0.0);
     ( 452600.0, 4616800.0,     179.4,     179.4,       0.0);         ( 452700.0,
4616800.0,     179.7,     179.7,       0.0);
     ( 452800.0, 4616800.0,     179.6,     179.6,       0.0);         ( 452900.0,
4616800.0,     179.3,     179.3,       0.0);
     ( 453000.0, 4616800.0,     178.8,     178.8,       0.0);         ( 453100.0,
4616800.0,     178.6,     178.6,       0.0);
     ( 453200.0, 4616800.0,     178.3,     178.3,       0.0);         ( 453300.0,
4616800.0,     178.5,     178.5,       0.0);
     ( 453400.0, 4616800.0,     178.9,     178.9,       0.0);         ( 453500.0,
4616800.0,     179.4,     179.4,       0.0);
     ( 453600.0, 4616800.0,     179.8,     179.8,       0.0);         ( 453700.0,
4616800.0,     180.1,     180.1,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 145
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453800.0, 4616800.0, 179.0, 179.0, 0.0); (453900.0, 4616800.0, 178.3, 178.3, 0.0);
(454000.0, 4616800.0, 178.2, 178.2, 0.0); (454100.0, 4616800.0, 178.2, 178.2, 0.0);
(454200.0, 4616800.0, 178.2, 178.2, 0.0); (454300.0, 4616800.0, 178.2, 178.2, 0.0);
(454400.0, 4616800.0, 179.1, 179.1, 0.0); (454500.0, 4616800.0, 175.2, 178.5, 0.0);
(454600.0, 4616800.0, 179.0, 179.0, 0.0); (454700.0, 4616800.0, 179.1, 179.1, 0.0);
(454800.0, 4616800.0, 178.2, 178.2, 0.0); (454900.0, 4616800.0, 178.4, 178.4, 0.0);
(455000.0, 4616800.0, 178.4, 178.4, 0.0); (455100.0, 4616800.0, 178.2, 178.2, 0.0);
(455200.0, 4616800.0, 178.2, 178.2, 0.0); (455300.0, 4616800.0, 178.5, 178.5, 0.0);
(455400.0, 4616800.0, 178.9, 178.9, 0.0); (455500.0, 4616800.0, 179.1, 179.1, 0.0);
(455600.0, 4616800.0, 179.3, 179.3, 0.0); (455700.0, 4616800.0, 179.1, 179.1, 0.0);
(455800.0, 4616800.0, 179.0, 179.0, 0.0); (455900.0, 4616800.0, 178.5, 178.5, 0.0);
(456000.0, 4616800.0, 178.2, 178.2, 0.0); (456100.0, 4616800.0, 178.3, 178.3, 0.0);
(456200.0, 4616800.0, 178.6, 178.6, 0.0); (456300.0, 4616800.0, 178.4, 178.4, 0.0);
(456400.0, 4616800.0, 178.1, 178.1, 0.0); (456500.0, 4616800.0, 178.7, 178.7, 0.0);
(456600.0, 4616800.0, 178.9, 178.9, 0.0); (452000.0, 4616900.0, 178.9, 178.9, 0.0);
(452100.0, 4616900.0, 178.4, 178.4, 0.0); (452200.0, 4616900.0, 178.3, 178.3, 0.0);
(452300.0, 4616900.0, 178.7, 178.7, 0.0); (452400.0, 4616900.0, 179.0, 179.0, 0.0);
(452500.0, 4616900.0, 179.3, 179.3, 0.0); (452600.0, 4616900.0, 179.6, 179.6, 0.0);
(452700.0, 4616900.0, 179.7, 179.7, 0.0); (452800.0, 4616900.0, 179.5, 179.5, 0.0);
(452900.0, 4616900.0, 179.2, 179.2, 0.0); (453000.0, 4616900.0, 179.1, 179.1, 0.0);
(453100.0, 4616900.0, 178.7, 178.7, 0.0); (453200.0, 4616900.0, 178.3, 178.3, 0.0);
(453300.0, 4616900.0, 178.3, 178.3, 0.0); (453400.0, 4616900.0, 178.7, 178.7, 0.0);
(453500.0, 4616900.0, 178.8, 178.8, 0.0); (453600.0, 4616900.0, 179.3, 179.3, 0.0);
(453700.0, 4616900.0, 178.2, 178.2, 0.0); (453800.0, 4616900.0, 178.2, 178.2, 0.0);
(453900.0, 4616900.0, 178.2, 178.2, 0.0); (454000.0, 4616900.0, 178.2, 178.2, 0.0);

```
     ( 454100.0, 4616900.0,     178.2,     178.2,       0.0);         ( 454200.0,
4616900.0,     178.2,     178.2,       0.0);
     ( 454300.0, 4616900.0,     178.2,     178.2,       0.0);         ( 454400.0,
4616900.0,     178.4,     178.4,       0.0);
     ( 454500.0, 4616900.0,     180.8,     182.2,       0.0);         ( 454600.0,
4616900.0,     176.3,     182.2,       0.0);
     ( 454700.0, 4616900.0,     179.5,     179.5,       0.0);         ( 454800.0,
4616900.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4616900.0,     178.2,     178.2,       0.0);         ( 455000.0,
4616900.0,     178.3,     178.3,       0.0);
     ( 455100.0, 4616900.0,     178.2,     178.2,       0.0);         ( 455200.0,
4616900.0,     178.2,     178.2,       0.0);
     ( 455300.0, 4616900.0,     178.6,     178.6,       0.0);         ( 455400.0,
4616900.0,     178.8,     178.8,       0.0);
     ( 455500.0, 4616900.0,     179.2,     179.2,       0.0);         ( 455600.0,
4616900.0,     179.4,     179.4,       0.0);
     ( 455700.0, 4616900.0,     179.2,     179.2,       0.0);         ( 455800.0,
4616900.0,     179.1,     179.1,       0.0);
     ( 455900.0, 4616900.0,     178.5,     178.5,       0.0);         ( 456000.0,
4616900.0,     178.3,     178.3,       0.0);
     ( 456100.0, 4616900.0,     178.9,     178.9,       0.0);         ( 456200.0,
4616900.0,     179.3,     179.3,       0.0);
     ( 456300.0, 4616900.0,     179.3,     179.3,       0.0);         ( 456400.0,
4616900.0,     179.1,     179.1,       0.0);
     ( 456500.0, 4616900.0,     179.3,     179.3,       0.0);         ( 456600.0,
4616900.0,     178.7,     178.7,       0.0);
     ( 452000.0, 4617000.0,     178.3,     178.3,       0.0);         ( 452100.0,
4617000.0,     178.3,     178.3,       0.0);
     ( 452200.0, 4617000.0,     178.6,     178.6,       0.0);         ( 452300.0,
4617000.0,     178.9,     178.9,       0.0);
     ( 452400.0, 4617000.0,     179.2,     179.2,       0.0);         ( 452500.0,
4617000.0,     179.5,     179.5,       0.0);
     ( 452600.0, 4617000.0,     179.7,     179.7,       0.0);         ( 452700.0,
4617000.0,     179.6,     179.6,       0.0);
     ( 452800.0, 4617000.0,     179.4,     179.4,       0.0);         ( 452900.0,
4617000.0,     179.3,     179.3,       0.0);
     ( 453000.0, 4617000.0,     179.0,     179.0,       0.0);         ( 453100.0,
4617000.0,     178.6,     178.6,       0.0);
     ( 453200.0, 4617000.0,     178.4,     178.4,       0.0);         ( 453300.0,
4617000.0,     178.3,     178.3,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 146
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453400.0, 4617000.0, 178.6, 178.6, 0.0); (453500.0, 4617000.0, 178.2, 178.2, 0.0);
(453600.0, 4617000.0, 178.9, 178.9, 0.0); (453700.0, 4617000.0, 179.1, 179.1, 0.0);
(453800.0, 4617000.0, 178.5, 178.5, 0.0); (453900.0, 4617000.0, 178.2, 178.2, 0.0);
(454000.0, 4617000.0, 178.2, 178.2, 0.0); (454100.0, 4617000.0, 178.2, 178.2, 0.0);
(454200.0, 4617000.0, 178.2, 178.2, 0.0); (454300.0, 4617000.0, 178.7, 178.7, 0.0);
(454400.0, 4617000.0, 179.7, 179.7, 0.0); (454500.0, 4617000.0, 178.6, 178.6, 0.0);
(454600.0, 4617000.0, 175.2, 175.2, 0.0); (454700.0, 4617000.0, 178.6, 178.6, 0.0);
(454800.0, 4617000.0, 178.2, 178.2, 0.0); (454900.0, 4617000.0, 178.2, 178.2, 0.0);
(455000.0, 4617000.0, 178.2, 178.2, 0.0); (455100.0, 4617000.0, 178.4, 178.4, 0.0);
(455200.0, 4617000.0, 178.7, 178.7, 0.0); (455300.0, 4617000.0, 178.7, 178.7, 0.0);
(455400.0, 4617000.0, 178.8, 178.8, 0.0); (455500.0, 4617000.0, 179.1, 179.1, 0.0);
(455600.0, 4617000.0, 179.4, 179.4, 0.0); (455700.0, 4617000.0, 179.3, 179.3, 0.0);
(455800.0, 4617000.0, 179.1, 179.1, 0.0); (455900.0, 4617000.0, 178.7, 178.7, 0.0);
(456000.0, 4617000.0, 178.3, 178.3, 0.0); (456100.0, 4617000.0, 178.6, 178.6, 0.0);
(456200.0, 4617000.0, 178.7, 178.7, 0.0); (456300.0, 4617000.0, 179.5, 186.7, 0.0);
(456400.0, 4617000.0, 179.5, 179.5, 0.0); (456500.0, 4617000.0, 179.6, 179.6, 0.0);
(456600.0, 4617000.0, 179.1, 179.1, 0.0); (452000.0, 4617100.0, 178.9, 178.9, 0.0);
(452100.0, 4617100.0, 178.6, 178.6, 0.0); (452200.0, 4617100.0, 179.0, 179.0, 0.0);
(452300.0, 4617100.0, 179.1, 179.1, 0.0); (452400.0, 4617100.0, 179.4, 179.4, 0.0);
(452500.0, 4617100.0, 179.7, 179.7, 0.0); (452600.0, 4617100.0, 179.7, 179.7, 0.0);
(452700.0, 4617100.0, 179.5, 179.5, 0.0); (452800.0, 4617100.0, 179.4, 179.4, 0.0);
(452900.0, 4617100.0, 179.2, 179.2, 0.0); (453000.0, 4617100.0, 178.8, 178.8, 0.0);
(453100.0, 4617100.0, 178.6, 178.6, 0.0); (453200.0, 4617100.0, 178.5, 178.5, 0.0);
(453300.0, 4617100.0, 178.3, 178.3, 0.0); (453400.0, 4617100.0, 178.5, 178.5, 0.0);
(453500.0, 4617100.0, 178.2, 178.2, 0.0); (453600.0, 4617100.0, 178.5, 178.5, 0.0);

```
     ( 453700.0, 4617100.0,     178.9,     178.9,       0.0);         ( 453800.0,
4617100.0,     178.7,     178.7,       0.0);
     ( 453900.0, 4617100.0,     178.5,     178.5,       0.0);         ( 454000.0,
4617100.0,     178.2,     178.2,       0.0);
     ( 454100.0, 4617100.0,     178.2,     178.2,       0.0);         ( 454200.0,
4617100.0,     178.4,     178.4,       0.0);
     ( 454300.0, 4617100.0,     179.0,     179.0,       0.0);         ( 454400.0,
4617100.0,     179.1,     179.1,       0.0);
     ( 454500.0, 4617100.0,     178.3,     178.3,       0.0);         ( 454600.0,
4617100.0,     175.2,     175.2,       0.0);
     ( 454700.0, 4617100.0,     178.2,     178.2,       0.0);         ( 454800.0,
4617100.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4617100.0,     178.2,     178.2,       0.0);         ( 455000.0,
4617100.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4617100.0,     178.4,     178.4,       0.0);         ( 455200.0,
4617100.0,     178.8,     178.8,       0.0);
     ( 455300.0, 4617100.0,     179.0,     179.0,       0.0);         ( 455400.0,
4617100.0,     179.2,     179.2,       0.0);
     ( 455500.0, 4617100.0,     179.3,     179.3,       0.0);         ( 455600.0,
4617100.0,     179.4,     179.4,       0.0);
     ( 455700.0, 4617100.0,     179.4,     179.4,       0.0);         ( 455800.0,
4617100.0,     179.1,     179.1,       0.0);
     ( 455900.0, 4617100.0,     179.0,     179.0,       0.0);         ( 456000.0,
4617100.0,     178.4,     178.4,       0.0);
     ( 456100.0, 4617100.0,     178.6,     178.6,       0.0);         ( 456200.0,
4617100.0,     178.7,     187.1,       0.0);
     ( 456300.0, 4617100.0,     181.1,     187.1,       0.0);         ( 456400.0,
4617100.0,     179.2,     179.2,       0.0);
     ( 456500.0, 4617100.0,     179.6,     179.6,       0.0);         ( 456600.0,
4617100.0,     180.1,     180.1,       0.0);
     ( 452000.0, 4617200.0,     179.3,     179.3,       0.0);         ( 452100.0,
4617200.0,     179.1,     179.1,       0.0);
     ( 452200.0, 4617200.0,     179.3,     179.3,       0.0);         ( 452300.0,
4617200.0,     179.4,     179.4,       0.0);
     ( 452400.0, 4617200.0,     179.6,     179.6,       0.0);         ( 452500.0,
4617200.0,     179.7,     179.7,       0.0);
     ( 452600.0, 4617200.0,     179.6,     179.6,       0.0);         ( 452700.0,
4617200.0,     179.6,     179.6,       0.0);
     ( 452800.0, 4617200.0,     179.4,     179.4,       0.0);         ( 452900.0,
4617200.0,     179.1,     179.1,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 147
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(453000.0, 4617200.0, 179.0, 179.0, 0.0); (453100.0, 4617200.0, 178.7, 178.7, 0.0);
(453200.0, 4617200.0, 178.4, 178.4, 0.0); (453300.0, 4617200.0, 178.4, 178.4, 0.0);
(453400.0, 4617200.0, 178.8, 178.8, 0.0); (453500.0, 4617200.0, 178.2, 178.2, 0.0);
(453600.0, 4617200.0, 178.4, 178.4, 0.0); (453700.0, 4617200.0, 178.7, 178.7, 0.0);
(453800.0, 4617200.0, 178.7, 178.7, 0.0); (453900.0, 4617200.0, 178.4, 178.4, 0.0);
(454000.0, 4617200.0, 176.9, 176.9, 0.0); (454100.0, 4617200.0, 176.8, 176.8, 0.0);
(454200.0, 4617200.0, 176.9, 176.9, 0.0); (454300.0, 4617200.0, 177.0, 177.0, 0.0);
(454400.0, 4617200.0, 177.1, 177.1, 0.0); (454500.0, 4617200.0, 176.8, 176.8, 0.0);
(454600.0, 4617200.0, 175.2, 175.2, 0.0); (454700.0, 4617200.0, 178.2, 178.2, 0.0);
(454800.0, 4617200.0, 178.2, 178.2, 0.0); (454900.0, 4617200.0, 178.2, 178.2, 0.0);
(455000.0, 4617200.0, 178.2, 178.2, 0.0); (455100.0, 4617200.0, 178.2, 178.2, 0.0);
(455200.0, 4617200.0, 178.8, 178.8, 0.0); (455300.0, 4617200.0, 179.2, 179.2, 0.0);
(455400.0, 4617200.0, 179.3, 179.3, 0.0); (455500.0, 4617200.0, 179.6, 179.6, 0.0);
(455600.0, 4617200.0, 179.6, 179.6, 0.0); (455700.0, 4617200.0, 179.5, 179.5, 0.0);
(455800.0, 4617200.0, 179.4, 179.4, 0.0); (455900.0, 4617200.0, 179.1, 179.1, 0.0);
(456000.0, 4617200.0, 178.5, 178.5, 0.0); (456100.0, 4617200.0, 178.7, 186.3, 0.0);
(456200.0, 4617200.0, 184.8, 186.5, 0.0); (456300.0, 4617200.0, 180.5, 180.5, 0.0);
(456400.0, 4617200.0, 179.5, 179.5, 0.0); (456500.0, 4617200.0, 180.7, 180.7, 0.0);
(456600.0, 4617200.0, 179.3, 179.3, 0.0); (452000.0, 4617300.0, 180.4, 180.4, 0.0);
(452100.0, 4617300.0, 180.2, 180.2, 0.0); (452200.0, 4617300.0, 179.7, 179.7, 0.0);
(452300.0, 4617300.0, 179.6, 179.6, 0.0); (452400.0, 4617300.0, 179.7, 179.7, 0.0);
(452500.0, 4617300.0, 179.9, 179.9, 0.0); (452600.0, 4617300.0, 180.0, 180.0, 0.0);
(452700.0, 4617300.0, 179.6, 179.6, 0.0); (452800.0, 4617300.0, 179.5, 179.5, 0.0);
(452900.0, 4617300.0, 179.2, 179.2, 0.0); (453000.0, 4617300.0, 178.8, 178.8, 0.0);
(453100.0, 4617300.0, 178.5, 178.5, 0.0); (453200.0, 4617300.0, 178.3, 178.3, 0.0);

```
     ( 453300.0, 4617300.0,     178.4,     178.4,       0.0);         ( 453400.0,
4617300.0,     179.3,     179.3,       0.0);
     ( 453500.0, 4617300.0,     178.8,     178.8,       0.0);         ( 453600.0,
4617300.0,     178.6,     178.6,       0.0);
     ( 453700.0, 4617300.0,     178.6,     178.6,       0.0);         ( 453800.0,
4617300.0,     178.3,     178.3,       0.0);
     ( 453900.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454000.0,
4617300.0,     178.3,     178.3,       0.0);
     ( 454100.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454200.0,
4617300.0,     178.2,     178.2,       0.0);
     ( 454300.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454400.0,
4617300.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454600.0,
4617300.0,     175.2,     175.2,       0.0);
     ( 454700.0, 4617300.0,     178.2,     178.2,       0.0);         ( 454800.0,
4617300.0,     178.2,     178.2,       0.0);
     ( 454900.0, 4617300.0,     178.2,     178.2,       0.0);         ( 455000.0,
4617300.0,     178.2,     178.2,       0.0);
     ( 455100.0, 4617300.0,     178.2,     178.2,       0.0);         ( 455200.0,
4617300.0,     178.4,     178.4,       0.0);
     ( 455300.0, 4617300.0,     178.9,     178.9,       0.0);         ( 455400.0,
4617300.0,     179.2,     179.2,       0.0);
     ( 455500.0, 4617300.0,     179.5,     179.5,       0.0);         ( 455600.0,
4617300.0,     179.7,     179.7,       0.0);
     ( 455700.0, 4617300.0,     179.7,     179.7,       0.0);         ( 455800.0,
4617300.0,     179.6,     179.6,       0.0);
     ( 455900.0, 4617300.0,     179.4,     179.4,       0.0);         ( 456000.0,
4617300.0,     178.8,     178.8,       0.0);
     ( 456100.0, 4617300.0,     182.1,     182.1,       0.0);         ( 456200.0,
4617300.0,     179.9,     179.9,       0.0);
     ( 456300.0, 4617300.0,     179.8,     179.8,       0.0);         ( 456400.0,
4617300.0,     180.8,     180.8,       0.0);
     ( 456500.0, 4617300.0,     179.4,     179.4,       0.0);         ( 456600.0,
4617300.0,     178.4,     178.4,       0.0);
     ( 449000.0, 4609000.0,     183.4,     183.4,       0.0);         ( 449500.0,
4609000.0,     184.0,     184.0,       0.0);
     ( 450000.0, 4609000.0,     184.3,     184.3,       0.0);         ( 450500.0,
4609000.0,     182.9,     182.9,       0.0);
     ( 451000.0, 4609000.0,     180.3,     180.3,       0.0);         ( 451500.0,
4609000.0,     179.6,     179.6,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 148
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452000.0, 4609000.0, 179.2, 179.2, 0.0); (452500.0, 4609000.0, 179.0, 179.0, 0.0);
(453000.0, 4609000.0, 178.4, 178.4, 0.0); (453500.0, 4609000.0, 178.2, 178.2, 0.0);
(454000.0, 4609000.0, 178.2, 178.2, 0.0); (454500.0, 4609000.0, 178.3, 178.3, 0.0);
(455000.0, 4609000.0, 178.9, 178.9, 0.0); (455500.0, 4609000.0, 178.6, 178.6, 0.0);
(456000.0, 4609000.0, 178.1, 178.1, 0.0); (456500.0, 4609000.0, 178.9, 178.9, 0.0);
(457000.0, 4609000.0, 179.3, 179.3, 0.0); (457500.0, 4609000.0, 178.7, 178.7, 0.0);
(458000.0, 4609000.0, 178.4, 178.4, 0.0); (458500.0, 4609000.0, 178.5, 178.5, 0.0);
(459000.0, 4609000.0, 178.7, 178.7, 0.0); (459500.0, 4609000.0, 178.0, 178.0, 0.0);
(460000.0, 4609000.0, 178.5, 178.5, 0.0); (449000.0, 4609500.0, 182.8, 182.8, 0.0);
(449500.0, 4609500.0, 184.0, 184.0, 0.0); (450000.0, 4609500.0, 182.4, 182.4, 0.0);
(450500.0, 4609500.0, 179.4, 179.4, 0.0); (451000.0, 4609500.0, 179.1, 179.1, 0.0);
(451500.0, 4609500.0, 178.5, 178.5, 0.0); (452000.0, 4609500.0, 179.6, 179.6, 0.0);
(452500.0, 4609500.0, 178.2, 178.2, 0.0); (453000.0, 4609500.0, 178.2, 178.2, 0.0);
(453500.0, 4609500.0, 180.9, 180.9, 0.0); (454000.0, 4609500.0, 178.2, 178.2, 0.0);
(454500.0, 4609500.0, 178.4, 178.4, 0.0); (455000.0, 4609500.0, 178.2, 178.2, 0.0);
(455500.0, 4609500.0, 178.2, 178.2, 0.0); (456000.0, 4609500.0, 178.4, 178.4, 0.0);
(456500.0, 4609500.0, 179.0, 179.0, 0.0); (457000.0, 4609500.0, 178.9, 178.9, 0.0);
(457500.0, 4609500.0, 178.3, 178.3, 0.0); (458000.0, 4609500.0, 179.4, 179.4, 0.0);
(458500.0, 4609500.0, 179.4, 179.4, 0.0); (459000.0, 4609500.0, 179.0, 179.0, 0.0);
(459500.0, 4609500.0, 178.2, 178.2, 0.0); (460000.0, 4609500.0, 178.5, 178.5, 0.0);
(449000.0, 4610000.0, 183.1, 183.1, 0.0); (449500.0, 4610000.0, 182.0, 182.0, 0.0);
(450000.0, 4610000.0, 180.2, 180.2, 0.0); (450500.0, 4610000.0, 179.6, 179.6, 0.0);
(451000.0, 4610000.0, 179.0, 179.0, 0.0); (451500.0, 4610000.0, 179.3, 179.3, 0.0);
(452000.0, 4610000.0, 177.0, 177.0, 0.0); (452500.0, 4610000.0, 180.6, 221.9, 0.0);
(453000.0, 4610000.0, 177.0, 221.9, 0.0); (453500.0, 4610000.0, 178.7, 178.7, 0.0);

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     ( 454000.0, 4610000.0,     178.2,     178.2,       0.0);         ( 454500.0,
4610000.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4610000.0,     178.4,     178.4,       0.0);         ( 455500.0,
4610000.0,     178.2,     178.2,       0.0);
     ( 456000.0, 4610000.0,     178.5,     178.5,       0.0);         ( 456500.0,
4610000.0,     178.5,     178.5,       0.0);
     ( 457000.0, 4610000.0,     178.4,     178.4,       0.0);         ( 457500.0,
4610000.0,     177.9,     177.9,       0.0);
     ( 458000.0, 4610000.0,     178.1,     178.1,       0.0);         ( 458500.0,
4610000.0,     178.4,     178.4,       0.0);
     ( 459000.0, 4610000.0,     178.3,     178.3,       0.0);         ( 459500.0,
4610000.0,     179.4,     179.4,       0.0);
     ( 460000.0, 4610000.0,     178.5,     178.5,       0.0);         ( 449000.0,
4610500.0,     182.7,     182.7,       0.0);
     ( 449500.0, 4610500.0,     179.8,     179.8,       0.0);         ( 450000.0,
4610500.0,     178.8,     183.9,       0.0);
     ( 450500.0, 4610500.0,     180.5,     197.1,       0.0);         ( 451000.0,
4610500.0,     178.6,     178.6,       0.0);
     ( 451500.0, 4610500.0,     178.5,     178.5,       0.0);         ( 452000.0,
4610500.0,     180.7,     180.7,       0.0);
     ( 452500.0, 4610500.0,     178.1,     221.9,       0.0);         ( 453000.0,
4610500.0,     178.5,     221.9,       0.0);
     ( 453500.0, 4610500.0,     178.5,     178.5,       0.0);         ( 454000.0,
4610500.0,     178.2,     178.2,       0.0);
     ( 454500.0, 4610500.0,     178.3,     178.3,       0.0);         ( 455000.0,
4610500.0,     179.1,     179.1,       0.0);
     ( 455500.0, 4610500.0,     178.2,     178.2,       0.0);         ( 456000.0,
4610500.0,     177.7,     177.7,       0.0);
     ( 456500.0, 4610500.0,     178.3,     178.3,       0.0);         ( 457000.0,
4610500.0,     178.1,     178.1,       0.0);
     ( 457500.0, 4610500.0,     179.3,     179.3,       0.0);         ( 458000.0,
4610500.0,     177.5,     177.5,       0.0);
     ( 458500.0, 4610500.0,     178.6,     178.6,       0.0);         ( 459000.0,
4610500.0,     176.3,     176.3,       0.0);
     ( 459500.0, 4610500.0,     178.9,     178.9,       0.0);         ( 460000.0,
4610500.0,     178.6,     178.6,       0.0);
     ( 449000.0, 4611000.0,     180.3,     180.3,       0.0);         ( 449500.0,
4611000.0,     178.3,     178.3,       0.0);
     ( 450000.0, 4611000.0,     177.0,     177.0,       0.0);         ( 450500.0,
4611000.0,     177.0,     198.9,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 149
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(451000.0, 4611000.0, 182.8, 185.1, 0.0); (451500.0, 4611000.0, 178.5, 178.5, 0.0);
(452000.0, 4611000.0, 195.1, 196.9, 0.0); (452500.0, 4611000.0, 179.5, 179.5, 0.0);
(453000.0, 4611000.0, 177.0, 177.0, 0.0); (453500.0, 4611000.0, 178.2, 178.2, 0.0);
(454000.0, 4611000.0, 178.2, 178.2, 0.0); (454500.0, 4611000.0, 178.6, 178.6, 0.0);
(455000.0, 4611000.0, 178.2, 178.2, 0.0); (455500.0, 4611000.0, 178.2, 178.2, 0.0);
(456000.0, 4611000.0, 178.7, 178.7, 0.0); (456500.0, 4611000.0, 178.0, 178.0, 0.0);
(457000.0, 4611000.0, 178.6, 178.6, 0.0); (457500.0, 4611000.0, 178.8, 178.8, 0.0);
(458000.0, 4611000.0, 178.8, 178.8, 0.0); (458500.0, 4611000.0, 179.0, 179.0, 0.0);
(459000.0, 4611000.0, 178.3, 178.3, 0.0); (459500.0, 4611000.0, 179.9, 179.9, 0.0);
(460000.0, 4611000.0, 178.3, 178.3, 0.0); (449000.0, 4611500.0, 179.9, 179.9, 0.0);
(449500.0, 4611500.0, 179.1, 179.1, 0.0); (450000.0, 4611500.0, 178.6, 178.6, 0.0);
(450500.0, 4611500.0, 178.4, 178.4, 0.0); (451000.0, 4611500.0, 178.1, 178.1, 0.0);
(451500.0, 4611500.0, 180.6, 225.4, 0.0); (452000.0, 4611500.0, 211.8, 211.8, 0.0);
(452500.0, 4611500.0, 179.0, 179.0, 0.0); (453000.0, 4611500.0, 178.2, 178.2, 0.0);
(453500.0, 4611500.0, 178.2, 178.2, 0.0); (454000.0, 4611500.0, 180.8, 180.8, 0.0);
(454500.0, 4611500.0, 178.5, 178.5, 0.0); (455000.0, 4611500.0, 178.2, 178.2, 0.0);
(455500.0, 4611500.0, 178.6, 178.6, 0.0); (456000.0, 4611500.0, 179.9, 179.9, 0.0);
(456500.0, 4611500.0, 178.7, 178.7, 0.0); (457000.0, 4611500.0, 178.4, 178.4, 0.0);
(457500.0, 4611500.0, 178.2, 178.2, 0.0); (458000.0, 4611500.0, 179.4, 179.4, 0.0);
(458500.0, 4611500.0, 179.9, 179.9, 0.0); (459000.0, 4611500.0, 179.5, 179.5, 0.0);
(459500.0, 4611500.0, 179.2, 179.2, 0.0); (460000.0, 4611500.0, 179.5, 184.0, 0.0);
(449000.0, 4612000.0, 179.7, 179.7, 0.0); (449500.0, 4612000.0, 179.5, 179.5, 0.0);
(450000.0, 4612000.0, 179.4, 179.4, 0.0); (450500.0, 4612000.0, 178.3, 178.3, 0.0);
(451000.0, 4612000.0, 182.4, 182.4, 0.0); (451500.0, 4612000.0, 182.4, 225.1, 0.0);
(452000.0, 4612000.0, 181.5, 225.4, 0.0); (452500.0, 4612000.0, 184.1, 184.1, 0.0);

```
     ( 453000.0, 4612000.0,     185.0,     185.0,       0.0);         ( 453500.0,
4612000.0,     178.6,     178.6,       0.0);
     ( 454000.0, 4612000.0,     180.5,     180.5,       0.0);         ( 454500.0,
4612000.0,     178.2,     178.2,       0.0);
     ( 455000.0, 4612000.0,     178.2,     178.2,       0.0);         ( 455500.0,
4612000.0,     178.5,     178.5,       0.0);
     ( 456000.0, 4612000.0,     177.6,     177.6,       0.0);         ( 456500.0,
4612000.0,     178.5,     178.5,       0.0);
     ( 457000.0, 4612000.0,     187.1,     187.1,       0.0);         ( 457500.0,
4612000.0,     178.9,     178.9,       0.0);
     ( 458000.0, 4612000.0,     180.2,     180.2,       0.0);         ( 458500.0,
4612000.0,     181.3,     181.3,       0.0);
     ( 459000.0, 4612000.0,     179.5,     179.5,       0.0);         ( 459500.0,
4612000.0,     179.2,     179.2,       0.0);
     ( 460000.0, 4612000.0,     179.4,     179.4,       0.0);         ( 449000.0,
4612500.0,     179.7,     179.7,       0.0);
     ( 449500.0, 4612500.0,     179.6,     179.6,       0.0);         ( 450000.0,
4612500.0,     179.8,     179.8,       0.0);
     ( 450500.0, 4612500.0,     178.5,     178.5,       0.0);         ( 451000.0,
4612500.0,     179.7,     179.7,       0.0);
     ( 451500.0, 4612500.0,     178.6,     178.6,       0.0);         ( 457000.0,
4612500.0,     179.0,     179.0,       0.0);
     ( 457500.0, 4612500.0,     179.4,     179.4,       0.0);         ( 458000.0,
4612500.0,     188.2,     188.2,       0.0);
     ( 458500.0, 4612500.0,     183.2,     183.2,       0.0);         ( 459000.0,
4612500.0,     178.1,     178.1,       0.0);
     ( 459500.0, 4612500.0,     178.9,     178.9,       0.0);         ( 460000.0,
4612500.0,     180.6,     180.6,       0.0);
     ( 449000.0, 4613000.0,     179.8,     179.8,       0.0);         ( 449500.0,
4613000.0,     178.5,     178.5,       0.0);
     ( 450000.0, 4613000.0,     179.7,     179.7,       0.0);         ( 450500.0,
4613000.0,     178.5,     178.5,       0.0);
     ( 451000.0, 4613000.0,     175.2,     175.2,       0.0);         ( 451500.0,
4613000.0,     178.3,     178.3,       0.0);
     ( 457000.0, 4613000.0,     177.1,     177.1,       0.0);         ( 457500.0,
4613000.0,     178.3,     178.3,       0.0);
     ( 458000.0, 4613000.0,     176.9,     176.9,       0.0);         ( 458500.0,
4613000.0,     177.3,     177.3,       0.0);
     ( 459000.0, 4613000.0,     178.5,     178.5,       0.0);         ( 459500.0,
4613000.0,     179.0,     179.0,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 150
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(460000.0, 4613000.0, 179.7, 179.7, 0.0); (449000.0, 4613500.0, 181.3, 181.3, 0.0);
(449500.0, 4613500.0, 179.7, 179.7, 0.0); (450000.0, 4613500.0, 179.2, 179.2, 0.0);
(450500.0, 4613500.0, 178.3, 178.3, 0.0); (451000.0, 4613500.0, 177.3, 178.5, 0.0);
(451500.0, 4613500.0, 178.4, 178.4, 0.0); (457000.0, 4613500.0, 177.1, 177.1, 0.0);
(457500.0, 4613500.0, 177.1, 177.1, 0.0); (458000.0, 4613500.0, 177.0, 177.0, 0.0);
(458500.0, 4613500.0, 180.9, 180.9, 0.0); (459000.0, 4613500.0, 178.2, 178.2, 0.0);
(459500.0, 4613500.0, 180.0, 180.0, 0.0); (460000.0, 4613500.0, 179.9, 179.9, 0.0);
(449000.0, 4614000.0, 182.5, 182.5, 0.0); (449500.0, 4614000.0, 179.7, 179.7, 0.0);
(450000.0, 4614000.0, 178.7, 178.7, 0.0); (450500.0, 4614000.0, 175.2, 175.2, 0.0);
(451000.0, 4614000.0, 175.2, 175.2, 0.0); (451500.0, 4614000.0, 178.3, 178.3, 0.0);
(457000.0, 4614000.0, 177.1, 177.1, 0.0); (457500.0, 4614000.0, 177.9, 177.9, 0.0);
(458000.0, 4614000.0, 177.9, 177.9, 0.0); (458500.0, 4614000.0, 177.9, 177.9, 0.0);
(459000.0, 4614000.0, 178.8, 178.8, 0.0); (459500.0, 4614000.0, 180.3, 180.3, 0.0);
(460000.0, 4614000.0, 179.3, 179.3, 0.0); (449000.0, 4614500.0, 180.5, 180.5, 0.0);
(449500.0, 4614500.0, 179.7, 179.7, 0.0); (450000.0, 4614500.0, 178.3, 178.3, 0.0);
(450500.0, 4614500.0, 175.2, 175.2, 0.0); (451000.0, 4614500.0, 175.2, 175.2, 0.0);
(451500.0, 4614500.0, 177.3, 177.3, 0.0); (457000.0, 4614500.0, 177.1, 177.1, 0.0);
(457500.0, 4614500.0, 177.7, 177.7, 0.0); (458000.0, 4614500.0, 178.4, 178.4, 0.0);
(458500.0, 4614500.0, 178.2, 178.2, 0.0); (459000.0, 4614500.0, 179.2, 179.2, 0.0);
(459500.0, 4614500.0, 180.7, 180.7, 0.0); (460000.0, 4614500.0, 175.5, 175.5, 0.0);
(449000.0, 4615000.0, 182.6, 182.6, 0.0); (449500.0, 4615000.0, 179.7, 179.7, 0.0);
(450000.0, 4615000.0, 178.7, 178.7, 0.0); (450500.0, 4615000.0, 178.3, 178.3, 0.0);
(451000.0, 4615000.0, 175.2, 175.2, 0.0); (451500.0, 4615000.0, 175.2, 175.2, 0.0);
(457000.0, 4615000.0, 177.1, 177.1, 0.0); (457500.0, 4615000.0, 177.7, 177.7, 0.0);
(458000.0, 4615000.0, 178.1, 178.1, 0.0); (458500.0, 4615000.0, 178.8, 178.8, 0.0);

```
     ( 459000.0, 4615000.0,     175.5,     175.5,       0.0);         ( 459500.0,
4615000.0,     175.5,     175.5,       0.0);
     ( 460000.0, 4615000.0,     175.5,     175.5,       0.0);         ( 449000.0,
4615500.0,     181.4,     181.4,       0.0);
     ( 449500.0, 4615500.0,     179.5,     179.5,       0.0);         ( 450000.0,
4615500.0,     178.6,     178.6,       0.0);
     ( 450500.0, 4615500.0,     180.6,     183.0,       0.0);         ( 451000.0,
4615500.0,     178.3,     178.3,       0.0);
     ( 451500.0, 4615500.0,     175.5,     175.5,       0.0);         ( 457000.0,
4615500.0,     178.5,     178.5,       0.0);
     ( 457500.0, 4615500.0,     178.2,     178.2,       0.0);         ( 458000.0,
4615500.0,     179.3,     179.3,       0.0);
     ( 458500.0, 4615500.0,     175.5,     175.5,       0.0);         ( 459000.0,
4615500.0,     175.5,     175.5,       0.0);
     ( 459500.0, 4615500.0,     175.5,     175.5,       0.0);         ( 460000.0,
4615500.0,     175.2,     175.2,       0.0);
     ( 449000.0, 4616000.0,     181.7,     181.7,       0.0);         ( 449500.0,
4616000.0,     180.8,     180.8,       0.0);
     ( 450000.0, 4616000.0,     179.3,     179.3,       0.0);         ( 450500.0,
4616000.0,     184.7,     184.7,       0.0);
     ( 451000.0, 4616000.0,     185.3,     185.3,       0.0);         ( 451500.0,
4616000.0,     176.6,     178.4,       0.0);
     ( 457000.0, 4616000.0,     178.6,     185.4,       0.0);         ( 457500.0,
4616000.0,     179.8,     179.8,       0.0);
     ( 458000.0, 4616000.0,     175.5,     175.5,       0.0);         ( 458500.0,
4616000.0,     175.5,     175.5,       0.0);
     ( 459000.0, 4616000.0,     175.5,     175.5,       0.0);         ( 459500.0,
4616000.0,     175.2,     175.2,       0.0);
     ( 460000.0, 4616000.0,     175.2,     175.2,       0.0);         ( 449000.0,
4616500.0,     182.2,     182.2,       0.0);
     ( 449500.0, 4616500.0,     181.9,     181.9,       0.0);         ( 450000.0,
4616500.0,     179.3,     179.3,       0.0);
     ( 450500.0, 4616500.0,     179.6,     179.6,       0.0);         ( 451000.0,
4616500.0,     191.5,     191.5,       0.0);
     ( 451500.0, 4616500.0,     194.0,     194.0,       0.0);         ( 457000.0,
4616500.0,     179.2,     179.2,       0.0);
     ( 457500.0, 4616500.0,     175.5,     175.5,       0.0);         ( 458000.0,
4616500.0,     175.5,     175.5,       0.0);
     ( 458500.0, 4616500.0,     175.4,     175.4,       0.0);         ( 459000.0,
4616500.0,     175.2,     175.2,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 151
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(459500.0, 4616500.0, 175.2, 175.2, 0.0); (460000.0, 4616500.0, 175.2, 175.2, 0.0);
(449000.0, 4617000.0, 182.1, 182.1, 0.0); (449500.0, 4617000.0, 182.5, 182.5, 0.0);
(450000.0, 4617000.0, 179.9, 179.9, 0.0); (450500.0, 4617000.0, 180.5, 180.5, 0.0);
(451000.0, 4617000.0, 184.0, 185.9, 0.0); (451500.0, 4617000.0, 183.1, 183.1, 0.0);
(457000.0, 4617000.0, 178.9, 178.9, 0.0); (457500.0, 4617000.0, 175.5, 175.5, 0.0);
(458000.0, 4617000.0, 175.3, 175.3, 0.0); (458500.0, 4617000.0, 175.2, 175.2, 0.0);
(459000.0, 4617000.0, 175.2, 175.2, 0.0); (459500.0, 4617000.0, 175.2, 175.2, 0.0);
(460000.0, 4617000.0, 175.2, 175.2, 0.0); (449000.0, 4617500.0, 181.8, 181.8, 0.0);
(449500.0, 4617500.0, 182.8, 182.8, 0.0); (450000.0, 4617500.0, 180.9, 180.9, 0.0);
(450500.0, 4617500.0, 179.7, 179.7, 0.0); (451000.0, 4617500.0, 179.7, 179.7, 0.0);
(451500.0, 4617500.0, 178.9, 178.9, 0.0); (452000.0, 4617500.0, 186.5, 186.5, 0.0);
(452500.0, 4617500.0, 183.1, 183.1, 0.0); (453000.0, 4617500.0, 178.7, 178.7, 0.0);
(453500.0, 4617500.0, 180.3, 180.3, 0.0); (454000.0, 4617500.0, 178.2, 178.2, 0.0);
(454500.0, 4617500.0, 178.2, 178.2, 0.0); (455000.0, 4617500.0, 178.2, 178.2, 0.0);
(455500.0, 4617500.0, 179.8, 179.8, 0.0); (456000.0, 4617500.0, 179.9, 179.9, 0.0);
(456500.0, 4617500.0, 178.4, 178.4, 0.0); (457000.0, 4617500.0, 175.5, 175.5, 0.0);
(457500.0, 4617500.0, 175.5, 175.5, 0.0); (458000.0, 4617500.0, 175.2, 175.2, 0.0);
(458500.0, 4617500.0, 175.2, 175.2, 0.0); (459000.0, 4617500.0, 175.2, 175.2, 0.0);
(459500.0, 4617500.0, 175.2, 175.2, 0.0); (460000.0, 4617500.0, 175.2, 175.2, 0.0);
(449000.0, 4618000.0, 181.5, 181.5, 0.0); (449500.0, 4618000.0, 181.7, 181.7, 0.0);
(450000.0, 4618000.0, 182.2, 182.2, 0.0); (450500.0, 4618000.0, 183.7, 183.7, 0.0);
(451000.0, 4618000.0, 179.8, 179.8, 0.0); (451500.0, 4618000.0, 180.3, 180.3, 0.0);
(452000.0, 4618000.0, 179.7, 179.7, 0.0); (452500.0, 4618000.0, 178.6, 178.6, 0.0);
(453000.0, 4618000.0, 178.5, 178.5, 0.0); (453500.0, 4618000.0, 181.2, 181.2, 0.0);
(454000.0, 4618000.0, 178.8, 178.8, 0.0); (454500.0, 4618000.0, 178.9, 178.9, 0.0);

```
     ( 455000.0, 4618000.0,     178.7,     178.7,       0.0);         ( 455500.0,
4618000.0,     180.3,     180.3,       0.0);
     ( 456000.0, 4618000.0,     179.5,     179.5,       0.0);         ( 456500.0,
4618000.0,     175.5,     175.5,       0.0);
     ( 457000.0, 4618000.0,     175.5,     175.5,       0.0);         ( 457500.0,
4618000.0,     175.4,     175.4,       0.0);
     ( 458000.0, 4618000.0,     175.2,     175.2,       0.0);         ( 458500.0,
4618000.0,     175.2,     175.2,       0.0);
     ( 459000.0, 4618000.0,     175.2,     175.2,       0.0);         ( 459500.0,
4618000.0,     175.2,     175.2,       0.0);
     ( 460000.0, 4618000.0,     175.2,     175.2,       0.0);         ( 449000.0,
4618500.0,     182.2,     182.2,       0.0);
     ( 449500.0, 4618500.0,     182.5,     182.5,       0.0);         ( 450000.0,
4618500.0,     181.8,     181.8,       0.0);
     ( 450500.0, 4618500.0,     183.5,     183.5,       0.0);         ( 451000.0,
4618500.0,     178.3,     178.3,       0.0);
     ( 451500.0, 4618500.0,     179.9,     179.9,       0.0);         ( 452000.0,
4618500.0,     179.2,     179.2,       0.0);
     ( 452500.0, 4618500.0,     178.6,     178.6,       0.0);         ( 453000.0,
4618500.0,     178.5,     178.5,       0.0);
     ( 453500.0, 4618500.0,     178.3,     178.3,       0.0);         ( 454000.0,
4618500.0,     178.6,     178.6,       0.0);
     ( 454500.0, 4618500.0,     179.5,     179.5,       0.0);         ( 455000.0,
4618500.0,     175.3,     187.0,       0.0);
     ( 455500.0, 4618500.0,     179.7,     179.7,       0.0);         ( 456000.0,
4618500.0,     179.8,     179.8,       0.0);
     ( 456500.0, 4618500.0,     175.5,     175.5,       0.0);         ( 457000.0,
4618500.0,     175.4,     175.4,       0.0);
     ( 457500.0, 4618500.0,     175.2,     175.2,       0.0);         ( 458000.0,
4618500.0,     175.2,     175.2,       0.0);
     ( 458500.0, 4618500.0,     175.2,     175.2,       0.0);         ( 459000.0,
4618500.0,     175.2,     175.2,       0.0);
     ( 459500.0, 4618500.0,     175.2,     175.2,       0.0);         ( 460000.0,
4618500.0,     175.2,     175.2,       0.0);
     ( 449000.0, 4619000.0,     182.3,     182.3,       0.0);         ( 449500.0,
4619000.0,     180.9,     180.9,       0.0);
     ( 450000.0, 4619000.0,     180.4,     180.4,       0.0);         ( 450500.0,
4619000.0,     178.6,     178.6,       0.0);
     ( 451000.0, 4619000.0,     178.3,     178.3,       0.0);         ( 451500.0,
4619000.0,     178.6,     178.6,       0.0);
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 152
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZHILL, ZFLAG)
(METERS)

(452000.0, 4619000.0, 178.3, 178.3, 0.0); (452500.0, 4619000.0, 178.2, 178.2, 0.0);
(453000.0, 4619000.0, 179.9, 179.9, 0.0); (453500.0, 4619000.0, 183.2, 183.2, 0.0);
(454000.0, 4619000.0, 178.2, 178.2, 0.0); (454500.0, 4619000.0, 182.7, 182.7, 0.0);
(455000.0, 4619000.0, 179.1, 179.1, 0.0); (455500.0, 4619000.0, 179.7, 179.7, 0.0);
(456000.0, 4619000.0, 182.4, 182.4, 0.0); (456500.0, 4619000.0, 175.2, 175.2, 0.0);
(457000.0, 4619000.0, 175.2, 175.2, 0.0); (457500.0, 4619000.0, 175.2, 175.2, 0.0);
(458000.0, 4619000.0, 175.2, 175.2, 0.0); (458500.0, 4619000.0, 175.2, 175.2, 0.0);
(459000.0, 4619000.0, 175.2, 175.2, 0.0); (459500.0, 4619000.0, 175.2, 175.2, 0.0);
(460000.0, 4619000.0, 175.2, 175.2, 0.0); (449000.0, 4619500.0, 181.6, 181.6, 0.0);
(449500.0, 4619500.0, 183.2, 183.2, 0.0); (450000.0, 4619500.0, 180.8, 180.8, 0.0);
(450500.0, 4619500.0, 179.9, 179.9, 0.0); (451000.0, 4619500.0, 180.4, 180.4, 0.0);
(451500.0, 4619500.0, 182.2, 182.2, 0.0); (452000.0, 4619500.0, 182.9, 182.9, 0.0);
(452500.0, 4619500.0, 182.6, 182.6, 0.0); (453000.0, 4619500.0, 180.9, 180.9, 0.0);
(453500.0, 4619500.0, 178.2, 178.2, 0.0); (454000.0, 4619500.0, 182.3, 182.3, 0.0);
(454500.0, 4619500.0, 179.2, 179.2, 0.0); (455000.0, 4619500.0, 176.8, 176.8, 0.0);
(455500.0, 4619500.0, 181.6, 181.6, 0.0); (456000.0, 4619500.0, 181.1, 181.1, 0.0);
(456500.0, 4619500.0, 175.2, 175.2, 0.0); (457000.0, 4619500.0, 175.2, 175.2, 0.0);
(457500.0, 4619500.0, 175.2, 175.2, 0.0); (458000.0, 4619500.0, 175.2, 175.2, 0.0);
(458500.0, 4619500.0, 175.2, 175.2, 0.0); (459000.0, 4619500.0, 175.2, 175.2, 0.0);
(459500.0, 4619500.0, 175.2, 175.2, 0.0); (460000.0, 4619500.0, 175.2, 175.2, 0.0);
(449000.0, 4620000.0, 178.1, 178.1, 0.0); (449500.0, 4620000.0, 181.2, 181.2, 0.0);
(450000.0, 4620000.0, 182.6, 182.6, 0.0); (450500.0, 4620000.0, 178.5, 178.5, 0.0);
(451000.0, 4620000.0, 178.9, 178.9, 0.0); (451500.0, 4620000.0, 178.5, 178.5, 0.0);
(452000.0, 4620000.0, 178.9, 178.9, 0.0); (452500.0, 4620000.0, 179.5, 179.5, 0.0);
(453000.0, 4620000.0, 178.9, 178.9, 0.0); (453500.0, 4620000.0, 184.2, 184.2, 0.0);

```
     ( 454000.0, 4620000.0,     179.8,     179.8,       0.0);         ( 454500.0,
4620000.0,     179.7,     179.7,       0.0);
     ( 455000.0, 4620000.0,     179.4,     179.4,       0.0);         ( 455500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 456000.0, 4620000.0,     182.5,     182.5,       0.0);         ( 456500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 457000.0, 4620000.0,     175.2,     175.2,       0.0);         ( 457500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 458000.0, 4620000.0,     175.2,     175.2,       0.0);         ( 458500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 459000.0, 4620000.0,     175.2,     175.2,       0.0);         ( 459500.0,
4620000.0,     175.2,     175.2,       0.0);
     ( 460000.0, 4620000.0,     175.2,     175.2,       0.0);         ( 449000.0,
4620500.0,     179.9,     179.9,       0.0);
     ( 449500.0, 4620500.0,     180.7,     180.7,       0.0);         ( 450000.0,
4620500.0,     181.2,     181.2,       0.0);
     ( 450500.0, 4620500.0,     179.9,     179.9,       0.0);         ( 451000.0,
4620500.0,     178.2,     178.2,       0.0);
     ( 451500.0, 4620500.0,     178.8,     178.8,       0.0);         ( 452000.0,
4620500.0,     180.5,     180.5,       0.0);
     ( 452500.0, 4620500.0,     182.0,     182.0,       0.0);         ( 453000.0,
4620500.0,     184.4,     184.4,       0.0);
     ( 453500.0, 4620500.0,     180.5,     180.5,       0.0);         ( 454000.0,
4620500.0,     179.8,     179.8,       0.0);
     ( 454500.0, 4620500.0,     178.9,     178.9,       0.0);         ( 455000.0,
4620500.0,     179.0,     179.0,       0.0);
     ( 455500.0, 4620500.0,     180.4,     180.4,       0.0);         ( 456000.0,
4620500.0,     176.8,     180.4,       0.0);
     ( 456500.0, 4620500.0,     175.2,     175.2,       0.0);         ( 457000.0,
4620500.0,     175.2,     175.2,       0.0);
     ( 457500.0, 4620500.0,     175.2,     175.2,       0.0);         ( 458000.0,
4620500.0,     175.2,     175.2,       0.0);
     ( 458500.0, 4620500.0,     175.2,     175.2,       0.0);         ( 459000.0,
4620500.0,     175.2,     175.2,       0.0);
     ( 459500.0, 4620500.0,     175.2,     175.2,       0.0);         ( 460000.0,
4620500.0,     175.2,     175.2,       0.0);
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

* SOURCE-RECEPTOR COMBINATIONS FOR WHICH CALCULATIONS MAY NOT BE PERFORMED *
LESS THAN 1.0 METER; WITHIN OPENPIT; OR BEYOND 80KM FOR FASTAREA/FASTALL

SOURCE ID	- - RECEPTOR LOCATION - - XR (METERS)	YR (METERS)	DISTANCE (METERS)
V13	454093.9	4614816.0	- 2.29

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***

(1=YES; 0=NO)

```
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1
```

METEOROLOGICAL DATA PROCESSED BETWEEN START DATE: 2012 1 1 1
AND END DATE: 2016 12 31 24

NOTE: METEOROLOGICAL DATA ACTUALLY PROCESSED WILL ALSO DEPEND ON WHAT IS INCLUDED IN THE DATA FILE.

*** UPPER BOUND OF FIRST THROUGH FIFTH WIND SPEED CATEGORIES ***

(METERS/SEC)

1.54, 3.09, 5.14, 8.23, 10.80,

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** UP TO THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

Surface file: AERMET.SFC
Met Version: 18081
Profile file: AERMET.PFL
Surface format: FREE
Profile format: FREE
Surface station no.: 14819 Upper air station no.: 94982
Name: CHICAGO MIDWAY INTL ARPT, IL Name: DAVENPORT MUNICIPAL AIRPT, IA
Year: 2012 Year: 2012

First 24 hours of scalar data

YR	MO	DY	JDY	HR	H0	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O LEN	Z0	BOWEN	ALBEDO	REF WS	WD	HT	REF TA	HT
12	01	01	1	01	-55.9	0.568	-9.000	-9.000	-999.	1027.	354.7	0.09	1.09	1.00	6.86	176.	10.0	278.8	2.0
12	01	01	1	02	-52.1	0.531	-9.000	-9.000	-999.	931.	310.0	0.09	1.09	1.00	6.43	177.	10.0	279.2	2.0
12	01	01	1	03	-44.7	0.456	-9.000	-9.000	-999.	744.	228.3	0.08	1.09	1.00	5.67	180.	10.0	279.2	2.0
12	01	01	1	04	-39.2	0.401	-9.000	-9.000	-999.	613.	177.0	0.08	1.09	1.00	5.02	200.	10.0	279.9	2.0
12	01	01	1	05	-44.7	0.457	-9.000	-9.000	-999.	741.	229.8	0.07	1.09	1.00	5.80	233.	10.0	279.9	2.0
12	01	01	1	06	-64.0	0.680	-9.000	-9.000	-999.	1344.	508.0	0.13	1.09	1.00	7.40	247.	10.0	278.8	2.0
12	01	01	1	07	-64.0	0.648	-9.000	-9.000	-999.	1254.	461.7	0.13	1.09	1.00	7.08	257.	10.0	278.1	2.0
12	01	01	1	08	-64.0	0.816	-9.000	-9.000	-999.	1765.	744.3	0.06	1.09	0.76	10.65	295.	10.0	275.9	2.0
12	01	01	1	09	-39.7	0.705	-9.000	-9.000	-999.	1440.	774.8	0.06	1.09	0.45	9.19	294.	10.0	275.4	2.0
12	01	01	1	10	16.9	0.759	0.503	0.006	264.	1584.	-2270.7	0.06	1.09	0.34	9.81	288.	10.0	275.9	2.0
12	01	01	1	11	31.1	0.826	0.739	0.005	457.	1797.	-1594.2	0.06	1.09	0.29	10.66	283.	10.0	277.0	2.0
12	01	01	1	12	37.9	0.927	0.837	0.005	546.	2133.	-1852.7	0.06	1.09	0.28	11.97	279.	10.0	275.9	2.0
12	01	01	1	13	13.8	0.928	0.608	0.005	572.	2146.	-5114.4	0.06	1.09	0.28	12.02	285.	10.0	274.2	2.0
12	01	01	1	14	28.5	0.825	0.797	0.005	625.	1820.	-1736.6	0.06	1.09	0.30	10.65	282.	10.0	273.1	2.0
12	01	01	1	15	1.4	0.791	0.293	0.006	628.	1696.	-8888.0	0.06	1.09	0.35	10.26	277.	10.0	273.8	2.0
12	01	01	1	16	-61.6	0.871	-9.000	-9.000	-999.	1944.	949.1	0.06	1.09	0.49	11.33	277.	10.0	273.8	2.0
12	01	01	1	17	-64.0	0.788	-9.000	-9.000	-999.	1692.	682.4	0.06	1.09	1.00	10.29	276.	10.0	273.8	2.0
12	01	01	1	18	-64.0	0.695	-9.000	-9.000	-999.	1406.	530.9	0.06	1.09	1.00	9.13	272.	10.0	273.1	2.0

```
 12 01 01   1 19  -64.0  0.714 -9.000 -9.000 -999. 1447.    560.9  0.06   1.09   1.00
9.37  278.   10.0  272.5    2.0
 12 01 01   1 20  -64.0  0.716 -9.000 -9.000 -999. 1453.    563.4  0.06   1.09   1.00
9.39  282.   10.0  272.5    2.0
 12 01 01   1 21  -64.0  0.714 -9.000 -9.000 -999. 1448.    560.9  0.06   1.09   1.00
9.37  281.   10.0  272.0    2.0
 12 01 01   1 22  -60.0  0.587 -9.000 -9.000 -999. 1099.    378.8  0.06   1.09   1.00
7.76  278.   10.0  272.5    2.0
 12 01 01   1 23  -59.7  0.583 -9.000 -9.000 -999. 1069.    373.7  0.06   1.09   1.00
7.71  276.   10.0  272.0    2.0
 12 01 01   1 24  -64.0  0.696 -9.000 -9.000 -999. 1392.    533.4  0.06   1.09   1.00
9.15  287.   10.0  272.0    2.0


 First hour of profile data
 YR MO DY HR HEIGHT F  WDIR    WSPD AMB_TMP sigmaA  sigmaW  sigmaV
 12 01 01 01   10.0 1  176.    6.86   278.8   99.0  -99.00  -99.00

 F indicates top of profile (=1) or below (=0)
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
454084.40	4615065.40	0.01214	454083.30	4615039.80	0.01222
454082.20	4615014.10	0.01247	454085.10	4614964.60	0.01407
454088.00	4614915.00	0.01745	454091.00	4614865.50	0.02668
454093.90	4614816.00	0.01992	454096.80	4614766.40	0.02153
454099.70	4614716.90	0.01496	454102.60	4614667.30	0.01161
454105.50	4614617.80	0.00935	454108.50	4614568.30	0.00804
454111.40	4614518.70	0.00721	454114.30	4614469.20	0.00658
454107.80	4614425.20	0.00592	454101.30	4614381.10	0.00551
454094.70	4614337.10	0.00508	454088.20	4614293.00	0.00471
454081.70	4614249.00	0.00435	454082.20	4614201.80	0.00411
454082.80	4614154.70	0.00388	454121.40	4614157.80	0.00392
454160.00	4614160.90	0.00393	454191.30	4614179.40	0.00402
454222.70	4614198.00	0.00413	454254.00	4614216.50	0.00424
454253.20	4614226.30	0.00431	454296.00	4614249.30	0.00447
454338.80	4614272.30	0.00462	454381.70	4614295.30	0.00476
454424.50	4614318.30	0.00489	454467.30	4614341.40	0.00498
454510.20	4614364.40	0.00505	454553.00	4614387.40	0.00513

454595.80	4614410.40	0.00523	454595.80	4614459.20 0.00572
454595.80	4614507.90	0.00636	454595.80	4614556.70 0.00717
454595.80	4614605.50	0.00815	454595.80	4614654.30 0.00926
454595.80	4614703.00	0.01042	454595.80	4614751.80 0.01144
454595.80	4614800.60	0.01209	454595.80	4614849.30 0.01228
454595.80	4614898.10	0.01259	454595.80	4614946.90 0.01386
454595.80	4614995.60	0.01732	454595.80	4615044.40 0.02209
454595.80	4615093.20	0.01674	454595.80	4615142.00 0.01362
454595.80	4615190.70	0.01194	454595.80	4615239.50 0.01083
454551.90	4615219.20	0.01222	454508.00	4615199.00 0.01360
454484.50	4615239.50	0.01262	454461.10	4615279.90 0.01188
454413.60	4615286.60	0.01216	454376.80	4615266.90 0.01287
454340.00	4615247.20	0.01355	454303.10	4615227.50 0.01410
454266.30	4615207.80	0.01445	454229.50	4615188.10 0.01451
454251.00	4615155.90	0.01521	454209.30	4615133.30 0.01482
454167.70	4615110.70	0.01427	454126.10	4615088.00 0.01350
452000.00	4612100.00	0.00126	452100.00	4612100.00 0.00129
452200.00	4612100.00	0.00129	452300.00	4612100.00 0.00129
452400.00	4612100.00	0.00125	452500.00	4612100.00 0.00128
452600.00	4612100.00	0.00134	452700.00	4612100.00 0.00136
452800.00	4612100.00	0.00137	452900.00	4612100.00 0.00136
453000.00	4612100.00	0.00137	453100.00	4612100.00 0.00137
453200.00	4612100.00	0.00137	453300.00	4612100.00 0.00138

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
453400.00	4612100.00	0.00138	453500.00	4612100.00	0.00137
453600.00	4612100.00	0.00135	453700.00	4612100.00	0.00134
453800.00	4612100.00	0.00131	453900.00	4612100.00	0.00129
454000.00	4612100.00	0.00127	454100.00	4612100.00	0.00126
454200.00	4612100.00	0.00125	454300.00	4612100.00	0.00123
454400.00	4612100.00	0.00121	454500.00	4612100.00	0.00119
454600.00	4612100.00	0.00117	454700.00	4612100.00	0.00114
454800.00	4612100.00	0.00111	454900.00	4612100.00	0.00113
455000.00	4612100.00	0.00112	455100.00	4612100.00	0.00110
455200.00	4612100.00	0.00109	455300.00	4612100.00	0.00108
455400.00	4612100.00	0.00108	455500.00	4612100.00	0.00108
455600.00	4612100.00	0.00109	455700.00	4612100.00	0.00109
455800.00	4612100.00	0.00110	455900.00	4612100.00	0.00111
456000.00	4612100.00	0.00112	456100.00	4612100.00	0.00112
456200.00	4612100.00	0.00112	456300.00	4612100.00	0.00112
456400.00	4612100.00	0.00112	456500.00	4612100.00	0.00111
456600.00	4612100.00	0.00110	452000.00	4612200.00	0.00128

452100.00	4612200.00	0.00131	452200.00	4612200.00	0.00133
452300.00	4612200.00	0.00132	452400.00	4612200.00	0.00131
452500.00	4612200.00	0.00135	452600.00	4612200.00	0.00140
452700.00	4612200.00	0.00142	452800.00	4612200.00	0.00142
452900.00	4612200.00	0.00141	453000.00	4612200.00	0.00141
453100.00	4612200.00	0.00141	453200.00	4612200.00	0.00142
453300.00	4612200.00	0.00142	453400.00	4612200.00	0.00142
453500.00	4612200.00	0.00142	453600.00	4612200.00	0.00140
453700.00	4612200.00	0.00138	453800.00	4612200.00	0.00136
453900.00	4612200.00	0.00134	454000.00	4612200.00	0.00131
454100.00	4612200.00	0.00130	454200.00	4612200.00	0.00129
454300.00	4612200.00	0.00127	454400.00	4612200.00	0.00125
454500.00	4612200.00	0.00123	454600.00	4612200.00	0.00118
454700.00	4612200.00	0.00115	454800.00	4612200.00	0.00113
454900.00	4612200.00	0.00115	455000.00	4612200.00	0.00115
455100.00	4612200.00	0.00114	455200.00	4612200.00	0.00112
455300.00	4612200.00	0.00112	455400.00	4612200.00	0.00112
455500.00	4612200.00	0.00112	455600.00	4612200.00	0.00113
455700.00	4612200.00	0.00114	455800.00	4612200.00	0.00114
455900.00	4612200.00	0.00115	456000.00	4612200.00	0.00116
456100.00	4612200.00	0.00116	456200.00	4612200.00	0.00116
456300.00	4612200.00	0.00116	456400.00	4612200.00	0.00115
456500.00	4612200.00	0.00114	456600.00	4612200.00	0.00113

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

PAGE 158
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452000.00	4612300.00	0.00129	452100.00	4612300.00	0.00133
452200.00	4612300.00	0.00136	452300.00	4612300.00	0.00135
452400.00	4612300.00	0.00138	452500.00	4612300.00	0.00142
452600.00	4612300.00	0.00146	452700.00	4612300.00	0.00147
452800.00	4612300.00	0.00147	452900.00	4612300.00	0.00146
453000.00	4612300.00	0.00146	453100.00	4612300.00	0.00146
453200.00	4612300.00	0.00147	453300.00	4612300.00	0.00147
453400.00	4612300.00	0.00147	453500.00	4612300.00	0.00147
453600.00	4612300.00	0.00145	453700.00	4612300.00	0.00143
453800.00	4612300.00	0.00141	453900.00	4612300.00	0.00138
454000.00	4612300.00	0.00136	454100.00	4612300.00	0.00134
454200.00	4612300.00	0.00133	454300.00	4612300.00	0.00131
454400.00	4612300.00	0.00128	454500.00	4612300.00	0.00127
454600.00	4612300.00	0.00120	454700.00	4612300.00	0.00120
454800.00	4612300.00	0.00117	454900.00	4612300.00	0.00117
455000.00	4612300.00	0.00118	455100.00	4612300.00	0.00117
455200.00	4612300.00	0.00116	455300.00	4612300.00	0.00116

455400.00 4612300.00 0.00116 455500.00 4612300.00 0.00116
455600.00 4612300.00 0.00117 455700.00 4612300.00 0.00118
455800.00 4612300.00 0.00119 455900.00 4612300.00 0.00120
456000.00 4612300.00 0.00120 456100.00 4612300.00 0.00120
456200.00 4612300.00 0.00119 456300.00 4612300.00 0.00119
456400.00 4612300.00 0.00116 456500.00 4612300.00 0.00115
456600.00 4612300.00 0.00115 452000.00 4612400.00 0.00131
452100.00 4612400.00 0.00135 452200.00 4612400.00 0.00136
452300.00 4612400.00 0.00139 452400.00 4612400.00 0.00143
452500.00 4612400.00 0.00147 452600.00 4612400.00 0.00151
452700.00 4612400.00 0.00151 452800.00 4612400.00 0.00151
452900.00 4612400.00 0.00151 453000.00 4612400.00 0.00151
453100.00 4612400.00 0.00151 453200.00 4612400.00 0.00151
453300.00 4612400.00 0.00152 453400.00 4612400.00 0.00151
453500.00 4612400.00 0.00152 453600.00 4612400.00 0.00152
453700.00 4612400.00 0.00149 453800.00 4612400.00 0.00146
453900.00 4612400.00 0.00143 454000.00 4612400.00 0.00141
454100.00 4612400.00 0.00139 454200.00 4612400.00 0.00137
454300.00 4612400.00 0.00135 454400.00 4612400.00 0.00132
454500.00 4612400.00 0.00131 454600.00 4612400.00 0.00124
454700.00 4612400.00 0.00124 454800.00 4612400.00 0.00122
454900.00 4612400.00 0.00121 455000.00 4612400.00 0.00122
455100.00 4612400.00 0.00121 455200.00 4612400.00 0.00120

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

PAGE 159
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
455300.00	4612400.00	0.00120	455400.00	4612400.00	0.00121
455500.00	4612400.00	0.00121	455600.00	4612400.00	0.00122
455700.00	4612400.00	0.00123	455800.00	4612400.00	0.00125
455900.00	4612400.00	0.00125	456000.00	4612400.00	0.00125
456100.00	4612400.00	0.00124	456200.00	4612400.00	0.00123
456300.00	4612400.00	0.00122	456400.00	4612400.00	0.00121
456500.00	4612400.00	0.00119	456600.00	4612400.00	0.00117
452000.00	4612500.00	0.00130	452100.00	4612500.00	0.00134
452200.00	4612500.00	0.00139	452300.00	4612500.00	0.00143
452400.00	4612500.00	0.00147	452500.00	4612500.00	0.00151
452600.00	4612500.00	0.00153	452700.00	4612500.00	0.00153
452800.00	4612500.00	0.00154	452900.00	4612500.00	0.00156
453000.00	4612500.00	0.00155	453100.00	4612500.00	0.00156
453200.00	4612500.00	0.00156	453300.00	4612500.00	0.00157
453400.00	4612500.00	0.00158	453500.00	4612500.00	0.00159
453600.00	4612500.00	0.00158	453700.00	4612500.00	0.00155
453800.00	4612500.00	0.00151	453900.00	4612500.00	0.00148

454000.00	4612500.00	0.00145	454100.00	4612500.00	0.00143
454200.00	4612500.00	0.00142	454300.00	4612500.00	0.00140
454400.00	4612500.00	0.00136	454500.00	4612500.00	0.00135
454600.00	4612500.00	0.00127	454700.00	4612500.00	0.00128
454800.00	4612500.00	0.00126	454900.00	4612500.00	0.00125
455000.00	4612500.00	0.00126	455100.00	4612500.00	0.00126
455200.00	4612500.00	0.00125	455300.00	4612500.00	0.00126
455400.00	4612500.00	0.00126	455500.00	4612500.00	0.00127
455600.00	4612500.00	0.00128	455700.00	4612500.00	0.00129
455800.00	4612500.00	0.00129	455900.00	4612500.00	0.00130
456000.00	4612500.00	0.00129	456100.00	4612500.00	0.00128
456200.00	4612500.00	0.00127	456300.00	4612500.00	0.00125
456400.00	4612500.00	0.00125	456500.00	4612500.00	0.00122
456600.00	4612500.00	0.00121	452000.00	4612600.00	0.00133
452100.00	4612600.00	0.00139	452200.00	4612600.00	0.00144
452300.00	4612600.00	0.00149	452400.00	4612600.00	0.00154
452500.00	4612600.00	0.00158	452600.00	4612600.00	0.00160
452700.00	4612600.00	0.00158	452800.00	4612600.00	0.00158
452900.00	4612600.00	0.00161	453000.00	4612600.00	0.00160
453100.00	4612600.00	0.00160	453200.00	4612600.00	0.00161
453300.00	4612600.00	0.00163	453400.00	4612600.00	0.00165
453500.00	4612600.00	0.00165	453600.00	4612600.00	0.00163
453700.00	4612600.00	0.00160	453800.00	4612600.00	0.00157

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
453900.00	4612600.00	0.00154	454000.00	4612600.00	0.00150
454100.00	4612600.00	0.00149	454200.00	4612600.00	0.00147
454300.00	4612600.00	0.00145	454400.00	4612600.00	0.00141
454500.00	4612600.00	0.00140	454600.00	4612600.00	0.00134
454700.00	4612600.00	0.00133	454800.00	4612600.00	0.00129
454900.00	4612600.00	0.00128	455000.00	4612600.00	0.00131
455100.00	4612600.00	0.00131	455200.00	4612600.00	0.00131
455300.00	4612600.00	0.00131	455400.00	4612600.00	0.00131
455500.00	4612600.00	0.00133	455600.00	4612600.00	0.00134
455700.00	4612600.00	0.00134	455800.00	4612600.00	0.00135
455900.00	4612600.00	0.00134	456000.00	4612600.00	0.00134
456100.00	4612600.00	0.00132	456200.00	4612600.00	0.00130
456300.00	4612600.00	0.00129	456400.00	4612600.00	0.00127
456500.00	4612600.00	0.00125	456600.00	4612600.00	0.00124
452000.00	4612700.00	0.00135	452100.00	4612700.00	0.00141
452200.00	4612700.00	0.00147	452300.00	4612700.00	0.00152
452400.00	4612700.00	0.00158	452500.00	4612700.00	0.00162

452600.00	4612700.00	0.00165	452700.00	4612700.00	0.00167
452800.00	4612700.00	0.00164	452900.00	4612700.00	0.00164
453000.00	4612700.00	0.00166	453100.00	4612700.00	0.00165
453200.00	4612700.00	0.00167	453300.00	4612700.00	0.00169
453400.00	4612700.00	0.00171	453500.00	4612700.00	0.00172
453600.00	4612700.00	0.00170	453700.00	4612700.00	0.00166
453800.00	4612700.00	0.00162	453900.00	4612700.00	0.00159
454000.00	4612700.00	0.00156	454100.00	4612700.00	0.00154
454200.00	4612700.00	0.00153	454300.00	4612700.00	0.00149
454400.00	4612700.00	0.00145	454500.00	4612700.00	0.00145
454600.00	4612700.00	0.00134	454700.00	4612700.00	0.00130
454800.00	4612700.00	0.00130	454900.00	4612700.00	0.00132
455000.00	4612700.00	0.00137	455100.00	4612700.00	0.00136
455200.00	4612700.00	0.00137	455300.00	4612700.00	0.00137
455400.00	4612700.00	0.00138	455500.00	4612700.00	0.00139
455600.00	4612700.00	0.00140	455700.00	4612700.00	0.00140
455800.00	4612700.00	0.00140	455900.00	4612700.00	0.00139
456000.00	4612700.00	0.00138	456100.00	4612700.00	0.00136
456200.00	4612700.00	0.00134	456300.00	4612700.00	0.00132
456400.00	4612700.00	0.00131	456500.00	4612700.00	0.00129
456600.00	4612700.00	0.00128	452000.00	4612800.00	0.00136
452100.00	4612800.00	0.00142	452200.00	4612800.00	0.00148
452300.00	4612800.00	0.00155	452400.00	4612800.00	0.00161

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452500.00	4612800.00	0.00166	452600.00	4612800.00	0.00170
452700.00	4612800.00	0.00172	452800.00	4612800.00	0.00169
452900.00	4612800.00	0.00169	453000.00	4612800.00	0.00169
453100.00	4612800.00	0.00171	453200.00	4612800.00	0.00173
453300.00	4612800.00	0.00175	453400.00	4612800.00	0.00177
453500.00	4612800.00	0.00178	453600.00	4612800.00	0.00177
453700.00	4612800.00	0.00173	453800.00	4612800.00	0.00169
453900.00	4612800.00	0.00165	454000.00	4612800.00	0.00163
454100.00	4612800.00	0.00159	454200.00	4612800.00	0.00158
454300.00	4612800.00	0.00155	454400.00	4612800.00	0.00152
454500.00	4612800.00	0.00150	454600.00	4612800.00	0.00148
454700.00	4612800.00	0.00147	454800.00	4612800.00	0.00144
454900.00	4612800.00	0.00143	455000.00	4612800.00	0.00142
455100.00	4612800.00	0.00142	455200.00	4612800.00	0.00143
455300.00	4612800.00	0.00143	455400.00	4612800.00	0.00145
455500.00	4612800.00	0.00146	455600.00	4612800.00	0.00146
455700.00	4612800.00	0.00146	455800.00	4612800.00	0.00146

455900.00 4612800.00 0.00144 456000.00 4612800.00 0.00143
456100.00 4612800.00 0.00140 456200.00 4612800.00 0.00138
456300.00 4612800.00 0.00136 456400.00 4612800.00 0.00135
456500.00 4612800.00 0.00133 456600.00 4612800.00 0.00132
452000.00 4612900.00 0.00138 452100.00 4612900.00 0.00143
452200.00 4612900.00 0.00148 452300.00 4612900.00 0.00157
452400.00 4612900.00 0.00165 452500.00 4612900.00 0.00171
452600.00 4612900.00 0.00175 452700.00 4612900.00 0.00177
452800.00 4612900.00 0.00179 452900.00 4612900.00 0.00176
453000.00 4612900.00 0.00179 453100.00 4612900.00 0.00175
453200.00 4612900.00 0.00177 453300.00 4612900.00 0.00182
453400.00 4612900.00 0.00184 453500.00 4612900.00 0.00185
453600.00 4612900.00 0.00184 453700.00 4612900.00 0.00181
453800.00 4612900.00 0.00176 453900.00 4612900.00 0.00173
454000.00 4612900.00 0.00170 454100.00 4612900.00 0.00166
454200.00 4612900.00 0.00165 454300.00 4612900.00 0.00162
454400.00 4612900.00 0.00159 454500.00 4612900.00 0.00156
454600.00 4612900.00 0.00154 454700.00 4612900.00 0.00152
454800.00 4612900.00 0.00149 454900.00 4612900.00 0.00148
455000.00 4612900.00 0.00148 455100.00 4612900.00 0.00149
455200.00 4612900.00 0.00150 455300.00 4612900.00 0.00151
455400.00 4612900.00 0.00152 455500.00 4612900.00 0.00153
455600.00 4612900.00 0.00153 455700.00 4612900.00 0.00152

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 162
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
455800.00	4612900.00	0.00151	455900.00	4612900.00	0.00149
456000.00	4612900.00	0.00147	456100.00	4612900.00	0.00144
456200.00	4612900.00	0.00142	456300.00	4612900.00	0.00141
456400.00	4612900.00	0.00139	456500.00	4612900.00	0.00138
456600.00	4612900.00	0.00137	452000.00	4613000.00	0.00140
452100.00	4613000.00	0.00145	452200.00	4613000.00	0.00149
452300.00	4613000.00	0.00159	452400.00	4613000.00	0.00167
452500.00	4613000.00	0.00174	452600.00	4613000.00	0.00179
452700.00	4613000.00	0.00183	452800.00	4613000.00	0.00185
452900.00	4613000.00	0.00186	453000.00	4613000.00	0.00186
453100.00	4613000.00	0.00184	453200.00	4613000.00	0.00183
453300.00	4613000.00	0.00187	453400.00	4613000.00	0.00192
453500.00	4613000.00	0.00193	453600.00	4613000.00	0.00192
453700.00	4613000.00	0.00189	453800.00	4613000.00	0.00183
453900.00	4613000.00	0.00180	454000.00	4613000.00	0.00177
454100.00	4613000.00	0.00173	454200.00	4613000.00	0.00172
454300.00	4613000.00	0.00169	454400.00	4613000.00	0.00166

454500.00	4613000.00	0.00163	454600.00	4613000.00	0.00161
454700.00	4613000.00	0.00159	454800.00	4613000.00	0.00157
454900.00	4613000.00	0.00156	455000.00	4613000.00	0.00155
455100.00	4613000.00	0.00157	455200.00	4613000.00	0.00158
455300.00	4613000.00	0.00160	455400.00	4613000.00	0.00160
455500.00	4613000.00	0.00160	455600.00	4613000.00	0.00160
455700.00	4613000.00	0.00158	455800.00	4613000.00	0.00156
455900.00	4613000.00	0.00155	456000.00	4613000.00	0.00152
456100.00	4613000.00	0.00149	456200.00	4613000.00	0.00147
456300.00	4613000.00	0.00146	456400.00	4613000.00	0.00145
456500.00	4613000.00	0.00144	456600.00	4613000.00	0.00144
452000.00	4613100.00	0.00142	452100.00	4613100.00	0.00146
452200.00	4613100.00	0.00150	452300.00	4613100.00	0.00161
452400.00	4613100.00	0.00169	452500.00	4613100.00	0.00177
452600.00	4613100.00	0.00184	452700.00	4613100.00	0.00189
452800.00	4613100.00	0.00192	452900.00	4613100.00	0.00193
453000.00	4613100.00	0.00194	453100.00	4613100.00	0.00194
453200.00	4613100.00	0.00194	453300.00	4613100.00	0.00193
453400.00	4613100.00	0.00201	453500.00	4613100.00	0.00202
453600.00	4613100.00	0.00201	453700.00	4613100.00	0.00197
453800.00	4613100.00	0.00192	453900.00	4613100.00	0.00188
454000.00	4613100.00	0.00185	454100.00	4613100.00	0.00183
454200.00	4613100.00	0.00180	454300.00	4613100.00	0.00177

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
454400.00	4613100.00	0.00173	454500.00	4613100.00	0.00170
454600.00	4613100.00	0.00168	454700.00	4613100.00	0.00167
454800.00	4613100.00	0.00165	454900.00	4613100.00	0.00164
455000.00	4613100.00	0.00165	455100.00	4613100.00	0.00166
455200.00	4613100.00	0.00168	455300.00	4613100.00	0.00169
455400.00	4613100.00	0.00168	455500.00	4613100.00	0.00168
455600.00	4613100.00	0.00166	455700.00	4613100.00	0.00165
455800.00	4613100.00	0.00162	455900.00	4613100.00	0.00159
456000.00	4613100.00	0.00157	456100.00	4613100.00	0.00154
456200.00	4613100.00	0.00152	456300.00	4613100.00	0.00151
456400.00	4613100.00	0.00150	456500.00	4613100.00	0.00150
456600.00	4613100.00	0.00149	452000.00	4613200.00	0.00144
452100.00	4613200.00	0.00149	452200.00	4613200.00	0.00152
452300.00	4613200.00	0.00162	452400.00	4613200.00	0.00171
452500.00	4613200.00	0.00180	452600.00	4613200.00	0.00188
452700.00	4613200.00	0.00195	452800.00	4613200.00	0.00199
452900.00	4613200.00	0.00202	453000.00	4613200.00	0.00203

453100.00 4613200.00 0.00203 453200.00 4613200.00 0.00204
453300.00 4613200.00 0.00206 453400.00 4613200.00 0.00205
453500.00 4613200.00 0.00207 453600.00 4613200.00 0.00211
453700.00 4613200.00 0.00208 453800.00 4613200.00 0.00202
453900.00 4613200.00 0.00198 454000.00 4613200.00 0.00194
454100.00 4613200.00 0.00191 454200.00 4613200.00 0.00189
454300.00 4613200.00 0.00175 454400.00 4613200.00 0.00174
454500.00 4613200.00 0.00178 454600.00 4613200.00 0.00177
454700.00 4613200.00 0.00174 454800.00 4613200.00 0.00172
454900.00 4613200.00 0.00174 455000.00 4613200.00 0.00175
455100.00 4613200.00 0.00176 455200.00 4613200.00 0.00177
455300.00 4613200.00 0.00178 455400.00 4613200.00 0.00177
455500.00 4613200.00 0.00175 455600.00 4613200.00 0.00173
455700.00 4613200.00 0.00170 455800.00 4613200.00 0.00168
455900.00 4613200.00 0.00165 456000.00 4613200.00 0.00163
456100.00 4613200.00 0.00160 456200.00 4613200.00 0.00159
456300.00 4613200.00 0.00158 456400.00 4613200.00 0.00157
456500.00 4613200.00 0.00157 456600.00 4613200.00 0.00156
452000.00 4613300.00 0.00148 452100.00 4613300.00 0.00151
452200.00 4613300.00 0.00154 452300.00 4613300.00 0.00164
452400.00 4613300.00 0.00172 452500.00 4613300.00 0.00182
452600.00 4613300.00 0.00192 452700.00 4613300.00 0.00200
452800.00 4613300.00 0.00207 452900.00 4613300.00 0.00211

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 164
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
453000.00	4613300.00	0.00211	453100.00	4613300.00	0.00212
453200.00	4613300.00	0.00214	453300.00	4613300.00	0.00216
453400.00	4613300.00	0.00218	453500.00	4613300.00	0.00219
453600.00	4613300.00	0.00216	453700.00	4613300.00	0.00219
453800.00	4613300.00	0.00213	453900.00	4613300.00	0.00208
454000.00	4613300.00	0.00204	454100.00	4613300.00	0.00202
454200.00	4613300.00	0.00198	454300.00	4613300.00	0.00179
454400.00	4613300.00	0.00181	454500.00	4613300.00	0.00188
454600.00	4613300.00	0.00186	454700.00	4613300.00	0.00184
454800.00	4613300.00	0.00183	454900.00	4613300.00	0.00185
455000.00	4613300.00	0.00186	455100.00	4613300.00	0.00187
455200.00	4613300.00	0.00188	455300.00	4613300.00	0.00187
455400.00	4613300.00	0.00186	455500.00	4613300.00	0.00183
455600.00	4613300.00	0.00180	455700.00	4613300.00	0.00177
455800.00	4613300.00	0.00174	455900.00	4613300.00	0.00171
456000.00	4613300.00	0.00170	456100.00	4613300.00	0.00167
456200.00	4613300.00	0.00166	456300.00	4613300.00	0.00166

456400.00 4613300.00 0.00165 456500.00 4613300.00 0.00164
456600.00 4613300.00 0.00163 452000.00 4613400.00 0.00152
452100.00 4613400.00 0.00155 452200.00 4613400.00 0.00157
452300.00 4613400.00 0.00166 452400.00 4613400.00 0.00174
452500.00 4613400.00 0.00184 452600.00 4613400.00 0.00195
452700.00 4613400.00 0.00205 452800.00 4613400.00 0.00214
452900.00 4613400.00 0.00219 453000.00 4613400.00 0.00221
453100.00 4613400.00 0.00223 453200.00 4613400.00 0.00224
453300.00 4613400.00 0.00226 453400.00 4613400.00 0.00231
453500.00 4613400.00 0.00234 453600.00 4613400.00 0.00228
453700.00 4613400.00 0.00224 453800.00 4613400.00 0.00224
453900.00 4613400.00 0.00219 454000.00 4613400.00 0.00215
454100.00 4613400.00 0.00213 454200.00 4613400.00 0.00209
454300.00 4613400.00 0.00197 454400.00 4613400.00 0.00188
454500.00 4613400.00 0.00198 454600.00 4613400.00 0.00197
454700.00 4613400.00 0.00196 454800.00 4613400.00 0.00196
454900.00 4613400.00 0.00197 455000.00 4613400.00 0.00198
455100.00 4613400.00 0.00199 455200.00 4613400.00 0.00199
455300.00 4613400.00 0.00197 455400.00 4613400.00 0.00194
455500.00 4613400.00 0.00190 455600.00 4613400.00 0.00187
455700.00 4613400.00 0.00184 455800.00 4613400.00 0.00181
455900.00 4613400.00 0.00179 456000.00 4613400.00 0.00177
456100.00 4613400.00 0.00175 456200.00 4613400.00 0.00174

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 ,
V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 ,
VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
456300.00	4613400.00	0.00174	456400.00	4613400.00	0.00172
456500.00	4613400.00	0.00171	456600.00	4613400.00	0.00171
452000.00	4613500.00	0.00157	452100.00	4613500.00	0.00159
452200.00	4613500.00	0.00160	452300.00	4613500.00	0.00169
452400.00	4613500.00	0.00176	452500.00	4613500.00	0.00186
452600.00	4613500.00	0.00197	452700.00	4613500.00	0.00209
452800.00	4613500.00	0.00220	452900.00	4613500.00	0.00227
453000.00	4613500.00	0.00232	453100.00	4613500.00	0.00235
453200.00	4613500.00	0.00236	453300.00	4613500.00	0.00239
453400.00	4613500.00	0.00242	453500.00	4613500.00	0.00246
453600.00	4613500.00	0.00248	453700.00	4613500.00	0.00241
453800.00	4613500.00	0.00231	453900.00	4613500.00	0.00225
454000.00	4613500.00	0.00228	454100.00	4613500.00	0.00225
454200.00	4613500.00	0.00221	454300.00	4613500.00	0.00215
454400.00	4613500.00	0.00211	454500.00	4613500.00	0.00210
454600.00	4613500.00	0.00209	454700.00	4613500.00	0.00210
454800.00	4613500.00	0.00210	454900.00	4613500.00	0.00211

455000.00 4613500.00 0.00212 455100.00 4613500.00 0.00211
455200.00 4613500.00 0.00210 455300.00 4613500.00 0.00207
455400.00 4613500.00 0.00203 455500.00 4613500.00 0.00199
455600.00 4613500.00 0.00195 455700.00 4613500.00 0.00192
455800.00 4613500.00 0.00189 455900.00 4613500.00 0.00188
456000.00 4613500.00 0.00186 456100.00 4613500.00 0.00185
456200.00 4613500.00 0.00183 456300.00 4613500.00 0.00182
456400.00 4613500.00 0.00180 456500.00 4613500.00 0.00178
456600.00 4613500.00 0.00174 452000.00 4613600.00 0.00162
452100.00 4613600.00 0.00164 452200.00 4613600.00 0.00165
452300.00 4613600.00 0.00170 452400.00 4613600.00 0.00179
452500.00 4613600.00 0.00188 452600.00 4613600.00 0.00199
452700.00 4613600.00 0.00212 452800.00 4613600.00 0.00225
452900.00 4613600.00 0.00236 453000.00 4613600.00 0.00243
453100.00 4613600.00 0.00248 453200.00 4613600.00 0.00250
453300.00 4613600.00 0.00252 453400.00 4613600.00 0.00255
453500.00 4613600.00 0.00259 453600.00 4613600.00 0.00262
453700.00 4613600.00 0.00260 453800.00 4613600.00 0.00253
453900.00 4613600.00 0.00239 454000.00 4613600.00 0.00235
454100.00 4613600.00 0.00239 454200.00 4613600.00 0.00234
454300.00 4613600.00 0.00230 454400.00 4613600.00 0.00226
454500.00 4613600.00 0.00224 454600.00 4613600.00 0.00225
454700.00 4613600.00 0.00225 454800.00 4613600.00 0.00226

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

PAGE 166
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
454900.00	4613600.00	0.00227	455000.00	4613600.00	0.00226
455100.00	4613600.00	0.00224	455200.00	4613600.00	0.00221
455300.00	4613600.00	0.00217	455400.00	4613600.00	0.00213
455500.00	4613600.00	0.00208	455600.00	4613600.00	0.00204
455700.00	4613600.00	0.00201	455800.00	4613600.00	0.00200
455900.00	4613600.00	0.00198	456000.00	4613600.00	0.00197
456100.00	4613600.00	0.00194	456200.00	4613600.00	0.00192
456300.00	4613600.00	0.00190	456400.00	4613600.00	0.00188
456500.00	4613600.00	0.00185	456600.00	4613600.00	0.00183
452000.00	4613700.00	0.00170	452100.00	4613700.00	0.00171
452200.00	4613700.00	0.00173	452300.00	4613700.00	0.00178
452400.00	4613700.00	0.00183	452500.00	4613700.00	0.00190
452600.00	4613700.00	0.00201	452700.00	4613700.00	0.00214
452800.00	4613700.00	0.00229	452900.00	4613700.00	0.00243
453000.00	4613700.00	0.00255	453100.00	4613700.00	0.00262
453200.00	4613700.00	0.00264	453300.00	4613700.00	0.00265
453400.00	4613700.00	0.00267	453500.00	4613700.00	0.00273

453600.00	4613700.00	0.00277	453700.00	4613700.00	0.00276
453800.00	4613700.00	0.00267	453900.00	4613700.00	0.00263
454000.00	4613700.00	0.00251	454100.00	4613700.00	0.00255
454200.00	4613700.00	0.00251	454300.00	4613700.00	0.00245
454400.00	4613700.00	0.00242	454500.00	4613700.00	0.00242
454600.00	4613700.00	0.00243	454700.00	4613700.00	0.00243
454800.00	4613700.00	0.00244	454900.00	4613700.00	0.00244
455000.00	4613700.00	0.00241	455100.00	4613700.00	0.00238
455200.00	4613700.00	0.00233	455300.00	4613700.00	0.00228
455400.00	4613700.00	0.00224	455500.00	4613700.00	0.00219
455600.00	4613700.00	0.00215	455700.00	4613700.00	0.00213
455800.00	4613700.00	0.00211	455900.00	4613700.00	0.00210
456000.00	4613700.00	0.00208	456100.00	4613700.00	0.00204
456200.00	4613700.00	0.00202	456300.00	4613700.00	0.00200
456400.00	4613700.00	0.00197	456500.00	4613700.00	0.00191
456600.00	4613700.00	0.00188	452000.00	4613800.00	0.00179
452100.00	4613800.00	0.00179	452200.00	4613800.00	0.00166
452300.00	4613800.00	0.00179	452400.00	4613800.00	0.00189
452500.00	4613800.00	0.00194	452600.00	4613800.00	0.00202
452700.00	4613800.00	0.00214	452800.00	4613800.00	0.00231
452900.00	4613800.00	0.00249	453000.00	4613800.00	0.00266
453100.00	4613800.00	0.00277	453200.00	4613800.00	0.00282
453300.00	4613800.00	0.00283	453400.00	4613800.00	0.00286

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
453500.00	4613800.00	0.00289	453600.00	4613800.00	0.00292
453700.00	4613800.00	0.00292	453800.00	4613800.00	0.00285
453900.00	4613800.00	0.00278	454000.00	4613800.00	0.00269
454100.00	4613800.00	0.00266	454200.00	4613800.00	0.00269
454300.00	4613800.00	0.00265	454400.00	4613800.00	0.00262
454500.00	4613800.00	0.00263	454600.00	4613800.00	0.00264
454700.00	4613800.00	0.00264	454800.00	4613800.00	0.00264
454900.00	4613800.00	0.00262	455000.00	4613800.00	0.00257
455100.00	4613800.00	0.00252	455200.00	4613800.00	0.00246
455300.00	4613800.00	0.00240	455400.00	4613800.00	0.00236
455500.00	4613800.00	0.00233	455600.00	4613800.00	0.00228
455700.00	4613800.00	0.00228	455800.00	4613800.00	0.00225
455900.00	4613800.00	0.00222	456000.00	4613800.00	0.00220
456100.00	4613800.00	0.00213	456200.00	4613800.00	0.00212
456300.00	4613800.00	0.00207	456400.00	4613800.00	0.00202
456500.00	4613800.00	0.00197	456600.00	4613800.00	0.00193
452000.00	4613900.00	0.00189	452100.00	4613900.00	0.00189

452200.00	4613900.00	0.00173	452300.00	4613900.00	0.00177
452400.00	4613900.00	0.00196	452500.00	4613900.00	0.00199
452600.00	4613900.00	0.00205	452700.00	4613900.00	0.00212
452800.00	4613900.00	0.00232	452900.00	4613900.00	0.00253
453000.00	4613900.00	0.00275	453100.00	4613900.00	0.00294
453200.00	4613900.00	0.00302	453300.00	4613900.00	0.00305
453400.00	4613900.00	0.00306	453500.00	4613900.00	0.00305
453600.00	4613900.00	0.00310	453700.00	4613900.00	0.00310
453800.00	4613900.00	0.00305	453900.00	4613900.00	0.00302
454000.00	4613900.00	0.00292	454100.00	4613900.00	0.00289
454200.00	4613900.00	0.00285	454300.00	4613900.00	0.00289
454400.00	4613900.00	0.00286	454500.00	4613900.00	0.00288
454600.00	4613900.00	0.00289	454700.00	4613900.00	0.00289
454800.00	4613900.00	0.00286	454900.00	4613900.00	0.00281
455000.00	4613900.00	0.00274	455100.00	4613900.00	0.00267
455200.00	4613900.00	0.00260	455300.00	4613900.00	0.00255
455400.00	4613900.00	0.00251	455500.00	4613900.00	0.00248
455600.00	4613900.00	0.00244	455700.00	4613900.00	0.00238
455800.00	4613900.00	0.00235	455900.00	4613900.00	0.00230
456000.00	4613900.00	0.00226	456100.00	4613900.00	0.00222
456200.00	4613900.00	0.00219	456300.00	4613900.00	0.00213
456400.00	4613900.00	0.00207	456500.00	4613900.00	0.00199
456600.00	4613900.00	0.00196	452000.00	4614000.00	0.00200

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 168
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452100.00	4614000.00	0.00201	452200.00	4614000.00	0.00185
452300.00	4614000.00	0.00187	452400.00	4614000.00	0.00206
452500.00	4614000.00	0.00207	452600.00	4614000.00	0.00211
452700.00	4614000.00	0.00216	452800.00	4614000.00	0.00232
452900.00	4614000.00	0.00254	453000.00	4614000.00	0.00282
453100.00	4614000.00	0.00308	453200.00	4614000.00	0.00323
453300.00	4614000.00	0.00330	453400.00	4614000.00	0.00330
453500.00	4614000.00	0.00328	453600.00	4614000.00	0.00331
453700.00	4614000.00	0.00331	453800.00	4614000.00	0.00326
453900.00	4614000.00	0.00329	454000.00	4614000.00	0.00320
454100.00	4614000.00	0.00318	454200.00	4614000.00	0.00324
454300.00	4614000.00	0.00319	454400.00	4614000.00	0.00318
454500.00	4614000.00	0.00319	454600.00	4614000.00	0.00319
454700.00	4614000.00	0.00316	454800.00	4614000.00	0.00310
454900.00	4614000.00	0.00302	455000.00	4614000.00	0.00293
455100.00	4614000.00	0.00285	455200.00	4614000.00	0.00278
455300.00	4614000.00	0.00273	455400.00	4614000.00	0.00269

455500.00 4614000.00 0.00266 455600.00
4614000.00 0.00259
455700.00 4614000.00 0.00252 455800.00
4614000.00 0.00246
455900.00 4614000.00 0.00240 456000.00
4614000.00 0.00234
456100.00 4614000.00 0.00227 456200.00
4614000.00 0.00222
456300.00 4614000.00 0.00218 456400.00
4614000.00 0.00211
456500.00 4614000.00 0.00201 456600.00
4614000.00 0.00199
452000.00 4614100.00 0.00210 452100.00
4614100.00 0.00213
452200.00 4614100.00 0.00198 452300.00
4614100.00 0.00201
452400.00 4614100.00 0.00219 452500.00
4614100.00 0.00219
452600.00 4614100.00 0.00218 452700.00
4614100.00 0.00225
452800.00 4614100.00 0.00236 452900.00
4614100.00 0.00251
453000.00 4614100.00 0.00284 453100.00
4614100.00 0.00319
453200.00 4614100.00 0.00344 453300.00
4614100.00 0.00357
453400.00 4614100.00 0.00360 453500.00
4614100.00 0.00356
453600.00 4614100.00 0.00357 453700.00
4614100.00 0.00355
453800.00 4614100.00 0.00348 453900.00
4614100.00 0.00356
454000.00 4614100.00 0.00353 454100.00
4614100.00 0.00366
454200.00 4614100.00 0.00362 454300.00
4614100.00 0.00358
454400.00 4614100.00 0.00358 454500.00
4614100.00 0.00358
454600.00 4614100.00 0.00353 454700.00
4614100.00 0.00346
454800.00 4614100.00 0.00336 454900.00
4614100.00 0.00326
455000.00 4614100.00 0.00315 455100.00
4614100.00 0.00307
455200.00 4614100.00 0.00300 455300.00
4614100.00 0.00295

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 169
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
455400.00	4614100.00	0.00290	455500.00	4614100.00	0.00284
455600.00	4614100.00	0.00276	455700.00	4614100.00	0.00267
455800.00	4614100.00	0.00257	455900.00	4614100.00	0.00249
456000.00	4614100.00	0.00241	456100.00	4614100.00	0.00233
456200.00	4614100.00	0.00227	456300.00	4614100.00	0.00222
456400.00	4614100.00	0.00215	456500.00	4614100.00	0.00202
456600.00	4614100.00	0.00202	452000.00	4614200.00	0.00219
452100.00	4614200.00	0.00223	452200.00	4614200.00	0.00210
452300.00	4614200.00	0.00217	452400.00	4614200.00	0.00235
452500.00	4614200.00	0.00229	452600.00	4614200.00	0.00234
452700.00	4614200.00	0.00237	452800.00	4614200.00	0.00244
452900.00	4614200.00	0.00259	453000.00	4614200.00	0.00286
453100.00	4614200.00	0.00325	453200.00	4614200.00	0.00362
453300.00	4614200.00	0.00386	453400.00	4614200.00	0.00395
453500.00	4614200.00	0.00391	453600.00	4614200.00	0.00393
453700.00	4614200.00	0.00385	453800.00	4614200.00	0.00374
453900.00	4614200.00	0.00385	454000.00	4614200.00	0.00394

454300.00	4614200.00	0.00412	454400.00	4614200.00	0.00410
454500.00	4614200.00	0.00405	454600.00	4614200.00	0.00394
454700.00	4614200.00	0.00381	454800.00	4614200.00	0.00368
454900.00	4614200.00	0.00355	455000.00	4614200.00	0.00343
455100.00	4614200.00	0.00335	455200.00	4614200.00	0.00328
455300.00	4614200.00	0.00320	455400.00	4614200.00	0.00311
455500.00	4614200.00	0.00301	455600.00	4614200.00	0.00291
455700.00	4614200.00	0.00278	455800.00	4614200.00	0.00267
455900.00	4614200.00	0.00257	456000.00	4614200.00	0.00247
456100.00	4614200.00	0.00238	456200.00	4614200.00	0.00232
456300.00	4614200.00	0.00225	456400.00	4614200.00	0.00218
456500.00	4614200.00	0.00202	456600.00	4614200.00	0.00204
452000.00	4614300.00	0.00227	452100.00	4614300.00	0.00233
452200.00	4614300.00	0.00220	452300.00	4614300.00	0.00228
452400.00	4614300.00	0.00251	452500.00	4614300.00	0.00252
452600.00	4614300.00	0.00252	452700.00	4614300.00	0.00254
452800.00	4614300.00	0.00258	452900.00	4614300.00	0.00268
453000.00	4614300.00	0.00289	453100.00	4614300.00	0.00327
453200.00	4614300.00	0.00373	453300.00	4614300.00	0.00413
453400.00	4614300.00	0.00434	453500.00	4614300.00	0.00433
453600.00	4614300.00	0.00435	453700.00	4614300.00	0.00422
453800.00	4614300.00	0.00409	453900.00	4614300.00	0.00419
454000.00	4614300.00	0.00440	454400.00	4614300.00	0.00478

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 170
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
454500.00	4614300.00	0.00462	454600.00	4614300.00	0.00443
454700.00	4614300.00	0.00426	454800.00	4614300.00	0.00409
454900.00	4614300.00	0.00393	455000.00	4614300.00	0.00380
455100.00	4614300.00	0.00369	455200.00	4614300.00	0.00357
455300.00	4614300.00	0.00343	455400.00	4614300.00	0.00329
455500.00	4614300.00	0.00315	455600.00	4614300.00	0.00301
455700.00	4614300.00	0.00288	455800.00	4614300.00	0.00275
455900.00	4614300.00	0.00263	456000.00	4614300.00	0.00252
456100.00	4614300.00	0.00243	456200.00	4614300.00	0.00234
456300.00	4614300.00	0.00227	456400.00	4614300.00	0.00220
456500.00	4614300.00	0.00203	456600.00	4614300.00	0.00206
452000.00	4614400.00	0.00235	452100.00	4614400.00	0.00242
452200.00	4614400.00	0.00234	452300.00	4614400.00	0.00254
452400.00	4614400.00	0.00264	452500.00	4614400.00	0.00269
452600.00	4614400.00	0.00270	452700.00	4614400.00	0.00271
452800.00	4614400.00	0.00279	452900.00	4614400.00	0.00285
453000.00	4614400.00	0.00298	453100.00	4614400.00	0.00329

453200.00 4614400.00 0.00377 453300.00 4614400.00 0.00434
453400.00 4614400.00 0.00474 453500.00 4614400.00 0.00483
453600.00 4614400.00 0.00486 453700.00 4614400.00 0.00475
453800.00 4614400.00 0.00454 453900.00 4614400.00 0.00465
454000.00 4614400.00 0.00493 454100.00 4614400.00 0.00559
454600.00 4614400.00 0.00513 454700.00 4614400.00 0.00489
454800.00 4614400.00 0.00464 454900.00 4614400.00 0.00443
455000.00 4614400.00 0.00424 455100.00 4614400.00 0.00404
455200.00 4614400.00 0.00382 455300.00 4614400.00 0.00362
455400.00 4614400.00 0.00343 455500.00 4614400.00 0.00326
455600.00 4614400.00 0.00310 455700.00 4614400.00 0.00296
455800.00 4614400.00 0.00281 455900.00 4614400.00 0.00269
456000.00 4614400.00 0.00258 456100.00 4614400.00 0.00247
456200.00 4614400.00 0.00238 456300.00 4614400.00 0.00230
456400.00 4614400.00 0.00223 456500.00 4614400.00 0.00209
456600.00 4614400.00 0.00209 452000.00 4614500.00 0.00244
452100.00 4614500.00 0.00252 452200.00 4614500.00 0.00256
452300.00 4614500.00 0.00261 452400.00 4614500.00 0.00268
452500.00 4614500.00 0.00277 452600.00 4614500.00 0.00283
452700.00 4614500.00 0.00297 452800.00 4614500.00 0.00306
452900.00 4614500.00 0.00311 453000.00 4614500.00 0.00319
453100.00 4614500.00 0.00334 453200.00 4614500.00 0.00379
453300.00 4614500.00 0.00445 453400.00 4614500.00 0.00512

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
453500.00	4614500.00	0.00545	453600.00	4614500.00	0.00549
453700.00	4614500.00	0.00536	453800.00	4614500.00	0.00516
453900.00	4614500.00	0.00535	454000.00	4614500.00	0.00573
454100.00	4614500.00	0.00665	454600.00	4614500.00	0.00623
454700.00	4614500.00	0.00579	454800.00	4614500.00	0.00539
454900.00	4614500.00	0.00501	455000.00	4614500.00	0.00465
455100.00	4614500.00	0.00431	455200.00	4614500.00	0.00402
455300.00	4614500.00	0.00377	455400.00	4614500.00	0.00355
455500.00	4614500.00	0.00335	455600.00	4614500.00	0.00318
455700.00	4614500.00	0.00302	455800.00	4614500.00	0.00288
455900.00	4614500.00	0.00275	456000.00	4614500.00	0.00264
456100.00	4614500.00	0.00252	456200.00	4614500.00	0.00243
456300.00	4614500.00	0.00234	456400.00	4614500.00	0.00226
456500.00	4614500.00	0.00220	456600.00	4614500.00	0.00213
452000.00	4614600.00	0.00254	452100.00	4614600.00	0.00261
452200.00	4614600.00	0.00247	452300.00	4614600.00	0.00256
452400.00	4614600.00	0.00268	452500.00	4614600.00	0.00280

452600.00	4614600.00	0.00295	452700.00	4614600.00	0.00319
452800.00	4614600.00	0.00333	452900.00	4614600.00	0.00344
453000.00	4614600.00	0.00353	453100.00	4614600.00	0.00360
453200.00	4614600.00	0.00383	453300.00	4614600.00	0.00449
453400.00	4614600.00	0.00540	453500.00	4614600.00	0.00608
453600.00	4614600.00	0.00623	453700.00	4614600.00	0.00612
453800.00	4614600.00	0.00591	453900.00	4614600.00	0.00627
454000.00	4614600.00	0.00715	454100.00	4614600.00	0.00859
454600.00	4614600.00	0.00799	454700.00	4614600.00	0.00698
454800.00	4614600.00	0.00616	454900.00	4614600.00	0.00550
455000.00	4614600.00	0.00497	455100.00	4614600.00	0.00455
455200.00	4614600.00	0.00420	455300.00	4614600.00	0.00391
455400.00	4614600.00	0.00367	455500.00	4614600.00	0.00345
455600.00	4614600.00	0.00326	455700.00	4614600.00	0.00309
455800.00	4614600.00	0.00294	455900.00	4614600.00	0.00281
456000.00	4614600.00	0.00269	456100.00	4614600.00	0.00257
456200.00	4614600.00	0.00248	456300.00	4614600.00	0.00239
456400.00	4614600.00	0.00230	456500.00	4614600.00	0.00219
456600.00	4614600.00	0.00217	452000.00	4614700.00	0.00265
452100.00	4614700.00	0.00267	452200.00	4614700.00	0.00255
452300.00	4614700.00	0.00267	452400.00	4614700.00	0.00280
452500.00	4614700.00	0.00295	452600.00	4614700.00	0.00311
452700.00	4614700.00	0.00342	452800.00	4614700.00	0.00359

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 , V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 , V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 , AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452900.00	4614700.00	0.00382	453000.00	4614700.00	0.00397
453100.00	4614700.00	0.00404	453200.00	4614700.00	0.00421
453300.00	4614700.00	0.00457	453400.00	4614700.00	0.00550
453500.00	4614700.00	0.00669	453600.00	4614700.00	0.00716
453700.00	4614700.00	0.00705	453800.00	4614700.00	0.00686
453900.00	4614700.00	0.00770	454000.00	4614700.00	0.00930
454100.00	4614700.00	0.01372	454600.00	4614700.00	0.01024
454700.00	4614700.00	0.00812	454800.00	4614700.00	0.00682
454900.00	4614700.00	0.00593	455000.00	4614700.00	0.00528
455100.00	4614700.00	0.00478	455200.00	4614700.00	0.00438
455300.00	4614700.00	0.00405	455400.00	4614700.00	0.00378
455500.00	4614700.00	0.00354	455600.00	4614700.00	0.00334
455700.00	4614700.00	0.00316	455800.00	4614700.00	0.00301
455900.00	4614700.00	0.00287	456000.00	4614700.00	0.00275
456100.00	4614700.00	0.00263	456200.00	4614700.00	0.00253
456300.00	4614700.00	0.00244	456400.00	4614700.00	0.00235
456500.00	4614700.00	0.00224	456600.00	4614700.00	0.00221

452000.00	4614800.00	0.00278	452100.00	4614800.00	0.00283
452200.00	4614800.00	0.00287	452300.00	4614800.00	0.00280
452400.00	4614800.00	0.00293	452500.00	4614800.00	0.00307
452600.00	4614800.00	0.00327	452700.00	4614800.00	0.00365
452800.00	4614800.00	0.00373	452900.00	4614800.00	0.00407
453000.00	4614800.00	0.00436	453100.00	4614800.00	0.00460
453200.00	4614800.00	0.00477	453300.00	4614800.00	0.00492
453400.00	4614800.00	0.00545	453500.00	4614800.00	0.00692
453600.00	4614800.00	0.00813	453700.00	4614800.00	0.00804
453800.00	4614800.00	0.00775	453900.00	4614800.00	0.00919
454000.00	4614800.00	0.01307	454600.00	4614800.00	0.01190
454700.00	4614800.00	0.00897	454800.00	4614800.00	0.00734
454900.00	4614800.00	0.00627	455000.00	4614800.00	0.00550
455100.00	4614800.00	0.00493	455200.00	4614800.00	0.00449
455300.00	4614800.00	0.00414	455400.00	4614800.00	0.00386
455500.00	4614800.00	0.00362	455600.00	4614800.00	0.00341
455700.00	4614800.00	0.00323	455800.00	4614800.00	0.00308
455900.00	4614800.00	0.00294	456000.00	4614800.00	0.00281
456100.00	4614800.00	0.00268	456200.00	4614800.00	0.00257
456300.00	4614800.00	0.00248	456400.00	4614800.00	0.00239
456500.00	4614800.00	0.00231	456600.00	4614800.00	0.00225
452000.00	4614900.00	0.00292	452100.00	4614900.00	0.00302
452200.00	4614900.00	0.00313	452300.00	4614900.00	0.00325

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 173
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452400.00	4614900.00	0.00338	452500.00	4614900.00	0.00351
452600.00	4614900.00	0.00367	452700.00	4614900.00	0.00385
452800.00	4614900.00	0.00407	452900.00	4614900.00	0.00433
453000.00	4614900.00	0.00464	453100.00	4614900.00	0.00499
453200.00	4614900.00	0.00536	453300.00	4614900.00	0.00567
453400.00	4614900.00	0.00587	453500.00	4614900.00	0.00668
453600.00	4614900.00	0.00872	453700.00	4614900.00	0.00884
453800.00	4614900.00	0.00801	453900.00	4614900.00	0.00939
454000.00	4614900.00	0.01240	454600.00	4614900.00	0.01243
454700.00	4614900.00	0.00930	454800.00	4614900.00	0.00745
454900.00	4614900.00	0.00629	455000.00	4614900.00	0.00552
455100.00	4614900.00	0.00496	455200.00	4614900.00	0.00454
455300.00	4614900.00	0.00420	455400.00	4614900.00	0.00392
455500.00	4614900.00	0.00368	455600.00	4614900.00	0.00348
455700.00	4614900.00	0.00329	455800.00	4614900.00	0.00313
455900.00	4614900.00	0.00299	456000.00	4614900.00	0.00285
456100.00	4614900.00	0.00274	456200.00	4614900.00	0.00261

456300.00 4614900.00 0.00251 456400.00 4614900.00 0.00242
456500.00 4614900.00 0.00234 456600.00 4614900.00 0.00227
452000.00 4615000.00 0.00305 452100.00 4615000.00 0.00316
452200.00 4615000.00 0.00328 452300.00 4615000.00 0.00342
452400.00 4615000.00 0.00355 452500.00 4615000.00 0.00370
452600.00 4615000.00 0.00387 452700.00 4615000.00 0.00407
452800.00 4615000.00 0.00430 452900.00 4615000.00 0.00456
453000.00 4615000.00 0.00488 453100.00 4615000.00 0.00527
453200.00 4615000.00 0.00576 453300.00 4615000.00 0.00636
453400.00 4615000.00 0.00693 453500.00 4615000.00 0.00723
453600.00 4615000.00 0.00828 453700.00 4615000.00 0.00915
453800.00 4615000.00 0.00767 453900.00 4615000.00 0.00911
454000.00 4615000.00 0.01037 454600.00 4615000.00 0.01729
454700.00 4615000.00 0.00991 454800.00 4615000.00 0.00759
454900.00 4615000.00 0.00637 455000.00 4615000.00 0.00560
455100.00 4615000.00 0.00504 455200.00 4615000.00 0.00461
455300.00 4615000.00 0.00427 455400.00 4615000.00 0.00398
455500.00 4615000.00 0.00374 455600.00 4615000.00 0.00353
455700.00 4615000.00 0.00334 455800.00 4615000.00 0.00317
455900.00 4615000.00 0.00302 456000.00 4615000.00 0.00288
456100.00 4615000.00 0.00275 456200.00 4615000.00 0.00264
456300.00 4615000.00 0.00253 456400.00 4615000.00 0.00244
456500.00 4615000.00 0.00236 456600.00 4615000.00 0.00228

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 174
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452000.00	4615100.00	0.00314	452100.00	4615100.00	0.00324
452200.00	4615100.00	0.00335	452300.00	4615100.00	0.00352
452400.00	4615100.00	0.00366	452500.00	4615100.00	0.00382
452600.00	4615100.00	0.00400	452700.00	4615100.00	0.00422
452800.00	4615100.00	0.00446	452900.00	4615100.00	0.00474
453000.00	4615100.00	0.00508	453100.00	4615100.00	0.00549
453200.00	4615100.00	0.00600	453300.00	4615100.00	0.00668
453400.00	4615100.00	0.00759	453500.00	4615100.00	0.00857
453600.00	4615100.00	0.00826	453700.00	4615100.00	0.00662
453800.00	4615100.00	0.00567	453900.00	4615100.00	0.00847
454000.00	4615100.00	0.01030	454100.00	4615100.00	0.01289
454600.00	4615100.00	0.01567	454700.00	4615100.00	0.00966
454800.00	4615100.00	0.00766	454900.00	4615100.00	0.00649
455000.00	4615100.00	0.00570	455100.00	4615100.00	0.00512
455200.00	4615100.00	0.00468	455300.00	4615100.00	0.00432
455400.00	4615100.00	0.00403	455500.00	4615100.00	0.00377
455600.00	4615100.00	0.00355	455700.00	4615100.00	0.00336

455800.00 4615100.00 0.00319 455900.00
4615100.00 0.00303
456000.00 4615100.00 0.00289 456100.00
4615100.00 0.00275
456200.00 4615100.00 0.00264 456300.00
4615100.00 0.00254
456400.00 4615100.00 0.00244 456500.00
4615100.00 0.00236
456600.00 4615100.00 0.00228 452000.00
4615200.00 0.00320
452100.00 4615200.00 0.00328 452200.00
4615200.00 0.00343
452300.00 4615200.00 0.00355 452400.00
4615200.00 0.00369
452500.00 4615200.00 0.00384 452600.00
4615200.00 0.00402
452700.00 4615200.00 0.00422 452800.00
4615200.00 0.00444
452900.00 4615200.00 0.00470 453000.00
4615200.00 0.00501
453100.00 4615200.00 0.00537 453200.00
4615200.00 0.00582
453300.00 4615200.00 0.00641 453400.00
4615200.00 0.00727
453500.00 4615200.00 0.00840 453600.00
4615200.00 0.00802
453700.00 4615200.00 0.00353 453800.00
4615200.00 0.00307
453900.00 4615200.00 0.00773 454000.00
4615200.00 0.01201
454100.00 4615200.00 0.01382 454200.00
4615200.00 0.01420
454600.00 4615200.00 0.01158 454700.00
4615200.00 0.00911
454800.00 4615200.00 0.00755 454900.00
4615200.00 0.00649
455000.00 4615200.00 0.00573 455100.00
4615200.00 0.00514
455200.00 4615200.00 0.00469 455300.00
4615200.00 0.00432
455400.00 4615200.00 0.00402 455500.00
4615200.00 0.00376
455600.00 4615200.00 0.00354 455700.00
4615200.00 0.00334
455800.00 4615200.00 0.00317 455900.00
4615200.00 0.00301

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 175
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
456000.00	4615200.00	0.00287	456100.00	4615200.00	0.00274
456200.00	4615200.00	0.00263	456300.00	4615200.00	0.00252
456400.00	4615200.00	0.00243	456500.00	4615200.00	0.00233
456600.00	4615200.00	0.00225	452000.00	4615300.00	0.00324
452100.00	4615300.00	0.00329	452200.00	4615300.00	0.00344
452300.00	4615300.00	0.00352	452400.00	4615300.00	0.00364
452500.00	4615300.00	0.00377	452600.00	4615300.00	0.00392
452700.00	4615300.00	0.00412	452800.00	4615300.00	0.00430
452900.00	4615300.00	0.00449	453000.00	4615300.00	0.00470
453100.00	4615300.00	0.00492	453200.00	4615300.00	0.00517
453300.00	4615300.00	0.00545	453400.00	4615300.00	0.00581
453500.00	4615300.00	0.00623	453600.00	4615300.00	0.00614
453700.00	4615300.00	0.00452	453800.00	4615300.00	0.00461
453900.00	4615300.00	0.01140	454000.00	4615300.00	0.01402
454100.00	4615300.00	0.01415	454200.00	4615300.00	0.01318
454300.00	4615300.00	0.01265	454400.00	4615300.00	0.01199
454500.00	4615300.00	0.01109	454600.00	4615300.00	0.00975

454700.00	4615300.00	0.00825	454800.00	4615300.00	0.00710
454900.00	4615300.00	0.00627	455000.00	4615300.00	0.00560
455100.00	4615300.00	0.00506	455200.00	4615300.00	0.00463
455300.00	4615300.00	0.00427	455400.00	4615300.00	0.00397
455500.00	4615300.00	0.00371	455600.00	4615300.00	0.00349
455700.00	4615300.00	0.00329	455800.00	4615300.00	0.00312
455900.00	4615300.00	0.00297	456000.00	4615300.00	0.00283
456100.00	4615300.00	0.00271	456200.00	4615300.00	0.00260
456300.00	4615300.00	0.00249	456400.00	4615300.00	0.00241
456500.00	4615300.00	0.00230	456600.00	4615300.00	0.00223
452000.00	4615400.00	0.00325	452100.00	4615400.00	0.00333
452200.00	4615400.00	0.00341	452300.00	4615400.00	0.00344
452400.00	4615400.00	0.00352	452500.00	4615400.00	0.00361
452600.00	4615400.00	0.00372	452700.00	4615400.00	0.00383
452800.00	4615400.00	0.00392	452900.00	4615400.00	0.00412
453000.00	4615400.00	0.00422	453100.00	4615400.00	0.00432
453200.00	4615400.00	0.00442	453300.00	4615400.00	0.00455
453400.00	4615400.00	0.00481	453500.00	4615400.00	0.00527
453600.00	4615400.00	0.00625	453700.00	4615400.00	0.00825
453800.00	4615400.00	0.01332	453900.00	4615400.00	0.01444
454000.00	4615400.00	0.01304	454100.00	4615400.00	0.01364
454200.00	4615400.00	0.01250	454300.00	4615400.00	0.01150
454400.00	4615400.00	0.01060	454500.00	4615400.00	0.00971

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
454600.00	4615400.00	0.00869	454700.00	4615400.00	0.00760
454800.00	4615400.00	0.00666	454900.00	4615400.00	0.00595
455000.00	4615400.00	0.00540	455100.00	4615400.00	0.00494
455200.00	4615400.00	0.00454	455300.00	4615400.00	0.00420
455400.00	4615400.00	0.00391	455500.00	4615400.00	0.00365
455600.00	4615400.00	0.00343	455700.00	4615400.00	0.00324
455800.00	4615400.00	0.00307	455900.00	4615400.00	0.00292
456000.00	4615400.00	0.00279	456100.00	4615400.00	0.00267
456200.00	4615400.00	0.00256	456300.00	4615400.00	0.00246
456400.00	4615400.00	0.00238	456500.00	4615400.00	0.00229
456600.00	4615400.00	0.00220	452000.00	4615500.00	0.00323
452100.00	4615500.00	0.00329	452200.00	4615500.00	0.00335
452300.00	4615500.00	0.00333	452400.00	4615500.00	0.00338
452500.00	4615500.00	0.00344	452600.00	4615500.00	0.00358
452700.00	4615500.00	0.00357	452800.00	4615500.00	0.00363
452900.00	4615500.00	0.00378	453000.00	4615500.00	0.00386
453100.00	4615500.00	0.00396	453200.00	4615500.00	0.00411

453300.00 4615500.00 0.00436 453400.00 4615500.00 0.00477
453500.00 4615500.00 0.00551 453600.00 4615500.00 0.00706
453700.00 4615500.00 0.00986 453800.00 4615500.00 0.01458
453900.00 4615500.00 0.01640 454000.00 4615500.00 0.01224
454100.00 4615500.00 0.01146 454200.00 4615500.00 0.01153
454300.00 4615500.00 0.01081 454400.00 4615500.00 0.00992
454500.00 4615500.00 0.00904 454600.00 4615500.00 0.00815
454700.00 4615500.00 0.00724 454800.00 4615500.00 0.00642
454900.00 4615500.00 0.00575 455000.00 4615500.00 0.00524
455100.00 4615500.00 0.00482 455200.00 4615500.00 0.00447
455300.00 4615500.00 0.00415 455400.00 4615500.00 0.00387
455500.00 4615500.00 0.00362 455600.00 4615500.00 0.00340
455700.00 4615500.00 0.00321 455800.00 4615500.00 0.00304
455900.00 4615500.00 0.00289 456000.00 4615500.00 0.00276
456100.00 4615500.00 0.00263 456200.00 4615500.00 0.00254
456300.00 4615500.00 0.00243 456400.00 4615500.00 0.00236
456500.00 4615500.00 0.00228 456600.00 4615500.00 0.00221
452000.00 4615600.00 0.00319 452100.00 4615600.00 0.00323
452200.00 4615600.00 0.00326 452300.00 4615600.00 0.00323
452400.00 4615600.00 0.00330 452500.00 4615600.00 0.00330
452600.00 4615600.00 0.00335 452700.00 4615600.00 0.00346
452800.00 4615600.00 0.00352 452900.00 4615600.00 0.00363
453000.00 4615600.00 0.00375 453100.00 4615600.00 0.00392

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
453200.00	4615600.00	0.00418	453300.00	4615600.00	0.00457
453400.00	4615600.00	0.00512	453500.00	4615600.00	0.00609
453600.00	4615600.00	0.00760	453700.00	4615600.00	0.01015
453800.00	4615600.00	0.01335	453900.00	4615600.00	0.01524
454000.00	4615600.00	0.01301	454100.00	4615600.00	0.01071
454200.00	4615600.00	0.01008	454300.00	4615600.00	0.00978
454400.00	4615600.00	0.00927	454500.00	4615600.00	0.00858
454600.00	4615600.00	0.00782	454700.00	4615600.00	0.00704
454800.00	4615600.00	0.00631	454900.00	4615600.00	0.00567
455000.00	4615600.00	0.00516	455100.00	4615600.00	0.00475
455200.00	4615600.00	0.00441	455300.00	4615600.00	0.00411
455400.00	4615600.00	0.00385	455500.00	4615600.00	0.00360
455600.00	4615600.00	0.00339	455700.00	4615600.00	0.00320
455800.00	4615600.00	0.00303	455900.00	4615600.00	0.00288
456000.00	4615600.00	0.00275	456100.00	4615600.00	0.00262
456200.00	4615600.00	0.00252	456300.00	4615600.00	0.00244
456400.00	4615600.00	0.00236	456500.00	4615600.00	0.00228

456600.00 4615600.00 0.00221 452000.00 4615700.00 0.00317
452100.00 4615700.00 0.00320 452200.00 4615700.00 0.00322
452300.00 4615700.00 0.00321 452400.00 4615700.00 0.00324
452500.00 4615700.00 0.00324 452600.00 4615700.00 0.00328
452700.00 4615700.00 0.00334 452800.00 4615700.00 0.00343
452900.00 4615700.00 0.00355 453000.00 4615700.00 0.00381
453100.00 4615700.00 0.00408 453200.00 4615700.00 0.00442
453300.00 4615700.00 0.00485 453400.00 4615700.00 0.00547
453500.00 4615700.00 0.00636 453600.00 4615700.00 0.00768
453700.00 4615700.00 0.00979 453800.00 4615700.00 0.01197
453900.00 4615700.00 0.01340 454000.00 4615700.00 0.01289
454100.00 4615700.00 0.01049 454200.00 4615700.00 0.00940
454300.00 4615700.00 0.00875 454400.00 4615700.00 0.00842
454500.00 4615700.00 0.00802 454600.00 4615700.00 0.00747
454700.00 4615700.00 0.00685 454800.00 4615700.00 0.00622
454900.00 4615700.00 0.00563 455000.00 4615700.00 0.00513
455100.00 4615700.00 0.00471 455200.00 4615700.00 0.00437
455300.00 4615700.00 0.00408 455400.00 4615700.00 0.00383
455500.00 4615700.00 0.00359 455600.00 4615700.00 0.00339
455700.00 4615700.00 0.00320 455800.00 4615700.00 0.00303
455900.00 4615700.00 0.00288 456000.00 4615700.00 0.00275
456100.00 4615700.00 0.00264 456200.00 4615700.00 0.00253
456300.00 4615700.00 0.00244 456400.00 4615700.00 0.00236

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 178
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
456500.00	4615700.00	0.00228	456600.00	4615700.00	0.00221
452000.00	4615800.00	0.00320	452100.00	4615800.00	0.00322
452200.00	4615800.00	0.00323	452300.00	4615800.00	0.00318
452400.00	4615800.00	0.00326	452500.00	4615800.00	0.00329
452600.00	4615800.00	0.00333	452700.00	4615800.00	0.00334
452800.00	4615800.00	0.00350	452900.00	4615800.00	0.00372
453000.00	4615800.00	0.00398	453100.00	4615800.00	0.00429
453200.00	4615800.00	0.00464	453300.00	4615800.00	0.00509
453400.00	4615800.00	0.00568	453500.00	4615800.00	0.00638
453600.00	4615800.00	0.00755	453700.00	4615800.00	0.00924
453800.00	4615800.00	0.01079	453900.00	4615800.00	0.01182
454000.00	4615800.00	0.01173	454100.00	4615800.00	0.01042
454200.00	4615800.00	0.00934	454300.00	4615800.00	0.00825
454400.00	4615800.00	0.00770	454500.00	4615800.00	0.00736
454600.00	4615800.00	0.00701	454700.00	4615800.00	0.00657
454800.00	4615800.00	0.00607	454900.00	4615800.00	0.00556
455000.00	4615800.00	0.00510	455100.00	4615800.00	0.00469

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         455200.00    4615800.00        0.00435                  455300.00
4615800.00        0.00406
         455400.00    4615800.00        0.00381                  455500.00
4615800.00        0.00359
         455600.00    4615800.00        0.00338                  455700.00
4615800.00        0.00320
         455800.00    4615800.00        0.00304                  455900.00
4615800.00        0.00289
         456000.00    4615800.00        0.00276                  456100.00
4615800.00        0.00264
         456200.00    4615800.00        0.00254                  456300.00
4615800.00        0.00245
         456400.00    4615800.00        0.00236                  456500.00
4615800.00        0.00228
         456600.00    4615800.00        0.00221                  452000.00
4615900.00        0.00326
         452100.00    4615900.00        0.00327                  452200.00
4615900.00        0.00327
         452300.00    4615900.00        0.00326                  452400.00
4615900.00        0.00328
         452500.00    4615900.00        0.00331                  452600.00
4615900.00        0.00335
         452700.00    4615900.00        0.00342                  452800.00
4615900.00        0.00366
         452900.00    4615900.00        0.00389                  453000.00
4615900.00        0.00416
         453100.00    4615900.00        0.00446                  453200.00
4615900.00        0.00481
         453300.00    4615900.00        0.00522                  453400.00
4615900.00        0.00570
         453500.00    4615900.00        0.00633                  453600.00
4615900.00        0.00735
         453700.00    4615900.00        0.00871                  453800.00
4615900.00        0.00976
         453900.00    4615900.00        0.01050                  454000.00
4615900.00        0.01046
         454100.00    4615900.00        0.01001                  454200.00
4615900.00        0.00932
         454300.00    4615900.00        0.00813                  454400.00
4615900.00        0.00732
         454500.00    4615900.00        0.00684                  454600.00
4615900.00        0.00652
         454700.00    4615900.00        0.00620                  454800.00
4615900.00        0.00584
         454900.00    4615900.00        0.00544                  455000.00
4615900.00        0.00504
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 ,
V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 ,
VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 ,
AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
455100.00	4615900.00	0.00466	455200.00	4615900.00	0.00434
455300.00	4615900.00	0.00405	455400.00	4615900.00	0.00379
455500.00	4615900.00	0.00357	455600.00	4615900.00	0.00338
455700.00	4615900.00	0.00320	455800.00	4615900.00	0.00305
455900.00	4615900.00	0.00290	456000.00	4615900.00	0.00277
456100.00	4615900.00	0.00265	456200.00	4615900.00	0.00255
456300.00	4615900.00	0.00246	456400.00	4615900.00	0.00237
456500.00	4615900.00	0.00228	456600.00	4615900.00	0.00221
452000.00	4616000.00	0.00336	452100.00	4616000.00	0.00335
452200.00	4616000.00	0.00333	452300.00	4616000.00	0.00332
452400.00	4616000.00	0.00334	452500.00	4616000.00	0.00338
452600.00	4616000.00	0.00341	452700.00	4616000.00	0.00356
452800.00	4616000.00	0.00381	452900.00	4616000.00	0.00400
453000.00	4616000.00	0.00431	453100.00	4616000.00	0.00459
453200.00	4616000.00	0.00492	453300.00	4616000.00	0.00525
453400.00	4616000.00	0.00563	453500.00	4616000.00	0.00623
453600.00	4616000.00	0.00714	453700.00	4616000.00	0.00831

453800.00 4616000.00 0.00912 453900.00 4616000.00 0.00965
454000.00 4616000.00 0.00954 454100.00 4616000.00 0.00975
454200.00 4616000.00 0.00911 454300.00 4616000.00 0.00809
454400.00 4616000.00 0.00718 454500.00 4616000.00 0.00655
454600.00 4616000.00 0.00613 454700.00 4616000.00 0.00582
454800.00 4616000.00 0.00554 454900.00 4616000.00 0.00524
455000.00 4616000.00 0.00492 455100.00 4616000.00 0.00460
455200.00 4616000.00 0.00430 455300.00 4616000.00 0.00403
455400.00 4616000.00 0.00378 455500.00 4616000.00 0.00356
455600.00 4616000.00 0.00337 455700.00 4616000.00 0.00320
455800.00 4616000.00 0.00305 455900.00 4616000.00 0.00291
456000.00 4616000.00 0.00279 456100.00 4616000.00 0.00267
456200.00 4616000.00 0.00257 456300.00 4616000.00 0.00248
456400.00 4616000.00 0.00239 456500.00 4616000.00 0.00230
456600.00 4616000.00 0.00222 452000.00 4616100.00 0.00349
452100.00 4616100.00 0.00345 452200.00 4616100.00 0.00343
452300.00 4616100.00 0.00342 452400.00 4616100.00 0.00341
452500.00 4616100.00 0.00348 452600.00 4616100.00 0.00357
452700.00 4616100.00 0.00376 452800.00 4616100.00 0.00398
452900.00 4616100.00 0.00420 453000.00 4616100.00 0.00444
453100.00 4616100.00 0.00469 453200.00 4616100.00 0.00496
453300.00 4616100.00 0.00524 453400.00 4616100.00 0.00562
453500.00 4616100.00 0.00617 453600.00 4616100.00 0.00696

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 180
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
453700.00	4616100.00	0.00779	453800.00	4616100.00	0.00841
453900.00	4616100.00	0.00880	454000.00	4616100.00	0.00879
454100.00	4616100.00	0.00916	454200.00	4616100.00	0.00874
454300.00	4616100.00	0.00798	454400.00	4616100.00	0.00713
454500.00	4616100.00	0.00642	454600.00	4616100.00	0.00590
454700.00	4616100.00	0.00553	454800.00	4616100.00	0.00524
454900.00	4616100.00	0.00500	455000.00	4616100.00	0.00475
455100.00	4616100.00	0.00450	455200.00	4616100.00	0.00424
455300.00	4616100.00	0.00399	455400.00	4616100.00	0.00376
455500.00	4616100.00	0.00355	455600.00	4616100.00	0.00336
455700.00	4616100.00	0.00319	455800.00	4616100.00	0.00305
455900.00	4616100.00	0.00292	456000.00	4616100.00	0.00280
456100.00	4616100.00	0.00269	456200.00	4616100.00	0.00259
456300.00	4616100.00	0.00250	456400.00	4616100.00	0.00241
456500.00	4616100.00	0.00233	456600.00	4616100.00	0.00223
452000.00	4616200.00	0.00364	452100.00	4616200.00	0.00360
452200.00	4616200.00	0.00356	452300.00	4616200.00	0.00356

452400.00	4616200.00	0.00360	452500.00	4616200.00	0.00369
452600.00	4616200.00	0.00382	452700.00	4616200.00	0.00399
452800.00	4616200.00	0.00417	452900.00	4616200.00	0.00435
453000.00	4616200.00	0.00454	453100.00	4616200.00	0.00475
453200.00	4616200.00	0.00497	453300.00	4616200.00	0.00523
453400.00	4616200.00	0.00561	453500.00	4616200.00	0.00615
453600.00	4616200.00	0.00683	453700.00	4616200.00	0.00752
453800.00	4616200.00	0.00807	453900.00	4616200.00	0.00825
454000.00	4616200.00	0.00828	454100.00	4616200.00	0.00854
454200.00	4616200.00	0.00830	454300.00	4616200.00	0.00776
454400.00	4616200.00	0.00706	454500.00	4616200.00	0.00636
454600.00	4616200.00	0.00578	454700.00	4616200.00	0.00534
454800.00	4616200.00	0.00502	454900.00	4616200.00	0.00477
455000.00	4616200.00	0.00456	455100.00	4616200.00	0.00435
455200.00	4616200.00	0.00414	455300.00	4616200.00	0.00393
455400.00	4616200.00	0.00373	455500.00	4616200.00	0.00353
455600.00	4616200.00	0.00335	455700.00	4616200.00	0.00318
455800.00	4616200.00	0.00304	455900.00	4616200.00	0.00292
456000.00	4616200.00	0.00281	456100.00	4616200.00	0.00271
456200.00	4616200.00	0.00261	456300.00	4616200.00	0.00252
456400.00	4616200.00	0.00243	456500.00	4616200.00	0.00235
456600.00	4616200.00	0.00225	452000.00	4616300.00	0.00384
452100.00	4616300.00	0.00380	452200.00	4616300.00	0.00375

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452300.00	4616300.00	0.00375	452400.00	4616300.00	0.00380
452500.00	4616300.00	0.00391	452600.00	4616300.00	0.00405
452700.00	4616300.00	0.00420	452800.00	4616300.00	0.00434
452900.00	4616300.00	0.00449	453000.00	4616300.00	0.00463
453100.00	4616300.00	0.00480	453200.00	4616300.00	0.00499
453300.00	4616300.00	0.00525	453400.00	4616300.00	0.00564
453500.00	4616300.00	0.00614	453600.00	4616300.00	0.00678
453700.00	4616300.00	0.00732	453800.00	4616300.00	0.00768
453900.00	4616300.00	0.00786	454000.00	4616300.00	0.00777
454100.00	4616300.00	0.00799	454200.00	4616300.00	0.00785
454300.00	4616300.00	0.00748	454400.00	4616300.00	0.00693
454500.00	4616300.00	0.00631	454600.00	4616300.00	0.00573
454700.00	4616300.00	0.00524	454800.00	4616300.00	0.00487
454900.00	4616300.00	0.00459	455000.00	4616300.00	0.00438
455100.00	4616300.00	0.00419	455200.00	4616300.00	0.00401
455300.00	4616300.00	0.00383	455400.00	4616300.00	0.00366
455500.00	4616300.00	0.00349	455600.00	4616300.00	0.00333

455700.00 4616300.00 0.00318 455800.00 4616300.00 0.00304
455900.00 4616300.00 0.00293 456000.00 4616300.00 0.00282
456100.00 4616300.00 0.00273 456200.00 4616300.00 0.00263
456300.00 4616300.00 0.00255 456400.00 4616300.00 0.00246
456500.00 4616300.00 0.00237 456600.00 4616300.00 0.00229
452000.00 4616400.00 0.00410 452100.00 4616400.00 0.00404
452200.00 4616400.00 0.00399 452300.00 4616400.00 0.00399
452400.00 4616400.00 0.00406 452500.00 4616400.00 0.00417
452600.00 4616400.00 0.00430 452700.00 4616400.00 0.00442
452800.00 4616400.00 0.00452 452900.00 4616400.00 0.00462
453000.00 4616400.00 0.00472 453100.00 4616400.00 0.00486
453200.00 4616400.00 0.00506 453300.00 4616400.00 0.00533
453400.00 4616400.00 0.00569 453500.00 4616400.00 0.00614
453600.00 4616400.00 0.00663 453700.00 4616400.00 0.00706
453800.00 4616400.00 0.00732 453900.00 4616400.00 0.00745
454000.00 4616400.00 0.00724 454100.00 4616400.00 0.00752
454200.00 4616400.00 0.00742 454300.00 4616400.00 0.00716
454400.00 4616400.00 0.00675 454500.00 4616400.00 0.00623
454600.00 4616400.00 0.00568 454700.00 4616400.00 0.00519
454800.00 4616400.00 0.00478 454900.00 4616400.00 0.00447
455000.00 4616400.00 0.00423 455100.00 4616400.00 0.00405
455200.00 4616400.00 0.00388 455300.00 4616400.00 0.00372
455400.00 4616400.00 0.00358 455500.00 4616400.00 0.00344

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 182
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
455600.00	4616400.00	0.00330	455700.00	4616400.00	0.00317
455800.00	4616400.00	0.00305	455900.00	4616400.00	0.00294
456000.00	4616400.00	0.00284	456100.00	4616400.00	0.00275
456200.00	4616400.00	0.00266	456300.00	4616400.00	0.00257
456400.00	4616400.00	0.00248	456500.00	4616400.00	0.00238
456600.00	4616400.00	0.00230	452000.00	4616500.00	0.00440
452100.00	4616500.00	0.00434	452200.00	4616500.00	0.00427
452300.00	4616500.00	0.00428	452400.00	4616500.00	0.00437
452500.00	4616500.00	0.00449	452600.00	4616500.00	0.00459
452700.00	4616500.00	0.00466	452800.00	4616500.00	0.00470
452900.00	4616500.00	0.00477	453000.00	4616500.00	0.00486
453100.00	4616500.00	0.00498	453200.00	4616500.00	0.00517
453300.00	4616500.00	0.00542	453400.00	4616500.00	0.00574
453500.00	4616500.00	0.00612	453600.00	4616500.00	0.00651
453700.00	4616500.00	0.00683	453800.00	4616500.00	0.00700
453900.00	4616500.00	0.00706	454000.00	4616500.00	0.00714
454100.00	4616500.00	0.00694	454200.00	4616500.00	0.00703

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         454300.00    4616500.00        0.00685                    454400.00
4616500.00        0.00654
         454500.00    4616500.00        0.00611                    454600.00
4616500.00        0.00562
         454700.00    4616500.00        0.00515                    454800.00
4616500.00        0.00473
         454900.00    4616500.00        0.00440                    455000.00
4616500.00        0.00414
         455100.00    4616500.00        0.00394                    455200.00
4616500.00        0.00377
         455300.00    4616500.00        0.00362                    455400.00
4616500.00        0.00349
         455500.00    4616500.00        0.00337                    455600.00
4616500.00        0.00326
         455700.00    4616500.00        0.00315                    455800.00
4616500.00        0.00305
         455900.00    4616500.00        0.00295                    456000.00
4616500.00        0.00286
         456100.00    4616500.00        0.00277                    456200.00
4616500.00        0.00267
         456300.00    4616500.00        0.00258                    456400.00
4616500.00        0.00249
         456500.00    4616500.00        0.00239                    456600.00
4616500.00        0.00232
         452000.00    4616600.00        0.00476                    452100.00
4616600.00        0.00470
         452200.00    4616600.00        0.00463                    452300.00
4616600.00        0.00466
         452400.00    4616600.00        0.00477                    452500.00
4616600.00        0.00487
         452600.00    4616600.00        0.00490                    452700.00
4616600.00        0.00490
         452800.00    4616600.00        0.00492                    452900.00
4616600.00        0.00498
         453000.00    4616600.00        0.00505                    453100.00
4616600.00        0.00514
         453200.00    4616600.00        0.00530                    453300.00
4616600.00        0.00551
         453400.00    4616600.00        0.00576                    453500.00
4616600.00        0.00607
         453600.00    4616600.00        0.00638                    453700.00
4616600.00        0.00661
         453800.00    4616600.00        0.00675                    453900.00
4616600.00        0.00682
         454000.00    4616600.00        0.00680                    454100.00
4616600.00        0.00657
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
454200.00	4616600.00	0.00648	454300.00	4616600.00	0.00654
454400.00	4616600.00	0.00630	454500.00	4616600.00	0.00596
454600.00	4616600.00	0.00554	454700.00	4616600.00	0.00510
454800.00	4616600.00	0.00470	454900.00	4616600.00	0.00436
455000.00	4616600.00	0.00408	455100.00	4616600.00	0.00387
455200.00	4616600.00	0.00369	455300.00	4616600.00	0.00354
455400.00	4616600.00	0.00341	455500.00	4616600.00	0.00330
455600.00	4616600.00	0.00321	455700.00	4616600.00	0.00313
455800.00	4616600.00	0.00304	455900.00	4616600.00	0.00296
456000.00	4616600.00	0.00287	456100.00	4616600.00	0.00279
456200.00	4616600.00	0.00270	456300.00	4616600.00	0.00260
456400.00	4616600.00	0.00251	456500.00	4616600.00	0.00240
456600.00	4616600.00	0.00233	452000.00	4616700.00	0.00528
452100.00	4616700.00	0.00514	452200.00	4616700.00	0.00509
452300.00	4616700.00	0.00517	452400.00	4616700.00	0.00528
452500.00	4616700.00	0.00529	452600.00	4616700.00	0.00523
452700.00	4616700.00	0.00520	452800.00	4616700.00	0.00522

452900.00 4616700.00 0.00526 453000.00 4616700.00 0.00529
453100.00 4616700.00 0.00532 453200.00 4616700.00 0.00540
453300.00 4616700.00 0.00554 453400.00 4616700.00 0.00574
453500.00 4616700.00 0.00598 453600.00 4616700.00 0.00623
453700.00 4616700.00 0.00641 453800.00 4616700.00 0.00651
453900.00 4616700.00 0.00654 454000.00 4616700.00 0.00651
454100.00 4616700.00 0.00646 454200.00 4616700.00 0.00640
454300.00 4616700.00 0.00611 454400.00 4616700.00 0.00590
454500.00 4616700.00 0.00580 454600.00 4616700.00 0.00545
454700.00 4616700.00 0.00506 454800.00 4616700.00 0.00467
454900.00 4616700.00 0.00435 455000.00 4616700.00 0.00406
455100.00 4616700.00 0.00383 455200.00 4616700.00 0.00364
455300.00 4616700.00 0.00349 455400.00 4616700.00 0.00336
455500.00 4616700.00 0.00325 455600.00 4616700.00 0.00316
455700.00 4616700.00 0.00310 455800.00 4616700.00 0.00303
455900.00 4616700.00 0.00296 456000.00 4616700.00 0.00288
456100.00 4616700.00 0.00280 456200.00 4616700.00 0.00271
456300.00 4616700.00 0.00261 456400.00 4616700.00 0.00251
456500.00 4616700.00 0.00243 456600.00 4616700.00 0.00235
452000.00 4616800.00 0.00589 452100.00 4616800.00 0.00572
452200.00 4616800.00 0.00573 452300.00 4616800.00 0.00585
452400.00 4616800.00 0.00585 452500.00 4616800.00 0.00573
452600.00 4616800.00 0.00563 452700.00 4616800.00 0.00561

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452800.00	4616800.00	0.00561	452900.00	4616800.00	0.00558
453000.00	4616800.00	0.00552	453100.00	4616800.00	0.00547
453200.00	4616800.00	0.00545	453300.00	4616800.00	0.00553
453400.00	4616800.00	0.00568	453500.00	4616800.00	0.00587
453600.00	4616800.00	0.00607	453700.00	4616800.00	0.00622
453800.00	4616800.00	0.00632	453900.00	4616800.00	0.00632
454000.00	4616800.00	0.00627	454100.00	4616800.00	0.00621
454200.00	4616800.00	0.00613	454300.00	4616800.00	0.00603
454400.00	4616800.00	0.00588	454500.00	4616800.00	0.00549
454600.00	4616800.00	0.00535	454700.00	4616800.00	0.00500
454800.00	4616800.00	0.00465	454900.00	4616800.00	0.00434
455000.00	4616800.00	0.00406	455100.00	4616800.00	0.00382
455200.00	4616800.00	0.00362	455300.00	4616800.00	0.00346
455400.00	4616800.00	0.00333	455500.00	4616800.00	0.00322
455600.00	4616800.00	0.00313	455700.00	4616800.00	0.00307
455800.00	4616800.00	0.00302	455900.00	4616800.00	0.00295
456000.00	4616800.00	0.00288	456100.00	4616800.00	0.00280

456200.00 4616800.00 0.00271 456300.00 4616800.00 0.00262
456400.00 4616800.00 0.00253 456500.00 4616800.00 0.00244
456600.00 4616800.00 0.00236 452000.00 4616900.00 0.00664
452100.00 4616900.00 0.00653 452200.00 4616900.00 0.00665
452300.00 4616900.00 0.00666 452400.00 4616900.00 0.00645
452500.00 4616900.00 0.00627 452600.00 4616900.00 0.00619
452700.00 4616900.00 0.00614 452800.00 4616900.00 0.00603
452900.00 4616900.00 0.00586 453000.00 4616900.00 0.00569
453100.00 4616900.00 0.00555 453200.00 4616900.00 0.00547
453300.00 4616900.00 0.00548 453400.00 4616900.00 0.00559
453500.00 4616900.00 0.00574 453600.00 4616900.00 0.00591
453700.00 4616900.00 0.00604 453800.00 4616900.00 0.00611
453900.00 4616900.00 0.00611 454000.00 4616900.00 0.00608
454100.00 4616900.00 0.00601 454200.00 4616900.00 0.00593
454300.00 4616900.00 0.00583 454400.00 4616900.00 0.00571
454500.00 4616900.00 0.00547 454600.00 4616900.00 0.00515
454700.00 4616900.00 0.00493 454800.00 4616900.00 0.00462
454900.00 4616900.00 0.00433 455000.00 4616900.00 0.00407
455100.00 4616900.00 0.00383 455200.00 4616900.00 0.00363
455300.00 4616900.00 0.00346 455400.00 4616900.00 0.00332
455500.00 4616900.00 0.00321 455600.00 4616900.00 0.00313
455700.00 4616900.00 0.00307 455800.00 4616900.00 0.00301
455900.00 4616900.00 0.00294 456000.00 4616900.00 0.00287

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
456100.00	4616900.00	0.00279	456200.00	4616900.00	0.00270
456300.00	4616900.00	0.00261	456400.00	4616900.00	0.00253
456500.00	4616900.00	0.00245	456600.00	4616900.00	0.00238
452000.00	4617000.00	0.00766	452100.00	4617000.00	0.00778
452200.00	4617000.00	0.00784	452300.00	4617000.00	0.00750
452400.00	4617000.00	0.00718	452500.00	4617000.00	0.00703
452600.00	4617000.00	0.00691	452700.00	4617000.00	0.00667
452800.00	4617000.00	0.00636	452900.00	4617000.00	0.00605
453000.00	4617000.00	0.00578	453100.00	4617000.00	0.00557
453200.00	4617000.00	0.00546	453300.00	4617000.00	0.00543
453400.00	4617000.00	0.00549	453500.00	4617000.00	0.00560
453600.00	4617000.00	0.00575	453700.00	4617000.00	0.00587
453800.00	4617000.00	0.00595	453900.00	4617000.00	0.00596
454000.00	4617000.00	0.00593	454100.00	4617000.00	0.00586
454200.00	4617000.00	0.00578	454300.00	4617000.00	0.00569
454400.00	4617000.00	0.00555	454500.00	4617000.00	0.00541
454600.00	4617000.00	0.00502	454700.00	4617000.00	0.00489

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         454800.00    4617000.00        0.00459                    454900.00
4617000.00        0.00432
         455000.00    4617000.00        0.00408                    455100.00
4617000.00        0.00385
         455200.00    4617000.00        0.00365                    455300.00
4617000.00        0.00348
         455400.00    4617000.00        0.00334                    455500.00
4617000.00        0.00323
         455600.00    4617000.00        0.00314                    455700.00
4617000.00        0.00307
         455800.00    4617000.00        0.00301                    455900.00
4617000.00        0.00294
         456000.00    4617000.00        0.00285                    456100.00
4617000.00        0.00277
         456200.00    4617000.00        0.00269                    456300.00
4617000.00        0.00260
         456400.00    4617000.00        0.00252                    456500.00
4617000.00        0.00245
         456600.00    4617000.00        0.00240                    452000.00
4617100.00        0.00949
         452100.00    4617100.00        0.00968                    452200.00
4617100.00        0.00913
         452300.00    4617100.00        0.00852                    452400.00
4617100.00        0.00826
         452500.00    4617100.00        0.00799                    452600.00
4617100.00        0.00755
         452700.00    4617100.00        0.00704                    452800.00
4617100.00        0.00657
         452900.00    4617100.00        0.00616                    453000.00
4617100.00        0.00583
         453100.00    4617100.00        0.00560                    453200.00
4617100.00        0.00545
         453300.00    4617100.00        0.00539                    453400.00
4617100.00        0.00542
         453500.00    4617100.00        0.00549                    453600.00
4617100.00        0.00561
         453700.00    4617100.00        0.00573                    453800.00
4617100.00        0.00581
         453900.00    4617100.00        0.00584                    454000.00
4617100.00        0.00581
         454100.00    4617100.00        0.00575                    454200.00
4617100.00        0.00568
         454300.00    4617100.00        0.00558                    454400.00
4617100.00        0.00546
         454500.00    4617100.00        0.00531                    454600.00
4617100.00        0.00495
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
454700.00	4617100.00	0.00483	454800.00	4617100.00	0.00456
454900.00	4617100.00	0.00431	455000.00	4617100.00	0.00408
455100.00	4617100.00	0.00387	455200.00	4617100.00	0.00368
455300.00	4617100.00	0.00351	455400.00	4617100.00	0.00337
455500.00	4617100.00	0.00327	455600.00	4617100.00	0.00318
455700.00	4617100.00	0.00310	455800.00	4617100.00	0.00301
455900.00	4617100.00	0.00293	456000.00	4617100.00	0.00284
456100.00	4617100.00	0.00275	456200.00	4617100.00	0.00267
456300.00	4617100.00	0.00256	456400.00	4617100.00	0.00253
456500.00	4617100.00	0.00246	456600.00	4617100.00	0.00240
452000.00	4617200.00	0.01271	452100.00	4617200.00	0.01186
452200.00	4617200.00	0.01068	452300.00	4617200.00	0.01016
452400.00	4617200.00	0.00954	452500.00	4617200.00	0.00877
452600.00	4617200.00	0.00799	452700.00	4617200.00	0.00731
452800.00	4617200.00	0.00673	452900.00	4617200.00	0.00627
453000.00	4617200.00	0.00592	453100.00	4617200.00	0.00566
453200.00	4617200.00	0.00548	453300.00	4617200.00	0.00540

453400.00	4617200.00	0.00540	453500.00	4617200.00	0.00543
453600.00	4617200.00	0.00551	453700.00	4617200.00	0.00560
453800.00	4617200.00	0.00568	453900.00	4617200.00	0.00572
454000.00	4617200.00	0.00565	454100.00	4617200.00	0.00561
454200.00	4617200.00	0.00553	454300.00	4617200.00	0.00543
454400.00	4617200.00	0.00532	454500.00	4617200.00	0.00516
454600.00	4617200.00	0.00489	454700.00	4617200.00	0.00478
454800.00	4617200.00	0.00453	454900.00	4617200.00	0.00430
455000.00	4617200.00	0.00409	455100.00	4617200.00	0.00389
455200.00	4617200.00	0.00371	455300.00	4617200.00	0.00355
455400.00	4617200.00	0.00343	455500.00	4617200.00	0.00333
455600.00	4617200.00	0.00323	455700.00	4617200.00	0.00313
455800.00	4617200.00	0.00302	455900.00	4617200.00	0.00292
456000.00	4617200.00	0.00282	456100.00	4617200.00	0.00273
456200.00	4617200.00	0.00255	456300.00	4617200.00	0.00257
456400.00	4617200.00	0.00253	456500.00	4617200.00	0.00246
456600.00	4617200.00	0.00243	452000.00	4617300.00	0.01729
452100.00	4617300.00	0.01475	452200.00	4617300.00	0.01347
452300.00	4617300.00	0.01201	452400.00	4617300.00	0.01059
452500.00	4617300.00	0.00939	452600.00	4617300.00	0.00841
452700.00	4617300.00	0.00758	452800.00	4617300.00	0.00694
452900.00	4617300.00	0.00643	453000.00	4617300.00	0.00604
453100.00	4617300.00	0.00575	453200.00	4617300.00	0.00555

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
453300.00	4617300.00	0.00544	453400.00	4617300.00	0.00541
453500.00	4617300.00	0.00540	453600.00	4617300.00	0.00543
453700.00	4617300.00	0.00548	453800.00	4617300.00	0.00553
453900.00	4617300.00	0.00559	454000.00	4617300.00	0.00563
454100.00	4617300.00	0.00562	454200.00	4617300.00	0.00555
454300.00	4617300.00	0.00544	454400.00	4617300.00	0.00532
454500.00	4617300.00	0.00517	454600.00	4617300.00	0.00484
454700.00	4617300.00	0.00473	454800.00	4617300.00	0.00449
454900.00	4617300.00	0.00428	455000.00	4617300.00	0.00409
455100.00	4617300.00	0.00391	455200.00	4617300.00	0.00375
455300.00	4617300.00	0.00362	455400.00	4617300.00	0.00350
455500.00	4617300.00	0.00340	455600.00	4617300.00	0.00328
455700.00	4617300.00	0.00315	455800.00	4617300.00	0.00302
455900.00	4617300.00	0.00290	456000.00	4617300.00	0.00281
456100.00	4617300.00	0.00266	456200.00	4617300.00	0.00263
456300.00	4617300.00	0.00258	456400.00	4617300.00	0.00252
456500.00	4617300.00	0.00249	456600.00	4617300.00	0.00246

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         449000.00    4609000.00        0.00048                  449500.00
4609000.00        0.00052
         450000.00    4609000.00        0.00058                  450500.00
4609000.00        0.00062
         451000.00    4609000.00        0.00064                  451500.00
4609000.00        0.00065
         452000.00    4609000.00        0.00064                  452500.00
4609000.00        0.00065
         453000.00    4609000.00        0.00067                  453500.00
4609000.00        0.00066
         454000.00    4609000.00        0.00062                  454500.00
4609000.00        0.00060
         455000.00    4609000.00        0.00059                  455500.00
4609000.00        0.00056
         456000.00    4609000.00        0.00055                  456500.00
4609000.00        0.00054
         457000.00    4609000.00        0.00053                  457500.00
4609000.00        0.00052
         458000.00    4609000.00        0.00053                  458500.00
4609000.00        0.00055
         459000.00    4609000.00        0.00055                  459500.00
4609000.00        0.00054
         460000.00    4609000.00        0.00053                  449000.00
4609500.00        0.00050
         449500.00    4609500.00        0.00053                  450000.00
4609500.00        0.00060
         450500.00    4609500.00        0.00067                  451000.00
4609500.00        0.00070
         451500.00    4609500.00        0.00071                  452000.00
4609500.00        0.00070
         452500.00    4609500.00        0.00071                  453000.00
4609500.00        0.00073
         453500.00    4609500.00        0.00071                  454000.00
4609500.00        0.00068
         454500.00    4609500.00        0.00066                  455000.00
4609500.00        0.00064
         455500.00    4609500.00        0.00061                  456000.00
4609500.00        0.00059
         456500.00    4609500.00        0.00058                  457000.00
4609500.00        0.00057
         457500.00    4609500.00        0.00058                  458000.00
4609500.00        0.00059
         458500.00    4609500.00        0.00059                  459000.00
4609500.00        0.00058
         459500.00    4609500.00        0.00057                  460000.00
4609500.00        0.00057
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
449000.00	4610000.00	0.00051	449500.00	4610000.00	0.00056
450000.00	4610000.00	0.00062	450500.00	4610000.00	0.00070
451000.00	4610000.00	0.00075	451500.00	4610000.00	0.00078
452000.00	4610000.00	0.00077	452500.00	4610000.00	0.00077
453000.00	4610000.00	0.00079	453500.00	4610000.00	0.00079
454000.00	4610000.00	0.00074	454500.00	4610000.00	0.00072
455000.00	4610000.00	0.00070	455500.00	4610000.00	0.00066
456000.00	4610000.00	0.00065	456500.00	4610000.00	0.00063
457000.00	4610000.00	0.00063	457500.00	4610000.00	0.00065
458000.00	4610000.00	0.00066	458500.00	4610000.00	0.00064
459000.00	4610000.00	0.00063	459500.00	4610000.00	0.00062
460000.00	4610000.00	0.00062	449000.00	4610500.00	0.00054
449500.00	4610500.00	0.00059	450000.00	4610500.00	0.00065
450500.00	4610500.00	0.00072	451000.00	4610500.00	0.00081
451500.00	4610500.00	0.00086	452000.00	4610500.00	0.00086
452500.00	4610500.00	0.00085	453000.00	4610500.00	0.00089
453500.00	4610500.00	0.00088	454000.00	4610500.00	0.00083

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         454500.00    4610500.00        0.00080                  455000.00
4610500.00        0.00076
         455500.00    4610500.00        0.00073                  456000.00
4610500.00        0.00071
         456500.00    4610500.00        0.00070                  457000.00
4610500.00        0.00071
         457500.00    4610500.00        0.00073                  458000.00
4610500.00        0.00071
         458500.00    4610500.00        0.00069                  459000.00
4610500.00        0.00067
         459500.00    4610500.00        0.00068                  460000.00
4610500.00        0.00069
         449000.00    4611000.00        0.00058                  449500.00
4611000.00        0.00062
         450000.00    4611000.00        0.00067                  450500.00
4611000.00        0.00075
         451000.00    4611000.00        0.00084                  451500.00
4611000.00        0.00094
         452000.00    4611000.00        0.00091                  452500.00
4611000.00        0.00096
         453000.00    4611000.00        0.00099                  453500.00
4611000.00        0.00099
         454000.00    4611000.00        0.00093                  454500.00
4611000.00        0.00090
         455000.00    4611000.00        0.00085                  455500.00
4611000.00        0.00081
         456000.00    4611000.00        0.00079                  456500.00
4611000.00        0.00080
         457000.00    4611000.00        0.00082                  457500.00
4611000.00        0.00081
         458000.00    4611000.00        0.00078                  458500.00
4611000.00        0.00076
         459000.00    4611000.00        0.00076                  459500.00
4611000.00        0.00077
         460000.00    4611000.00        0.00077                  449000.00
4611500.00        0.00065
         449500.00    4611500.00        0.00067                  450000.00
4611500.00        0.00071
         450500.00    4611500.00        0.00079                  451000.00
4611500.00        0.00089
         451500.00    4611500.00        0.00102                  452000.00
4611500.00        0.00098
         452500.00    4611500.00        0.00110                  453000.00
4611500.00        0.00113
         453500.00    4611500.00        0.00113                  454000.00
4611500.00        0.00105
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 189
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
454500.00	4611500.00	0.00101	455000.00	4611500.00	0.00095
455500.00	4611500.00	0.00091	456000.00	4611500.00	0.00090
456500.00	4611500.00	0.00093	457000.00	4611500.00	0.00093
457500.00	4611500.00	0.00089	458000.00	4611500.00	0.00086
458500.00	4611500.00	0.00086	459000.00	4611500.00	0.00087
459500.00	4611500.00	0.00087	460000.00	4611500.00	0.00085
449000.00	4612000.00	0.00073	449500.00	4612000.00	0.00076
450000.00	4612000.00	0.00078	450500.00	4612000.00	0.00085
451000.00	4612000.00	0.00093	451500.00	4612000.00	0.00106
452000.00	4612000.00	0.00123	452500.00	4612000.00	0.00125
453000.00	4612000.00	0.00127	453500.00	4612000.00	0.00132
454000.00	4612000.00	0.00122	454500.00	4612000.00	0.00116
455000.00	4612000.00	0.00108	455500.00	4612000.00	0.00105
456000.00	4612000.00	0.00107	456500.00	4612000.00	0.00108
457000.00	4612000.00	0.00098	457500.00	4612000.00	0.00099
458000.00	4612000.00	0.00098	458500.00	4612000.00	0.00099
459000.00	4612000.00	0.00098	459500.00	4612000.00	0.00095

460000.00 4612000.00 0.00091 449000.00
4612500.00 0.00080
449500.00 4612500.00 0.00085 450000.00
4612500.00 0.00089
450500.00 4612500.00 0.00094 451000.00
4612500.00 0.00102
451500.00 4612500.00 0.00114 457000.00
4612500.00 0.00118
457500.00 4612500.00 0.00117 458000.00
4612500.00 0.00111
458500.00 4612500.00 0.00110 459000.00
4612500.00 0.00107
459500.00 4612500.00 0.00101 460000.00
4612500.00 0.00093
449000.00 4613000.00 0.00085 449500.00
4613000.00 0.00093
450000.00 4613000.00 0.00101 450500.00
4613000.00 0.00108
451000.00 4613000.00 0.00115 451500.00
4613000.00 0.00126
457000.00 4613000.00 0.00141 457500.00
4613000.00 0.00138
458000.00 4613000.00 0.00129 458500.00
4613000.00 0.00121
459000.00 4613000.00 0.00113 459500.00
4613000.00 0.00104
460000.00 4613000.00 0.00094 449000.00
4613500.00 0.00089
449500.00 4613500.00 0.00103 450000.00
4613500.00 0.00112
450500.00 4613500.00 0.00122 451000.00
4613500.00 0.00137
451500.00 4613500.00 0.00151 457000.00
4613500.00 0.00165
457500.00 4613500.00 0.00150 458000.00
4613500.00 0.00137
458500.00 4613500.00 0.00125 459000.00
4613500.00 0.00114
459500.00 4613500.00 0.00103 460000.00
4613500.00 0.00095
449000.00 4614000.00 0.00094 449500.00
4614000.00 0.00112
450000.00 4614000.00 0.00128 450500.00
4614000.00 0.00136
451000.00 4614000.00 0.00153 451500.00
4614000.00 0.00181

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

PAGE 190
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
457000.00	4614000.00	0.00177	457500.00	4614000.00	0.00158
458000.00	4614000.00	0.00142	458500.00	4614000.00	0.00129
459000.00	4614000.00	0.00117	459500.00	4614000.00	0.00106
460000.00	4614000.00	0.00099	449000.00	4614500.00	0.00108
449500.00	4614500.00	0.00124	450000.00	4614500.00	0.00149
450500.00	4614500.00	0.00163	451000.00	4614500.00	0.00180
451500.00	4614500.00	0.00212	457000.00	4614500.00	0.00189
457500.00	4614500.00	0.00168	458000.00	4614500.00	0.00151
458500.00	4614500.00	0.00135	459000.00	4614500.00	0.00121
459500.00	4614500.00	0.00110	460000.00	4614500.00	0.00102
449000.00	4615000.00	0.00117	449500.00	4615000.00	0.00135
450000.00	4615000.00	0.00165	450500.00	4615000.00	0.00201
451000.00	4615000.00	0.00220	451500.00	4615000.00	0.00259
457000.00	4615000.00	0.00200	457500.00	4615000.00	0.00176
458000.00	4615000.00	0.00155	458500.00	4615000.00	0.00138
459000.00	4615000.00	0.00123	459500.00	4615000.00	0.00113
460000.00	4615000.00	0.00105	449000.00	4615500.00	0.00136

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         449500.00    4615500.00        0.00148                  450000.00
4615500.00        0.00172
         450500.00    4615500.00        0.00222                  451000.00
4615500.00        0.00263
         451500.00    4615500.00        0.00291                  457000.00
4615500.00        0.00197
         457500.00    4615500.00        0.00170                  458000.00
4615500.00        0.00149
         458500.00    4615500.00        0.00132                  459000.00
4615500.00        0.00122
         459500.00    4615500.00        0.00113                  460000.00
4615500.00        0.00105
         449000.00    4616000.00        0.00143                  449500.00
4616000.00        0.00165
         450000.00    4616000.00        0.00178                  450500.00
4616000.00        0.00201
         451000.00    4616000.00        0.00286                  451500.00
4616000.00        0.00328
         457000.00    4616000.00        0.00195                  457500.00
4616000.00        0.00167
         458000.00    4616000.00        0.00148                  458500.00
4616000.00        0.00135
         459000.00    4616000.00        0.00124                  459500.00
4616000.00        0.00113
         460000.00    4616000.00        0.00104                  449000.00
4616500.00        0.00147
         449500.00    4616500.00        0.00171                  450000.00
4616500.00        0.00209
         450500.00    4616500.00        0.00242                  451000.00
4616500.00        0.00283
         451500.00    4616500.00        0.00420                  457000.00
4616500.00        0.00202
         457500.00    4616500.00        0.00174                  458000.00
4616500.00        0.00156
         458500.00    4616500.00        0.00139                  459000.00
4616500.00        0.00126
         459500.00    4616500.00        0.00114                  460000.00
4616500.00        0.00104
         449000.00    4617000.00        0.00170                  449500.00
4617000.00        0.00198
         450000.00    4617000.00        0.00243                  450500.00
4617000.00        0.00311
         451000.00    4617000.00        0.00421                  451500.00
4617000.00        0.00821
         457000.00    4617000.00        0.00218                  457500.00
4617000.00        0.00188
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 191
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
458000.00	4617000.00	0.00165	458500.00	4617000.00	0.00145
459000.00	4617000.00	0.00128	459500.00	4617000.00	0.00115
460000.00	4617000.00	0.00104	449000.00	4617500.00	0.00189
449500.00	4617500.00	0.00231	450000.00	4617500.00	0.00305
450500.00	4617500.00	0.00436	451000.00	4617500.00	0.00739
451500.00	4617500.00	0.01853	452000.00	4617500.00	0.03536
452500.00	4617500.00	0.01003	453000.00	4617500.00	0.00609
453500.00	4617500.00	0.00523	454000.00	4617500.00	0.00534
454500.00	4617500.00	0.00508	455000.00	4617500.00	0.00407
455500.00	4617500.00	0.00351	456000.00	4617500.00	0.00279
456500.00	4617500.00	0.00252	457000.00	4617500.00	0.00220
457500.00	4617500.00	0.00193	458000.00	4617500.00	0.00167
458500.00	4617500.00	0.00146	459000.00	4617500.00	0.00129
459500.00	4617500.00	0.00115	460000.00	4617500.00	0.00104
449000.00	4618000.00	0.00186	449500.00	4618000.00	0.00221
450000.00	4618000.00	0.00272	450500.00	4618000.00	0.00347
451000.00	4618000.00	0.00481	451500.00	4618000.00	0.00976

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         452000.00    4618000.00        0.02157                  452500.00
4618000.00        0.00871
         453000.00    4618000.00        0.00554                  453500.00
4618000.00        0.00484
         454000.00    4618000.00        0.00468                  454500.00
4618000.00        0.00571
         455000.00    4618000.00        0.00458                  455500.00
4618000.00        0.00369
         456000.00    4618000.00        0.00309                  456500.00
4618000.00        0.00246
         457000.00    4618000.00        0.00208                  457500.00
4618000.00        0.00182
         458000.00    4618000.00        0.00162                  458500.00
4618000.00        0.00144
         459000.00    4618000.00        0.00128                  459500.00
4618000.00        0.00115
         460000.00    4618000.00        0.00104                  449000.00
4618500.00        0.00164
         449500.00    4618500.00        0.00191                  450000.00
4618500.00        0.00225
         450500.00    4618500.00        0.00270                  451000.00
4618500.00        0.00395
         451500.00    4618500.00        0.00582                  452000.00
4618500.00        0.00919
         452500.00    4618500.00        0.00660                  453000.00
4618500.00        0.00500
         453500.00    4618500.00        0.00475                  454000.00
4618500.00        0.00487
         454500.00    4618500.00        0.00741                  455000.00
4618500.00        0.00847
         455500.00    4618500.00        0.00491                  456000.00
4618500.00        0.00344
         456500.00    4618500.00        0.00259                  457000.00
4618500.00        0.00210
         457500.00    4618500.00        0.00180                  458000.00
4618500.00        0.00159
         458500.00    4618500.00        0.00143                  459000.00
4618500.00        0.00129
         459500.00    4618500.00        0.00117                  460000.00
4618500.00        0.00106
         449000.00    4619000.00        0.00145                  449500.00
4619000.00        0.00165
         450000.00    4619000.00        0.00198                  450500.00
4619000.00        0.00247
         451000.00    4619000.00        0.00296                  451500.00
4619000.00        0.00415
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
452000.00	4619000.00	0.00546	452500.00	4619000.00	0.00516
453000.00	4619000.00	0.00396	453500.00	4619000.00	0.00350
454000.00	4619000.00	0.00351	454500.00	4619000.00	0.00462
455000.00	4619000.00	0.00728	455500.00	4619000.00	0.00469
456000.00	4619000.00	0.00323	456500.00	4619000.00	0.00246
457000.00	4619000.00	0.00199	457500.00	4619000.00	0.00169
458000.00	4619000.00	0.00149	458500.00	4619000.00	0.00134
459000.00	4619000.00	0.00123	459500.00	4619000.00	0.00113
460000.00	4619000.00	0.00104	449000.00	4619500.00	0.00128
449500.00	4619500.00	0.00146	450000.00	4619500.00	0.00174
450500.00	4619500.00	0.00204	451000.00	4619500.00	0.00228
451500.00	4619500.00	0.00309	452000.00	4619500.00	0.00372
452500.00	4619500.00	0.00380	453000.00	4619500.00	0.00340
453500.00	4619500.00	0.00304	454000.00	4619500.00	0.00311
454500.00	4619500.00	0.00407	455000.00	4619500.00	0.00534
455500.00	4619500.00	0.00368	456000.00	4619500.00	0.00301
456500.00	4619500.00	0.00244	457000.00	4619500.00	0.00197

457500.00 4619500.00 0.00163 458000.00 4619500.00 0.00140
458500.00 4619500.00 0.00125 459000.00 4619500.00 0.00115
459500.00 4619500.00 0.00107 460000.00 4619500.00 0.00100
449000.00 4620000.00 0.00118 449500.00 4620000.00 0.00133
450000.00 4620000.00 0.00149 450500.00 4620000.00 0.00164
451000.00 4620000.00 0.00191 451500.00 4620000.00 0.00247
452000.00 4620000.00 0.00287 452500.00 4620000.00 0.00298
453000.00 4620000.00 0.00300 453500.00 4620000.00 0.00276
454000.00 4620000.00 0.00279 454500.00 4620000.00 0.00331
455000.00 4620000.00 0.00387 455500.00 4620000.00 0.00345
456000.00 4620000.00 0.00260 456500.00 4620000.00 0.00221
457000.00 4620000.00 0.00194 457500.00 4620000.00 0.00164
458000.00 4620000.00 0.00140 458500.00 4620000.00 0.00122
459000.00 4620000.00 0.00110 459500.00 4620000.00 0.00101
460000.00 4620000.00 0.00094 449000.00 4620500.00 0.00108
449500.00 4620500.00 0.00121 450000.00 4620500.00 0.00130
450500.00 4620500.00 0.00139 451000.00 4620500.00 0.00163
451500.00 4620500.00 0.00204 452000.00 4620500.00 0.00232
452500.00 4620500.00 0.00244 453000.00 4620500.00 0.00255
453500.00 4620500.00 0.00256 454000.00 4620500.00 0.00251
454500.00 4620500.00 0.00281 455000.00 4620500.00 0.00303
455500.00 4620500.00 0.00300 456000.00 4620500.00 0.00251
456500.00 4620500.00 0.00202 457000.00 4620500.00 0.00177

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

PAGE 193
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE ANNUAL AVERAGE CONCENTRATION VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
457500.00	4620500.00	0.00159	458000.00	4620500.00	0.00140
458500.00	4620500.00	0.00122	459000.00	4620500.00	0.00109
459500.00	4620500.00	0.00099	460000.00	4620500.00	0.00091

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454084.40	4615065.40	0.14408	(12122824)	454083.30	4615039.80	0.16243	(13012624)
454082.20	4615014.10	0.19188	(13012624)	454085.10	4614964.60	0.23423	(13012624)
454088.00	4614915.00	0.33166	(12110724)	454091.00	4614865.50	0.33097	(16110324)
454093.90	4614816.00	0.28428	(16012124)	454096.80	4614766.40	0.38654	(12012616)
454099.70	4614716.90	0.25101	(12012616)	454102.60	4614667.30	0.26586	(13121924)
454105.50	4614617.80	0.23196	(13121924)	454108.50	4614568.30	0.20055	(12012616)
454111.40	4614518.70	0.17965	(12012616)	454114.30	4614469.20	0.13784	(12012616)
454107.80	4614425.20	0.12111	(12011624)	454101.30	4614381.10	0.10764	(12011624)
454094.70	4614337.10	0.10388	(16112124)	454088.20	4614293.00	0.09940	(16112124)
454081.70	4614249.00	0.09273	(16112124)	454082.20	4614201.80	0.08795	(16112124)
454082.80	4614154.70	0.08086	(16112124)	454121.40	4614157.80	0.07730	(16112124)
454160.00	4614160.90	0.07260	(14122908)	454191.30	4614179.40	0.07186	(12020708)
454222.70	4614198.00	0.07732	(12020708)	454254.00	4614216.50	0.07969	(14121008)
454253.20	4614226.30	0.08131	(14121008)	454296.00	4614249.30	0.09212	(14121008)
454338.80	4614272.30	0.09258	(14121008)	454381.70	4614295.30	0.10090	(12112708)
454424.50	4614318.30	0.11188	(14020208)	454467.30	4614341.40	0.12048	(14020208)
454510.20	4614364.40	0.11490	(14020208)	454553.00	4614387.40	0.11688	(16021608)

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        454595.80   4614410.40        0.14636  (16021608)              454595.80
4614459.20        0.16454  (16021608)
        454595.80   4614507.90        0.17235  (16021608)              454595.80
4614556.70        0.17384  (13120724)
        454595.80   4614605.50        0.21039  (12010724)              454595.80
4614654.30        0.25343  (12010724)
        454595.80   4614703.00        0.23250  (12010724)              454595.80
4614751.80        0.20222  (12022724)
        454595.80   4614800.60        0.19840  (12012508)              454595.80
4614849.30        0.14963  (12012508)
        454595.80   4614898.10        0.14037  (14102924)              454595.80
4614946.90        0.13007  (14102924)
        454595.80   4614995.60        0.17978  (14010808)              454595.80
4615044.40        0.23809  (15010208)
        454595.80   4615093.20        0.18513  (14121924)              454595.80
4615142.00        0.18016  (12011008)
        454595.80   4615190.70        0.17342  (12011008)              454595.80
4615239.50        0.16187  (12011008)
        454551.90   4615219.20        0.18732  (12011008)              454508.00
4615199.00        0.20235  (12011008)
        454484.50   4615239.50        0.15764  (12011008)              454461.10
4615279.90        0.12982  (14021724)
        454413.60   4615286.60        0.11849  (14021724)              454376.80
4615266.90        0.11921  (13110124)
        454340.00   4615247.20        0.12443  (12101924)              454303.10
4615227.50        0.12645  (13020324)
        454266.30   4615207.80        0.12960  (14122424)              454229.50
4615188.10        0.12557  (16082108)
        454251.00   4615155.90        0.12439  (16111524)              454209.30
4615133.30        0.13734  (16111524)
        454167.70   4615110.70        0.14687  (13121308)              454126.10
4615088.00        0.14876  (16111524)
        452000.00   4612100.00        0.03628  (15072608)              452100.00
4612100.00        0.03342  (16101924)
        452200.00   4612100.00        0.03700  (16101924)              452300.00
4612100.00        0.03997  (16101924)
        452400.00   4612100.00        0.04077  (16101924)              452500.00
4612100.00        0.03883  (16101924)
        452600.00   4612100.00        0.04025  (13050408)              452700.00
4612100.00        0.04198  (13050408)
        452800.00   4612100.00        0.04234  (13050408)              452900.00
4612100.00        0.04188  (13050408)
        453000.00   4612100.00        0.04070  (13050408)              453100.00
4612100.00        0.03878  (14061008)
        453200.00   4612100.00        0.04090  (15090408)              453300.00
4612100.00        0.04109  (15090408)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 195
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453400.00	4612100.00	0.04400	(15062008)	453500.00	4612100.00	0.04904	(15062008)
453600.00	4612100.00	0.04863	(15062008)	453700.00	4612100.00	0.04309	(15062008)
453800.00	4612100.00	0.03513	(15062008)	453900.00	4612100.00	0.03333	(14040908)
454000.00	4612100.00	0.03744	(13050508)	454100.00	4612100.00	0.03835	(13050508)
454200.00	4612100.00	0.03621	(13082308)	454300.00	4612100.00	0.03525	(13082308)
454400.00	4612100.00	0.03286	(13091524)	454500.00	4612100.00	0.03114	(13082308)
454600.00	4612100.00	0.03238	(13082308)	454700.00	4612100.00	0.03440	(13082308)
454800.00	4612100.00	0.03608	(13082308)	454900.00	4612100.00	0.03751	(13082308)
455000.00	4612100.00	0.03597	(13082308)	455100.00	4612100.00	0.03375	(13082308)
455200.00	4612100.00	0.03142	(13082308)	455300.00	4612100.00	0.02938	(16100124)
455400.00	4612100.00	0.02952	(14052508)	455500.00	4612100.00	0.03175	(13092208)
455600.00	4612100.00	0.03554	(13092208)	455700.00	4612100.00	0.03887	(13092208)
455800.00	4612100.00	0.04322	(16121708)	455900.00	4612100.00	0.04645	(16121708)
456000.00	4612100.00	0.04763	(16121708)	456100.00	4612100.00	0.04502	(16121708)
456200.00	4612100.00	0.04286	(13092208)	456300.00	4612100.00	0.04292	(14112724)
456400.00	4612100.00	0.04269	(14112724)	456500.00	4612100.00	0.04469	(15111008)
456600.00	4612100.00	0.05274	(15111008)	452000.00	4612200.00	0.03799	(15072608)

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        452100.00   4612200.00        0.03317  (15072608)              452200.00
4612200.00        0.03656  (16101924)
        452300.00   4612200.00        0.03974  (16101924)              452400.00
4612200.00        0.04173  (16101924)
        452500.00   4612200.00        0.04223  (16101924)              452600.00
4612200.00        0.04169  (13050408)
        452700.00   4612200.00        0.04378  (13050408)              452800.00
4612200.00        0.04431  (13050408)
        452900.00   4612200.00        0.04362  (13050408)              453000.00
4612200.00        0.04199  (13050408)
        453100.00   4612200.00        0.04045  (14061008)              453200.00
4612200.00        0.04047  (15090408)
        453300.00   4612200.00        0.04169  (15090408)              453400.00
4612200.00        0.04405  (15062008)
        453500.00   4612200.00        0.04973  (15062008)              453600.00
4612200.00        0.04966  (15062008)
        453700.00   4612200.00        0.04401  (15062008)              453800.00
4612200.00        0.03567  (15062008)
        453900.00   4612200.00        0.03391  (13050508)              454000.00
4612200.00        0.03881  (13050508)
        454100.00   4612200.00        0.03909  (13050508)              454200.00
4612200.00        0.03723  (13082308)
        454300.00   4612200.00        0.03578  (13082308)              454400.00
4612200.00        0.03352  (13091524)
        454500.00   4612200.00        0.03211  (13082308)              454600.00
4612200.00        0.03247  (13082308)
        454700.00   4612200.00        0.03529  (13082308)              454800.00
4612200.00        0.03698  (13082308)
        454900.00   4612200.00        0.03700  (13082308)              455000.00
4612200.00        0.03562  (13082308)
        455100.00   4612200.00        0.03304  (16100124)              455200.00
4612200.00        0.03143  (16100124)
        455300.00   4612200.00        0.02973  (14052508)              455400.00
4612200.00        0.03094  (13092208)
        455500.00   4612200.00        0.03453  (13092208)              455600.00
4612200.00        0.03839  (13092208)
        455700.00   4612200.00        0.04243  (16121708)              455800.00
4612200.00        0.04634  (16121708)
        455900.00   4612200.00        0.04795  (16121708)              456000.00
4612200.00        0.04681  (16121708)
        456100.00   4612200.00        0.04464  (13092208)              456200.00
4612200.00        0.04386  (14112724)
        456300.00   4612200.00        0.04420  (14112724)              456400.00
4612200.00        0.04472  (15111008)
        456500.00   4612200.00        0.05344  (15111008)              456600.00
4612200.00        0.05990  (15111008)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 196
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4612300.00	0.03938	(15072608)	452100.00	4612300.00	0.03496c	(12060624)
452200.00	4612300.00	0.03538	(16101924)	452300.00	4612300.00	0.03886	(16101924)
452400.00	4612300.00	0.04219	(16101924)	452500.00	4612300.00	0.04314	(16101924)
452600.00	4612300.00	0.04254	(13050408)	452700.00	4612300.00	0.04547	(13050408)
452800.00	4612300.00	0.04637	(13050408)	452900.00	4612300.00	0.04550	(13050408)
453000.00	4612300.00	0.04336	(13050408)	453100.00	4612300.00	0.04207	(14061008)
453200.00	4612300.00	0.03973	(15090408)	453300.00	4612300.00	0.04211	(15090408)
453400.00	4612300.00	0.04400	(15062008)	453500.00	4612300.00	0.05039	(15062008)
453600.00	4612300.00	0.05070	(15062008)	453700.00	4612300.00	0.04494	(15062008)
453800.00	4612300.00	0.03621	(15062008)	453900.00	4612300.00	0.03511	(13050508)
454000.00	4612300.00	0.04011	(13050508)	454100.00	4612300.00	0.03986	(13050508)
454200.00	4612300.00	0.03816	(13082308)	454300.00	4612300.00	0.03629	(13082308)
454400.00	4612300.00	0.03394	(13091524)	454500.00	4612300.00	0.03324	(13082308)
454600.00	4612300.00	0.03332	(13082308)	454700.00	4612300.00	0.03715	(13082308)
454800.00	4612300.00	0.03772	(13082308)	454900.00	4612300.00	0.03639	(13082308)
455000.00	4612300.00	0.03486	(13082308)	455100.00	4612300.00	0.03358	(16100124)
455200.00	4612300.00	0.03159	(16100124)	455300.00	4612300.00	0.03026	(14052508)

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        455400.00   4612300.00        0.03370  (13092208)              455500.00
4612300.00        0.03756  (13092208)
        455600.00   4612300.00        0.04153  (13092208)              455700.00
4612300.00        0.04603  (16121708)
        455800.00   4612300.00        0.04850  (16121708)              455900.00
4612300.00        0.04817  (16121708)
        456000.00   4612300.00        0.04666  (13092208)              456100.00
4612300.00        0.04485  (14112724)
        456200.00   4612300.00        0.04532  (14112724)              456300.00
4612300.00        0.04481  (15111008)
        456400.00   4612300.00        0.05251  (15111008)              456500.00
4612300.00        0.06034  (15111008)
        456600.00   4612300.00        0.06443  (15111008)              452000.00
4612400.00        0.04039  (15072608)
        452100.00   4612400.00        0.03588  (15072608)              452200.00
4612400.00        0.03393c (12060624)
        452300.00   4612400.00        0.03746  (16101924)              452400.00
4612400.00        0.04189  (16101924)
        452500.00   4612400.00        0.04403  (16101924)              452600.00
4612400.00        0.04365  (16101924)
        452700.00   4612400.00        0.04697  (13050408)              452800.00
4612400.00        0.04840  (13050408)
        452900.00   4612400.00        0.04752  (13050408)              453000.00
4612400.00        0.04484  (13050408)
        453100.00   4612400.00        0.04361  (14061008)              453200.00
4612400.00        0.04037  (14061008)
        453300.00   4612400.00        0.04235  (15090408)              453400.00
4612400.00        0.04378  (15062008)
        453500.00   4612400.00        0.05097  (15062008)              453600.00
4612400.00        0.05176  (15062008)
        453700.00   4612400.00        0.04591  (15062008)              453800.00
4612400.00        0.03670  (15062008)
        453900.00   4612400.00        0.03640  (13050508)              454000.00
4612400.00        0.04141  (13050508)
        454100.00   4612400.00        0.04055  (13050508)              454200.00
4612400.00        0.03904  (13082308)
        454300.00   4612400.00        0.03715  (13091524)              454400.00
4612400.00        0.03393  (13091524)
        454500.00   4612400.00        0.03451  (13082308)              454600.00
4612400.00        0.03510  (13082308)
        454700.00   4612400.00        0.03845  (13082308)              454800.00
4612400.00        0.03817  (13082308)
        454900.00   4612400.00        0.03586  (13082308)              455000.00
4612400.00        0.03564  (16100124)
        455100.00   4612400.00        0.03403  (16100124)              455200.00
4612400.00        0.03173  (16100124)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 197
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455300.00	4612400.00	0.03291	(13092208)	455400.00	4612400.00	0.03671	(13092208)
455500.00	4612400.00	0.04081	(13092208)	455600.00	4612400.00	0.04544	(16121708)
455700.00	4612400.00	0.04879	(16121708)	455800.00	4612400.00	0.04970	(16121708)
455900.00	4612400.00	0.04843	(13092208)	456000.00	4612400.00	0.04615	(13092208)
456100.00	4612400.00	0.04687	(14112724)	456200.00	4612400.00	0.04545	(14112724)
456300.00	4612400.00	0.05392	(15111008)	456400.00	4612400.00	0.06226	(15111008)
456500.00	4612400.00	0.06553	(15111008)	456600.00	4612400.00	0.06610	(15111008)
452000.00	4612500.00	0.03992	(15072608)	452100.00	4612500.00	0.03613	(15072608)
452200.00	4612500.00	0.03542c	(12060624)	452300.00	4612500.00	0.03573	(16101924)
452400.00	4612500.00	0.04090	(16101924)	452500.00	4612500.00	0.04452	(16101924)
452600.00	4612500.00	0.04499	(16101924)	452700.00	4612500.00	0.04548	(13050408)
452800.00	4612500.00	0.04845	(13050408)	452900.00	4612500.00	0.04957	(13050408)
453000.00	4612500.00	0.04640	(13050408)	453100.00	4612500.00	0.04502	(14061008)
453200.00	4612500.00	0.04256	(14061008)	453300.00	4612500.00	0.04206	(15090408)
453400.00	4612500.00	0.04342	(15062008)	453500.00	4612500.00	0.05145	(15062008)
453600.00	4612500.00	0.05281	(15062008)	453700.00	4612500.00	0.04684	(15062008)
453800.00	4612500.00	0.03717	(15062008)	453900.00	4612500.00	0.03781	(13050508)

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        454000.00   4612500.00        0.04258  (13050508)              454100.00
4612500.00        0.04073  (13050508)
        454200.00   4612500.00        0.03997  (13082308)              454300.00
4612500.00        0.03831  (13091524)
        454400.00   4612500.00        0.03453  (13082308)              454500.00
4612500.00        0.03589  (13082308)
        454600.00   4612500.00        0.03682  (13082308)              454700.00
4612500.00        0.03957  (13082308)
        454800.00   4612500.00        0.03804  (13082308)              454900.00
4612500.00        0.03657  (16100124)
        455000.00   4612500.00        0.03632  (16100124)              455100.00
4612500.00        0.03440  (16100124)
        455200.00   4612500.00        0.03217  (13092208)              455300.00
4612500.00        0.03608  (13092208)
        455400.00   4612500.00        0.03996  (13092208)              455500.00
4612500.00        0.04455  (16121708)
        455600.00   4612500.00        0.04879  (16121708)              455700.00
4612500.00        0.05031  (16121708)
        455800.00   4612500.00        0.04987  (13092208)              455900.00
4612500.00        0.04808  (13092208)
        456000.00   4612500.00        0.04865  (14112724)              456100.00
4612500.00        0.04739  (14112724)
        456200.00   4612500.00        0.05433  (15111008)              456300.00
4612500.00        0.06258  (15111008)
        456400.00   4612500.00        0.06817  (15111008)              456500.00
4612500.00        0.06783  (15111008)
        456600.00   4612500.00        0.06497  (15111008)              452000.00
4612600.00        0.04111  (15072608)
        452100.00   4612600.00        0.03803  (15072608)              452200.00
4612600.00        0.03718c (12060624)
        452300.00   4612600.00        0.03763c (12060624)              452400.00
4612600.00        0.04097  (16101924)
        452500.00   4612600.00        0.04608  (16101924)              452600.00
4612600.00        0.04774  (16101924)
        452700.00   4612600.00        0.04624  (13050408)              452800.00
4612600.00        0.04898  (13050408)
        452900.00   4612600.00        0.05160  (13050408)              453000.00
4612600.00        0.04760  (13050408)
        453100.00   4612600.00        0.04616  (14061008)              453200.00
4612600.00        0.04468  (14061008)
        453300.00   4612600.00        0.04117  (15090408)              453400.00
4612600.00        0.04283  (15062008)
        453500.00   4612600.00        0.05174  (15062008)              453600.00
4612600.00        0.05376  (15062008)
        453700.00   4612600.00        0.04766  (15062008)              453800.00
4612600.00        0.03748  (15062008)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453900.00	4612600.00	0.03926	(13050508)	454000.00	4612600.00	0.04360	(13050508)
454100.00	4612600.00	0.04180	(15012108)	454200.00	4612600.00	0.04184	(15012108)
454300.00	4612600.00	0.03935	(13091524)	454400.00	4612600.00	0.03538	(13082308)
454500.00	4612600.00	0.03731	(13082308)	454600.00	4612600.00	0.03907	(13082308)
454700.00	4612600.00	0.04013	(13082308)	454800.00	4612600.00	0.03786	(16100124)
454900.00	4612600.00	0.03693	(16100124)	455000.00	4612600.00	0.03693	(16100124)
455100.00	4612600.00	0.03460	(16100124)	455200.00	4612600.00	0.03526	(13092208)
455300.00	4612600.00	0.03907	(13092208)	455400.00	4612600.00	0.04344	(13092208)
455500.00	4612600.00	0.04868	(16121708)	455600.00	4612600.00	0.05137	(16121708)
455700.00	4612600.00	0.05112	(13092208)	455800.00	4612600.00	0.04989	(13092208)
455900.00	4612600.00	0.05020	(14112724)	456000.00	4612600.00	0.04962	(14112724)
456100.00	4612600.00	0.05475	(15111008)	456200.00	4612600.00	0.06357	(15111008)
456300.00	4612600.00	0.06885	(15111008)	456400.00	4612600.00	0.07009	(15111008)
456500.00	4612600.00	0.06665	(15111008)	456600.00	4612600.00	0.06081	(15111008)
452000.00	4612700.00	0.04158	(15072608)	452100.00	4612700.00	0.03858	(15072608)
452200.00	4612700.00	0.03613c	(12060624)	452300.00	4612700.00	0.03918c	(12060624)
452400.00	4612700.00	0.03909	(16101924)	452500.00	4612700.00	0.04507	(16101924)

452600.00 4612700.00 0.04912 (16101924) 452700.00
4612700.00 0.04934 (16101924)
452800.00 4612700.00 0.05032 (13050408) 452900.00
4612700.00 0.05081 (13050408)
453000.00 4612700.00 0.04962 (13050408) 453100.00
4612700.00 0.04708 (14061008)
453200.00 4612700.00 0.04678 (14061008) 453300.00
4612700.00 0.04099 (14061008)
453400.00 4612700.00 0.04223 (15062008) 453500.00
4612700.00 0.05214 (15062008)
453600.00 4612700.00 0.05482 (15062008) 453700.00
4612700.00 0.04853 (15062008)
453800.00 4612700.00 0.03773 (15062008) 453900.00
4612700.00 0.04045 (13050508)
454000.00 4612700.00 0.04497 (13050508) 454100.00
4612700.00 0.04380 (15012108)
454200.00 4612700.00 0.04379 (15012108) 454300.00
4612700.00 0.03995 (13091524)
454400.00 4612700.00 0.03532 (13082308) 454500.00
4612700.00 0.03876 (13082308)
454600.00 4612700.00 0.03949 (14122908) 454700.00
4612700.00 0.03887 (13082308)
454800.00 4612700.00 0.03759 (16100124) 454900.00
4612700.00 0.03741 (16100124)
455000.00 4612700.00 0.03739 (16100124) 455100.00
4612700.00 0.03511 (14121008)
455200.00 4612700.00 0.03856 (13092208) 455300.00
4612700.00 0.04259 (13092208)
455400.00 4612700.00 0.04776 (16121708) 455500.00
4612700.00 0.05136 (16121708)
455600.00 4612700.00 0.05220 (13092208) 455700.00
4612700.00 0.05163 (13092208)
455800.00 4612700.00 0.05170 (14112724) 455900.00
4612700.00 0.05170 (14112724)
456000.00 4612700.00 0.05547 (15111008) 456100.00
4612700.00 0.06464 (15111008)
456200.00 4612700.00 0.07032 (15111008) 456300.00
4612700.00 0.07160 (15111008)
456400.00 4612700.00 0.06872 (15111008) 456500.00
4612700.00 0.06221 (15111008)
456600.00 4612700.00 0.05431 (15111008) 452000.00
4612800.00 0.04127 (15072608)
452100.00 4612800.00 0.03848 (15072608) 452200.00
4612800.00 0.03399 (15072608)
452300.00 4612800.00 0.03898c (12060624) 452400.00
4612800.00 0.04024c (12060624)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 199
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452500.00	4612800.00	0.04339	(16101924)	452600.00	4612800.00	0.04891	(16101924)
452700.00	4612800.00	0.05113	(16101924)	452800.00	4612800.00	0.05120	(13050408)
452900.00	4612800.00	0.05169	(13050408)	453000.00	4612800.00	0.04837	(13050408)
453100.00	4612800.00	0.04769	(14061008)	453200.00	4612800.00	0.04880	(14061008)
453300.00	4612800.00	0.04383	(14061008)	453400.00	4612800.00	0.04149	(15062008)
453500.00	4612800.00	0.05234	(15062008)	453600.00	4612800.00	0.05587	(15062008)
453700.00	4612800.00	0.04957	(15062008)	453800.00	4612800.00	0.03806	(15062008)
453900.00	4612800.00	0.04186	(13050508)	454000.00	4612800.00	0.04652	(13050508)
454100.00	4612800.00	0.04578	(15012108)	454200.00	4612800.00	0.04561	(15012108)
454300.00	4612800.00	0.04070	(13091524)	454400.00	4612800.00	0.03716	(13082308)
454500.00	4612800.00	0.04009	(13082308)	454600.00	4612800.00	0.04244	(13082308)
454700.00	4612800.00	0.04231	(16100124)	454800.00	4612800.00	0.04181	(16100124)
454900.00	4612800.00	0.04003	(16100124)	455000.00	4612800.00	0.03773	(16100124)
455100.00	4612800.00	0.03770	(13092208)	455200.00	4612800.00	0.04207	(13092208)
455300.00	4612800.00	0.04669	(16121708)	455400.00	4612800.00	0.05137	(16121708)
455500.00	4612800.00	0.05301	(13092208)	455600.00	4612800.00	0.05323	(13092208)
455700.00	4612800.00	0.05312	(14112724)	455800.00	4612800.00	0.05380	(14112724)

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        455900.00   4612800.00        0.05568  (15111008)              456000.00
4612800.00        0.06617  (15111008)
        456100.00   4612800.00        0.07196  (15111008)              456200.00
4612800.00        0.07332  (15111008)
        456300.00   4612800.00        0.07033  (15111008)              456400.00
4612800.00        0.06413  (15111008)
        456500.00   4612800.00        0.05530  (15111008)              456600.00
4612800.00        0.04653  (15111008)
        452000.00   4612900.00        0.04078  (15072608)              452100.00
4612900.00        0.03793  (15072608)
        452200.00   4612900.00        0.03353  (12110224)              452300.00
4612900.00        0.03675c (12060624)
        452400.00   4612900.00        0.04138c (12060624)              452500.00
4612900.00        0.04117  (16101924)
        452600.00   4612900.00        0.04765  (16101924)              452700.00
4612900.00        0.05155  (16101924)
        452800.00   4612900.00        0.05445  (13050408)              452900.00
4612900.00        0.05326  (13050408)
        453000.00   4612900.00        0.05313  (13050408)              453100.00
4612900.00        0.04647  (14061008)
        453200.00   4612900.00        0.04919  (14061008)              453300.00
4612900.00        0.04664  (14061008)
        453400.00   4612900.00        0.04050  (15062008)              453500.00
4612900.00        0.05237  (15062008)
        453600.00   4612900.00        0.05687  (15062008)              453700.00
4612900.00        0.05065  (15062008)
        453800.00   4612900.00        0.03834  (15062008)              453900.00
4612900.00        0.04406  (13050508)
        454000.00   4612900.00        0.04767  (13050508)              454100.00
4612900.00        0.04817  (15012108)
        454200.00   4612900.00        0.04756  (15012108)              454300.00
4612900.00        0.04125  (13091524)
        454400.00   4612900.00        0.03864  (13082308)              454500.00
4612900.00        0.04277  (14122908)
        454600.00   4612900.00        0.04336  (14122908)              454700.00
4612900.00        0.04391  (16100124)
        454800.00   4612900.00        0.04245  (16100124)              454900.00
4612900.00        0.04014  (16100124)
        455000.00   4612900.00        0.03885  (14121008)              455100.00
4612900.00        0.04109  (13092208)
        455200.00   4612900.00        0.04585  (13092208)              455300.00
4612900.00        0.05097  (16121708)
        455400.00   4612900.00        0.05364  (16121708)              455500.00
4612900.00        0.05464  (13092208)
        455600.00   4612900.00        0.05443  (14112724)              455700.00
4612900.00        0.05592  (14112724)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 200
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455800.00	4612900.00	0.05573	(15111008)	455900.00	4612900.00	0.06744	(15111008)
456000.00	4612900.00	0.07416	(15111008)	456100.00	4612900.00	0.07524	(15111008)
456200.00	4612900.00	0.07195	(15111008)	456300.00	4612900.00	0.06516	(15111008)
456400.00	4612900.00	0.05627	(15111008)	456500.00	4612900.00	0.04710	(15111008)
456600.00	4612900.00	0.04636	(12020508)	452000.00	4613000.00	0.04030	(15072608)
452100.00	4613000.00	0.03733	(15092508)	452200.00	4613000.00	0.03443	(12110224)
452300.00	4613000.00	0.03707	(16092008)	452400.00	4613000.00	0.04045c	(12060624)
452500.00	4613000.00	0.04284c	(12060624)	452600.00	4613000.00	0.04540	(16101924)
452700.00	4613000.00	0.05138	(16101924)	452800.00	4613000.00	0.05393	(13050408)
452900.00	4613000.00	0.05699	(13050408)	453000.00	4613000.00	0.05483	(13050408)
453100.00	4613000.00	0.04743	(14061008)	453200.00	4613000.00	0.05032	(14061008)
453300.00	4613000.00	0.04856	(14061008)	453400.00	4613000.00	0.04038	(14061008)
453500.00	4613000.00	0.05220	(15062008)	453600.00	4613000.00	0.05781	(15062008)
453700.00	4613000.00	0.05162	(15062008)	453800.00	4613000.00	0.03987	(16042308)
453900.00	4613000.00	0.04580	(13050508)	454000.00	4613000.00	0.04890	(13050508)
454100.00	4613000.00	0.05075	(15012108)	454200.00	4613000.00	0.04925	(15012108)
454300.00	4613000.00	0.04135	(13091524)	454400.00	4613000.00	0.04077	(14122908)

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        454500.00   4613000.00        0.04544  (14122908)              454600.00
4613000.00        0.04524  (16100124)
        454700.00   4613000.00        0.04551  (16100124)              454800.00
4613000.00        0.04349  (16100124)
        454900.00   4613000.00        0.04089  (16100124)              455000.00
4613000.00        0.04138  (14121008)
        455100.00   4613000.00        0.04484  (13092208)              455200.00
4613000.00        0.05063  (16121708)
        455300.00   4613000.00        0.05480  (16121708)              455400.00
4613000.00        0.05580  (13092208)
        455500.00   4613000.00        0.05687  (14020208)              455600.00
4613000.00        0.05801  (14112724)
        455700.00   4613000.00        0.05644  (14112724)              455800.00
4613000.00        0.06803  (15111008)
        455900.00   4613000.00        0.07662  (15111008)              456000.00
4613000.00        0.07778  (15111008)
        456100.00   4613000.00        0.07380  (15111008)              456200.00
4613000.00        0.06650  (15111008)
        456300.00   4613000.00        0.05759  (15111008)              456400.00
4613000.00        0.04799  (15111008)
        456500.00   4613000.00        0.04739  (12020508)              456600.00
4613000.00        0.04702  (12020508)
        452000.00   4613100.00        0.03999  (15072608)              452100.00
4613100.00        0.03796  (15092508)
        452200.00   4613100.00        0.03534  (15092508)              452300.00
4613100.00        0.03883  (16092008)
        452400.00   4613100.00        0.04199  (16092008)              452500.00
4613100.00        0.04336c (12060624)
        452600.00   4613100.00        0.04307  (16101924)              452700.00
4613100.00        0.05027  (16101924)
        452800.00   4613100.00        0.05458  (16101924)              452900.00
4613100.00        0.05708  (13050408)
        453000.00   4613100.00        0.05588  (13050408)              453100.00
4613100.00        0.04893  (13050408)
        453200.00   4613100.00        0.05306  (14061008)              453300.00
4613100.00        0.05045  (14061008)
        453400.00   4613100.00        0.04383  (14061008)              453500.00
4613100.00        0.05161  (15062008)
        453600.00   4613100.00        0.05830  (15062008)              453700.00
4613100.00        0.05247  (15062008)
        453800.00   4613100.00        0.04187  (16042308)              453900.00
4613100.00        0.04746  (13050508)
        454000.00   4613100.00        0.04997  (13050508)              454100.00
4613100.00        0.05403  (15012108)
        454200.00   4613100.00        0.05064  (15012108)              454300.00
4613100.00        0.04094  (13091524)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 201
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454400.00	4613100.00	0.04473	(14122908)	454500.00	4613100.00	0.04755	(14122908)
454600.00	4613100.00	0.04749	(16100124)	454700.00	4613100.00	0.04688	(16100124)
454800.00	4613100.00	0.04440	(16100124)	454900.00	4613100.00	0.04294	(14121008)
455000.00	4613100.00	0.04379	(13092208)	455100.00	4613100.00	0.04927	(16121708)
455200.00	4613100.00	0.05474	(16121708)	455300.00	4613100.00	0.05735	(13092208)
455400.00	4613100.00	0.05932	(14020208)	455500.00	4613100.00	0.06005	(14112724)
455600.00	4613100.00	0.05924	(14112724)	455700.00	4613100.00	0.06925	(15111008)
455800.00	4613100.00	0.07755	(15111008)	455900.00	4613100.00	0.07987	(15111008)
456000.00	4613100.00	0.07622	(15111008)	456100.00	4613100.00	0.06795	(15111008)
456200.00	4613100.00	0.05815	(15111008)	456300.00	4613100.00	0.04829	(15111008)
456400.00	4613100.00	0.04657	(12020508)	456500.00	4613100.00	0.04689	(16112108)
456600.00	4613100.00	0.05215	(16112108)	452000.00	4613200.00	0.03997	(15072608)
452100.00	4613200.00	0.03711	(15092508)	452200.00	4613200.00	0.03624	(15092508)
452300.00	4613200.00	0.03868	(16092008)	452400.00	4613200.00	0.04457	(16092008)
452500.00	4613200.00	0.04595	(16092008)	452600.00	4613200.00	0.04553c	(12060624)
452700.00	4613200.00	0.04833	(16101924)	452800.00	4613200.00	0.05473	(16101924)
452900.00	4613200.00	0.05651	(16101924)	453000.00	4613200.00	0.05619	(13050408)

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        453100.00   4613200.00        0.04995  (13050408)              453200.00
4613200.00        0.05433  (14061008)
        453300.00   4613200.00        0.05493  (14061008)              453400.00
4613200.00        0.04537  (14061008)
        453500.00   4613200.00        0.04743  (15062008)              453600.00
4613200.00        0.05841  (15062008)
        453700.00   4613200.00        0.05359  (15062008)              453800.00
4613200.00        0.04405  (16042308)
        453900.00   4613200.00        0.04929  (13050508)              454000.00
4613200.00        0.05080  (13050508)
        454100.00   4613200.00        0.05625  (15012108)              454200.00
4613200.00        0.05161  (15012108)
        454300.00   4613200.00        0.03925  (15112908)              454400.00
4613200.00        0.04756  (14122908)
        454500.00   4613200.00        0.04887  (14122908)              454600.00
4613200.00        0.04944  (16100124)
        454700.00   4613200.00        0.04773  (16100124)              454800.00
4613200.00        0.04451  (16100124)
        454900.00   4613200.00        0.04581  (14121008)              455000.00
4613200.00        0.04813  (13092208)
        455100.00   4613200.00        0.05411  (16121708)              455200.00
4613200.00        0.05784  (13092208)
        455300.00   4613200.00        0.06204  (14020208)              455400.00
4613200.00        0.06282  (14020208)
        455500.00   4613200.00        0.06212  (14112724)              455600.00
4613200.00        0.06940  (15111008)
        455700.00   4613200.00        0.07907  (15111008)              455800.00
4613200.00        0.08186  (15111008)
        455900.00   4613200.00        0.07815  (15111008)              456000.00
4613200.00        0.07053  (15111008)
        456100.00   4613200.00        0.05903  (15111008)              456200.00
4613200.00        0.04985  (14121808)
        456300.00   4613200.00        0.04686  (12020508)              456400.00
4613200.00        0.05104  (16112108)
        456500.00   4613200.00        0.05603  (16112108)              456600.00
4613200.00        0.05885  (16112108)
        452000.00   4613300.00        0.04027  (15072608)              452100.00
4613300.00        0.03471  (15092508)
        452200.00   4613300.00        0.03570  (15092508)              452300.00
4613300.00        0.03835  (15092508)
        452400.00   4613300.00        0.04527  (16092008)              452500.00
4613300.00        0.04948  (16092008)
        452600.00   4613300.00        0.04753  (16092008)              452700.00
4613300.00        0.04639c (12060624)
        452800.00   4613300.00        0.05405  (16101924)              452900.00
4613300.00        0.05865  (16101924)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 202
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453000.00	4613300.00	0.05557	(16101924)	453100.00	4613300.00	0.05073	(13050408)
453200.00	4613300.00	0.05453	(14061008)	453300.00	4613300.00	0.05786	(14061008)
453400.00	4613300.00	0.05040	(14061008)	453500.00	4613300.00	0.04720	(15062008)
453600.00	4613300.00	0.05469	(15062008)	453700.00	4613300.00	0.05432	(15062008)
453800.00	4613300.00	0.04650	(16042308)	453900.00	4613300.00	0.05076	(13050508)
454000.00	4613300.00	0.05285	(15012108)	454100.00	4613300.00	0.05816	(15012108)
454200.00	4613300.00	0.05201	(15012108)	454300.00	4613300.00	0.04252	(14122908)
454400.00	4613300.00	0.05050	(14122908)	454500.00	4613300.00	0.05058	(16100124)
454600.00	4613300.00	0.05109	(16100124)	454700.00	4613300.00	0.04868	(16100124)
454800.00	4613300.00	0.04799	(14121008)	454900.00	4613300.00	0.04757	(14121008)
455000.00	4613300.00	0.05274	(16121708)	455100.00	4613300.00	0.05781	(13092208)
455200.00	4613300.00	0.06427	(14020208)	455300.00	4613300.00	0.06643	(14020208)
455400.00	4613300.00	0.06567	(14112724)	455500.00	4613300.00	0.06946	(15111008)
455600.00	4613300.00	0.08045	(15111008)	455700.00	4613300.00	0.08391	(15111008)
455800.00	4613300.00	0.08009	(15111008)	455900.00	4613300.00	0.07129	(15111008)
456000.00	4613300.00	0.06073	(15111008)	456100.00	4613300.00	0.05196	(14121808)
456200.00	4613300.00	0.04861	(16112108)	456300.00	4613300.00	0.05575	(16112108)

456400.00 4613300.00 0.06001 (16112108) 456500.00
4613300.00 0.06202 (16112108)
456600.00 4613300.00 0.06172 (16112108) 452000.00
4613400.00 0.04092 (15072608)
452100.00 4613400.00 0.03752 (13121924) 452200.00
4613400.00 0.03351 (15092508)
452300.00 4613400.00 0.03822 (15092508) 452400.00
4613400.00 0.04400 (16092008)
452500.00 4613400.00 0.05110 (16092008) 452600.00
4613400.00 0.05180 (16092008)
452700.00 4613400.00 0.04840c (12060624) 452800.00
4613400.00 0.05206 (16101924)
452900.00 4613400.00 0.05894 (16101924) 453000.00
4613400.00 0.05895 (16101924)
453100.00 4613400.00 0.05281 (16101924) 453200.00
4613400.00 0.05431 (15061224)
453300.00 4613400.00 0.05984 (14061008) 453400.00
4613400.00 0.05530 (14061008)
453500.00 4613400.00 0.04765 (15062008) 453600.00
4613400.00 0.05466 (15062008)
453700.00 4613400.00 0.05089 (15062008) 453800.00
4613400.00 0.04903 (16042308)
453900.00 4613400.00 0.05205 (13050508) 454000.00
4613400.00 0.05567 (15012108)
454100.00 4613400.00 0.05933 (15012108) 454200.00
4613400.00 0.05174 (15012108)
454300.00 4613400.00 0.04932 (14122908) 454400.00
4613400.00 0.05222 (14122908)
454500.00 4613400.00 0.05303 (16100124) 454600.00
4613400.00 0.05244 (16100124)
454700.00 4613400.00 0.05006 (16100124) 454800.00
4613400.00 0.05108 (14121008)
454900.00 4613400.00 0.05259 (15082608) 455000.00
4613400.00 0.05743 (13092208)
455100.00 4613400.00 0.06613 (14020208) 455200.00
4613400.00 0.07002 (14020208)
455300.00 4613400.00 0.06861 (14112724) 455400.00
4613400.00 0.07002 (15111008)
455500.00 4613400.00 0.08147 (15111008) 455600.00
4613400.00 0.08560 (15111008)
455700.00 4613400.00 0.08187 (15111008) 455800.00
4613400.00 0.07269 (15111008)
455900.00 4613400.00 0.06101 (15111008) 456000.00
4613400.00 0.05441 (14121808)
456100.00 4613400.00 0.05335 (16112108) 456200.00
4613400.00 0.06011 (16112108)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 203
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456300.00	4613400.00	0.06444	(16112108)	456400.00	4613400.00	0.06500	(16112108)
456500.00	4613400.00	0.06356	(16112108)	456600.00	4613400.00	0.06099	(16112108)
452000.00	4613500.00	0.04186	(15072608)	452100.00	4613500.00	0.03927	(13121924)
452200.00	4613500.00	0.03543	(13121924)	452300.00	4613500.00	0.03613	(15092508)
452400.00	4613500.00	0.04114	(16092008)	452500.00	4613500.00	0.05037	(16092008)
452600.00	4613500.00	0.05426	(16092008)	452700.00	4613500.00	0.05031	(16092008)
452800.00	4613500.00	0.04932c	(12060624)	452900.00	4613500.00	0.05771	(16101924)
453000.00	4613500.00	0.06162	(16101924)	453100.00	4613500.00	0.05748	(16101924)
453200.00	4613500.00	0.05648	(15061224)	453300.00	4613500.00	0.06162	(14061008)
453400.00	4613500.00	0.05929	(14061008)	453500.00	4613500.00	0.05053	(12011708)
453600.00	4613500.00	0.05808	(15062008)	453700.00	4613500.00	0.05269	(15062008)
453800.00	4613500.00	0.04952	(16042308)	453900.00	4613500.00	0.04951	(13050508)
454000.00	4613500.00	0.05849	(15012108)	454100.00	4613500.00	0.05967	(15012108)
454200.00	4613500.00	0.05074	(15012108)	454300.00	4613500.00	0.05529	(14122908)
454400.00	4613500.00	0.05487	(14122908)	454500.00	4613500.00	0.05504	(16100124)
454600.00	4613500.00	0.05367	(16100124)	454700.00	4613500.00	0.05392	(14121008)
454800.00	4613500.00	0.05294	(14121008)	454900.00	4613500.00	0.05818	(15082608)

455000.00 4613500.00 0.06757 (14020208) 455100.00
4613500.00 0.07352 (14020208)
455200.00 4613500.00 0.07212 (14020208) 455300.00
4613500.00 0.06978 (15111008)
455400.00 4613500.00 0.08345 (15111008) 455500.00
4613500.00 0.08718 (15111008)
455600.00 4613500.00 0.08340 (15111008) 455700.00
4613500.00 0.07372 (15111008)
455800.00 4613500.00 0.06158 (15111008) 455900.00
4613500.00 0.05659 (14121808)
456000.00 4613500.00 0.05884 (16112108) 456100.00
4613500.00 0.06505 (16112108)
456200.00 4613500.00 0.06787 (16112108) 456300.00
4613500.00 0.06776 (16112108)
456400.00 4613500.00 0.06493 (16112108) 456500.00
4613500.00 0.06069 (16112108)
456600.00 4613500.00 0.05567 (13030308) 452000.00
4613600.00 0.04299 (15072608)
452100.00 4613600.00 0.03737 (13121924) 452200.00
4613600.00 0.03696 (13121924)
452300.00 4613600.00 0.03525 (13121924) 452400.00
4613600.00 0.03721 (16092008)
452500.00 4613600.00 0.04735 (16092008) 452600.00
4613600.00 0.05399 (16092008)
452700.00 4613600.00 0.05341 (16092008) 452800.00
4613600.00 0.05012c (12060624)
452900.00 4613600.00 0.05520 (16101924) 453000.00
4613600.00 0.06256 (16101924)
453100.00 4613600.00 0.06212 (16101924) 453200.00
4613600.00 0.05795 (15061224)
453300.00 4613600.00 0.06236 (14061008) 453400.00
4613600.00 0.06312 (14061008)
453500.00 4613600.00 0.05518 (12011708) 453600.00
4613600.00 0.05682 (15062008)
453700.00 4613600.00 0.05502 (15062008) 453800.00
4613600.00 0.05586 (16042308)
453900.00 4613600.00 0.05038 (13050508) 454000.00
4613600.00 0.05700 (15012108)
454100.00 4613600.00 0.05983 (13091524) 454200.00
4613600.00 0.05030 (14122908)
454300.00 4613600.00 0.05968 (14122908) 454400.00
4613600.00 0.05584 (16100124)
454500.00 4613600.00 0.05652 (16100124) 454600.00
4613600.00 0.05535 (14121008)
454700.00 4613600.00 0.05761 (14121008) 454800.00
4613600.00 0.05964 (15082608)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 204
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454900.00	4613600.00	0.06831	(14020208)	455000.00	4613600.00	0.07692	(14020208)
455100.00	4613600.00	0.07708	(14020208)	455200.00	4613600.00	0.07264	(14112724)
455300.00	4613600.00	0.08424	(15111008)	455400.00	4613600.00	0.09000	(15111008)
455500.00	4613600.00	0.08585	(15111008)	455600.00	4613600.00	0.07475	(15111008)
455700.00	4613600.00	0.06393	(14121808)	455800.00	4613600.00	0.05864	(14121808)
455900.00	4613600.00	0.06413	(16112108)	456000.00	4613600.00	0.07017	(16112108)
456100.00	4613600.00	0.07147	(16112108)	456200.00	4613600.00	0.06977	(16112108)
456300.00	4613600.00	0.06572	(16112108)	456400.00	4613600.00	0.06038	(16112108)
456500.00	4613600.00	0.06041	(13030308)	456600.00	4613600.00	0.06231	(13030308)
452000.00	4613700.00	0.04413	(15072608)	452100.00	4613700.00	0.03874	(12062308)
452200.00	4613700.00	0.03700	(12062308)	452300.00	4613700.00	0.03877	(13121924)
452400.00	4613700.00	0.03643	(13121924)	452500.00	4613700.00	0.04283	(16092008)
452600.00	4613700.00	0.05075	(16092008)	452700.00	4613700.00	0.05440	(12110224)
452800.00	4613700.00	0.05377	(12110224)	452900.00	4613700.00	0.05389	(15100524)
453000.00	4613700.00	0.06146	(16101924)	453100.00	4613700.00	0.06570	(16101924)
453200.00	4613700.00	0.05814	(16101924)	453300.00	4613700.00	0.06122	(14061008)
453400.00	4613700.00	0.06572	(14061008)	453500.00	4613700.00	0.06008	(12011708)

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        453600.00   4613700.00        0.05508  (15062008)              453700.00
4613700.00        0.05536  (16062408)
        453800.00   4613700.00        0.05985  (16042308)              453900.00
4613700.00        0.05711  (15012108)
        454000.00   4613700.00        0.05848  (15012108)              454100.00
4613700.00        0.06079  (13091524)
        454200.00   4613700.00        0.05721  (14122908)              454300.00
4613700.00        0.06207  (14122908)
        454400.00   4613700.00        0.05785  (16100124)              454500.00
4613700.00        0.05788  (16100124)
        454600.00   4613700.00        0.06147  (14121008)              454700.00
4613700.00        0.06011  (15082608)
        454800.00   4613700.00        0.06803  (14020208)              454900.00
4613700.00        0.07995  (14020208)
        455000.00   4613700.00        0.08229  (14020208)              455100.00
4613700.00        0.07642  (14112724)
        455200.00   4613700.00        0.08407  (15111008)              455300.00
4613700.00        0.09106  (15111008)
        455400.00   4613700.00        0.08748  (15111008)              455500.00
4613700.00        0.07647  (15111008)
        455600.00   4613700.00        0.06699  (14121808)              455700.00
4613700.00        0.06044  (14121808)
        455800.00   4613700.00        0.06951  (16112108)              455900.00
4613700.00        0.07469  (16112108)
        456000.00   4613700.00        0.07507  (16112108)              456100.00
4613700.00        0.07122  (16112108)
        456200.00   4613700.00        0.06613  (16112108)              456300.00
4613700.00        0.06384  (13030308)
        456400.00   4613700.00        0.06551  (13030308)              456500.00
4613700.00        0.06360  (13030308)
        456600.00   4613700.00        0.06187  (13030308)              452000.00
4613800.00        0.04527  (15072608)
        452100.00   4613800.00        0.03965  (12062308)              452200.00
4613800.00        0.03813  (12062308)
        452300.00   4613800.00        0.03551  (13121924)              452400.00
4613800.00        0.03807  (13121924)
        452500.00   4613800.00        0.03795  (16092008)              452600.00
4613800.00        0.04514  (16092008)
        452700.00   4613800.00        0.05319  (12110224)              452800.00
4613800.00        0.05925  (12110224)
        452900.00   4613800.00        0.05467  (12110224)              453000.00
4613800.00        0.06179  (15100524)
        453100.00   4613800.00        0.06672  (16101924)              453200.00
4613800.00        0.06397  (16101924)
        453300.00   4613800.00        0.06022  (14061008)              453400.00
4613800.00        0.06925  (14061008)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 205
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453500.00	4613800.00	0.06538	(12011708)	453600.00	4613800.00	0.05379	(16041908)
453700.00	4613800.00	0.05750	(16062408)	453800.00	4613800.00	0.06516	(16042308)
453900.00	4613800.00	0.05889	(15012108)	454000.00	4613800.00	0.05918	(15012108)
454100.00	4613800.00	0.05682	(16110224)	454200.00	4613800.00	0.06316	(14122908)
454300.00	4613800.00	0.06204	(14122908)	454400.00	4613800.00	0.05923	(16100124)
454500.00	4613800.00	0.06343	(14121008)	454600.00	4613800.00	0.06545	(14121008)
454700.00	4613800.00	0.06930	(12112708)	454800.00	4613800.00	0.08226	(14020208)
454900.00	4613800.00	0.08763	(14020208)	455000.00	4613800.00	0.08126	(14020208)
455100.00	4613800.00	0.08336	(15111008)	455200.00	4613800.00	0.09181	(15111008)
455300.00	4613800.00	0.08833	(15111008)	455400.00	4613800.00	0.07702	(15111008)
455500.00	4613800.00	0.06959	(14121808)	455600.00	4613800.00	0.06513	(16112108)
455700.00	4613800.00	0.07593	(16112108)	455800.00	4613800.00	0.07928	(16112108)
455900.00	4613800.00	0.07759	(16112108)	456000.00	4613800.00	0.07313	(16112108)
456100.00	4613800.00	0.06498	(16112108)	456200.00	4613800.00	0.06850	(13030308)
456300.00	4613800.00	0.06820	(13030308)	456400.00	4613800.00	0.06499	(13030308)
456500.00	4613800.00	0.06029	(13030308)	456600.00	4613800.00	0.06162	(14020308)
452000.00	4613900.00	0.04654	(15072608)	452100.00	4613900.00	0.03840	(12062308)

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        452200.00   4613900.00        0.03886  (12113024)              452300.00
4613900.00        0.03843m (13090524)
        452400.00   4613900.00        0.03851m (13090524)              452500.00
4613900.00        0.03723  (16103024)
        452600.00   4613900.00        0.03868  (16092008)              452700.00
4613900.00        0.04656  (12110224)
        452800.00   4613900.00        0.05994  (12110224)              452900.00
4613900.00        0.06341  (12110224)
        453000.00   4613900.00        0.06007  (15100524)              453100.00
4613900.00        0.07010  (15100524)
        453200.00   4613900.00        0.06933  (15100524)              453300.00
4613900.00        0.06267  (13091324)
        453400.00   4613900.00        0.07081  (14061008)              453500.00
4613900.00        0.07011  (12011708)
        453600.00   4613900.00        0.06041  (12012616)              453700.00
4613900.00        0.05983  (13070108)
        453800.00   4613900.00        0.07095  (16042308)              453900.00
4613900.00        0.06152  (15012108)
        454000.00   4613900.00        0.06360  (16110224)              454100.00
4613900.00        0.06090  (16110224)
        454200.00   4613900.00        0.06416  (14122908)              454300.00
4613900.00        0.05979  (16100124)
        454400.00   4613900.00        0.06186  (14121008)              454500.00
4613900.00        0.07088  (14121008)
        454600.00   4613900.00        0.07054  (12112708)              454700.00
4613900.00        0.08340  (14020208)
        454800.00   4613900.00        0.09289  (14020208)              454900.00
4613900.00        0.08799  (14020208)
        455000.00   4613900.00        0.08189  (15111008)              455100.00
4613900.00        0.09183  (15111008)
        455200.00   4613900.00        0.08896  (15111008)              455300.00
4613900.00        0.07744  (15111008)
        455400.00   4613900.00        0.07168  (14121808)              455500.00
4613900.00        0.07167  (16112108)
        455600.00   4613900.00        0.08031  (16112108)              455700.00
4613900.00        0.08072  (16112108)
        455800.00   4613900.00        0.07677  (16112108)              455900.00
4613900.00        0.06982  (16112108)
        456000.00   4613900.00        0.06955  (13030308)              456100.00
4613900.00        0.07083  (13030308)
        456200.00   4613900.00        0.06908  (13030308)              456300.00
4613900.00        0.06404  (13030308)
        456400.00   4613900.00        0.06398  (14020308)              456500.00
4613900.00        0.06639  (14020308)
        456600.00   4613900.00        0.07155  (14020308)              452000.00
4614000.00        0.04789  (15072608)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 206
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452100.00	4614000.00	0.04041	(13071508)	452200.00	4614000.00	0.03842	(12113024)
452300.00	4614000.00	0.04030	(12113024)	452400.00	4614000.00	0.04238	(12113024)
452500.00	4614000.00	0.04187m	(13090524)	452600.00	4614000.00	0.03948	(16103024)
452700.00	4614000.00	0.04097	(15080608)	452800.00	4614000.00	0.05433	(12110224)
452900.00	4614000.00	0.06714	(12110224)	453000.00	4614000.00	0.06599	(12110224)
453100.00	4614000.00	0.07093	(15100524)	453200.00	4614000.00	0.07626	(15100524)
453300.00	4614000.00	0.06793	(15100524)	453400.00	4614000.00	0.07085	(14061008)
453500.00	4614000.00	0.07491	(12011708)	453600.00	4614000.00	0.06443	(12012616)
453700.00	4614000.00	0.06881	(12012616)	453800.00	4614000.00	0.07579	(16042308)
453900.00	4614000.00	0.06421	(16042308)	454000.00	4614000.00	0.07120	(16110224)
454100.00	4614000.00	0.06422	(16110224)	454200.00	4614000.00	0.07084	(14122908)
454300.00	4614000.00	0.06141	(15012124)	454400.00	4614000.00	0.07359	(14121008)
454500.00	4614000.00	0.07473	(14121008)	454600.00	4614000.00	0.08282	(12112708)
454700.00	4614000.00	0.09769	(14020208)	454800.00	4614000.00	0.09526	(14020208)
454900.00	4614000.00	0.08646	(14112724)	455000.00	4614000.00	0.09158	(15111008)
455100.00	4614000.00	0.08927	(15111008)	455200.00	4614000.00	0.07891	(14121808)
455300.00	4614000.00	0.07375	(14121808)	455400.00	4614000.00	0.07747	(16112108)

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        455500.00   4614000.00        0.08468  (16112108)              455600.00
4614000.00        0.08298  (16112108)
        455700.00   4614000.00        0.07562  (16112108)              455800.00
4614000.00        0.07131  (13030308)
        455900.00   4614000.00        0.07319  (13030308)              456000.00
4614000.00        0.07082  (13030308)
        456100.00   4614000.00        0.06538  (13030308)              456200.00
4614000.00        0.06557  (14020308)
        456300.00   4614000.00        0.07077  (14020308)              456400.00
4614000.00        0.07401  (14020308)
        456500.00   4614000.00        0.07209  (14020308)              456600.00
4614000.00        0.07580  (14020308)
        452000.00   4614100.00        0.04938  (15072608)              452100.00
4614100.00        0.04578  (13071508)
        452200.00   4614100.00        0.04312  (13071508)              452300.00
4614100.00        0.03831  (12113024)
        452400.00   4614100.00        0.04186  (12113024)              452500.00
4614100.00        0.04439m (13090524)
        452600.00   4614100.00        0.04497m (13090524)              452700.00
4614100.00        0.04278  (15080608)
        452800.00   4614100.00        0.04465  (15080608)              452900.00
4614100.00        0.06225  (12110224)
        453000.00   4614100.00        0.07413  (12110224)              453100.00
4614100.00        0.06722  (15100524)
        453200.00   4614100.00        0.08095  (15100524)              453300.00
4614100.00        0.07854  (15100524)
        453400.00   4614100.00        0.07336  (13091324)              453500.00
4614100.00        0.07845  (12011708)
        453600.00   4614100.00        0.06971  (12011708)              453700.00
4614100.00        0.07776  (12012616)
        453800.00   4614100.00        0.07794  (16042308)              453900.00
4614100.00        0.06747  (16042308)
        454000.00   4614100.00        0.07875  (16110224)              454100.00
4614100.00        0.07200  (14122908)
        454200.00   4614100.00        0.06783  (14122908)              454300.00
4614100.00        0.07067  (14121008)
        454400.00   4614100.00        0.08256  (14121008)              454500.00
4614100.00        0.08559  (12112708)
        454600.00   4614100.00        0.10135  (14020208)              454700.00
4614100.00        0.10297  (14020208)
        454800.00   4614100.00        0.09297  (14112724)              454900.00
4614100.00        0.09260  (16021608)
        455000.00   4614100.00        0.08965  (15111008)              455100.00
4614100.00        0.08341  (14121808)
        455200.00   4614100.00        0.07577  (14121808)              455300.00
4614100.00        0.08349  (16112108)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 207
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455400.00	4614100.00	0.08732	(16112108)	455500.00	4614100.00	0.08312	(16112108)
455600.00	4614100.00	0.07431	(16112108)	455700.00	4614100.00	0.07666	(13030308)
455800.00	4614100.00	0.07456	(13030308)	455900.00	4614100.00	0.06890	(13030308)
456000.00	4614100.00	0.06771	(14020308)	456100.00	4614100.00	0.07153	(14020308)
456200.00	4614100.00	0.07474	(14020308)	456300.00	4614100.00	0.07690	(14020308)
456400.00	4614100.00	0.07675	(14020308)	456500.00	4614100.00	0.07026	(14020308)
456600.00	4614100.00	0.07150	(14020308)	452000.00	4614200.00	0.05116	(15072608)
452100.00	4614200.00	0.04806	(12040624)	452200.00	4614200.00	0.04853	(13071508)
452300.00	4614200.00	0.04562	(14041908)	452400.00	4614200.00	0.04305	(14041908)
452500.00	4614200.00	0.04061	(12113024)	452600.00	4614200.00	0.04652m	(13090524)
452700.00	4614200.00	0.04806m	(13090524)	452800.00	4614200.00	0.04727	(15080608)
452900.00	4614200.00	0.05107	(12110224)	453000.00	4614200.00	0.07314	(12110224)
453100.00	4614200.00	0.08011	(12110224)	453200.00	4614200.00	0.08080	(15100524)
453300.00	4614200.00	0.08801	(15100524)	453400.00	4614200.00	0.08023	(13091324)
453500.00	4614200.00	0.07941	(12011708)	453600.00	4614200.00	0.07721	(12011708)
453700.00	4614200.00	0.07570	(13070108)	453800.00	4614200.00	0.09141	(12012616)
453900.00	4614200.00	0.08182	(12012616)	454000.00	4614200.00	0.08650	(16110224)

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        454300.00   4614200.00        0.08627  (14121008)              454400.00
4614200.00        0.08602  (12112708)
        454500.00   4614200.00        0.10276  (14020208)              454600.00
4614200.00        0.11081  (14020208)
        454700.00   4614200.00        0.09927  (14112724)              454800.00
4614200.00        0.10717  (16021608)
        454900.00   4614200.00        0.09026  (16021608)              455000.00
4614200.00        0.08884  (14121808)
        455100.00   4614200.00        0.07771  (14121808)              455200.00
4614200.00        0.08905  (16112108)
        455300.00   4614200.00        0.08826  (16112108)              455400.00
4614200.00        0.08004  (16112108)
        455500.00   4614200.00        0.07963  (13030308)              455600.00
4614200.00        0.07948  (13030308)
        455700.00   4614200.00        0.07319  (15022708)              455800.00
4614200.00        0.07017  (15022708)
        455900.00   4614200.00        0.07316  (14020308)              456000.00
4614200.00        0.07500  (14020308)
        456100.00   4614200.00        0.07559  (14020308)              456200.00
4614200.00        0.07538  (14020308)
        456300.00   4614200.00        0.07347  (14020308)              456400.00
4614200.00        0.07019  (14020308)
        456500.00   4614200.00        0.05956  (14020308)              456600.00
4614200.00        0.06049  (14020308)
        452000.00   4614300.00        0.05347  (15072608)              452100.00
4614300.00        0.05206  (12040624)
        452200.00   4614300.00        0.05195  (12040624)              452300.00
4614300.00        0.04922  (12040624)
        452400.00   4614300.00        0.05035  (14041908)              452500.00
4614300.00        0.04950  (14041908)
        452600.00   4614300.00        0.04453m (13090508)              452700.00
4614300.00        0.04852m (13090524)
        452800.00   4614300.00        0.05074m (13090524)              452900.00
4614300.00        0.05236  (15080608)
        453000.00   4614300.00        0.06069  (12110224)              453100.00
4614300.00        0.08431  (12110224)
        453200.00   4614300.00        0.08145  (12110224)              453300.00
4614300.00        0.09349  (15100524)
        453400.00   4614300.00        0.08664  (15100524)              453500.00
4614300.00        0.07849  (15062608)
        453600.00   4614300.00        0.08271  (12011708)              453700.00
4614300.00        0.08131  (13070108)
        453800.00   4614300.00        0.09326  (12012616)              453900.00
4614300.00        0.10640  (12012616)
        454000.00   4614300.00        0.09093  (16110224)              454400.00
4614300.00        0.10421  (12112708)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 208
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454500.00	4614300.00	0.11792	(14020208)	454600.00	4614300.00	0.10470	(14112724)
454700.00	4614300.00	0.12399	(16021608)	454800.00	4614300.00	0.10712	(16021608)
454900.00	4614300.00	0.09542	(14121808)	455000.00	4614300.00	0.08504	(16112108)
455100.00	4614300.00	0.09255	(16112108)	455200.00	4614300.00	0.08597	(16112108)
455300.00	4614300.00	0.08041	(13030308)	455400.00	4614300.00	0.08171	(13030308)
455500.00	4614300.00	0.07979	(15022708)	455600.00	4614300.00	0.07650	(15022708)
455700.00	4614300.00	0.07360	(14020308)	455800.00	4614300.00	0.07464	(14020308)
455900.00	4614300.00	0.07438	(14020308)	456000.00	4614300.00	0.07262	(14020308)
456100.00	4614300.00	0.06928	(14020308)	456200.00	4614300.00	0.06538	(14020308)
456300.00	4614300.00	0.06124	(14020308)	456400.00	4614300.00	0.05684	(14020308)
456500.00	4614300.00	0.04981	(16100308)	456600.00	4614300.00	0.04806	(13102224)
452000.00	4614400.00	0.05659	(15072608)	452100.00	4614400.00	0.04737	(12040624)
452200.00	4614400.00	0.05077	(12040624)	452300.00	4614400.00	0.05657	(12040624)
452400.00	4614400.00	0.05760	(12040624)	452500.00	4614400.00	0.05424	(14041908)
452600.00	4614400.00	0.05635	(14041908)	452700.00	4614400.00	0.05494m	(13090508)
452800.00	4614400.00	0.05012m	(13090524)	452900.00	4614400.00	0.05329m	(13090524)
453000.00	4614400.00	0.05812	(15080608)	453100.00	4614400.00	0.07280	(12110224)

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        453200.00   4614400.00        0.09350  (12110224)              453300.00
4614400.00        0.09035  (15100524)
        453400.00   4614400.00        0.09936  (15100524)              453500.00
4614400.00        0.08885  (15112808)
        453600.00   4614400.00        0.08996  (16090124)              453700.00
4614400.00        0.08724  (13070108)
        453800.00   4614400.00        0.09552  (13121924)              453900.00
4614400.00        0.10817  (12012616)
        454000.00   4614400.00        0.12520  (12012616)              454100.00
4614400.00        0.11278  (12011624)
        454600.00   4614400.00        0.14278  (16021608)              454700.00
4614400.00        0.13227  (16021608)
        454800.00   4614400.00        0.10541  (14010824)              454900.00
4614400.00        0.09974  (13032124)
        455000.00   4614400.00        0.09566  (13032124)              455100.00
4614400.00        0.08892  (13032124)
        455200.00   4614400.00        0.08845  (15022708)              455300.00
4614400.00        0.08754  (15022708)
        455400.00   4614400.00        0.08252  (15022708)              455500.00
4614400.00        0.07556  (15022708)
        455600.00   4614400.00        0.07673  (13122108)              455700.00
4614400.00        0.07754  (13122108)
        455800.00   4614400.00        0.07470  (13122108)              455900.00
4614400.00        0.07088  (13122108)
        456000.00   4614400.00        0.06582  (13122108)              456100.00
4614400.00        0.05976  (13122108)
        456200.00   4614400.00        0.05545  (13102224)              456300.00
4614400.00        0.05417  (16100308)
        456400.00   4614400.00        0.05233  (16100308)              456500.00
4614400.00        0.05060  (16100308)
        456600.00   4614400.00        0.04703  (13102224)              452000.00
4614500.00        0.05992  (15072608)
        452100.00   4614500.00        0.05968  (12032824)              452200.00
4614500.00        0.05672  (12032824)
        452300.00   4614500.00        0.05496  (15072524)              452400.00
4614500.00        0.05593  (12040624)
        452500.00   4614500.00        0.06005  (12040624)              452600.00
4614500.00        0.05828  (12040624)
        452700.00   4614500.00        0.06502m (13090508)              452800.00
4614500.00        0.06225m (13090508)
        452900.00   4614500.00        0.05320  (16012224)              453000.00
4614500.00        0.05888  (16012224)
        453100.00   4614500.00        0.06331  (15080608)              453200.00
4614500.00        0.08507  (12110224)
        453300.00   4614500.00        0.09711  (12110224)              453400.00
4614500.00        0.10489  (15100524)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 209
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453500.00	4614500.00	0.09833	(15112808)	453600.00	4614500.00	0.09910	(16090124)
453700.00	4614500.00	0.09161	(13070108)	453800.00	4614500.00	0.10621	(13121924)
453900.00	4614500.00	0.12845	(13121924)	454000.00	4614500.00	0.13220	(12012616)
454100.00	4614500.00	0.16361	(12012616)	454600.00	4614500.00	0.17031	(16021608)
454700.00	4614500.00	0.13113	(13120724)	454800.00	4614500.00	0.12844	(12010724)
454900.00	4614500.00	0.11699	(12010724)	455000.00	4614500.00	0.10109	(15022708)
455100.00	4614500.00	0.09816	(15022708)	455200.00	4614500.00	0.08911	(15022708)
455300.00	4614500.00	0.07849	(15022708)	455400.00	4614500.00	0.08028	(13122108)
455500.00	4614500.00	0.08079	(13122108)	455600.00	4614500.00	0.07837	(13122108)
455700.00	4614500.00	0.07372	(13122108)	455800.00	4614500.00	0.06755	(13122108)
455900.00	4614500.00	0.06328	(13102224)	456000.00	4614500.00	0.06069	(13102224)
456100.00	4614500.00	0.05811	(16100308)	456200.00	4614500.00	0.05725	(16100308)
456300.00	4614500.00	0.05525	(16100308)	456400.00	4614500.00	0.05301	(16100308)
456500.00	4614500.00	0.04926	(16100308)	456600.00	4614500.00	0.04538	(16100308)
452000.00	4614600.00	0.06262	(15072608)	452100.00	4614600.00	0.05892	(12032824)
452200.00	4614600.00	0.06246	(12032824)	452300.00	4614600.00	0.07687	(15121224)
452400.00	4614600.00	0.08561	(15121224)	452500.00	4614600.00	0.08966	(15121224)

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        452600.00   4614600.00        0.06078  (12040624)              452700.00
4614600.00        0.06290  (12040624)
        452800.00   4614600.00        0.06769  (14041908)              452900.00
4614600.00        0.06955  (14041908)
        453000.00   4614600.00        0.06229  (14051608)              453100.00
4614600.00        0.06705  (16012224)
        453200.00   4614600.00        0.06904  (15080608)              453300.00
4614600.00        0.09637  (12110224)
        453400.00   4614600.00        0.09588  (12071008)              453500.00
4614600.00        0.10348  (16032308)
        453600.00   4614600.00        0.10235  (16090124)              453700.00
4614600.00        0.09952  (15043008)
        453800.00   4614600.00        0.09612  (13121924)              453900.00
4614600.00        0.14853  (13121924)
        454000.00   4614600.00        0.17757  (13121924)              454100.00
4614600.00        0.20197  (13121924)
        454600.00   4614600.00        0.20397  (12010724)              454700.00
4614600.00        0.18218  (12010724)
        454800.00   4614600.00        0.13939  (12010724)              454900.00
4614600.00        0.11374  (15022708)
        455000.00   4614600.00        0.09890  (12022724)              455100.00
4614600.00        0.08563  (12022724)
        455200.00   4614600.00        0.08053  (13122108)              455300.00
4614600.00        0.08148  (13122108)
        455400.00   4614600.00        0.07902  (13122108)              455500.00
4614600.00        0.07472  (13102224)
        455600.00   4614600.00        0.07161  (13102224)              455700.00
4614600.00        0.06802  (13102224)
        455800.00   4614600.00        0.06411  (13102224)              455900.00
4614600.00        0.06304  (16100308)
        456000.00   4614600.00        0.06242  (16100308)              456100.00
4614600.00        0.06036  (16100308)
        456200.00   4614600.00        0.05789  (16100308)              456300.00
4614600.00        0.05453  (16100308)
        456400.00   4614600.00        0.05078  (16100308)              456500.00
4614600.00        0.04718  (15091024)
        456600.00   4614600.00        0.04948  (15091024)              452000.00
4614700.00        0.06346  (15072608)
        452100.00   4614700.00        0.05113  (15072524)              452200.00
4614700.00        0.05904  (15072524)
        452300.00   4614700.00        0.06532  (15072524)              452400.00
4614700.00        0.07227  (15121224)
        452500.00   4614700.00        0.08404  (15121224)              452600.00
4614700.00        0.06721  (12032824)
        452700.00   4614700.00        0.06365  (13032408)              452800.00
4614700.00        0.06671  (13032408)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 210
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452900.00	4614700.00	0.06856	(14041908)	453000.00	4614700.00	0.07943	(14041908)
453100.00	4614700.00	0.07297	(14051608)	453200.00	4614700.00	0.07921	(16012224)
453300.00	4614700.00	0.07629	(15080608)	453400.00	4614700.00	0.09965	(12110224)
453500.00	4614700.00	0.10998	(12092624)	453600.00	4614700.00	0.12163	(15112808)
453700.00	4614700.00	0.11307	(15043008)	453800.00	4614700.00	0.09047	(15020824)
453900.00	4614700.00	0.10939	(14030208)	454000.00	4614700.00	0.17009	(13121924)
454100.00	4614700.00	0.26778	(13121924)	454600.00	4614700.00	0.23036	(12010724)
454700.00	4614700.00	0.16318	(12022724)	454800.00	4614700.00	0.12246	(12022724)
454900.00	4614700.00	0.09925	(13102224)	455000.00	4614700.00	0.09178	(13102224)
455100.00	4614700.00	0.08699	(13102224)	455200.00	4614700.00	0.08323	(13102224)
455300.00	4614700.00	0.07933	(13102224)	455400.00	4614700.00	0.07463	(13102224)
455500.00	4614700.00	0.06967	(13102224)	455600.00	4614700.00	0.06460	(13102224)
455700.00	4614700.00	0.06581	(16100308)	455800.00	4614700.00	0.06646	(16100308)
455900.00	4614700.00	0.06550	(16100308)	456000.00	4614700.00	0.06301	(16100308)
456100.00	4614700.00	0.05883	(16100308)	456200.00	4614700.00	0.05468	(16100308)
456300.00	4614700.00	0.05056	(15091024)	456400.00	4614700.00	0.05084	(15091024)
456500.00	4614700.00	0.04972	(15091024)	456600.00	4614700.00	0.05178	(15091024)

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        452000.00   4614800.00        0.06247  (15072608)              452100.00
4614800.00        0.05009  (13050508)
        452200.00   4614800.00        0.05627  (15072524)              452300.00
4614800.00        0.06108  (15072524)
        452400.00   4614800.00        0.06319  (14062208)              452500.00
4614800.00        0.06641  (13051624)
        452600.00   4614800.00        0.06583  (12032824)              452700.00
4614800.00        0.07662  (12032824)
        452800.00   4614800.00        0.07106  (12032824)              452900.00
4614800.00        0.07864  (13032408)
        453000.00   4614800.00        0.08160  (13032408)              453100.00
4614800.00        0.08204  (14041908)
        453200.00   4614800.00        0.08672  (14051608)              453300.00
4614800.00        0.08893  (16012224)
        453400.00   4614800.00        0.07986  (16093008)              453500.00
4614800.00        0.10496  (12071008)
        453600.00   4614800.00        0.11977  (15112808)              453700.00
4614800.00        0.11826  (15043008)
        453800.00   4614800.00        0.10451  (14092524)              453900.00
4614800.00        0.14518  (14092524)
        454000.00   4614800.00        0.19542  (14092524)              454600.00
4614800.00        0.19669  (12012508)
        454700.00   4614800.00        0.14642  (12012508)              454800.00
4614800.00        0.10554  (12012508)
        454900.00   4614800.00        0.08734  (12012508)              455000.00
4614800.00        0.07987  (13102224)
        455100.00   4614800.00        0.07598  (13102224)              455200.00
4614800.00        0.07190  (13102224)
        455300.00   4614800.00        0.06740  (13102224)              455400.00
4614800.00        0.06346  (16100308)
        455500.00   4614800.00        0.06698  (16100308)              455600.00
4614800.00        0.06869  (16100308)
        455700.00   4614800.00        0.06854  (16100308)              455800.00
4614800.00        0.06652  (16100308)
        455900.00   4614800.00        0.06285  (16100308)              456000.00
4614800.00        0.05820  (16100308)
        456100.00   4614800.00        0.05233  (16100308)              456200.00
4614800.00        0.05085  (15091024)
        456300.00   4614800.00        0.05138  (15091024)              456400.00
4614800.00        0.05114  (15091024)
        456500.00   4614800.00        0.05085  (15091024)              456600.00
4614800.00        0.05130  (15091024)
        452000.00   4614900.00        0.06125  (14092624)              452100.00
4614900.00        0.06182  (14092624)
        452200.00   4614900.00        0.06151  (14092624)              452300.00
4614900.00        0.06004  (14092624)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 211
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452400.00	4614900.00	0.05909	(12061324)	452500.00	4614900.00	0.06081	(15020108)
452600.00	4614900.00	0.06596	(12020408)	452700.00	4614900.00	0.07287	(12020408)
452800.00	4614900.00	0.07762	(12020408)	452900.00	4614900.00	0.07720	(12020408)
453000.00	4614900.00	0.08082	(12080824)	453100.00	4614900.00	0.09744	(13032408)
453200.00	4614900.00	0.09446	(16080724)	453300.00	4614900.00	0.09929	(12022324)
453400.00	4614900.00	0.09782	(16043024)	453500.00	4614900.00	0.08276	(14031608)
453600.00	4614900.00	0.12063	(13050316)	453700.00	4614900.00	0.14760	(13040916)
453800.00	4614900.00	0.11595	(13112216)	453900.00	4614900.00	0.13602	(14091724)
454000.00	4614900.00	0.17169	(16031424)	454600.00	4614900.00	0.13797	(14102924)
454700.00	4614900.00	0.09532	(13011508)	454800.00	4614900.00	0.09454	(15030208)
454900.00	4614900.00	0.09077	(15030208)	455000.00	4614900.00	0.08244	(15030208)
455100.00	4614900.00	0.07358	(15030208)	455200.00	4614900.00	0.06984	(13032708)
455300.00	4614900.00	0.06888	(13032708)	455400.00	4614900.00	0.06859	(16100308)
455500.00	4614900.00	0.06863	(16100308)	455600.00	4614900.00	0.06691	(16100308)
455700.00	4614900.00	0.06367	(16100308)	455800.00	4614900.00	0.05919	(16100308)
455900.00	4614900.00	0.05448	(13032708)	456000.00	4614900.00	0.05176	(13032708)
456100.00	4614900.00	0.05081	(15091024)	456200.00	4614900.00	0.04971	(15091024)

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        456300.00   4614900.00        0.04973  (15091024)              456400.00
4614900.00        0.04929  (15091024)
        456500.00   4614900.00        0.04851  (15091024)              456600.00
4614900.00        0.04790  (15091024)
        452000.00   4615000.00        0.06227  (14092624)              452100.00
4615000.00        0.06528  (14092624)
        452200.00   4615000.00        0.06819  (14092624)              452300.00
4615000.00        0.07082  (14092624)
        452400.00   4615000.00        0.07278  (14092624)              452500.00
4615000.00        0.07308  (14092624)
        452600.00   4615000.00        0.07377  (13092224)              452700.00
4615000.00        0.07639  (13092224)
        452800.00   4615000.00        0.07808  (12061324)              452900.00
4615000.00        0.08004  (12020408)
        453000.00   4615000.00        0.08894  (12020408)              453100.00
4615000.00        0.09155  (12020408)
        453200.00   4615000.00        0.09568  (16080808)              453300.00
4615000.00        0.10887  (13032408)
        453400.00   4615000.00        0.12139  (12020316)              453500.00
4615000.00        0.10472  (16042816)
        453600.00   4615000.00        0.12454  (15051316)              453700.00
4615000.00        0.19042  (13040916)
        453800.00   4615000.00        0.13586  (14101516)              453900.00
4615000.00        0.13708  (14020216)
        454000.00   4615000.00        0.16278  (13012624)              454600.00
4615000.00        0.19418  (14010808)
        454700.00   4615000.00        0.11478  (15030208)              454800.00
4615000.00        0.08925  (13032708)
        454900.00   4615000.00        0.08586  (13032708)              455000.00
4615000.00        0.08226  (13032708)
        455100.00   4615000.00        0.07830  (13032708)              455200.00
4615000.00        0.07414  (13032708)
        455300.00   4615000.00        0.06990  (13032708)              455400.00
4615000.00        0.06571  (13032708)
        455500.00   4615000.00        0.06164  (13032708)              455600.00
4615000.00        0.05775  (13032708)
        455700.00   4615000.00        0.05407  (13032708)              455800.00
4615000.00        0.05062  (13032708)
        455900.00   4615000.00        0.04772  (13011508)              456000.00
4615000.00        0.04958  (13011508)
        456100.00   4615000.00        0.05081  (13011508)              456200.00
4615000.00        0.05159  (13011508)
        456300.00   4615000.00        0.05112  (13011508)              456400.00
4615000.00        0.05173  (13011508)
        456500.00   4615000.00        0.05006  (13011508)              456600.00
4615000.00        0.04815  (13011508)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 212
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4615100.00	0.05942	(15072608)	452100.00	4615100.00	0.05808	(13061924)
452200.00	4615100.00	0.05885	(13061924)	452300.00	4615100.00	0.06281	(14092624)
452400.00	4615100.00	0.06619	(14092624)	452500.00	4615100.00	0.06930	(14092624)
452600.00	4615100.00	0.07239	(14092624)	452700.00	4615100.00	0.07507	(14092624)
452800.00	4615100.00	0.07909	(13092224)	452900.00	4615100.00	0.08678	(13030508)
453000.00	4615100.00	0.09455	(13030508)	453100.00	4615100.00	0.09885	(13030508)
453200.00	4615100.00	0.09570	(14080724)	453300.00	4615100.00	0.09837	(14080724)
453400.00	4615100.00	0.09544	(13031716)	453500.00	4615100.00	0.13317	(12021916)
453600.00	4615100.00	0.14301	(16091416)	453700.00	4615100.00	0.14885	(12040116)
453800.00	4615100.00	0.11563	(14092216)	453900.00	4615100.00	0.14642	(13073116)
454000.00	4615100.00	0.13218	(15101316)	454100.00	4615100.00	0.13112	(12122824)
454600.00	4615100.00	0.17596	(14121924)	454700.00	4615100.00	0.11627	(15010208)
454800.00	4615100.00	0.08837	(16112524)	454900.00	4615100.00	0.08110	(16112524)
455000.00	4615100.00	0.07418	(16112524)	455100.00	4615100.00	0.06895	(12101924)
455200.00	4615100.00	0.06571	(12101924)	455300.00	4615100.00	0.06238	(12101924)
455400.00	4615100.00	0.05915	(12121708)	455500.00	4615100.00	0.05589	(12101924)
455600.00	4615100.00	0.05314	(12122208)	455700.00	4615100.00	0.05072	(12122208)

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        455800.00   4615100.00        0.05336  (13011508)              455900.00
4615100.00        0.05538  (13011508)
        456000.00   4615100.00        0.05655  (13011508)              456100.00
4615100.00        0.05656  (13011508)
        456200.00   4615100.00        0.05602  (13011508)              456300.00
4615100.00        0.05461  (13011508)
        456400.00   4615100.00        0.05395  (13011508)              456500.00
4615100.00        0.05150  (13011508)
        456600.00   4615100.00        0.04841  (13011508)              452000.00
4615200.00        0.05957  (15072608)
        452100.00   4615200.00        0.06170  (14062224)              452200.00
4615200.00        0.05982  (15110924)
        452300.00   4615200.00        0.06231  (15110924)              452400.00
4615200.00        0.06473  (15110924)
        452500.00   4615200.00        0.06677  (15110924)              452600.00
4615200.00        0.06805  (15110924)
        452700.00   4615200.00        0.06899  (13012824)              452800.00
4615200.00        0.07290  (13012824)
        452900.00   4615200.00        0.07610  (13012824)              453000.00
4615200.00        0.07933  (12071224)
        453100.00   4615200.00        0.08403  (12071224)              453200.00
4615200.00        0.08919  (13022124)
        453300.00   4615200.00        0.10220  (15113016)              453400.00
4615200.00        0.12556  (15113016)
        453500.00   4615200.00        0.15933  (16051116)              453600.00
4615200.00        0.17706  (16051116)
        453700.00   4615200.00        0.08158  (12091516)              453800.00
4615200.00        0.09371  (13012624)
        453900.00   4615200.00        0.11911  (12092916)              454000.00
4615200.00        0.14530  (15022716)
        454100.00   4615200.00        0.12735  (16082108)              454200.00
4615200.00        0.13178  (14122424)
        454600.00   4615200.00        0.16873  (12011008)              454700.00
4615200.00        0.09915  (12101924)
        454800.00   4615200.00        0.09258  (12101924)              454900.00
4615200.00        0.08668  (12101924)
        455000.00   4615200.00        0.08116  (12101924)              455100.00
4615200.00        0.07643  (14073008)
        455200.00   4615200.00        0.07458  (14073008)              455300.00
4615200.00        0.07242  (14073008)
        455400.00   4615200.00        0.07008  (14073008)              455500.00
4615200.00        0.06766  (14073008)
        455600.00   4615200.00        0.06523  (14073008)              455700.00
4615200.00        0.06282  (14073008)
        455800.00   4615200.00        0.06046  (14073008)              455900.00
4615200.00        0.05817  (14073008)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 213
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456000.00	4615200.00	0.05763	(13011508)	456100.00	4615200.00	0.05702	(13011508)
456200.00	4615200.00	0.05568	(13011508)	456300.00	4615200.00	0.05332	(13011508)
456400.00	4615200.00	0.05155	(13011508)	456500.00	4615200.00	0.04871	(13011508)
456600.00	4615200.00	0.04653	(16080708)	452000.00	4615300.00	0.06182	(13050508)
452100.00	4615300.00	0.06218	(14062224)	452200.00	4615300.00	0.06256	(13051824)
452300.00	4615300.00	0.06511	(13051824)	452400.00	4615300.00	0.06853	(13051824)
452500.00	4615300.00	0.07298	(15102708)	452600.00	4615300.00	0.07823	(15102708)
452700.00	4615300.00	0.08464	(15102708)	452800.00	4615300.00	0.09007	(15102708)
452900.00	4615300.00	0.09437	(15102708)	453000.00	4615300.00	0.09792	(15041908)
453100.00	4615300.00	0.10101	(15041908)	453200.00	4615300.00	0.09728	(15041908)
453300.00	4615300.00	0.10159	(15102724)	453400.00	4615300.00	0.11792	(15102724)
453500.00	4615300.00	0.11866	(13052716)	453600.00	4615300.00	0.18507	(13102916)
453700.00	4615300.00	0.09994	(14082308)	453800.00	4615300.00	0.08964	(12111616)
453900.00	4615300.00	0.16685	(13031516)	454000.00	4615300.00	0.14303	(12102016)
454100.00	4615300.00	0.15440	(13101624)	454200.00	4615300.00	0.14090	(13101624)
454300.00	4615300.00	0.11526	(13101624)	454400.00	4615300.00	0.10763	(13110124)
454500.00	4615300.00	0.12651	(12011008)	454600.00	4615300.00	0.14853	(12011008)

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        454700.00   4615300.00        0.09523c (14013124)              454800.00
4615300.00        0.08431  (12101924)
        454900.00   4615300.00        0.08591  (14073008)              455000.00
4615300.00        0.08631  (14073008)
        455100.00   4615300.00        0.08512  (14073008)              455200.00
4615300.00        0.08290  (14073008)
        455300.00   4615300.00        0.08039  (14073008)              455400.00
4615300.00        0.07772  (14073008)
        455500.00   4615300.00        0.07498  (14073008)              455600.00
4615300.00        0.07223  (14073008)
        455700.00   4615300.00        0.06952  (14073008)              455800.00
4615300.00        0.06688  (14073008)
        455900.00   4615300.00        0.06433  (14073008)              456000.00
4615300.00        0.06189  (14073008)
        456100.00   4615300.00        0.05960  (14073008)              456200.00
4615300.00        0.05732  (14073008)
        456300.00   4615300.00        0.05495  (14073008)              456400.00
4615300.00        0.05404  (16080708)
        456500.00   4615300.00        0.05408  (16080708)              456600.00
4615300.00        0.05477  (16080708)
        452000.00   4615400.00        0.06791  (15071608)              452100.00
4615400.00        0.06990  (15071608)
        452200.00   4615400.00        0.06346  (16092024)              452300.00
4615400.00        0.06572  (16092024)
        452400.00   4615400.00        0.06982  (15041908)              452500.00
4615400.00        0.07391  (15041908)
        452600.00   4615400.00        0.07748  (15041908)              452700.00
4615400.00        0.08003  (15041908)
        452800.00   4615400.00        0.08030  (15041908)              452900.00
4615400.00        0.08054  (15041908)
        453000.00   4615400.00        0.07812  (15032424)              453100.00
4615400.00        0.08602  (13120224)
        453200.00   4615400.00        0.09643  (16051008)              453300.00
4615400.00        0.10444  (16120416)
        453400.00   4615400.00        0.10961  (16120416)              453500.00
4615400.00        0.13039  (12050116)
        453600.00   4615400.00        0.18793  (13103016)              453700.00
4615400.00        0.19220  (12102116)
        453800.00   4615400.00        0.19425  (12111916)              453900.00
4615400.00        0.16171  (16111416)
        454000.00   4615400.00        0.12794  (15112316)              454100.00
4615400.00        0.14000  (13022308)
        454200.00   4615400.00        0.11939  (15082408)              454300.00
4615400.00        0.11947  (14020608)
        454400.00   4615400.00        0.10755  (14020608)              454500.00
4615400.00        0.09843  (13022408)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 214
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454600.00	4615400.00	0.12200	(12011008)	454700.00	4615400.00	0.10027	(12011008)
454800.00	4615400.00	0.08878	(13032808)	454900.00	4615400.00	0.09335	(13032808)
455000.00	4615400.00	0.09446	(13032808)	455100.00	4615400.00	0.09341	(13032808)
455200.00	4615400.00	0.09031	(13032808)	455300.00	4615400.00	0.08663	(13032808)
455400.00	4615400.00	0.08268	(13032808)	455500.00	4615400.00	0.07866	(13032808)
455600.00	4615400.00	0.07470	(13032808)	455700.00	4615400.00	0.07089	(13032808)
455800.00	4615400.00	0.06726	(13032808)	455900.00	4615400.00	0.06383	(13032808)
456000.00	4615400.00	0.06061	(13032808)	456100.00	4615400.00	0.05761	(13032808)
456200.00	4615400.00	0.05863	(16080708)	456300.00	4615400.00	0.05926	(16080708)
456400.00	4615400.00	0.06023	(16080708)	456500.00	4615400.00	0.05985	(16080708)
456600.00	4615400.00	0.05924	(16080708)	452000.00	4615500.00	0.06889	(13050508)
452100.00	4615500.00	0.06591	(15071608)	452200.00	4615500.00	0.06390	(13101024)
452300.00	4615500.00	0.06344	(13101024)	452400.00	4615500.00	0.06349	(13101024)
452500.00	4615500.00	0.06229	(13101024)	452600.00	4615500.00	0.06471	(14071024)
452700.00	4615500.00	0.07022	(14071024)	452800.00	4615500.00	0.07900	(15050824)
452900.00	4615500.00	0.08954	(15050824)	453000.00	4615500.00	0.09819	(14092324)
453100.00	4615500.00	0.10088	(14092324)	453200.00	4615500.00	0.11208	(16112224)

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        453300.00   4615500.00        0.12208  (14122224)              453400.00
4615500.00        0.12156  (14122224)
        453500.00   4615500.00        0.12386  (13103016)              453600.00
4615500.00        0.13873  (13103016)
        453700.00   4615500.00        0.17152  (15022816)              453800.00
4615500.00        0.17256  (12111916)
        453900.00   4615500.00        0.13742  (12112116)              454000.00
4615500.00        0.10690  (13090924)
        454100.00   4615500.00        0.11614  (13091008)              454200.00
4615500.00        0.13412  (16111008)
        454300.00   4615500.00        0.11368  (16040808)              454400.00
4615500.00        0.11360  (16040808)
        454500.00   4615500.00        0.09679  (16040808)              454600.00
4615500.00        0.08913  (12011008)
        454700.00   4615500.00        0.09783  (12011008)              454800.00
4615500.00        0.08780  (13022408)
        454900.00   4615500.00        0.08456  (13022408)              455000.00
4615500.00        0.07976  (13022408)
        455100.00   4615500.00        0.08024  (13032808)              455200.00
4615500.00        0.08254  (13032808)
        455300.00   4615500.00        0.08317  (13032808)              455400.00
4615500.00        0.08256  (13032808)
        455500.00   4615500.00        0.08104  (13032808)              455600.00
4615500.00        0.07892  (13032808)
        455700.00   4615500.00        0.07641  (13032808)              455800.00
4615500.00        0.07367  (13032808)
        455900.00   4615500.00        0.07083  (13032808)              456000.00
4615500.00        0.06795  (13032808)
        456100.00   4615500.00        0.06481  (13032808)              456200.00
4615500.00        0.06237  (13032808)
        456300.00   4615500.00        0.06014  (16080708)              456400.00
4615500.00        0.06119  (16080708)
        456500.00   4615500.00        0.06035  (16080708)              456600.00
4615500.00        0.05935  (16080708)
        452000.00   4615600.00        0.07274  (13050508)              452100.00
4615600.00        0.06239  (13050508)
        452200.00   4615600.00        0.06083  (13091524)              452300.00
4615600.00        0.06405  (14071024)
        452400.00   4615600.00        0.07365  (14071024)              452500.00
4615600.00        0.07896  (14071024)
        452600.00   4615600.00        0.08351  (15050824)              452700.00
4615600.00        0.08981  (15050824)
        452800.00   4615600.00        0.09965  (14092324)              452900.00
4615600.00        0.10382  (14092324)
        453000.00   4615600.00        0.09607  (16112224)              453100.00
4615600.00        0.10182  (16112224)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 215
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453200.00	4615600.00	0.11257	(14122224)	453300.00	4615600.00	0.10197	(13110324)
453400.00	4615600.00	0.10858	(15031224)	453500.00	4615600.00	0.12473	(15111708)
453600.00	4615600.00	0.13355m	(12082524)	453700.00	4615600.00	0.13200	(13091908)
453800.00	4615600.00	0.13421	(12102424)	453900.00	4615600.00	0.14235	(14122708)
454000.00	4615600.00	0.12654	(14072524)	454100.00	4615600.00	0.11822	(13081208)
454200.00	4615600.00	0.11272	(12010608)	454300.00	4615600.00	0.11775	(12010608)
454400.00	4615600.00	0.10279	(16070508)	454500.00	4615600.00	0.09797	(16070508)
454600.00	4615600.00	0.09470	(16040808)	454700.00	4615600.00	0.08363	(16040808)
454800.00	4615600.00	0.07487	(13122708)	454900.00	4615600.00	0.06902	(14101108)
455000.00	4615600.00	0.07057	(13022408)	455100.00	4615600.00	0.07005	(13022408)
455200.00	4615600.00	0.06806	(13022408)	455300.00	4615600.00	0.06517	(13022408)
455400.00	4615600.00	0.06387	(13032808)	455500.00	4615600.00	0.06633	(13032808)
455600.00	4615600.00	0.06770	(13032808)	455700.00	4615600.00	0.06819	(13032808)
455800.00	4615600.00	0.06796	(13032808)	455900.00	4615600.00	0.06720	(13032808)
456000.00	4615600.00	0.06602	(13032808)	456100.00	4615600.00	0.06395	(13032808)
456200.00	4615600.00	0.06274	(13032808)	456300.00	4615600.00	0.06115	(13032808)
456400.00	4615600.00	0.05924	(13032808)	456500.00	4615600.00	0.05726	(13032808)

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        456600.00   4615600.00        0.05534  (13032808)              452000.00
4615700.00        0.07678  (13050508)
        452100.00   4615700.00        0.06915  (14071024)              452200.00
4615700.00        0.07534  (14071024)
        452300.00   4615700.00        0.07827  (14071024)              452400.00
4615700.00        0.08198  (15050824)
        452500.00   4615700.00        0.08304  (14092324)              452600.00
4615700.00        0.09110  (14092324)
        452700.00   4615700.00        0.09272  (14092324)              452800.00
4615700.00        0.08446  (14092324)
        452900.00   4615700.00        0.08373  (16112224)              453000.00
4615700.00        0.09241  (16021808)
        453100.00   4615700.00        0.09425  (16021808)              453200.00
4615700.00        0.09501  (13110324)
        453300.00   4615700.00        0.10991  (15031224)              453400.00
4615700.00        0.12352  (15111708)
        453500.00   4615700.00        0.11956  (12082424)              453600.00
4615700.00        0.15564m (12082524)
        453700.00   4615700.00        0.13003m (14071208)              453800.00
4615700.00        0.13563  (15110424)
        453900.00   4615700.00        0.13053  (15110508)              454000.00
4615700.00        0.12627  (13100108)
        454100.00   4615700.00        0.10305  (14092024)              454200.00
4615700.00        0.11169  (12112724)
        454300.00   4615700.00        0.09394  (14121308)              454400.00
4615700.00        0.10363  (12010608)
        454500.00   4615700.00        0.09026m (13090408)              454600.00
4615700.00        0.09031  (16070508)
        454700.00   4615700.00        0.08257  (16070508)              454800.00
4615700.00        0.08249  (13122708)
        454900.00   4615700.00        0.07703  (13122708)              455000.00
4615700.00        0.06488  (13122708)
        455100.00   4615700.00        0.06166  (14102924)              455200.00
4615700.00        0.05896  (14102924)
        455300.00   4615700.00        0.05661  (13022408)              455400.00
4615700.00        0.05625  (13022408)
        455500.00   4615700.00        0.05505  (13022408)              455600.00
4615700.00        0.05328  (13022408)
        455700.00   4615700.00        0.05116  (13022408)              455800.00
4615700.00        0.05278  (13032808)
        455900.00   4615700.00        0.05441  (13032808)              456000.00
4615700.00        0.05542  (13032808)
        456100.00   4615700.00        0.05599  (13032808)              456200.00
4615700.00        0.05603  (13032808)
        456300.00   4615700.00        0.05571  (13032808)              456400.00
4615700.00        0.05511  (13032808)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 216
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456500.00	4615700.00	0.05427	(13032808)	456600.00	4615700.00	0.05326	(13032808)
452000.00	4615800.00	0.08097	(13050508)	452100.00	4615800.00	0.07378	(15050824)
452200.00	4615800.00	0.07782	(15050824)	452300.00	4615800.00	0.07701	(14092324)
452400.00	4615800.00	0.08437	(14092324)	452500.00	4615800.00	0.08509	(14092324)
452600.00	4615800.00	0.07868	(14092324)	452700.00	4615800.00	0.06970	(16112224)
452800.00	4615800.00	0.07831	(16021808)	452900.00	4615800.00	0.08630	(16021808)
453000.00	4615800.00	0.08072	(16021808)	453100.00	4615800.00	0.09186	(13092408)
453200.00	4615800.00	0.10131	(15031224)	453300.00	4615800.00	0.10658	(15111708)
453400.00	4615800.00	0.09887	(14031808)	453500.00	4615800.00	0.12478m	(12082524)
453600.00	4615800.00	0.13745m	(12082524)	453700.00	4615800.00	0.12560	(12102324)
453800.00	4615800.00	0.12706	(15110424)	453900.00	4615800.00	0.12083	(12121308)
454000.00	4615800.00	0.11641	(15111508)	454100.00	4615800.00	0.11006	(12121124)
454200.00	4615800.00	0.09638	(16110524)	454300.00	4615800.00	0.10340	(12021424)
454400.00	4615800.00	0.09024	(12021424)	454500.00	4615800.00	0.08762	(12010608)
454600.00	4615800.00	0.08982m	(13090408)	454700.00	4615800.00	0.08546m	(13090408)
454800.00	4615800.00	0.07644	(16070508)	454900.00	4615800.00	0.07569	(13122708)
455000.00	4615800.00	0.07210	(13122708)	455100.00	4615800.00	0.06353	(12081208)

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        455200.00   4615800.00        0.06043  (14102924)              455300.00
4615800.00        0.05977  (14102924)
        455400.00   4615800.00        0.05768  (14102924)              455500.00
4615800.00        0.05454  (14102924)
        455600.00   4615800.00        0.05108  (14102924)              455700.00
4615800.00        0.04756  (14102924)
        455800.00   4615800.00        0.04520  (13022408)              455900.00
4615800.00        0.04409  (13022408)
        456000.00   4615800.00        0.04273  (13022408)              456100.00
4615800.00        0.04224  (13032808)
        456200.00   4615800.00        0.04398  (13032808)              456300.00
4615800.00        0.04515  (13032808)
        456400.00   4615800.00        0.04593  (13032808)              456500.00
4615800.00        0.04638  (13032808)
        456600.00   4615800.00        0.04637  (13032808)              452000.00
4615900.00        0.08523  (13050508)
        452100.00   4615900.00        0.07691  (13091524)              452200.00
4615900.00        0.07524  (14092324)
        452300.00   4615900.00        0.07516  (14092324)              452400.00
4615900.00        0.07009  (14092324)
        452500.00   4615900.00        0.07054  (13050708)              452600.00
4615900.00        0.06778  (16021808)
        452700.00   4615900.00        0.07351  (16021808)              452800.00
4615900.00        0.07617  (16021808)
        452900.00   4615900.00        0.07158  (14100108)              453000.00
4615900.00        0.08914  (13092408)
        453100.00   4615900.00        0.09167  (13092408)              453200.00
4615900.00        0.09853  (13112008)
        453300.00   4615900.00        0.09247  (15111708)              453400.00
4615900.00        0.10361  (12032108)
        453500.00   4615900.00        0.13111m (12082524)              453600.00
4615900.00        0.11127m (12082524)
        453700.00   4615900.00        0.12287  (12102324)              453800.00
4615900.00        0.11401  (14120808)
        453900.00   4615900.00        0.12218  (15110424)              454000.00
4615900.00        0.10849  (15110508)
        454100.00   4615900.00        0.09952  (16081708)              454200.00
4615900.00        0.10217  (12121124)
        454300.00   4615900.00        0.08733  (16110524)              454400.00
4615900.00        0.09743  (12021424)
        454500.00   4615900.00        0.08442  (12021424)              454600.00
4615900.00        0.07353  (12010608)
        454700.00   4615900.00        0.08789m (13090408)              454800.00
4615900.00        0.08640m (13090408)
        454900.00   4615900.00        0.07530m (13090408)              455000.00
4615900.00        0.06718  (15071008)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 217
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455100.00	4615900.00	0.06416	(13122708)	455200.00	4615900.00	0.06164	(12081208)
455300.00	4615900.00	0.05843	(12081208)	455400.00	4615900.00	0.05729	(12082108)
455500.00	4615900.00	0.05565	(12082108)	455600.00	4615900.00	0.05378	(14102924)
455700.00	4615900.00	0.05158	(14102924)	455800.00	4615900.00	0.04898	(14102924)
455900.00	4615900.00	0.04619	(14102924)	456000.00	4615900.00	0.04333	(14102924)
456100.00	4615900.00	0.04041	(14102924)	456200.00	4615900.00	0.04129	(13072508)
456300.00	4615900.00	0.04248	(13072508)	456400.00	4615900.00	0.04306	(13072508)
456500.00	4615900.00	0.04362	(13072508)	456600.00	4615900.00	0.04289	(13072508)
452000.00	4616000.00	0.08968	(13050508)	452100.00	4616000.00	0.08270	(13091524)
452200.00	4616000.00	0.07386	(16082608)	452300.00	4616000.00	0.07171	(14122908)
452400.00	4616000.00	0.07365	(12062908)	452500.00	4616000.00	0.07013	(13050708)
452600.00	4616000.00	0.06699	(16021808)	452700.00	4616000.00	0.06442	(16021808)
452800.00	4616000.00	0.06738	(13092408)	452900.00	4616000.00	0.08291	(13092408)
453000.00	4616000.00	0.08586	(13092408)	453100.00	4616000.00	0.09226	(13112008)
453200.00	4616000.00	0.08455	(15111708)	453300.00	4616000.00	0.09052	(15111008)
453400.00	4616000.00	0.09828m	(12082524)	453500.00	4616000.00	0.12084m	(12082524)
453600.00	4616000.00	0.10012	(12111008)	453700.00	4616000.00	0.11593	(12102324)

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        453800.00   4616000.00        0.11751  (16010608)              453900.00
4616000.00        0.11867  (15110424)
        454000.00   4616000.00        0.10321  (12100808)              454100.00
4616000.00        0.10782  (13082008)
        454200.00   4616000.00        0.10025  (12100324)              454300.00
4616000.00        0.09579  (16110524)
        454400.00   4616000.00        0.08113  (12112724)              454500.00
4616000.00        0.08970  (12021424)
        454600.00   4616000.00        0.08025  (13070908)              454700.00
4616000.00        0.06729m (13090408)
        454800.00   4616000.00        0.08305m (13090408)              454900.00
4616000.00        0.08479m (13090408)
        455000.00   4616000.00        0.07676m (13090408)              455100.00
4616000.00        0.06495m (13090408)
        455200.00   4616000.00        0.05994  (15071008)              455300.00
4616000.00        0.05714  (12082108)
        455400.00   4616000.00        0.05703  (12082108)              455500.00
4616000.00        0.05593  (12082108)
        455600.00   4616000.00        0.05399  (12082108)              455700.00
4616000.00        0.05144  (12082108)
        455800.00   4616000.00        0.04945  (14102924)              455900.00
4616000.00        0.04803  (14102924)
        456000.00   4616000.00        0.04620  (14102924)              456100.00
4616000.00        0.04476  (13072508)
        456200.00   4616000.00        0.04544  (13072508)              456300.00
4616000.00        0.04598  (13072508)
        456400.00   4616000.00        0.04581  (13072508)              456500.00
4616000.00        0.04580  (13072508)
        456600.00   4616000.00        0.04498  (13072508)              452000.00
4616100.00        0.09535  (13050508)
        452100.00   4616100.00        0.08815  (13091524)              452200.00
4616100.00        0.07940  (16082608)
        452300.00   4616100.00        0.08097  (12062908)              452400.00
4616100.00        0.07691  (13050708)
        452500.00   4616100.00        0.06481  (13050708)              452600.00
4616100.00        0.05842  (14121008)
        452700.00   4616100.00        0.06664  (13092408)              452800.00
4616100.00        0.07996  (13092408)
        452900.00   4616100.00        0.07981  (13092408)              453000.00
4616100.00        0.08446  (13112008)
        453100.00   4616100.00        0.08637  (15111008)              453200.00
4616100.00        0.09448  (15111008)
        453300.00   4616100.00        0.08644  (12032108)              453400.00
4616100.00        0.10195m (12082524)
        453500.00   4616100.00        0.10504m (12082524)              453600.00
4616100.00        0.10113  (12111008)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 218
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453700.00	4616100.00	0.10476	(15082208)	453800.00	4616100.00	0.11134	(16010608)
453900.00	4616100.00	0.10930	(15110424)	454000.00	4616100.00	0.09478	(12100808)
454100.00	4616100.00	0.10071	(12100808)	454200.00	4616100.00	0.10531	(13082008)
454300.00	4616100.00	0.08965	(14122008)	454400.00	4616100.00	0.08516	(16110524)
454500.00	4616100.00	0.07454	(12021424)	454600.00	4616100.00	0.08182	(12021424)
454700.00	4616100.00	0.07552	(13070908)	454800.00	4616100.00	0.06305	(13070908)
454900.00	4616100.00	0.07752m	(13090408)	455000.00	4616100.00	0.08176m	(13090408)
455100.00	4616100.00	0.07625m	(13090408)	455200.00	4616100.00	0.06596m	(13090408)
455300.00	4616100.00	0.05482m	(13090408)	455400.00	4616100.00	0.05305	(15071008)
455500.00	4616100.00	0.05175	(12082108)	455600.00	4616100.00	0.05043	(12081208)
455700.00	4616100.00	0.04872	(13072508)	455800.00	4616100.00	0.04941	(13072508)
455900.00	4616100.00	0.04955	(13072508)	456000.00	4616100.00	0.04926	(13072508)
456100.00	4616100.00	0.04859	(13072508)	456200.00	4616100.00	0.04786	(13072508)
456300.00	4616100.00	0.04701	(13072508)	456400.00	4616100.00	0.04595	(13072508)
456500.00	4616100.00	0.04503	(13072508)	456600.00	4616100.00	0.04398	(13072508)
452000.00	4616200.00	0.09965	(13050508)	452100.00	4616200.00	0.09324	(13091524)
452200.00	4616200.00	0.08197	(16082608)	452300.00	4616200.00	0.08993	(12062908)

452400.00 4616200.00 0.07838 (13050708) 452500.00 4616200.00 0.06350 (14121008)
452600.00 4616200.00 0.06626 (13092408) 452700.00 4616200.00 0.07964 (13092208)
452800.00 4616200.00 0.08561 (13092208) 452900.00 4616200.00 0.08306 (16092224)
453000.00 4616200.00 0.08940 (15111008) 453100.00 4616200.00 0.09976 (15111008)
453200.00 4616200.00 0.08984 (15111008) 453300.00 4616200.00 0.07740m (12082524)
453400.00 4616200.00 0.09711m (12082524) 453500.00 4616200.00 0.09530 (16012508)
453600.00 4616200.00 0.09875 (12111008) 453700.00 4616200.00 0.10113 (15082208)
453800.00 4616200.00 0.10963 (16010608) 453900.00 4616200.00 0.09881 (15110424)
454000.00 4616200.00 0.09010 (16091908) 454100.00 4616200.00 0.10214 (12100808)
454200.00 4616200.00 0.10368 (13082008) 454300.00 4616200.00 0.08702 (13082008)
454400.00 4616200.00 0.08894 (14122008) 454500.00 4616200.00 0.07466 (16110524)
454600.00 4616200.00 0.07048 (12021424) 454700.00 4616200.00 0.07443 (12021424)
454800.00 4616200.00 0.07060 (13070908) 454900.00 4616200.00 0.06035 (13070908)
455000.00 4616200.00 0.07151m (13090408) 455100.00 4616200.00 0.07681m (13090408)
455200.00 4616200.00 0.07386m (13090408) 455300.00 4616200.00 0.06584m (13090408)
455400.00 4616200.00 0.05611m (13090408) 455500.00 4616200.00 0.05231 (13072508)
455600.00 4616200.00 0.05344 (13072508) 455700.00 4616200.00 0.05390 (13072508)
455800.00 4616200.00 0.05367 (13072508) 455900.00 4616200.00 0.05285 (13072508)
456000.00 4616200.00 0.05154 (13072508) 456100.00 4616200.00 0.04982 (13072508)
456200.00 4616200.00 0.04801 (13072508) 456300.00 4616200.00 0.04607 (13072508)
456400.00 4616200.00 0.04393 (13072508) 456500.00 4616200.00 0.04228 (13072508)
456600.00 4616200.00 0.04068 (13072508) 452000.00 4616300.00 0.10725 (13091524)
452100.00 4616300.00 0.09678 (13091524) 452200.00 4616300.00 0.09233 (14122908)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 219
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452300.00	4616300.00	0.09429	(12062908)	452400.00	4616300.00	0.07701	(16100124)
452500.00	4616300.00	0.07281	(14121008)	452600.00	4616300.00	0.08009	(13092208)
452700.00	4616300.00	0.09177	(13092208)	452800.00	4616300.00	0.09018	(16092224)
452900.00	4616300.00	0.09254	(15111008)	453000.00	4616300.00	0.10554	(15111008)
453100.00	4616300.00	0.09477	(15111008)	453200.00	4616300.00	0.07388	(16061808)
453300.00	4616300.00	0.08153	(16100308)	453400.00	4616300.00	0.09006	(16100308)
453500.00	4616300.00	0.09708	(16100308)	453600.00	4616300.00	0.09901	(12111908)
453700.00	4616300.00	0.09728	(15082208)	453800.00	4616300.00	0.10385	(16010608)
453900.00	4616300.00	0.09449	(12091108)	454000.00	4616300.00	0.08667	(16091908)
454100.00	4616300.00	0.09725	(12100808)	454200.00	4616300.00	0.09311	(13082008)
454300.00	4616300.00	0.09446	(13082008)	454400.00	4616300.00	0.08667	(14122008)
454500.00	4616300.00	0.08358	(14122008)	454600.00	4616300.00	0.06538	(16110524)
454700.00	4616300.00	0.06587	(12021424)	454800.00	4616300.00	0.06776	(12021424)
454900.00	4616300.00	0.06582	(13070908)	455000.00	4616300.00	0.05735	(13070908)
455100.00	4616300.00	0.06493m	(13090408)	455200.00	4616300.00	0.07138m	(13090408)
455300.00	4616300.00	0.07062m	(13090408)	455400.00	4616300.00	0.06487m	(13090408)
455500.00	4616300.00	0.05653m	(13090408)	455600.00	4616300.00	0.05557	(13072508)

455700.00 4616300.00 0.05493 (13072508) 455800.00
4616300.00 0.05380 (13072508)
455900.00 4616300.00 0.05221 (13072508) 456000.00
4616300.00 0.05024 (13072508)
456100.00 4616300.00 0.04804 (13072508) 456200.00
4616300.00 0.04561 (13072508)
456300.00 4616300.00 0.04316 (13072508) 456400.00
4616300.00 0.04061 (13072508)
456500.00 4616300.00 0.03918 (15072208) 456600.00
4616300.00 0.04014 (15072208)
452000.00 4616400.00 0.11949 (13091524) 452100.00
4616400.00 0.09740 (13091524)
452200.00 4616400.00 0.10883 (12062908) 452300.00
4616400.00 0.09289 (12062908)
452400.00 4616400.00 0.08018 (14121008) 452500.00
4616400.00 0.08304 (15082608)
452600.00 4616400.00 0.09662 (13092208) 452700.00
4616400.00 0.09885 (16092224)
452800.00 4616400.00 0.09833 (16083024) 452900.00
4616400.00 0.11255 (15111008)
453000.00 4616400.00 0.09990 (15111008) 453100.00
4616400.00 0.07902 (16100308)
453200.00 4616400.00 0.08889 (16100308) 453300.00
4616400.00 0.09723 (16100308)
453400.00 4616400.00 0.09826 (16100308) 453500.00
4616400.00 0.09100 (16100308)
453600.00 4616400.00 0.09250 (12111908) 453700.00
4616400.00 0.09102 (15082208)
453800.00 4616400.00 0.09720 (16010608) 453900.00
4616400.00 0.09015 (12091108)
454000.00 4616400.00 0.07913 (16091908) 454100.00
4616400.00 0.08905 (12100808)
454200.00 4616400.00 0.08528 (12100808) 454300.00
4616400.00 0.09300 (13082008)
454400.00 4616400.00 0.07969 (12111524) 454500.00
4616400.00 0.08668 (14122008)
454600.00 4616400.00 0.07619 (14122008) 454700.00
4616400.00 0.05939 (13090724)
454800.00 4616400.00 0.06122 (12021424) 454900.00
4616400.00 0.06276 (13070908)
455000.00 4616400.00 0.06131 (13070908) 455100.00
4616400.00 0.05595 (13072508)
455200.00 4616400.00 0.05884m (13090408) 455300.00
4616400.00 0.06592m (13090408)
455400.00 4616400.00 0.06699m (13090408) 455500.00
4616400.00 0.06305m (13090408)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 220
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455600.00	4616400.00	0.05626m	(13090408)	455700.00	4616400.00	0.05186	(13072508)
455800.00	4616400.00	0.05003	(13072508)	455900.00	4616400.00	0.04803	(13072508)
456000.00	4616400.00	0.04586	(13072508)	456100.00	4616400.00	0.04370	(13072508)
456200.00	4616400.00	0.04125	(13072508)	456300.00	4616400.00	0.03889	(13072508)
456400.00	4616400.00	0.03688	(15072208)	456500.00	4616400.00	0.03807	(15072208)
456600.00	4616400.00	0.03908	(15072208)	452000.00	4616500.00	0.13093	(13091524)
452100.00	4616500.00	0.10484	(14122908)	452200.00	4616500.00	0.12193	(12062908)
452300.00	4616500.00	0.09572	(16100124)	452400.00	4616500.00	0.09237	(14121008)
452500.00	4616500.00	0.09986	(15082608)	452600.00	4616500.00	0.10886	(16092224)
452700.00	4616500.00	0.11155	(16083024)	452800.00	4616500.00	0.12112	(15111008)
452900.00	4616500.00	0.10731	(15111008)	453000.00	4616500.00	0.08620	(16100308)
453100.00	4616500.00	0.09504	(16100308)	453200.00	4616500.00	0.10067	(16100308)
453300.00	4616500.00	0.09775	(16100308)	453400.00	4616500.00	0.08873	(16112108)
453500.00	4616500.00	0.09779	(13030308)	453600.00	4616500.00	0.10070	(13030308)
453700.00	4616500.00	0.09591	(13030308)	453800.00	4616500.00	0.09099	(16010608)
453900.00	4616500.00	0.08464	(12091108)	454000.00	4616500.00	0.08454	(15110308)
454100.00	4616500.00	0.07656	(12100808)	454200.00	4616500.00	0.08395	(12100808)

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        454300.00   4616500.00        0.08554  (13082008)              454400.00
4616500.00        0.08353  (13082008)
        454500.00   4616500.00        0.08054  (14122008)              454600.00
4616500.00        0.08216  (14122008)
        454700.00   4616500.00        0.06821  (14122008)              454800.00
4616500.00        0.06026  (13072508)
        454900.00   4616500.00        0.06017  (13072508)              455000.00
4616500.00        0.05935  (13072508)
        455100.00   4616500.00        0.05795  (13072508)              455200.00
4616500.00        0.05631  (13072508)
        455300.00   4616500.00        0.05422  (13072508)              455400.00
4616500.00        0.06076m (13090408)
        455500.00   4616500.00        0.06298m (13090408)              455600.00
4616500.00        0.06066m (13090408)
        455700.00   4616500.00        0.05539m (13090408)              455800.00
4616500.00        0.05191  (15101008)
        455900.00   4616500.00        0.04992  (15101008)              456000.00
4616500.00        0.04725  (15101008)
        456100.00   4616500.00        0.04511  (15101008)              456200.00
4616500.00        0.04340  (15101008)
        456300.00   4616500.00        0.04233  (15101008)              456400.00
4616500.00        0.04189  (15101008)
        456500.00   4616500.00        0.04263  (15101008)              456600.00
4616500.00        0.04254  (15101008)
        452000.00   4616600.00        0.14153  (13091524)              452100.00
4616600.00        0.12651  (12062908)
        452200.00   4616600.00        0.12671  (12062908)              452300.00
4616600.00        0.10469  (14121008)
        452400.00   4616600.00        0.10893  (15082608)              452500.00
4616600.00        0.11988  (16092224)
        452600.00   4616600.00        0.12685  (16083024)              452700.00
4616600.00        0.12781  (15111008)
        452800.00   4616600.00        0.11432  (15111008)              452900.00
4616600.00        0.09636  (16100308)
        453000.00   4616600.00        0.10214  (16100308)              453100.00
4616600.00        0.10210  (16100308)
        453200.00   4616600.00        0.09906  (16112108)              453300.00
4616600.00        0.10148  (13030308)
        453400.00   4616600.00        0.10840  (13030308)              453500.00
4616600.00        0.10565  (13030308)
        453600.00   4616600.00        0.09534  (13030308)              453700.00
4616600.00        0.08581  (12111408)
        453800.00   4616600.00        0.08565  (16010608)              453900.00
4616600.00        0.08334  (16110724)
        454000.00   4616600.00        0.08212  (15110308)              454100.00
4616600.00        0.07286  (16091908)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 221
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454200.00	4616600.00	0.07605	(12100808)	454300.00	4616600.00	0.07487	(13082008)
454400.00	4616600.00	0.08230	(13082008)	454500.00	4616600.00	0.08262	(12111524)
454600.00	4616600.00	0.08045	(14122008)	454700.00	4616600.00	0.07601	(14122008)
454800.00	4616600.00	0.06303	(13072508)	454900.00	4616600.00	0.06067	(13072508)
455000.00	4616600.00	0.05785	(13072508)	455100.00	4616600.00	0.05480	(13072508)
455200.00	4616600.00	0.05340	(13070908)	455300.00	4616600.00	0.04886	(13072508)
455400.00	4616600.00	0.05155	(16091108)	455500.00	4616600.00	0.05574m	(13090408)
455600.00	4616600.00	0.05879m	(13090408)	455700.00	4616600.00	0.05935	(15101008)
455800.00	4616600.00	0.06126	(15101008)	455900.00	4616600.00	0.06057	(15101008)
456000.00	4616600.00	0.05801	(15101008)	456100.00	4616600.00	0.05515	(15101008)
456200.00	4616600.00	0.05224	(15101008)	456300.00	4616600.00	0.04951	(15101008)
456400.00	4616600.00	0.04714	(15101008)	456500.00	4616600.00	0.04614	(15101008)
456600.00	4616600.00	0.04426	(15101008)	452000.00	4616700.00	0.15254	(13091524)
452100.00	4616700.00	0.15764	(12062908)	452200.00	4616700.00	0.12382	(12062908)
452300.00	4616700.00	0.12073	(14121008)	452400.00	4616700.00	0.13096	(16092224)
452500.00	4616700.00	0.14469	(16083024)	452600.00	4616700.00	0.13506	(16083024)
452700.00	4616700.00	0.11931	(15111008)	452800.00	4616700.00	0.10141	(16100308)

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        452900.00   4616700.00        0.10788  (16100308)              453000.00
4616700.00        0.11399  (12062824)
        453100.00   4616700.00        0.11730  (12062824)              453200.00
4616700.00        0.11507  (13030308)
        453300.00   4616700.00        0.11425  (13030308)              453400.00
4616700.00        0.10402  (13030308)
        453500.00   4616700.00        0.08803  (13030308)              453600.00
4616700.00        0.08500  (12082108)
        453700.00   4616700.00        0.08460  (12111408)              453800.00
4616700.00        0.08226  (13122108)
        453900.00   4616700.00        0.08054  (16110724)              454000.00
4616700.00        0.07823  (15110308)
        454100.00   4616700.00        0.07292  (16091908)              454200.00
4616700.00        0.07407  (12100808)
        454300.00   4616700.00        0.06821  (13072508)              454400.00
4616700.00        0.07343  (13082008)
        454500.00   4616700.00        0.08075  (12111524)              454600.00
4616700.00        0.08076  (12111524)
        454700.00   4616700.00        0.07712  (14122008)              454800.00
4616700.00        0.06885  (14122008)
        454900.00   4616700.00        0.05561  (13072508)              455000.00
4616700.00        0.05260  (13090724)
        455100.00   4616700.00        0.05100  (15101008)              455200.00
4616700.00        0.05248  (13102708)
        455300.00   4616700.00        0.05357  (13102708)              455400.00
4616700.00        0.05106  (13102708)
        455500.00   4616700.00        0.05251  (15101008)              455600.00
4616700.00        0.05694  (15101008)
        455700.00   4616700.00        0.06136  (15101008)              455800.00
4616700.00        0.06437  (15101008)
        455900.00   4616700.00        0.06491  (15101008)              456000.00
4616700.00        0.06353  (15101008)
        456100.00   4616700.00        0.06081  (15101008)              456200.00
4616700.00        0.05756  (15101008)
        456300.00   4616700.00        0.05385  (15101008)              456400.00
4616700.00        0.05005  (15101008)
        456500.00   4616700.00        0.04735  (15101008)              456600.00
4616700.00        0.04474  (15101008)
        452000.00   4616800.00        0.15454  (13091524)              452100.00
4616800.00        0.17904  (12062908)
        452200.00   4616800.00        0.14355  (14121008)              452300.00
4616800.00        0.14705  (15082608)
        452400.00   4616800.00        0.16485  (16083024)              452500.00
4616800.00        0.15896  (16083024)
        452600.00   4616800.00        0.12268  (15111008)              452700.00
4616800.00        0.10508  (16062908)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 222
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452800.00	4616800.00	0.12329	(12062824)	452900.00	4616800.00	0.14081	(12062824)
453000.00	4616800.00	0.13685	(12062824)	453100.00	4616800.00	0.12570	(13030308)
453200.00	4616800.00	0.11328	(13030308)	453300.00	4616800.00	0.09415	(13030308)
453400.00	4616800.00	0.09083	(13122108)	453500.00	4616800.00	0.09315	(13122108)
453600.00	4616800.00	0.09110	(13122108)	453700.00	4616800.00	0.08556	(13122108)
453800.00	4616800.00	0.07949	(12111408)	453900.00	4616800.00	0.07829	(13072508)
454000.00	4616800.00	0.07886	(13072508)	454100.00	4616800.00	0.07798	(13072508)
454200.00	4616800.00	0.07578	(13072508)	454300.00	4616800.00	0.07244	(13072508)
454400.00	4616800.00	0.06979	(13072508)	454500.00	4616800.00	0.06969	(13082008)
454600.00	4616800.00	0.08253	(12111524)	454700.00	4616800.00	0.07441	(12111524)
454800.00	4616800.00	0.07206	(14122008)	454900.00	4616800.00	0.06202	(14122008)
455000.00	4616800.00	0.06194	(15101008)	455100.00	4616800.00	0.06212	(15101008)
455200.00	4616800.00	0.05989	(15101008)	455300.00	4616800.00	0.05703	(15101008)
455400.00	4616800.00	0.05600	(13102708)	455500.00	4616800.00	0.05429	(15101008)
455600.00	4616800.00	0.05564	(15101008)	455700.00	4616800.00	0.05803	(15101008)
455800.00	4616800.00	0.06059	(15101008)	455900.00	4616800.00	0.06191	(15101008)
456000.00	4616800.00	0.06170	(15101008)	456100.00	4616800.00	0.06016	(15101008)

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        456200.00   4616800.00        0.05757  (15101008)              456300.00
4616800.00        0.05400  (15101008)
        456400.00   4616800.00        0.05002  (15101008)              456500.00
4616800.00        0.04665  (15101008)
        456600.00   4616800.00        0.04315  (15101008)              452000.00
4616900.00        0.19042  (12062908)
        452100.00   4616900.00        0.18507  (12062908)              452200.00
4616900.00        0.16222  (14121008)
        452300.00   4616900.00        0.18556  (16083024)              452400.00
4616900.00        0.18955  (16083024)
        452500.00   4616900.00        0.13509  (16083024)              452600.00
4616900.00        0.12300  (16062908)
        452700.00   4616900.00        0.16094  (12062824)              452800.00
4616900.00        0.17105  (12062824)
        452900.00   4616900.00        0.15423  (12062824)              453000.00
4616900.00        0.12776  (13030308)
        453100.00   4616900.00        0.10337  (13030308)              453200.00
4616900.00        0.10146  (13122108)
        453300.00   4616900.00        0.10211  (13122108)              453400.00
4616900.00        0.09825  (13122108)
        453500.00   4616900.00        0.08999  (13122108)              453600.00
4616900.00        0.08730  (13072508)
        453700.00   4616900.00        0.08633  (13072508)              453800.00
4616900.00        0.08556  (13072508)
        453900.00   4616900.00        0.08308  (13072508)              454000.00
4616900.00        0.07929  (13072508)
        454100.00   4616900.00        0.07462  (13072508)              454200.00
4616900.00        0.06953  (13072508)
        454300.00   4616900.00        0.06569  (12100808)              454400.00
4616900.00        0.06079  (13082008)
        454500.00   4616900.00        0.06890  (13082008)              454600.00
4616900.00        0.07591  (12111524)
        454700.00   4616900.00        0.07812  (12111524)              454800.00
4616900.00        0.07044  (14122008)
        454900.00   4616900.00        0.06651  (14122008)              455000.00
4616900.00        0.06540  (15101008)
        455100.00   4616900.00        0.06614  (15101008)              455200.00
4616900.00        0.06412  (15101008)
        455300.00   4616900.00        0.06037  (15101008)              455400.00
4616900.00        0.05735  (13102708)
        455500.00   4616900.00        0.05665  (13102708)              455600.00
4616900.00        0.05358  (13102708)
        455700.00   4616900.00        0.05026  (15101008)              455800.00
4616900.00        0.05136  (15101008)
        455900.00   4616900.00        0.05258  (15101008)              456000.00
4616900.00        0.05334  (15101008)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 223
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456100.00	4616900.00	0.05334	(15101008)	456200.00	4616900.00	0.05275	(12091608)
456300.00	4616900.00	0.05158	(12091608)	456400.00	4616900.00	0.04876	(12091608)
456500.00	4616900.00	0.04529	(16082208)	456600.00	4616900.00	0.04428	(16082208)
452000.00	4617000.00	0.24937	(12062908)	452100.00	4617000.00	0.20874	(14121008)
452200.00	4617000.00	0.21566	(16092224)	452300.00	4617000.00	0.22929	(16083024)
452400.00	4617000.00	0.15898	(16083024)	452500.00	4617000.00	0.16799	(12062824)
452600.00	4617000.00	0.21069	(12062824)	452700.00	4617000.00	0.20183	(12062824)
452800.00	4617000.00	0.16455	(12062824)	452900.00	4617000.00	0.12212	(12062824)
453000.00	4617000.00	0.11645	(13122108)	453100.00	4617000.00	0.11443	(13122108)
453200.00	4617000.00	0.10584	(13122108)	453300.00	4617000.00	0.09345	(13122108)
453400.00	4617000.00	0.09429	(13072508)	453500.00	4617000.00	0.09328	(13072508)
453600.00	4617000.00	0.09262	(13072508)	453700.00	4617000.00	0.08847	(13072508)
453800.00	4617000.00	0.08160	(13072508)	453900.00	4617000.00	0.07501	(13072508)
454000.00	4617000.00	0.06892	(13072508)	454100.00	4617000.00	0.06701	(15110308)
454200.00	4617000.00	0.06442	(15101008)	454300.00	4617000.00	0.06574	(15101008)
454400.00	4617000.00	0.06696	(15101008)	454500.00	4617000.00	0.06416	(15101008)
454600.00	4617000.00	0.06841	(12111524)	454700.00	4617000.00	0.07928	(12111524)

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        454800.00   4617000.00        0.07234  (12111524)              454900.00
4617000.00        0.06699  (14122008)
        455000.00   4617000.00        0.06087  (14122008)              455100.00
4617000.00        0.06097  (15101008)
        455200.00   4617000.00        0.06016  (15101008)              455300.00
4617000.00        0.05663  (15101008)
        455400.00   4617000.00        0.05481  (13102708)              455500.00
4617000.00        0.05613  (13102708)
        455600.00   4617000.00        0.05502  (13102708)              455700.00
4617000.00        0.05192  (13102708)
        455800.00   4617000.00        0.04733  (13102708)              455900.00
4617000.00        0.04622  (16091108)
        456000.00   4617000.00        0.04557  (16091108)              456100.00
4617000.00        0.04684  (12091608)
        456200.00   4617000.00        0.05062  (12091608)              456300.00
4617000.00        0.05177  (12091608)
        456400.00   4617000.00        0.05157  (12091608)              456500.00
4617000.00        0.04954  (12091608)
        456600.00   4617000.00        0.04632  (12091608)              452000.00
4617100.00        0.29763  (12062908)
        452100.00   4617100.00        0.24858  (16080608)              452200.00
4617100.00        0.28141  (16083024)
        452300.00   4617100.00        0.18932  (16083024)              452400.00
4617100.00        0.24673  (12062824)
        452500.00   4617100.00        0.27067  (12062824)              452600.00
4617100.00        0.22430  (12062824)
        452700.00   4617100.00        0.16027  (12062824)              452800.00
4617100.00        0.14329  (16082124)
        452900.00   4617100.00        0.13184  (16082124)              453000.00
4617100.00        0.11449  (16082124)
        453100.00   4617100.00        0.09786  (13072508)              453200.00
4617100.00        0.10024  (13072508)
        453300.00   4617100.00        0.09760  (13072508)              453400.00
4617100.00        0.09363  (13072508)
        453500.00   4617100.00        0.08688  (13072508)              453600.00
4617100.00        0.08063  (13072508)
        453700.00   4617100.00        0.07801  (12111408)              453800.00
4617100.00        0.07499  (15091024)
        453900.00   4617100.00        0.07191  (15091024)              454000.00
4617100.00        0.06853  (15091024)
        454100.00   4617100.00        0.06736  (15101008)              454200.00
4617100.00        0.06627  (15101008)
        454300.00   4617100.00        0.06502  (15101008)              454400.00
4617100.00        0.06266  (15101008)
        454500.00   4617100.00        0.05850  (15101008)              454600.00
4617100.00        0.06094  (12111524)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 224
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454700.00	4617100.00	0.07580	(12111524)	454800.00	4617100.00	0.07501	(12111524)
454900.00	4617100.00	0.06477	(12111524)	455000.00	4617100.00	0.06282	(14122008)
455100.00	4617100.00	0.05901	(15092008)	455200.00	4617100.00	0.05741	(15092008)
455300.00	4617100.00	0.05464	(15092008)	455400.00	4617100.00	0.05114	(15092008)
455500.00	4617100.00	0.05184	(13102708)	455600.00	4617100.00	0.05275	(13102708)
455700.00	4617100.00	0.05155	(13102708)	455800.00	4617100.00	0.04861	(13102708)
455900.00	4617100.00	0.04424	(13102708)	456000.00	4617100.00	0.04250	(16091108)
456100.00	4617100.00	0.04229	(16091108)	456200.00	4617100.00	0.04463	(12091608)
456300.00	4617100.00	0.04677	(12091608)	456400.00	4617100.00	0.05081	(12091608)
456500.00	4617100.00	0.05107	(12091608)	456600.00	4617100.00	0.04964	(12091608)
452000.00	4617200.00	0.33787	(12062908)	452100.00	4617200.00	0.34295	(16083024)
452200.00	4617200.00	0.24267	(13061124)	452300.00	4617200.00	0.36672	(12062824)
452400.00	4617200.00	0.32491	(12062824)	452500.00	4617200.00	0.22052	(12062824)
452600.00	4617200.00	0.18612	(16082124)	452700.00	4617200.00	0.16406	(16082124)
452800.00	4617200.00	0.13559	(16082124)	452900.00	4617200.00	0.11564	(13102224)
453000.00	4617200.00	0.10412	(13102224)	453100.00	4617200.00	0.09921	(15091024)
453200.00	4617200.00	0.09903	(15091024)	453300.00	4617200.00	0.09748	(15091024)

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        453400.00   4617200.00        0.09534  (15091024)              453500.00
4617200.00        0.09020  (15091024)
        453600.00   4617200.00        0.08605  (15091024)              453700.00
4617200.00        0.08195  (15091024)
        453800.00   4617200.00        0.07723  (15091024)              453900.00
4617200.00        0.07227  (15091024)
        454000.00   4617200.00        0.06643  (15091024)              454100.00
4617200.00        0.06240  (15091024)
        454200.00   4617200.00        0.05875  (15091024)              454300.00
4617200.00        0.05669  (15072008)
        454400.00   4617200.00        0.05662  (15072008)              454500.00
4617200.00        0.05762  (15072008)
        454600.00   4617200.00        0.05898  (15072008)              454700.00
4617200.00        0.07010  (12111524)
        454800.00   4617200.00        0.07452  (12111524)              454900.00
4617200.00        0.06904  (12111524)
        455000.00   4617200.00        0.06165  (14122008)              455100.00
4617200.00        0.05834  (14122008)
        455200.00   4617200.00        0.05483  (15092008)              455300.00
4617200.00        0.05250  (15092008)
        455400.00   4617200.00        0.04922  (15092008)              455500.00
4617200.00        0.04556  (15092008)
        455600.00   4617200.00        0.04779  (13102708)              455700.00
4617200.00        0.04852  (13102708)
        455800.00   4617200.00        0.04738  (13102708)              455900.00
4617200.00        0.04462  (13102708)
        456000.00   4617200.00        0.04069  (13102708)              456100.00
4617200.00        0.03887  (16091108)
        456200.00   4617200.00        0.03703  (16091108)              456300.00
4617200.00        0.04100  (12091608)
        456400.00   4617200.00        0.04610  (12091608)              456500.00
4617200.00        0.04819  (12091608)
        456600.00   4617200.00        0.05048  (12091608)              452000.00
4617300.00        0.44079  (13090308)
        452100.00   4617300.00        0.43718  (12062824)              452200.00
4617300.00        0.51790  (12062824)
        452300.00   4617300.00        0.32574  (12062824)              452400.00
4617300.00        0.24647  (16082124)
        452500.00   4617300.00        0.20287  (16082124)              452600.00
4617300.00        0.16788  (12072124)
        452700.00   4617300.00        0.14508  (12072124)              452800.00
4617300.00        0.12827  (15091024)
        452900.00   4617300.00        0.12737  (15091024)              453000.00
4617300.00        0.12237  (15091024)
        453100.00   4617300.00        0.11573  (15091024)              453200.00
4617300.00        0.10847  (15091024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 225
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453300.00	4617300.00	0.10138	(15091024)	453400.00	4617300.00	0.09609	(15091024)
453500.00	4617300.00	0.08806	(15091024)	453600.00	4617300.00	0.08246	(15072008)
453700.00	4617300.00	0.07885	(15072008)	453800.00	4617300.00	0.07488	(15072008)
453900.00	4617300.00	0.07116	(15072008)	454000.00	4617300.00	0.06769	(15072008)
454100.00	4617300.00	0.06493	(12082008)	454200.00	4617300.00	0.06270	(12082008)
454300.00	4617300.00	0.06059	(12082008)	454400.00	4617300.00	0.05855	(12082008)
454500.00	4617300.00	0.05658	(12082008)	454600.00	4617300.00	0.05512	(15072008)
454700.00	4617300.00	0.06297	(12111524)	454800.00	4617300.00	0.07142	(12111524)
454900.00	4617300.00	0.07071	(12111524)	455000.00	4617300.00	0.06243	(12111524)
455100.00	4617300.00	0.05858	(14122008)	455200.00	4617300.00	0.05385	(14122008)
455300.00	4617300.00	0.04601	(15092008)	455400.00	4617300.00	0.04465	(15050208)
455500.00	4617300.00	0.04407	(15050208)	455600.00	4617300.00	0.04205	(12082008)
455700.00	4617300.00	0.04397	(13102708)	455800.00	4617300.00	0.04457	(13102708)
455900.00	4617300.00	0.04356	(13102708)	456000.00	4617300.00	0.04122	(13102708)
456100.00	4617300.00	0.03836	(15110808)	456200.00	4617300.00	0.03858	(15110808)
456300.00	4617300.00	0.03828	(15110808)	456400.00	4617300.00	0.03872	(12091608)
456500.00	4617300.00	0.04412	(12091608)	456600.00	4617300.00	0.04788	(12091608)

449000.00 4609000.00 0.01651 (16092008) 449500.00
4609000.00 0.02061 (16092008)
450000.00 4609000.00 0.01782c (12060624) 450500.00
4609000.00 0.01781 (15080824)
451000.00 4609000.00 0.02254 (16112124) 451500.00
4609000.00 0.02258 (13050408)
452000.00 4609000.00 0.02994 (13081808) 452500.00
4609000.00 0.02452 (15090408)
453000.00 4609000.00 0.02534 (15090408) 453500.00
4609000.00 0.02830 (15062008)
454000.00 4609000.00 0.01883 (15072608) 454500.00
4609000.00 0.02054 (13050508)
455000.00 4609000.00 0.01919 (16031108) 455500.00
4609000.00 0.01771 (16031108)
456000.00 4609000.00 0.02127 (13082308) 456500.00
4609000.00 0.01992 (13082308)
457000.00 4609000.00 0.02113 (14052508) 457500.00
4609000.00 0.02381 (14052508)
458000.00 4609000.00 0.02788 (16121708) 458500.00
4609000.00 0.02662 (13121608)
459000.00 4609000.00 0.02668 (13121608) 459500.00
4609000.00 0.02825 (15111008)
460000.00 4609000.00 0.03174 (15111008) 449000.00
4609500.00 0.01719 (12012616)
449500.00 4609500.00 0.02121 (16092008) 450000.00
4609500.00 0.01930 (14053008)
450500.00 4609500.00 0.02023 (14053008) 451000.00
4609500.00 0.02202 (16101924)
451500.00 4609500.00 0.02569 (16112124) 452000.00
4609500.00 0.03092 (13081808)
452500.00 4609500.00 0.02391 (14061008) 453000.00
4609500.00 0.02870 (15090408)
453500.00 4609500.00 0.03069 (15062008) 454000.00
4609500.00 0.01959 (15072608)
454500.00 4609500.00 0.02207 (13082308) 455000.00
4609500.00 0.02083 (16031108)
455500.00 4609500.00 0.02048 (13082308) 456000.00
4609500.00 0.02345 (13082308)
456500.00 4609500.00 0.02113 (13082308) 457000.00
4609500.00 0.02413 (14052508)
457500.00 4609500.00 0.02718 (16121708) 458000.00
4609500.00 0.03037 (16121708)
458500.00 4609500.00 0.03013 (13121608) 459000.00
4609500.00 0.03010 (15111008)
459500.00 4609500.00 0.03479 (15111008) 460000.00
4609500.00 0.02621 (12020508)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 226
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
449000.00	4610000.00	0.01836	(13121924)	449500.00	4610000.00	0.01936	(16092008)
450000.00	4610000.00	0.02077	(16092008)	450500.00	4610000.00	0.02503	(14053008)
451000.00	4610000.00	0.02125	(15080824)	451500.00	4610000.00	0.02716	(16112124)
452000.00	4610000.00	0.02945	(13081808)	452500.00	4610000.00	0.02624	(14061008)
453000.00	4610000.00	0.03142	(15090408)	453500.00	4610000.00	0.03390	(15062008)
454000.00	4610000.00	0.02071	(13050508)	454500.00	4610000.00	0.02435	(13082308)
455000.00	4610000.00	0.02018	(16031108)	455500.00	4610000.00	0.02424	(13082308)
456000.00	4610000.00	0.02562	(13082308)	456500.00	4610000.00	0.02349	(14052508)
457000.00	4610000.00	0.02583	(14052508)	457500.00	4610000.00	0.03387	(16121708)
458000.00	4610000.00	0.03316	(13121608)	458500.00	4610000.00	0.03189	(15111008)
459000.00	4610000.00	0.03837	(15111008)	459500.00	4610000.00	0.02910	(12020508)
460000.00	4610000.00	0.03283	(12020508)	449000.00	4610500.00	0.02036	(13121924)
449500.00	4610500.00	0.02005	(13121924)	450000.00	4610500.00	0.02117	(16092008)
450500.00	4610500.00	0.02512	(14053008)	451000.00	4610500.00	0.02333c	(12060624)
451500.00	4610500.00	0.02742	(16101924)	452000.00	4610500.00	0.02872	(16112124)
452500.00	4610500.00	0.02742	(14061008)	453000.00	4610500.00	0.03502	(15090408)
453500.00	4610500.00	0.03723	(15062008)	454000.00	4610500.00	0.02369	(13050508)

454500.00	4610500.00	0.02601	(13082308)	455000.00	
4610500.00	0.02090	(13082308)			
455500.00	4610500.00	0.02797	(13082308)	456000.00	
4610500.00	0.02647	(13082308)			
456500.00	4610500.00	0.02650	(14052508)	457000.00	
4610500.00	0.03605	(16121708)			
457500.00	4610500.00	0.03531	(13121608)	458000.00	
4610500.00	0.03344	(15111008)			
458500.00	4610500.00	0.04258	(15111008)	459000.00	
4610500.00	0.03141	(12020508)			
459500.00	4610500.00	0.03542	(12020508)	460000.00	
4610500.00	0.02829	(12020508)			
449000.00	4611000.00	0.01832	(13051524)	449500.00	
4611000.00	0.02353	(13121924)			
450000.00	4611000.00	0.02113	(13121924)	450500.00	
4611000.00	0.02069	(14053008)			
451000.00	4611000.00	0.02610	(14053008)	451500.00	
4611000.00	0.02999	(15072608)			
452000.00	4611000.00	0.02914	(16112124)	452500.00	
4611000.00	0.02711	(13050408)			
453000.00	4611000.00	0.03540	(15090408)	453500.00	
4611000.00	0.04075	(15062008)			
454000.00	4611000.00	0.02723	(13050508)	454500.00	
4611000.00	0.02705	(13082308)			
455000.00	4611000.00	0.02610	(13082308)	455500.00	
4611000.00	0.03073	(13082308)			
456000.00	4611000.00	0.02634	(14052508)	456500.00	
4611000.00	0.03510	(16121708)			
457000.00	4611000.00	0.03591	(16121708)	457500.00	
4611000.00	0.03517	(15111008)			
458000.00	4611000.00	0.04755	(15111008)	458500.00	
4611000.00	0.03521	(12020508)			
459000.00	4611000.00	0.03768	(12020508)	459500.00	
4611000.00	0.03106	(16100308)			
460000.00	4611000.00	0.03627	(16100308)	449000.00	
4611500.00	0.01816	(12113024)			
449500.00	4611500.00	0.01990	(13121924)	450000.00	
4611500.00	0.02641	(13121924)			
450500.00	4611500.00	0.02259	(13121924)	451000.00	
4611500.00	0.02683	(15092508)			
451500.00	4611500.00	0.03674	(15072608)	452000.00	
4611500.00	0.03171	(16101924)			
452500.00	4611500.00	0.03225	(13050408)	453000.00	
4611500.00	0.03435	(15090408)			
453500.00	4611500.00	0.04451	(15062008)	454000.00	
4611500.00	0.03135	(14040908)			

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 227
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454500.00	4611500.00	0.02805	(13082308)	455000.00	4611500.00	0.03247	(13082308)
455500.00	4611500.00	0.03075	(13082308)	456000.00	4611500.00	0.03148	(13092208)
456500.00	4611500.00	0.04263	(16121708)	457000.00	4611500.00	0.03671	(13121608)
457500.00	4611500.00	0.05339	(15111008)	458000.00	4611500.00	0.03841	(12020508)
458500.00	4611500.00	0.03916	(12020508)	459000.00	4611500.00	0.03441	(16100308)
459500.00	4611500.00	0.03594	(16100308)	460000.00	4611500.00	0.03243	(16100308)
449000.00	4612000.00	0.02281	(13071508)	449500.00	4612000.00	0.02284	(13051524)
450000.00	4612000.00	0.02132	(13121924)	450500.00	4612000.00	0.02982	(13121924)
451000.00	4612000.00	0.02698	(15090408)	451500.00	4612000.00	0.04019	(15072608)
452000.00	4612000.00	0.03494	(15072608)	452500.00	4612000.00	0.03607	(16112124)
453000.00	4612000.00	0.03874	(14061008)	453500.00	4612000.00	0.04833	(15062008)
454000.00	4612000.00	0.03623	(13050508)	454500.00	4612000.00	0.03032	(13082308)
455000.00	4612000.00	0.03603	(13082308)	455500.00	4612000.00	0.02959	(14052508)
456000.00	4612000.00	0.04613	(16121708)	456500.00	4612000.00	0.04117	(14112724)
457000.00	4612000.00	0.06062	(15111008)	457500.00	4612000.00	0.04213	(12020508)
458000.00	4612000.00	0.04011	(12020508)	458500.00	4612000.00	0.04006	(16112108)
459000.00	4612000.00	0.03440	(16112108)	459500.00	4612000.00	0.03848	(13011508)

460000.00 4612000.00 0.03975 (13011508) 449000.00
4612500.00 0.02452 (14040708)
449500.00 4612500.00 0.02611 (13071508) 450000.00
4612500.00 0.02589 (13071508)
450500.00 4612500.00 0.02374 (12113024) 451000.00
4612500.00 0.03311 (13121924)
451500.00 4612500.00 0.04162 (15092508) 457000.00
4612500.00 0.04569 (12020508)
457500.00 4612500.00 0.04452 (16112108) 458000.00
4612500.00 0.04257 (16112108)
458500.00 4612500.00 0.03925 (13030308) 459000.00
4612500.00 0.04293 (13011508)
459500.00 4612500.00 0.03990 (14020308) 460000.00
4612500.00 0.04049 (14020308)
449000.00 4613000.00 0.02799 (14092608) 449500.00
4613000.00 0.02881 (15121224)
450000.00 4613000.00 0.03061 (13051524) 450500.00
4613000.00 0.03341 (13071508)
451000.00 4613000.00 0.03537 (15090408) 451500.00
4613000.00 0.04505 (15072608)
457000.00 4613000.00 0.05505 (16112108) 457500.00
4613000.00 0.04649 (13030308)
458000.00 4613000.00 0.04650 (13011508) 458500.00
4613000.00 0.04936 (14020308)
459000.00 4613000.00 0.05010 (14020308) 459500.00
4613000.00 0.04171 (14020308)
460000.00 4613000.00 0.03133 (14020308) 449000.00
4613500.00 0.04009 (14092608)
449500.00 4613500.00 0.02645 (15080824) 450000.00
4613500.00 0.03299 (13051524)
450500.00 4613500.00 0.03172 (15121224) 451000.00
4613500.00 0.04070 (15090408)
451500.00 4613500.00 0.05129 (15072608) 457000.00
4613500.00 0.05475 (13030308)
457500.00 4613500.00 0.06143 (14020308) 458000.00
4613500.00 0.05881 (14020308)
458500.00 4613500.00 0.04307 (14020308) 459000.00
4613500.00 0.03255 (13080908)
459500.00 4613500.00 0.02959 (13080908) 460000.00
4613500.00 0.02570 (14020408)
449000.00 4614000.00 0.03730 (14092608) 449500.00
4614000.00 0.03473 (14092608)
450000.00 4614000.00 0.03348 (15080824) 450500.00
4614000.00 0.03586 (13051524)
451000.00 4614000.00 0.05085 (15090408) 451500.00
4614000.00 0.05914 (15072608)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 228
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
457000.00	4614000.00	0.06247	(14020308)	457500.00	4614000.00	0.03920	(14020308)
458000.00	4614000.00	0.03244	(13032208)	458500.00	4614000.00	0.03328	(13032208)
459000.00	4614000.00	0.02975	(15091024)	459500.00	4614000.00	0.02864	(15101008)
460000.00	4614000.00	0.02978	(15101008)	449000.00	4614500.00	0.03803	(13121924)
449500.00	4614500.00	0.04888	(14092608)	450000.00	4614500.00	0.03839	(15080824)
450500.00	4614500.00	0.04169	(13051524)	451000.00	4614500.00	0.03778	(16041608)
451500.00	4614500.00	0.07020	(15072608)	457000.00	4614500.00	0.04605	(15091024)
457500.00	4614500.00	0.04431	(15091024)	458000.00	4614500.00	0.03878	(15091024)
458500.00	4614500.00	0.03246	(15091024)	459000.00	4614500.00	0.03116	(12082008)
459500.00	4614500.00	0.03285	(12082008)	460000.00	4614500.00	0.03375	(12082008)
449000.00	4615000.00	0.03794	(13121924)	449500.00	4615000.00	0.04350	(13121924)
450000.00	4615000.00	0.05798	(14092608)	450500.00	4615000.00	0.05121	(15080824)
451000.00	4615000.00	0.04601	(13051524)	451500.00	4615000.00	0.06579	(15072608)
457000.00	4615000.00	0.03791	(12082008)	457500.00	4615000.00	0.03954	(12082008)
458000.00	4615000.00	0.04202	(12082008)	458500.00	4615000.00	0.04293	(12082008)
459000.00	4615000.00	0.04031	(12082008)	459500.00	4615000.00	0.03839	(12082008)
460000.00	4615000.00	0.03628	(12082008)	449000.00	4615500.00	0.05169	(13071508)

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        449500.00   4615500.00        0.04738  (13121924)              450000.00
4615500.00        0.04856  (13121924)
        450500.00   4615500.00        0.05624  (14092608)              451000.00
4615500.00        0.06220  (16112124)
        451500.00   4615500.00        0.08879  (15090408)              457000.00
4615500.00        0.05175  (16080708)
        457500.00   4615500.00        0.04193  (16080708)              458000.00
4615500.00        0.03379  (16080708)
        458500.00   4615500.00        0.02873  (14073008)              459000.00
4615500.00        0.02627  (14073008)
        459500.00   4615500.00        0.02357  (14073008)              460000.00
4615500.00        0.02200  (15070408)
        449000.00   4616000.00        0.05968  (15121224)              449500.00
4616000.00        0.07106  (13071508)
        450000.00   4616000.00        0.05583  (13121924)              450500.00
4616000.00        0.05657  (14092608)
        451000.00   4616000.00        0.08744  (15080824)              451500.00
4616000.00        0.10994  (15090408)
        457000.00   4616000.00        0.03772  (13072508)              457500.00
4616000.00        0.03278  (13032808)
        458000.00   4616000.00        0.03226  (12082808)              458500.00
4616000.00        0.03235  (12082808)
        459000.00   4616000.00        0.03081  (12082808)              459500.00
4616000.00        0.02830  (12082808)
        460000.00   4616000.00        0.02758  (16082208)              449000.00
4616500.00        0.04984  (15121224)
        449500.00   4616500.00        0.08023  (15121224)              450000.00
4616500.00        0.08294  (13071508)
        450500.00   4616500.00        0.10400  (13071508)              451000.00
4616500.00        0.09555  (14092608)
        451500.00   4616500.00        0.11041  (14061008)              457000.00
4616500.00        0.04163  (15101008)
        457500.00   4616500.00        0.03616  (15070408)              458000.00
4616500.00        0.03247  (15070408)
        458500.00   4616500.00        0.02781  (15070408)              459000.00
4616500.00        0.02471  (16082208)
        459500.00   4616500.00        0.02707  (12082808)              460000.00
4616500.00        0.02851  (12082808)
        449000.00   4617000.00        0.06414  (13082408)              449500.00
4617000.00        0.07420  (16041608)
        450000.00   4617000.00        0.09281  (16041608)              450500.00
4617000.00        0.10612  (12032824)
        451000.00   4617000.00        0.21601  (13071508)              451500.00
4617000.00        0.21626c (12060624)
        457000.00   4617000.00        0.03813  (16082208)              457500.00
4617000.00        0.03354  (14090308)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 229
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
458000.00	4617000.00	0.03121	(12041208)	458500.00	4617000.00	0.02783	(12041208)
459000.00	4617000.00	0.02260	(15092008)	459500.00	4617000.00	0.02249	(12092824)
460000.00	4617000.00	0.02205	(12092824)	449000.00	4617500.00	0.07957	(16041708)
449500.00	4617500.00	0.09477	(16080308)	450000.00	4617500.00	0.12129	(16080308)
450500.00	4617500.00	0.16177	(16080308)	451000.00	4617500.00	0.22672	(16080308)
451500.00	4617500.00	0.47571	(12071124)	452000.00	4617500.00	0.71677	(12072124)
452500.00	4617500.00	0.18670	(14073008)	453000.00	4617500.00	0.11956	(14073008)
453500.00	4617500.00	0.08241	(14073008)	454000.00	4617500.00	0.05924	(14073008)
454500.00	4617500.00	0.04745	(16082208)	455000.00	4617500.00	0.06647	(12111524)
455500.00	4617500.00	0.04468	(15110808)	456000.00	4617500.00	0.04664	(15110808)
456500.00	4617500.00	0.04392	(15110808)	457000.00	4617500.00	0.04551	(12091608)
457500.00	4617500.00	0.03793	(12092908)	458000.00	4617500.00	0.03696	(12092908)
458500.00	4617500.00	0.03467	(12092908)	459000.00	4617500.00	0.03178	(12092908)
459500.00	4617500.00	0.02854	(12092908)	460000.00	4617500.00	0.02515	(12092908)
449000.00	4618000.00	0.08625	(15092308)	449500.00	4618000.00	0.08484	(15092308)
450000.00	4618000.00	0.12441	(13082924)	450500.00	4618000.00	0.16004	(13082924)
451000.00	4618000.00	0.19573	(16071824)	451500.00	4618000.00	0.28006	(12081224)

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        452000.00   4618000.00        0.42733  (12071608)              452500.00
4618000.00        0.20869m (13090408)
        453000.00   4618000.00        0.11234  (16071908)              453500.00
4618000.00        0.08400  (16071908)
        454000.00   4618000.00        0.08913  (12082808)              454500.00
4618000.00        0.09209  (15112808)
        455000.00   4618000.00        0.07958  (14120108)              455500.00
4618000.00        0.05809  (12082808)
        456000.00   4618000.00        0.04776  (12082808)              456500.00
4618000.00        0.03938  (12082808)
        457000.00   4618000.00        0.03568  (12082808)              457500.00
4618000.00        0.03853  (12091608)
        458000.00   4618000.00        0.04005  (12091608)              458500.00
4618000.00        0.02997  (12092908)
        459000.00   4618000.00        0.02963  (12092908)              459500.00
4618000.00        0.02818  (12092908)
        460000.00   4618000.00        0.02687  (12041208)              449000.00
4618500.00        0.07957  (13082924)
        449500.00   4618500.00        0.07602  (12082908)              450000.00
4618500.00        0.08665  (16071824)
        450500.00   4618500.00        0.10425  (16071824)              451000.00
4618500.00        0.11518  (16121624)
        451500.00   4618500.00        0.15004  (16110708)              452000.00
4618500.00        0.15565  (13071608)
        452500.00   4618500.00        0.17465  (16082724)              453000.00
4618500.00        0.11671  (12091608)
        453500.00   4618500.00        0.09152  (12091608)              454000.00
4618500.00        0.06714  (12041208)
        454500.00   4618500.00        0.22679  (13022608)              455000.00
4618500.00        0.18974  (13013124)
        455500.00   4618500.00        0.05695  (14111708)              456000.00
4618500.00        0.04512  (12082808)
        456500.00   4618500.00        0.04259  (12082808)              457000.00
4618500.00        0.04052  (12082808)
        457500.00   4618500.00        0.03856  (12082808)              458000.00
4618500.00        0.03558  (12082808)
        458500.00   4618500.00        0.03782  (12091608)              459000.00
4618500.00        0.03351  (15011908)
        459500.00   4618500.00        0.02905  (15011908)              460000.00
4618500.00        0.02139  (12041208)
        449000.00   4619000.00        0.05325  (12082908)              449500.00
4619000.00        0.07165  (16071824)
        450000.00   4619000.00        0.07608  (13073108)              450500.00
4619000.00        0.08368  (13061508)
        451000.00   4619000.00        0.09516  (12081224)              451500.00
4619000.00        0.11549  (16110708)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 230
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 8-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4619000.00	0.10691	(13071608)	452500.00	4619000.00	0.11292	(12111524)
453000.00	4619000.00	0.09500	(16082724)	453500.00	4619000.00	0.07004	(15091008)
454000.00	4619000.00	0.10223	(12091608)	454500.00	4619000.00	0.08396	(16061424)
455000.00	4619000.00	0.09935	(13011908)	455500.00	4619000.00	0.05280	(16071908)
456000.00	4619000.00	0.03884	(15041708)	456500.00	4619000.00	0.03476	(13022408)
457000.00	4619000.00	0.03433	(12110808)	457500.00	4619000.00	0.03303	(13032808)
458000.00	4619000.00	0.03225	(13032808)	458500.00	4619000.00	0.03118	(12082808)
459000.00	4619000.00	0.03306	(12091608)	459500.00	4619000.00	0.03283	(12091608)
460000.00	4619000.00	0.03162	(15011908)	449000.00	4619500.00	0.05011	(14092408)
449500.00	4619500.00	0.05981	(13073108)	450000.00	4619500.00	0.06600	(13061508)
450500.00	4619500.00	0.06457	(15010224)	451000.00	4619500.00	0.05989	(13100908)
451500.00	4619500.00	0.08121	(12032208)	452000.00	4619500.00	0.08582	(12111508)
452500.00	4619500.00	0.07970	(15072408)	453000.00	4619500.00	0.07012	(12111524)
453500.00	4619500.00	0.05967	(15050208)	454000.00	4619500.00	0.05226	(15091008)
454500.00	4619500.00	0.08116	(12091608)	455000.00	4619500.00	0.06890	(12091608)
455500.00	4619500.00	0.04719	(14080308)	456000.00	4619500.00	0.04484	(12041208)
456500.00	4619500.00	0.03573	(12041208)	457000.00	4619500.00	0.03494	(12010824)

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        457500.00   4619500.00        0.03218  (15041708)              458000.00
4619500.00        0.02581  (15101808)
        458500.00   4619500.00        0.02294  (16060208)              459000.00
4619500.00        0.02197  (15101808)
        459500.00   4619500.00        0.02814  (12091608)              460000.00
4619500.00        0.03076  (12091608)
        449000.00   4620000.00        0.04565  (13073108)              449500.00
4620000.00        0.05194  (13061508)
        450000.00   4620000.00        0.04948  (15010224)              450500.00
4620000.00        0.05270  (12081224)
        451000.00   4620000.00        0.05476  (15012008)              451500.00
4620000.00        0.06986  (12032208)
        452000.00   4620000.00        0.07858  (12111508)              452500.00
4620000.00        0.06315  (15072408)
        453000.00   4620000.00        0.06718  (12111524)              453500.00
4620000.00        0.05038  (14110208)
        454000.00   4620000.00        0.04412  (15050208)              454500.00
4620000.00        0.04830  (16081008)
        455000.00   4620000.00        0.06287  (12091608)              455500.00
4620000.00        0.06170  (12091608)
        456000.00   4620000.00        0.04014  (12091608)              456500.00
4620000.00        0.03853  (12041208)
        457000.00   4620000.00        0.03512  (12041208)              457500.00
4620000.00        0.03248  (12041208)
        458000.00   4620000.00        0.02982  (12041208)              458500.00
4620000.00        0.02786  (12010824)
        459000.00   4620000.00        0.02745  (12010824)              459500.00
4620000.00        0.02159  (12010824)
        460000.00   4620000.00        0.02381  (12091608)              449000.00
4620500.00        0.04434  (12020124)
        449500.00   4620500.00        0.04782  (13061508)              450000.00
4620500.00        0.04595  (12081224)
        450500.00   4620500.00        0.03698  (16101324)              451000.00
4620500.00        0.05153  (16110708)
        451500.00   4620500.00        0.05963  (12032208)              452000.00
4620500.00        0.06903  (12111508)
        452500.00   4620500.00        0.05140c (13101008)              453000.00
4620500.00        0.05869  (15042408)
        453500.00   4620500.00        0.04866  (12111524)              454000.00
4620500.00        0.04432  (14110208)
        454500.00   4620500.00        0.03883  (12111508)              455000.00
4620500.00        0.04662  (16081008)
        455500.00   4620500.00        0.04466  (12091608)              456000.00
4620500.00        0.05087  (12091608)
        456500.00   4620500.00        0.04284  (12091608)              457000.00
4620500.00        0.03304  (12091608)
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 *** AERMOD - VERSION  19191 ***   *** IEPA Audit Run2 - General III HAP (Mn) Emissions
***        05/23/20
 *** AERMET - VERSION  18081 ***   ***
***        12:35:28

PAGE 231
 *** MODELOPTs:    RegDFAULT  CONC  ELEV  NODRYDPLT  NOWETDPLT  RURAL  ADJ_U*

                              *** THE   1ST HIGHEST  8-HR AVERAGE CONCENTRATION
VALUES FOR SOURCE GROUP:  ALL      ***
                                   INCLUDING SOURCE(S):     RTO         , V1          ,
V2          , V3          , V4          ,
                V5          , V6          , V7          , V8          , V9          ,
V10         , V11         , V12         ,
                V13         , VN1         , VN2         , VN3         , VN4         ,
VN5         , VN6         , DC1         ,
                AB_0001     , AB_0002     , AB_0003     , AB_0004     , AB_0005     ,
AB_0006     , AB_0007     ,  . . .      ,

                                        *** DISCRETE CARTESIAN RECEPTOR POINTS ***

                                      ** CONC OF OTHER    IN MICROGRAMS/M**3
**

      X-COORD (M)  Y-COORD (M)        CONC     (YYMMDDHH)              X-COORD (M)  Y-
COORD (M)        CONC     (YYMMDDHH)
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - - - - - - - -
        457500.00   4620500.00        0.03297  (12041208)               458000.00
4620500.00        0.03022  (12041208)
        458500.00   4620500.00        0.02877  (12041208)               459000.00
4620500.00        0.02710  (12041208)
        459500.00   4620500.00        0.02676  (12010824)               460000.00
4620500.00        0.02463  (12010824)
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454084.40	4615065.40	0.07999	(15101324)	454083.30	4615039.80	0.08306	(12122824)
454082.20	4615014.10	0.08672	(12122824)	454085.10	4614964.60	0.12056c	(14010924)
454088.00	4614915.00	0.16135c	(14010924)	454091.00	4614865.50	0.21383	(12110724)
454093.90	4614816.00	0.14707	(12110724)	454096.80	4614766.40	0.15294	(13122124)
454099.70	4614716.90	0.09852	(13121924)	454102.60	4614667.30	0.11024	(13121924)
454105.50	4614617.80	0.09151	(13121924)	454108.50	4614568.30	0.07507	(14121024)
454111.40	4614518.70	0.06984	(14121024)	454114.30	4614469.20	0.06375	(14121024)
454107.80	4614425.20	0.05480	(14121024)	454101.30	4614381.10	0.04881	(14121024)
454094.70	4614337.10	0.04894	(14122924)	454088.20	4614293.00	0.04883	(14122924)
454081.70	4614249.00	0.04680	(14122924)	454082.20	4614201.80	0.04574	(14122924)
454082.80	4614154.70	0.04384	(14122924)	454121.40	4614157.80	0.04455	(14122924)
454160.00	4614160.90	0.04320	(15012124)	454191.30	4614179.40	0.04674	(15012124)
454222.70	4614198.00	0.05014	(14121024)	454254.00	4614216.50	0.05718	(14121024)
454253.20	4614226.30	0.05815	(14121024)	454296.00	4614249.30	0.06512	(14121024)
454338.80	4614272.30	0.06760	(14121024)	454381.70	4614295.30	0.06570	(14121024)
454424.50	4614318.30	0.06111	(14121024)	454467.30	4614341.40	0.05631	(12112624)
454510.20	4614364.40	0.05293	(12112624)	454553.00	4614387.40	0.06382	(13120724)

454595.80	4614410.40	0.07940	(13120724)	454595.80
4614459.20	0.09590	(13120724)		
454595.80	4614507.90	0.11326	(13120724)	454595.80
4614556.70	0.12694	(13120724)		
454595.80	4614605.50	0.12776	(13120724)	454595.80
4614654.30	0.13771	(14010824)		
454595.80	4614703.00	0.12650	(14010824)	454595.80
4614751.80	0.10183	(14010824)		
454595.80	4614800.60	0.07922	(14010824)	454595.80
4614849.30	0.08554	(13011524)		
454595.80	4614898.10	0.08872	(13011524)	454595.80
4614946.90	0.08354	(13011524)		
454595.80	4614995.60	0.13150	(14010824)	454595.80
4615044.40	0.14577	(13011524)		
454595.80	4615093.20	0.09197c	(13123124)	454595.80
4615142.00	0.08440	(12011024)		
454595.80	4615190.70	0.08083	(12011024)	454595.80
4615239.50	0.07585	(12011024)		
454551.90	4615219.20	0.09194	(12011024)	454508.00
4615199.00	0.10225	(12011024)		
454484.50	4615239.50	0.08336	(12011024)	454461.10
4615279.90	0.06681c	(14013124)		
454413.60	4615286.60	0.06655	(13110124)	454376.80
4615266.90	0.06955	(13110124)		
454340.00	4615247.20	0.07667	(14020824)	454303.10
4615227.50	0.08014	(14020824)		
454266.30	4615207.80	0.08533m	(16120824)	454229.50
4615188.10	0.09271m	(16120824)		
454251.00	4615155.90	0.08564	(14020824)	454209.30
4615133.30	0.08342	(14012724)		
454167.70	4615110.70	0.09711	(13012124)	454126.10
4615088.00	0.09810	(14111324)		
452000.00	4612100.00	0.01845	(15072624)	452100.00
4612100.00	0.01689	(15072624)		
452200.00	4612100.00	0.01615	(15100524)	452300.00
4612100.00	0.01649	(15100524)		
452400.00	4612100.00	0.01660	(15100524)	452500.00
4612100.00	0.01634	(15100524)		
452600.00	4612100.00	0.01542	(15100524)	452700.00
4612100.00	0.01495	(15112824)		
452800.00	4612100.00	0.01568	(14061024)	452900.00
4612100.00	0.01687	(14061024)		
453000.00	4612100.00	0.01727	(14061024)	453100.00
4612100.00	0.01655	(14061024)		
453200.00	4612100.00	0.01478	(14061024)	453300.00
4612100.00	0.01722	(15012124)		

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 233
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453400.00	4612100.00	0.01978	(15012124)	453500.00	4612100.00	0.02088	(15012124)
453600.00	4612100.00	0.02052	(15012124)	453700.00	4612100.00	0.01949	(15012124)
453800.00	4612100.00	0.01883	(15012124)	453900.00	4612100.00	0.01918	(15012124)
454000.00	4612100.00	0.02018	(15012124)	454100.00	4612100.00	0.02142	(15012124)
454200.00	4612100.00	0.02156	(15012124)	454300.00	4612100.00	0.02043	(15012124)
454400.00	4612100.00	0.01841	(15012124)	454500.00	4612100.00	0.01614	(15012124)
454600.00	4612100.00	0.01421	(15012124)	454700.00	4612100.00	0.01482	(14122924)
454800.00	4612100.00	0.01514	(14122924)	454900.00	4612100.00	0.01530	(16100124)
455000.00	4612100.00	0.01510	(16100124)	455100.00	4612100.00	0.01485	(14121024)
455200.00	4612100.00	0.01622	(14121024)	455300.00	4612100.00	0.01734	(14121024)
455400.00	4612100.00	0.01806	(14121024)	455500.00	4612100.00	0.01827	(14121024)
455600.00	4612100.00	0.01792	(14121024)	455700.00	4612100.00	0.01699	(14121024)
455800.00	4612100.00	0.01796	(12121724)	455900.00	4612100.00	0.01971	(12121724)
456000.00	4612100.00	0.02124	(12121724)	456100.00	4612100.00	0.02181	(12121724)
456200.00	4612100.00	0.02180	(12121724)	456300.00	4612100.00	0.02186	(13121624)
456400.00	4612100.00	0.02173	(13121624)	456500.00	4612100.00	0.02038	(13121624)
456600.00	4612100.00	0.01927	(15111024)	452000.00	4612200.00	0.01942	(15072624)

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        452100.00   4612200.00        0.01794  (15072624)              452200.00
4612200.00        0.01644  (15100524)
        452300.00   4612200.00        0.01680  (15100524)              452400.00
4612200.00        0.01705  (15100524)
        452500.00   4612200.00        0.01716  (15100524)              452600.00
4612200.00        0.01638  (15100524)
        452700.00   4612200.00        0.01545  (15112824)              452800.00
4612200.00        0.01565  (14061024)
        452900.00   4612200.00        0.01704  (14061024)              453000.00
4612200.00        0.01771  (14061024)
        453100.00   4612200.00        0.01725  (14061024)              453200.00
4612200.00        0.01558  (14061024)
        453300.00   4612200.00        0.01710  (15012124)              453400.00
4612200.00        0.02001  (15012124)
        453500.00   4612200.00        0.02139  (15012124)              453600.00
4612200.00        0.02114  (15012124)
        453700.00   4612200.00        0.02006  (15012124)              453800.00
4612200.00        0.01936  (15012124)
        453900.00   4612200.00        0.01979  (15012124)              454000.00
4612200.00        0.02107  (15012124)
        454100.00   4612200.00        0.02239  (15012124)              454200.00
4612200.00        0.02253  (15012124)
        454300.00   4612200.00        0.02119  (15012124)              454400.00
4612200.00        0.01894  (15012124)
        454500.00   4612200.00        0.01651  (15012124)              454600.00
4612200.00        0.01447  (14122924)
        454700.00   4612200.00        0.01544  (14122924)              454800.00
4612200.00        0.01554  (14122924)
        454900.00   4612200.00        0.01564  (16100124)              455000.00
4612200.00        0.01544  (16100124)
        455100.00   4612200.00        0.01610  (14121024)              455200.00
4612200.00        0.01745  (14121024)
        455300.00   4612200.00        0.01846  (14121024)              455400.00
4612200.00        0.01895  (14121024)
        455500.00   4612200.00        0.01883  (14121024)              455600.00
4612200.00        0.01809  (14121024)
        455700.00   4612200.00        0.01777  (12121724)              455800.00
4612200.00        0.01963  (12121724)
        455900.00   4612200.00        0.02127  (12121724)              456000.00
4612200.00        0.02236  (12121724)
        456100.00   4612200.00        0.02251  (12121724)              456200.00
4612200.00        0.02194  (13121624)
        456300.00   4612200.00        0.02219  (13121624)              456400.00
4612200.00        0.02091  (13121624)
        456500.00   4612200.00        0.01953  (15111024)              456600.00
4612200.00        0.02181  (15111024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 234
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4612300.00	0.02011	(15072624)	452100.00	4612300.00	0.01883	(15072624)
452200.00	4612300.00	0.01657	(15100524)	452300.00	4612300.00	0.01709	(15100524)
452400.00	4612300.00	0.01754	(15100524)	452500.00	4612300.00	0.01764	(15100524)
452600.00	4612300.00	0.01732	(15100524)	452700.00	4612300.00	0.01610	(15100524)
452800.00	4612300.00	0.01589	(15112824)	452900.00	4612300.00	0.01715	(14061024)
453000.00	4612300.00	0.01811	(14061024)	453100.00	4612300.00	0.01793	(14061024)
453200.00	4612300.00	0.01643	(14061024)	453300.00	4612300.00	0.01693	(15012124)
453400.00	4612300.00	0.02021	(15012124)	453500.00	4612300.00	0.02192	(15012124)
453600.00	4612300.00	0.02181	(15012124)	453700.00	4612300.00	0.02069	(15012124)
453800.00	4612300.00	0.01992	(15012124)	453900.00	4612300.00	0.02041	(15012124)
454000.00	4612300.00	0.02195	(15012124)	454100.00	4612300.00	0.02342	(15012124)
454200.00	4612300.00	0.02354	(15012124)	454300.00	4612300.00	0.02198	(15012124)
454400.00	4612300.00	0.01942	(15012124)	454500.00	4612300.00	0.01688	(15012124)
454600.00	4612300.00	0.01529	(14122924)	454700.00	4612300.00	0.01622	(14122924)
454800.00	4612300.00	0.01586	(16100124)	454900.00	4612300.00	0.01595	(16100124)
455000.00	4612300.00	0.01585	(14121024)	455100.00	4612300.00	0.01745	(14121024)
455200.00	4612300.00	0.01873	(14121024)	455300.00	4612300.00	0.01955	(14121024)

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        455400.00   4612300.00        0.01973  (14121024)              455500.00
4612300.00        0.01922  (14121024)
        455600.00   4612300.00        0.01810  (14121024)              455700.00
4612300.00        0.01948  (12121724)
        455800.00   4612300.00        0.02134  (12121724)              455900.00
4612300.00        0.02272  (12121724)
        456000.00   4612300.00        0.02327  (12121724)              456100.00
4612300.00        0.02274  (12121724)
        456200.00   4612300.00        0.02230  (13121624)              456300.00
4612300.00        0.02158  (13121624)
        456400.00   4612300.00        0.01930  (13121624)              456500.00
4612300.00        0.02197  (15111024)
        456600.00   4612300.00        0.02345  (15111024)              452000.00
4612400.00        0.02059  (15072624)
        452100.00   4612400.00        0.01961  (15072624)              452200.00
4612400.00        0.01716  (15072624)
        452300.00   4612400.00        0.01730  (15100524)              452400.00
4612400.00        0.01797  (15100524)
        452500.00   4612400.00        0.01820  (15100524)              452600.00
4612400.00        0.01806  (15100524)
        452700.00   4612400.00        0.01721  (15100524)              452800.00
4612400.00        0.01648  (15112824)
        452900.00   4612400.00        0.01721  (14061024)              453000.00
4612400.00        0.01845  (14061024)
        453100.00   4612400.00        0.01858  (14061024)              453200.00
4612400.00        0.01728  (14061024)
        453300.00   4612400.00        0.01671  (15012124)              453400.00
4612400.00        0.02036  (15012124)
        453500.00   4612400.00        0.02248  (15012124)              453600.00
4612400.00        0.02253  (15012124)
        453700.00   4612400.00        0.02136  (15012124)              453800.00
4612400.00        0.02050  (15012124)
        453900.00   4612400.00        0.02107  (15012124)              454000.00
4612400.00        0.02288  (15012124)
        454100.00   4612400.00        0.02453  (15012124)              454200.00
4612400.00        0.02459  (15012124)
        454300.00   4612400.00        0.02280  (15012124)              454400.00
4612400.00        0.01978  (15012124)
        454500.00   4612400.00        0.01724  (15012124)              454600.00
4612400.00        0.01623  (14122924)
        454700.00   4612400.00        0.01684  (14122924)              454800.00
4612400.00        0.01655  (16100124)
        454900.00   4612400.00        0.01632  (16100124)              455000.00
4612400.00        0.01727  (14121024)
        455100.00   4612400.00        0.01889  (14121024)              455200.00
4612400.00        0.02003  (14121024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 235
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455300.00	4612400.00	0.02057	(14121024)	455400.00	4612400.00	0.02035	(14121024)
455500.00	4612400.00	0.01940	(14121024)	455600.00	4612400.00	0.01926	(12121724)
455700.00	4612400.00	0.02129	(12121724)	455800.00	4612400.00	0.02307	(12121724)
455900.00	4612400.00	0.02386	(12121724)	456000.00	4612400.00	0.02373	(12121724)
456100.00	4612400.00	0.02279	(13121624)	456200.00	4612400.00	0.02190	(13121624)
456300.00	4612400.00	0.01991	(13121624)	456400.00	4612400.00	0.02266	(15111024)
456500.00	4612400.00	0.02385	(15111024)	456600.00	4612400.00	0.02410	(15111024)
452000.00	4612500.00	0.02030	(15072624)	452100.00	4612500.00	0.01985	(15072624)
452200.00	4612500.00	0.01821	(15072624)	452300.00	4612500.00	0.01740	(15100524)
452400.00	4612500.00	0.01833	(15100524)	452500.00	4612500.00	0.01880	(15100524)
452600.00	4612500.00	0.01871	(15100524)	452700.00	4612500.00	0.01795	(15100524)
452800.00	4612500.00	0.01695	(15112824)	452900.00	4612500.00	0.01721	(14061024)
453000.00	4612500.00	0.01873	(14061024)	453100.00	4612500.00	0.01921	(14061024)
453200.00	4612500.00	0.01816	(14061024)	453300.00	4612500.00	0.01638	(15012124)
453400.00	4612500.00	0.02047	(15012124)	453500.00	4612500.00	0.02302	(15012124)
453600.00	4612500.00	0.02328	(15012124)	453700.00	4612500.00	0.02207	(15012124)
453800.00	4612500.00	0.02113	(15012124)	453900.00	4612500.00	0.02180	(15012124)

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        454000.00   4612500.00        0.02380  (15012124)              454100.00
4612500.00        0.02565  (15012124)
        454200.00   4612500.00        0.02573  (15012124)              454300.00
4612500.00        0.02363  (15012124)
        454400.00   4612500.00        0.02038  (15012124)              454500.00
4612500.00        0.01760  (15012124)
        454600.00   4612500.00        0.01714  (14122924)              454700.00
4612500.00        0.01736  (14122924)
        454800.00   4612500.00        0.01707  (16100124)              454900.00
4612500.00        0.01675  (14121024)
        455000.00   4612500.00        0.01884  (14121024)              455100.00
4612500.00        0.02041  (14121024)
        455200.00   4612500.00        0.02130  (14121024)              455300.00
4612500.00        0.02149  (14121024)
        455400.00   4612500.00        0.02075  (14121024)              455500.00
4612500.00        0.01933  (14121024)
        455600.00   4612500.00        0.02114  (12121724)              455700.00
4612500.00        0.02308  (12121724)
        455800.00   4612500.00        0.02434  (12121724)              455900.00
4612500.00        0.02455  (12121724)
        456000.00   4612500.00        0.02361  (12121724)              456100.00
4612500.00        0.02259  (13121624)
        456200.00   4612500.00        0.02065  (13121624)              456300.00
4612500.00        0.02279  (15111024)
        456400.00   4612500.00        0.02478  (15111024)              456500.00
4612500.00        0.02472  (15111024)
        456600.00   4612500.00        0.02377  (15111024)              452000.00
4612600.00        0.02073  (15072624)
        452100.00   4612600.00        0.02085  (15072624)              452200.00
4612600.00        0.01963  (15072624)
        452300.00   4612600.00        0.01796  (12050524)              452400.00
4612600.00        0.01895  (15100524)
        452500.00   4612600.00        0.01974  (15100524)              452600.00
4612600.00        0.01980  (15100524)
        452700.00   4612600.00        0.01899  (15100524)              452800.00
4612600.00        0.01768  (15100524)
        452900.00   4612600.00        0.01772  (15112824)              453000.00
4612600.00        0.01886  (14061024)
        453100.00   4612600.00        0.01975  (14061024)              453200.00
4612600.00        0.01904  (14061024)
        453300.00   4612600.00        0.01668  (14061024)              453400.00
4612600.00        0.02048  (15012124)
        453500.00   4612600.00        0.02353  (15012124)              453600.00
4612600.00        0.02406  (15012124)
        453700.00   4612600.00        0.02279  (15012124)              453800.00
4612600.00        0.02175  (15012124)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 236
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453900.00	4612600.00	0.02256	(15012124)	454000.00	4612600.00	0.02475	(15012124)
454100.00	4612600.00	0.02694	(15012124)	454200.00	4612600.00	0.02691	(15012124)
454300.00	4612600.00	0.02447	(15012124)	454400.00	4612600.00	0.02089	(15012124)
454500.00	4612600.00	0.01793	(15012124)	454600.00	4612600.00	0.01813	(14122924)
454700.00	4612600.00	0.01771	(14122924)	454800.00	4612600.00	0.01743	(16100124)
454900.00	4612600.00	0.01838	(14121024)	455000.00	4612600.00	0.02054	(14121024)
455100.00	4612600.00	0.02194	(14121024)	455200.00	4612600.00	0.02251	(14121024)
455300.00	4612600.00	0.02212	(14121024)	455400.00	4612600.00	0.02088	(14121024)
455500.00	4612600.00	0.02096	(12121724)	455600.00	4612600.00	0.02320	(12121724)
455700.00	4612600.00	0.02469	(12121724)	455800.00	4612600.00	0.02529	(12121724)
455900.00	4612600.00	0.02467	(12121724)	456000.00	4612600.00	0.02347	(13121624)
456100.00	4612600.00	0.02148	(13121624)	456200.00	4612600.00	0.02315	(15111024)
456300.00	4612600.00	0.02504	(15111024)	456400.00	4612600.00	0.02552	(15111024)
456500.00	4612600.00	0.02437	(15111024)	456600.00	4612600.00	0.02237	(15111024)
452000.00	4612700.00	0.02077	(15072624)	452100.00	4612700.00	0.02109	(15072624)
452200.00	4612700.00	0.02034	(15072624)	452300.00	4612700.00	0.01847c	(12060624)
452400.00	4612700.00	0.01979c	(12060624)	452500.00	4612700.00	0.02022	(15100524)

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        452600.00   4612700.00        0.02073  (15100524)              452700.00
4612700.00        0.02048  (15100524)
        452800.00   4612700.00        0.01893  (15100524)              452900.00
4612700.00        0.01829  (15112824)
        453000.00   4612700.00        0.01903  (14061024)              453100.00
4612700.00        0.02025  (14061024)
        453200.00   4612700.00        0.01992  (14061024)              453300.00
4612700.00        0.01773  (14061024)
        453400.00   4612700.00        0.02045  (15012124)              453500.00
4612700.00        0.02408  (15012124)
        453600.00   4612700.00        0.02492  (15012124)              453700.00
4612700.00        0.02360  (15012124)
        453800.00   4612700.00        0.02242  (15012124)              453900.00
4612700.00        0.02318  (15012124)
        454000.00   4612700.00        0.02589  (15012124)              454100.00
4612700.00        0.02815  (15012124)
        454200.00   4612700.00        0.02814  (15012124)              454300.00
4612700.00        0.02518  (15012124)
        454400.00   4612700.00        0.02107  (15012124)              454500.00
4612700.00        0.01838  (14122924)
        454600.00   4612700.00        0.01853  (14122924)              454700.00
4612700.00        0.01735  (16100124)
        454800.00   4612700.00        0.01759  (14121024)              454900.00
4612700.00        0.02023  (14121024)
        455000.00   4612700.00        0.02233  (14121024)              455100.00
4612700.00        0.02343  (14121024)
        455200.00   4612700.00        0.02353  (14121024)              455300.00
4612700.00        0.02251  (14121024)
        455400.00   4612700.00        0.02070  (14121024)              455500.00
4612700.00        0.02294  (12121724)
        455600.00   4612700.00        0.02492  (12121724)              455700.00
4612700.00        0.02593  (12121724)
        455800.00   4612700.00        0.02568  (12121724)              455900.00
4612700.00        0.02421  (13121624)
        456000.00   4612700.00        0.02252  (13121624)              456100.00
4612700.00        0.02354  (15111024)
        456200.00   4612700.00        0.02557  (15111024)              456300.00
4612700.00        0.02607  (15111024)
        456400.00   4612700.00        0.02511  (15111024)              456500.00
4612700.00        0.02288  (15111024)
        456600.00   4612700.00        0.02283  (14121824)              452000.00
4612800.00        0.02041  (15072624)
        452100.00   4612800.00        0.02093  (15072624)              452200.00
4612800.00        0.02057  (15072624)
        452300.00   4612800.00        0.01910  (15072624)              452400.00
4612800.00        0.02080c (12060624)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 237
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452500.00	4612800.00	0.02136c	(12060624)	452600.00	4612800.00	0.02144	(15100524)
452700.00	4612800.00	0.02153	(15100524)	452800.00	4612800.00	0.02020	(15100524)
452900.00	4612800.00	0.01900	(15112824)	453000.00	4612800.00	0.01893	(15112824)
453100.00	4612800.00	0.02066	(14061024)	453200.00	4612800.00	0.02079	(14061024)
453300.00	4612800.00	0.01887	(14061024)	453400.00	4612800.00	0.02034	(15012124)
453500.00	4612800.00	0.02457	(15012124)	453600.00	4612800.00	0.02583	(15012124)
453700.00	4612800.00	0.02453	(15012124)	453800.00	4612800.00	0.02319	(15012124)
453900.00	4612800.00	0.02395	(15012124)	454000.00	4612800.00	0.02714	(15012124)
454100.00	4612800.00	0.02936	(15012124)	454200.00	4612800.00	0.02934	(15012124)
454300.00	4612800.00	0.02603	(15012124)	454400.00	4612800.00	0.02177	(15012124)
454500.00	4612800.00	0.01956	(14122924)	454600.00	4612800.00	0.01965	(14122924)
454700.00	4612800.00	0.01946	(16100124)	454800.00	4612800.00	0.02003	(14121024)
454900.00	4612800.00	0.02244	(14121024)	455000.00	4612800.00	0.02416	(14121024)
455100.00	4612800.00	0.02480	(14121024)	455200.00	4612800.00	0.02425	(14121024)
455300.00	4612800.00	0.02256	(14121024)	455400.00	4612800.00	0.02259	(12121724)
455500.00	4612800.00	0.02494	(12121724)	455600.00	4612800.00	0.02643	(12121724)
455700.00	4612800.00	0.02662	(12121724)	455800.00	4612800.00	0.02533	(12121724)

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        455900.00   4612800.00        0.02346  (13121624)              456000.00
4612800.00        0.02408  (15111024)
        456100.00   4612800.00        0.02616  (15111024)              456200.00
4612800.00        0.02669  (15111024)
        456300.00   4612800.00        0.02570  (15111024)              456400.00
4612800.00        0.02399  (14121824)
        456500.00   4612800.00        0.02387  (14121824)              456600.00
4612800.00        0.02326  (14121824)
        452000.00   4612900.00        0.01997  (15072624)              452100.00
4612900.00        0.02050  (15072624)
        452200.00   4612900.00        0.02006  (15072624)              452300.00
4612900.00        0.01947  (15072624)
        452400.00   4612900.00        0.02135c (12060624)              452500.00
4612900.00        0.02270c (12060624)
        452600.00   4612900.00        0.02206c (12060624)              452700.00
4612900.00        0.02248  (15100524)
        452800.00   4612900.00        0.02196  (15100524)              452900.00
4612900.00        0.01997  (15100524)
        453000.00   4612900.00        0.02018  (15112824)              453100.00
4612900.00        0.02048  (14061024)
        453200.00   4612900.00        0.02113  (14061024)              453300.00
4612900.00        0.02001  (14061024)
        453400.00   4612900.00        0.02010  (15012124)              453500.00
4612900.00        0.02500  (15012124)
        453600.00   4612900.00        0.02676  (15012124)              453700.00
4612900.00        0.02554  (15012124)
        453800.00   4612900.00        0.02405  (15012124)              453900.00
4612900.00        0.02523  (15012124)
        454000.00   4612900.00        0.02837  (15012124)              454100.00
4612900.00        0.03078  (15012124)
        454200.00   4612900.00        0.03064  (15012124)              454300.00
4612900.00        0.02687  (15012124)
        454400.00   4612900.00        0.02229  (15012124)              454500.00
4612900.00        0.02069  (14122924)
        454600.00   4612900.00        0.02010  (14122924)              454700.00
4612900.00        0.01999  (16100124)
        454800.00   4612900.00        0.02215  (14121024)              454900.00
4612900.00        0.02458  (14121024)
        455000.00   4612900.00        0.02600  (14121024)              455100.00
4612900.00        0.02592  (14121024)
        455200.00   4612900.00        0.02460  (14121024)              455300.00
4612900.00        0.02222  (14121024)
        455400.00   4612900.00        0.02476  (12121724)              455500.00
4612900.00        0.02670  (12121724)
        455600.00   4612900.00        0.02738  (12121724)              455700.00
4612900.00        0.02653  (12121724)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 238
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455800.00	4612900.00	0.02443	(13121624)	455900.00	4612900.00	0.02454	(15111024)
456000.00	4612900.00	0.02694	(15111024)	456100.00	4612900.00	0.02739	(15111024)
456200.00	4612900.00	0.02630	(15111024)	456300.00	4612900.00	0.02511	(14121824)
456400.00	4612900.00	0.02500	(14121824)	456500.00	4612900.00	0.02423	(14121824)
456600.00	4612900.00	0.02290	(14121824)	452000.00	4613000.00	0.01957	(15072624)
452100.00	4613000.00	0.01992	(15072624)	452200.00	4613000.00	0.01958	(15072624)
452300.00	4613000.00	0.01945	(15072624)	452400.00	4613000.00	0.02132c	(12060624)
452500.00	4613000.00	0.02365c	(12060624)	452600.00	4613000.00	0.02353c	(12060624)
452700.00	4613000.00	0.02339	(15100524)	452800.00	4613000.00	0.02332	(15100524)
452900.00	4613000.00	0.02198	(15100524)	453000.00	4613000.00	0.02125	(15112824)
453100.00	4613000.00	0.02110	(14061024)	453200.00	4613000.00	0.02175	(14061024)
453300.00	4613000.00	0.02087	(14061024)	453400.00	4613000.00	0.01974	(13122024)
453500.00	4613000.00	0.02533	(15012124)	453600.00	4613000.00	0.02771	(15012124)
453700.00	4613000.00	0.02658	(15012124)	453800.00	4613000.00	0.02497	(15012124)
453900.00	4613000.00	0.02630	(15012124)	454000.00	4613000.00	0.02973	(15012124)
454100.00	4613000.00	0.03232	(15012124)	454200.00	4613000.00	0.03188	(15012124)
454300.00	4613000.00	0.02759	(15012124)	454400.00	4613000.00	0.02263	(15012124)

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        454500.00   4613000.00        0.02168  (14122924)              454600.00
4613000.00        0.02090  (16100124)
        454700.00   4613000.00        0.02167  (14121024)              454800.00
4613000.00        0.02464  (14121024)
        454900.00   4613000.00        0.02683  (14121024)              455000.00
4613000.00        0.02763  (14121024)
        455100.00   4613000.00        0.02669  (14121024)              455200.00
4613000.00        0.02453  (14121024)
        455300.00   4613000.00        0.02467  (12121724)              455400.00
4613000.00        0.02680  (12121724)
        455500.00   4613000.00        0.02799  (12121724)              455600.00
4613000.00        0.02761  (12121724)
        455700.00   4613000.00        0.02552  (12121724)              455800.00
4613000.00        0.02477  (15111024)
        455900.00   4613000.00        0.02781  (15111024)              456000.00
4613000.00        0.02829  (15111024)
        456100.00   4613000.00        0.02697  (15111024)              456200.00
4613000.00        0.02643  (14121824)
        456300.00   4613000.00        0.02636  (14121824)              456400.00
4613000.00        0.02542  (14121824)
        456500.00   4613000.00        0.02387  (14121824)              456600.00
4613000.00        0.02194  (14121824)
        452000.00   4613100.00        0.01928  (15072624)              452100.00
4613100.00        0.01931  (15072624)
        452200.00   4613100.00        0.01885  (15072624)              452300.00
4613100.00        0.01903  (15072624)
        452400.00   4613100.00        0.02060c (12060624)              452500.00
4613100.00        0.02401c (12060624)
        452600.00   4613100.00        0.02484c (12060624)              452700.00
4613100.00        0.02414  (15100524)
        452800.00   4613100.00        0.02463  (15100524)              452900.00
4613100.00        0.02371  (15100524)
        453000.00   4613100.00        0.02231  (15112824)              453100.00
4613100.00        0.02221  (15112824)
        453200.00   4613100.00        0.02297  (14061024)              453300.00
4613100.00        0.02174  (14061024)
        453400.00   4613100.00        0.02049  (13122024)              453500.00
4613100.00        0.02555  (15012124)
        453600.00   4613100.00        0.02857  (15012124)              453700.00
4613100.00        0.02767  (15012124)
        453800.00   4613100.00        0.02613  (15012124)              453900.00
4613100.00        0.02741  (15012124)
        454000.00   4613100.00        0.03113  (15012124)              454100.00
4613100.00        0.03421  (15012124)
        454200.00   4613100.00        0.03306  (15012124)              454300.00
4613100.00        0.02818  (15012124)
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 239
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454400.00	4613100.00	0.02292	(15012124)	454500.00	4613100.00	0.02244	(14122924)
454600.00	4613100.00	0.02167	(16100124)	454700.00	4613100.00	0.02431	(14121024)
454800.00	4613100.00	0.02731	(14121024)	454900.00	4613100.00	0.02900	(14121024)
455000.00	4613100.00	0.02888	(14121024)	455100.00	4613100.00	0.02697	(14121024)
455200.00	4613100.00	0.02421	(12121724)	455300.00	4613100.00	0.02698	(12121724)
455400.00	4613100.00	0.02844	(12121724)	455500.00	4613100.00	0.02859	(12121724)
455600.00	4613100.00	0.02690	(12121724)	455700.00	4613100.00	0.02522	(15111024)
455800.00	4613100.00	0.02817	(15111024)	455900.00	4613100.00	0.02905	(15111024)
456000.00	4613100.00	0.02785	(15111024)	456100.00	4613100.00	0.02789	(14121824)
456200.00	4613100.00	0.02756	(14121824)	456300.00	4613100.00	0.02646	(14121824)
456400.00	4613100.00	0.02459	(14121824)	456500.00	4613100.00	0.02245	(14121824)
456600.00	4613100.00	0.02108	(13120724)	452000.00	4613200.00	0.01916	(15072624)
452100.00	4613200.00	0.01881	(15072624)	452200.00	4613200.00	0.01803	(15072624)
452300.00	4613200.00	0.01814	(15072624)	452400.00	4613200.00	0.01951c	(12060624)
452500.00	4613200.00	0.02364c	(12060624)	452600.00	4613200.00	0.02562c	(12060624)
452700.00	4613200.00	0.02460	(15100524)	452800.00	4613200.00	0.02583	(15100524)
452900.00	4613200.00	0.02554	(15100524)	453000.00	4613200.00	0.02351	(15100524)

453100.00 4613200.00 0.02364 (15112824) 453200.00
4613200.00 0.02375 (14061024)
453300.00 4613200.00 0.02355 (14061024) 453400.00
4613200.00 0.02069 (13122024)
453500.00 4613200.00 0.02432 (15012124) 453600.00
4613200.00 0.02935 (15012124)
453700.00 4613200.00 0.02909 (15012124) 453800.00
4613200.00 0.02745 (15012124)
453900.00 4613200.00 0.02876 (15012124) 454000.00
4613200.00 0.03258 (15012124)
454100.00 4613200.00 0.03568 (15012124) 454200.00
4613200.00 0.03417 (15012124)
454300.00 4613200.00 0.02735 (15012124) 454400.00
4613200.00 0.02349 (14122924)
454500.00 4613200.00 0.02291 (14122924) 454600.00
4613200.00 0.02347 (14121024)
454700.00 4613200.00 0.02727 (14121024) 454800.00
4613200.00 0.03004 (14121024)
454900.00 4613200.00 0.03090 (14121024) 455000.00
4613200.00 0.02960 (14121024)
455100.00 4613200.00 0.02670 (14121024) 455200.00
4613200.00 0.02672 (12121724)
455300.00 4613200.00 0.02901 (12121724) 455400.00
4613200.00 0.02965 (12121724)
455500.00 4613200.00 0.02826 (12121724) 455600.00
4613200.00 0.02530 (15111024)
455700.00 4613200.00 0.02873 (15111024) 455800.00
4613200.00 0.02978 (15111024)
455900.00 4613200.00 0.02898 (14121824) 456000.00
4613200.00 0.02983 (14121824)
456100.00 4613200.00 0.02901 (14121824) 456200.00
4613200.00 0.02759 (14121824)
456300.00 4613200.00 0.02557 (14121824) 456400.00
4613200.00 0.02310 (13120724)
456500.00 4613200.00 0.02159 (13120724) 456600.00
4613200.00 0.02130 (14010824)
452000.00 4613300.00 0.01920 (15072624) 452100.00
4613300.00 0.01847 (15072624)
452200.00 4613300.00 0.01725 (15072624) 452300.00
4613300.00 0.01703 (15072624)
452400.00 4613300.00 0.01811c (12060624) 452500.00
4613300.00 0.02258c (12060624)
452600.00 4613300.00 0.02559c (12060624) 452700.00
4613300.00 0.02570c (12060624)
452800.00 4613300.00 0.02681 (15100524) 452900.00
4613300.00 0.02734 (15100524)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 240
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453000.00	4613300.00	0.02565	(15100524)	453100.00	4613300.00	0.02513	(15112824)
453200.00	4613300.00	0.02451	(15112824)	453300.00	4613300.00	0.02488	(14061024)
453400.00	4613300.00	0.02235	(15032724)	453500.00	4613300.00	0.02461	(15012124)
453600.00	4613300.00	0.02859	(15012124)	453700.00	4613300.00	0.03032	(15012124)
453800.00	4613300.00	0.02893	(15012124)	453900.00	4613300.00	0.03020	(15012124)
454000.00	4613300.00	0.03402	(15012124)	454100.00	4613300.00	0.03711	(15012124)
454200.00	4613300.00	0.03515	(15012124)	454300.00	4613300.00	0.02675	(15012124)
454400.00	4613300.00	0.02453	(14122924)	454500.00	4613300.00	0.02328	(16100124)
454600.00	4613300.00	0.02666	(14121024)	454700.00	4613300.00	0.03057	(14121024)
454800.00	4613300.00	0.03270	(14121024)	454900.00	4613300.00	0.03230	(14121024)
455000.00	4613300.00	0.02973	(14121024)	455100.00	4613300.00	0.02628	(12121724)
455200.00	4613300.00	0.02910	(12121724)	455300.00	4613300.00	0.03045	(12121724)
455400.00	4613300.00	0.02983	(12121724)	455500.00	4613300.00	0.02684	(12121724)
455600.00	4613300.00	0.02925	(15111024)	455700.00	4613300.00	0.03053	(15111024)
455800.00	4613300.00	0.03064	(14121824)	455900.00	4613300.00	0.03133	(14121824)
456000.00	4613300.00	0.03091	(14121824)	456100.00	4613300.00	0.02886	(14121824)
456200.00	4613300.00	0.02646	(14121824)	456300.00	4613300.00	0.02396	(13120724)

456400.00 4613300.00 0.02220 (14010824) 456500.00
4613300.00 0.02234 (14010824)
456600.00 4613300.00 0.02224 (14010824) 452000.00
4613400.00 0.01938 (15072624)
452100.00 4613400.00 0.01831 (15072624) 452200.00
4613400.00 0.01664 (15072624)
452300.00 4613400.00 0.01591 (15072624) 452400.00
4613400.00 0.01676c (12060624)
452500.00 4613400.00 0.02102c (12060624) 452600.00
4613400.00 0.02463c (12060624)
452700.00 4613400.00 0.02607c (12060624) 452800.00
4613400.00 0.02736 (15100524)
452900.00 4613400.00 0.02887 (15100524) 453000.00
4613400.00 0.02802 (15100524)
453100.00 4613400.00 0.02661 (15112824) 453200.00
4613400.00 0.02644 (15112824)
453300.00 4613400.00 0.02597 (14061024) 453400.00
4613400.00 0.02393 (14061024)
453500.00 4613400.00 0.02520 (15012124) 453600.00
4613400.00 0.02924 (15012124)
453700.00 4613400.00 0.02991 (15012124) 453800.00
4613400.00 0.03022 (15012124)
453900.00 4613400.00 0.03167 (15012124) 454000.00
4613400.00 0.03552 (15012124)
454100.00 4613400.00 0.03832 (15012124) 454200.00
4613400.00 0.03599 (15012124)
454300.00 4613400.00 0.02861 (15012124) 454400.00
4613400.00 0.02505 (14122924)
454500.00 4613400.00 0.02535 (14121024) 454600.00
4613400.00 0.03038 (14121024)
454700.00 4613400.00 0.03398 (14121024) 454800.00
4613400.00 0.03491 (14121024)
454900.00 4613400.00 0.03304 (14121024) 455000.00
4613400.00 0.02915 (14121024)
455100.00 4613400.00 0.02895 (12121724) 455200.00
4613400.00 0.03100 (12121724)
455300.00 4613400.00 0.03106 (12121724) 455400.00
4613400.00 0.02874 (12121724)
455500.00 4613400.00 0.02965 (15111024) 455600.00
4613400.00 0.03155 (13120724)
455700.00 4613400.00 0.03238 (14121824) 455800.00
4613400.00 0.03313 (14121824)
455900.00 4613400.00 0.03237 (14121824) 456000.00
4613400.00 0.03035 (14121824)
456100.00 4613400.00 0.02746 (14121824) 456200.00
4613400.00 0.02477 (13120724)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 241
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456300.00	4613400.00	0.02357	(14010824)	456400.00	4613400.00	0.02342	(14010824)
456500.00	4613400.00	0.02311	(14010824)	456600.00	4613400.00	0.02277	(14010824)
452000.00	4613500.00	0.01966	(15072624)	452100.00	4613500.00	0.01828	(15072624)
452200.00	4613500.00	0.01621	(15072624)	452300.00	4613500.00	0.01506	(16103024)
452400.00	4613500.00	0.01583	(15092524)	452500.00	4613500.00	0.01932c	(12060624)
452600.00	4613500.00	0.02287c	(12060624)	452700.00	4613500.00	0.02530c	(12060624)
452800.00	4613500.00	0.02722	(15100524)	452900.00	4613500.00	0.03002	(15100524)
453000.00	4613500.00	0.03038	(15100524)	453100.00	4613500.00	0.02790	(15112824)
453200.00	4613500.00	0.02856	(15112824)	453300.00	4613500.00	0.02715	(14061024)
453400.00	4613500.00	0.02569	(14061024)	453500.00	4613500.00	0.02477	(15012124)
453600.00	4613500.00	0.03151	(15012124)	453700.00	4613500.00	0.03182	(15012124)
453800.00	4613500.00	0.03024	(15012124)	453900.00	4613500.00	0.03186	(15012124)
454000.00	4613500.00	0.03704	(15012124)	454100.00	4613500.00	0.03927	(15012124)
454200.00	4613500.00	0.03671	(15012124)	454300.00	4613500.00	0.02998	(15012124)
454400.00	4613500.00	0.02634	(14122924)	454500.00	4613500.00	0.02925	(14121024)
454600.00	4613500.00	0.03453	(14121024)	454700.00	4613500.00	0.03725	(14121024)
454800.00	4613500.00	0.03652	(14121024)	454900.00	4613500.00	0.03294	(14121024)

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        455000.00   4613500.00        0.02868  (12121724)              455100.00
4613500.00        0.03134  (12121724)
        455200.00   4613500.00        0.03210  (12121724)              455300.00
4613500.00        0.03047  (12121724)
        455400.00   4613500.00        0.03108  (13120724)              455500.00
4613500.00        0.03336  (13120724)
        455600.00   4613500.00        0.03438  (13120724)              455700.00
4613500.00        0.03503  (14121824)
        455800.00   4613500.00        0.03410  (14121824)              455900.00
4613500.00        0.03175  (14121824)
        456000.00   4613500.00        0.02860  (14121824)              456100.00
4613500.00        0.02576  (13120724)
        456200.00   4613500.00        0.02480  (14010824)              456300.00
4613500.00        0.02457  (14010824)
        456400.00   4613500.00        0.02395  (14010824)              456500.00
4613500.00        0.02306  (14010824)
        456600.00   4613500.00        0.02188  (14010824)              452000.00
4613600.00        0.02001  (15072624)
        452100.00   4613600.00        0.01834  (15072624)              452200.00
4613600.00        0.01625  (16103024)
        452300.00   4613600.00        0.01579  (16103024)              452400.00
4613600.00        0.01518  (16103024)
        452500.00   4613600.00        0.01773c (12060624)              452600.00
4613600.00        0.02062c (12060624)
        452700.00   4613600.00        0.02347c (12060624)              452800.00
4613600.00        0.02629  (15100524)
        452900.00   4613600.00        0.03060  (15100524)              453000.00
4613600.00        0.03244  (15100524)
        453100.00   4613600.00        0.03104  (15100524)              453200.00
4613600.00        0.03073  (15112824)
        453300.00   4613600.00        0.02961  (15112824)              453400.00
4613600.00        0.02752  (14061024)
        453500.00   4613600.00        0.02658  (15032724)              453600.00
4613600.00        0.03198  (15012124)
        453700.00   4613600.00        0.03408  (15012124)              453800.00
4613600.00        0.03325  (15012124)
        453900.00   4613600.00        0.03335  (15012124)              454000.00
4613600.00        0.03660  (15012124)
        454100.00   4613600.00        0.03997  (15012124)              454200.00
4613600.00        0.03736  (15012124)
        454300.00   4613600.00        0.03099  (15012124)              454400.00
4613600.00        0.02723  (14121024)
        454500.00   4613600.00        0.03392  (14121024)              454600.00
4613600.00        0.03889  (14121024)
        454700.00   4613600.00        0.03997  (14121024)              454800.00
4613600.00        0.03716  (14121024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 242
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454900.00	4613600.00	0.03189	(14121024)	455000.00	4613600.00	0.03149	(12121724)
455100.00	4613600.00	0.03310	(12121724)	455200.00	4613600.00	0.03216	(12121724)
455300.00	4613600.00	0.03254	(13120724)	455400.00	4613600.00	0.03567	(13120724)
455500.00	4613600.00	0.03693	(13120724)	455600.00	4613600.00	0.03707	(14121824)
455700.00	4613600.00	0.03589	(14121824)	455800.00	4613600.00	0.03316	(14121824)
455900.00	4613600.00	0.02975	(13120724)	456000.00	4613600.00	0.02685	(13120724)
456100.00	4613600.00	0.02625	(14010824)	456200.00	4613600.00	0.02568	(14010824)
456300.00	4613600.00	0.02476	(14010824)	456400.00	4613600.00	0.02360	(14010824)
456500.00	4613600.00	0.02243	(14010824)	456600.00	4613600.00	0.02173	(14010824)
452000.00	4613700.00	0.02042	(15072624)	452100.00	4613700.00	0.01859	(15072624)
452200.00	4613700.00	0.01654	(16103024)	452300.00	4613700.00	0.01667	(16103024)
452400.00	4613700.00	0.01641	(16103024)	452500.00	4613700.00	0.01659c	(12060624)
452600.00	4613700.00	0.01880	(12110224)	452700.00	4613700.00	0.02143	(12110224)
452800.00	4613700.00	0.02507	(12071024)	452900.00	4613700.00	0.03017	(15100524)
453000.00	4613700.00	0.03397	(15100524)	453100.00	4613700.00	0.03429	(15100524)
453200.00	4613700.00	0.03280	(15112824)	453300.00	4613700.00	0.03252	(15112824)
453400.00	4613700.00	0.02908	(14061024)	453500.00	4613700.00	0.02849	(15032724)

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        453600.00   4613700.00        0.03223  (15012124)              453700.00
4613700.00        0.03531  (15012124)
        453800.00   4613700.00        0.03420  (15012124)              453900.00
4613700.00        0.03661  (15012124)
        454000.00   4613700.00        0.03762  (15012124)              454100.00
4613700.00        0.04031  (15012124)
        454200.00   4613700.00        0.03805  (15012124)              454300.00
4613700.00        0.03209  (15012124)
        454400.00   4613700.00        0.03196  (14121024)              454500.00
4613700.00        0.03928  (14121024)
        454600.00   4613700.00        0.04301  (14121024)              454700.00
4613700.00        0.04171  (14121024)
        454800.00   4613700.00        0.03664  (14121024)              454900.00
4613700.00        0.03210  (14020224)
        455000.00   4613700.00        0.03382  (12121724)              455100.00
4613700.00        0.03385  (12121724)
        455200.00   4613700.00        0.03426  (13120724)              455300.00
4613700.00        0.03797  (13120724)
        455400.00   4613700.00        0.03947  (13120724)              455500.00
4613700.00        0.03955  (14121824)
        455600.00   4613700.00        0.03791  (14121824)              455700.00
4613700.00        0.03453  (14121824)
        455800.00   4613700.00        0.03122  (13120724)              455900.00
4613700.00        0.02848  (14010824)
        456000.00   4613700.00        0.02794  (14010824)              456100.00
4613700.00        0.02684  (14010824)
        456200.00   4613700.00        0.02566  (14010824)              456300.00
4613700.00        0.02452  (14010824)
        456400.00   4613700.00        0.02324  (14010824)              456500.00
4613700.00        0.02206  (13030324)
        456600.00   4613700.00        0.02185  (13011524)              452000.00
4613800.00        0.02097  (15072624)
        452100.00   4613800.00        0.01884  (15072624)              452200.00
4613800.00        0.01487m (13090524)
        452300.00   4613800.00        0.01625  (16103024)              452400.00
4613800.00        0.01710  (16103024)
        452500.00   4613800.00        0.01710  (16103024)              452600.00
4613800.00        0.01714  (12100224)
        452700.00   4613800.00        0.02127  (12110224)              452800.00
4613800.00        0.02376  (12071024)
        452900.00   4613800.00        0.02874  (12071024)              453000.00
4613800.00        0.03451  (15100524)
        453100.00   4613800.00        0.03713  (15100524)              453200.00
4613800.00        0.03442  (15100524)
        453300.00   4613800.00        0.03581  (15112824)              453400.00
4613800.00        0.03268  (15112824)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 243
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453500.00	4613800.00	0.03122	(15060524)	453600.00	4613800.00	0.03237	(15012124)
453700.00	4613800.00	0.03638	(15012124)	453800.00	4613800.00	0.03548	(15012124)
453900.00	4613800.00	0.03714	(15012124)	454000.00	4613800.00	0.03836	(15012124)
454100.00	4613800.00	0.03855	(15012124)	454200.00	4613800.00	0.03876	(15012124)
454300.00	4613800.00	0.03375	(15012124)	454400.00	4613800.00	0.03788	(14121024)
454500.00	4613800.00	0.04495	(14121024)	454600.00	4613800.00	0.04631	(14121024)
454700.00	4613800.00	0.04206	(14121024)	454800.00	4613800.00	0.03493	(14121024)
454900.00	4613800.00	0.03564	(14020224)	455000.00	4613800.00	0.03540	(12121724)
455100.00	4613800.00	0.03630	(13120724)	455200.00	4613800.00	0.04080	(13120724)
455300.00	4613800.00	0.04250	(13120724)	455400.00	4613800.00	0.04194	(13120724)
455500.00	4613800.00	0.03994	(14121824)	455600.00	4613800.00	0.03670	(13120724)
455700.00	4613800.00	0.03293	(13120724)	455800.00	4613800.00	0.03071	(14010824)
455900.00	4613800.00	0.02980	(14010824)	456000.00	4613800.00	0.02845	(14010824)
456100.00	4613800.00	0.02636	(14010824)	456200.00	4613800.00	0.02514	(14010824)
456300.00	4613800.00	0.02385	(14010824)	456400.00	4613800.00	0.02265	(14010824)
456500.00	4613800.00	0.02173	(14010824)	456600.00	4613800.00	0.02219	(14020324)
452000.00	4613900.00	0.02177	(15072624)	452100.00	4613900.00	0.01928	(15072624)

452200.00 4613900.00 0.01656m (13090524) 452300.00
4613900.00 0.01646m (13090524)
452400.00 4613900.00 0.01693 (16103024) 452500.00
4613900.00 0.01790 (16103024)
452600.00 4613900.00 0.01819 (16103024) 452700.00
4613900.00 0.01934 (12110224)
452800.00 4613900.00 0.02390 (12110224) 452900.00
4613900.00 0.02799 (12071024)
453000.00 4613900.00 0.03362 (15100524) 453100.00
4613900.00 0.03929 (15100524)
453200.00 4613900.00 0.03899 (15100524) 453300.00
4613900.00 0.03910 (15112824)
453400.00 4613900.00 0.03685 (15112824) 453500.00
4613900.00 0.03427 (15060524)
453600.00 4613900.00 0.03455 (13063024) 453700.00
4613900.00 0.03730 (15012124)
453800.00 4613900.00 0.03656 (15012124) 453900.00
4613900.00 0.03867 (15012124)
454000.00 4613900.00 0.03857 (15012124) 454100.00
4613900.00 0.03809 (15012124)
454200.00 4613900.00 0.03872 (15012124) 454300.00
4613900.00 0.03603 (15012124)
454400.00 4613900.00 0.04487 (14121024) 454500.00
4613900.00 0.05025 (14121024)
454600.00 4613900.00 0.04808 (14121024) 454700.00
4613900.00 0.04086 (14121024)
454800.00 4613900.00 0.03789 (14020224) 454900.00
4613900.00 0.03703 (14020224)
455000.00 4613900.00 0.03867 (13120724) 455100.00
4613900.00 0.04421 (13120724)
455200.00 4613900.00 0.04626 (13120724) 455300.00
4613900.00 0.04535 (13120724)
455400.00 4613900.00 0.04259 (13120724) 455500.00
4613900.00 0.03868 (13120724)
455600.00 4613900.00 0.03436 (13120724) 455700.00
4613900.00 0.03249 (14010824)
455800.00 4613900.00 0.03119 (14010824) 455900.00
4613900.00 0.02937 (14010824)
456000.00 4613900.00 0.02747 (14010824) 456100.00
4613900.00 0.02601 (14010824)
456200.00 4613900.00 0.02455 (14010824) 456300.00
4613900.00 0.02334 (14010824)
456400.00 4613900.00 0.02303 (14020324) 456500.00
4613900.00 0.02373 (14020324)
456600.00 4613900.00 0.02550 (14020324) 452000.00
4614000.00 0.02288 (15072624)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 244
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452100.00	4614000.00	0.02002	(15072624)	452200.00	4614000.00	0.01725m	(13090524)
452300.00	4614000.00	0.01816m	(13090524)	452400.00	4614000.00	0.01981m	(13090524)
452500.00	4614000.00	0.01889m	(13090524)	452600.00	4614000.00	0.01911	(16103024)
452700.00	4614000.00	0.01945	(16103024)	452800.00	4614000.00	0.02227	(12110224)
452900.00	4614000.00	0.02651	(12110224)	453000.00	4614000.00	0.03305	(12071024)
453100.00	4614000.00	0.03971	(15100524)	453200.00	4614000.00	0.04294	(15100524)
453300.00	4614000.00	0.04193	(15112824)	453400.00	4614000.00	0.04170	(15112824)
453500.00	4614000.00	0.03751	(15060524)	453600.00	4614000.00	0.03760	(13063024)
453700.00	4614000.00	0.03802	(15012124)	453800.00	4614000.00	0.03724	(15012124)
453900.00	4614000.00	0.03918	(15012124)	454000.00	4614000.00	0.03824	(15012124)
454100.00	4614000.00	0.03753	(15012124)	454200.00	4614000.00	0.04215	(15012124)
454300.00	4614000.00	0.04221	(14121024)	454400.00	4614000.00	0.05232	(14121024)
454500.00	4614000.00	0.05419	(14121024)	454600.00	4614000.00	0.04786	(14121024)
454700.00	4614000.00	0.04009	(14020224)	454800.00	4614000.00	0.04010	(14020224)
454900.00	4614000.00	0.04141	(13120724)	455000.00	4614000.00	0.04834	(13120724)
455100.00	4614000.00	0.05094	(13120724)	455200.00	4614000.00	0.04953	(13120724)
455300.00	4614000.00	0.04579	(13120724)	455400.00	4614000.00	0.04078	(13120724)

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        455500.00   4614000.00        0.03598  (14010824)              455600.00
4614000.00        0.03504  (14010824)
        455700.00   4614000.00        0.03301  (14010824)              455800.00
4614000.00        0.03070  (14010824)
        455900.00   4614000.00        0.02859  (14010824)              456000.00
4614000.00        0.02679  (14010824)
        456100.00   4614000.00        0.02525  (14010824)              456200.00
4614000.00        0.02431  (13110224)
        456300.00   4614000.00        0.02529  (14020324)              456400.00
4614000.00        0.02635  (14020324)
        456500.00   4614000.00        0.02565  (14020324)              456600.00
4614000.00        0.02699  (14020324)
        452000.00   4614100.00        0.02430  (15072624)              452100.00
4614100.00        0.02112  (15072624)
        452200.00   4614100.00        0.01964  (15012724)              452300.00
4614100.00        0.01944  (13082324)
        452400.00   4614100.00        0.02205m (13090524)              452500.00
4614100.00        0.02251m (13090524)
        452600.00   4614100.00        0.02165m (13090524)              452700.00
4614100.00        0.02076  (16103024)
        452800.00   4614100.00        0.02139  (16103024)              452900.00
4614100.00        0.02518  (12110224)
        453000.00   4614100.00        0.03091  (12071024)              453100.00
4614100.00        0.03877  (12071024)
        453200.00   4614100.00        0.04547  (15100524)              453300.00
4614100.00        0.04447  (15100524)
        453400.00   4614100.00        0.04701  (15112824)              453500.00
4614100.00        0.04071  (15060524)
        453600.00   4614100.00        0.04088  (13063024)              453700.00
4614100.00        0.03845  (15012124)
        453800.00   4614100.00        0.03751  (15012124)              453900.00
4614100.00        0.03900  (15012124)
        454000.00   4614100.00        0.03706  (15012124)              454100.00
4614100.00        0.04253  (14122924)
        454200.00   4614100.00        0.04483  (15012124)              454300.00
4614100.00        0.05133  (14121024)
        454400.00   4614100.00        0.05905  (14121024)              454500.00
4614100.00        0.05577  (14121024)
        454600.00   4614100.00        0.04577  (14121024)              454700.00
4614100.00        0.04343  (14020224)
        454800.00   4614100.00        0.04459  (13120724)              454900.00
4614100.00        0.05334  (13120724)
        455000.00   4614100.00        0.05685  (13120724)              455100.00
4614100.00        0.05479  (13120724)
        455200.00   4614100.00        0.04960  (13120724)              455300.00
4614100.00        0.04299  (13120724)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 245
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455400.00	4614100.00	0.03864	(14010824)	455500.00	4614100.00	0.03725	(14010824)
455600.00	4614100.00	0.03507	(14010824)	455700.00	4614100.00	0.03245	(14010824)
455800.00	4614100.00	0.02991	(14010824)	455900.00	4614100.00	0.02777	(14010824)
456000.00	4614100.00	0.02662	(13110224)	456100.00	4614100.00	0.02578	(13110224)
456200.00	4614100.00	0.02659	(14020324)	456300.00	4614100.00	0.02736	(14020324)
456400.00	4614100.00	0.02735	(14020324)	456500.00	4614100.00	0.02510	(14020324)
456600.00	4614100.00	0.02564	(14020324)	452000.00	4614200.00	0.02598	(15072624)
452100.00	4614200.00	0.02513	(12040624)	452200.00	4614200.00	0.02176	(12040624)
452300.00	4614200.00	0.02135	(12032924)	452400.00	4614200.00	0.02270m	(13090524)
452500.00	4614200.00	0.02426m	(13090524)	452600.00	4614200.00	0.02577m	(13090524)
452700.00	4614200.00	0.02487m	(13090524)	452800.00	4614200.00	0.02276	(16103024)
452900.00	4614200.00	0.02344	(16103024)	453000.00	4614200.00	0.02903	(12100224)
453100.00	4614200.00	0.03808	(12071024)	453200.00	4614200.00	0.04534	(15100524)
453300.00	4614200.00	0.04989	(15100524)	453400.00	4614200.00	0.05213	(15112824)
453500.00	4614200.00	0.04649	(15112824)	453600.00	4614200.00	0.04436	(13063024)
453700.00	4614200.00	0.04309	(13063024)	453800.00	4614200.00	0.03738	(15012124)
453900.00	4614200.00	0.03837	(15012124)	454000.00	4614200.00	0.03776	(14030224)

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        454300.00   4614200.00        0.06105  (14121024)              454400.00
4614200.00        0.06336  (14121024)
        454500.00   4614200.00        0.05473  (14121024)              454600.00
4614200.00        0.04696  (14020224)
        454700.00   4614200.00        0.04821  (13120724)              454800.00
4614200.00        0.05943  (13120724)
        454900.00   4614200.00        0.06448  (13120724)              455000.00
4614200.00        0.06158  (13120724)
        455100.00   4614200.00        0.05418  (13120724)              455200.00
4614200.00        0.04522  (13120724)
        455300.00   4614200.00        0.04188  (14010824)              455400.00
4614200.00        0.03975  (14010824)
        455500.00   4614200.00        0.03657  (14010824)              455600.00
4614200.00        0.03353  (14010824)
        455700.00   4614200.00        0.03108  (14010824)              455800.00
4614200.00        0.02951  (13110224)
        455900.00   4614200.00        0.02834  (13110224)              456000.00
4614200.00        0.02690  (13110224)
        456100.00   4614200.00        0.02691  (14020324)              456200.00
4614200.00        0.02690  (14020324)
        456300.00   4614200.00        0.02632  (14020324)              456400.00
4614200.00        0.02527  (14020324)
        456500.00   4614200.00        0.02159  (14020324)              456600.00
4614200.00        0.02203  (14020324)
        452000.00   4614300.00        0.02775  (15072624)              452100.00
4614300.00        0.02743  (12040624)
        452200.00   4614300.00        0.02759  (12040624)              452300.00
4614300.00        0.02628  (12040624)
        452400.00   4614300.00        0.02425  (12040624)              452500.00
4614300.00        0.02530m (13090524)
        452600.00   4614300.00        0.02825m (13090524)              452700.00
4614300.00        0.02929m (13090524)
        452800.00   4614300.00        0.02716m (13090524)              452900.00
4614300.00        0.02510  (16103024)
        453000.00   4614300.00        0.02647  (12100224)              453100.00
4614300.00        0.03399  (12100224)
        453200.00   4614300.00        0.04632  (12071024)              453300.00
4614300.00        0.05280  (15100524)
        453400.00   4614300.00        0.05570  (15112824)              453500.00
4614300.00        0.05487  (15112824)
        453600.00   4614300.00        0.04914  (15060524)              453700.00
4614300.00        0.04864  (13063024)
        453800.00   4614300.00        0.03710  (15012124)              453900.00
4614300.00        0.04180c (15011224)
        454000.00   4614300.00        0.04244  (14030224)              454400.00
4614300.00        0.06401  (14121024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 246
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454500.00	4614300.00	0.05248	(14121024)	454600.00	4614300.00	0.05210	(13120724)
454700.00	4614300.00	0.06704	(13120724)	454800.00	4614300.00	0.07461	(13120724)
454900.00	4614300.00	0.07058	(13120724)	455000.00	4614300.00	0.05969	(13120724)
455100.00	4614300.00	0.04810	(14010824)	455200.00	4614300.00	0.04586	(14010824)
455300.00	4614300.00	0.04240	(14010824)	455400.00	4614300.00	0.03822	(14010824)
455500.00	4614300.00	0.03509	(13032124)	455600.00	4614300.00	0.03321	(13110224)
455700.00	4614300.00	0.03161	(13110224)	455800.00	4614300.00	0.02957	(13110224)
455900.00	4614300.00	0.02748	(13110224)	456000.00	4614300.00	0.02600	(14020324)
456100.00	4614300.00	0.02504	(14021024)	456200.00	4614300.00	0.02440	(14021024)
456300.00	4614300.00	0.02378	(14021024)	456400.00	4614300.00	0.02308	(14021024)
456500.00	4614300.00	0.02220	(14021024)	456600.00	4614300.00	0.02152	(14021024)
452000.00	4614400.00	0.02942	(15072624)	452100.00	4614400.00	0.02599	(15072624)
452200.00	4614400.00	0.02750	(12040624)	452300.00	4614400.00	0.03038	(12040624)
452400.00	4614400.00	0.03101	(12040624)	452500.00	4614400.00	0.02872	(12040624)
452600.00	4614400.00	0.02806m	(13090524)	452700.00	4614400.00	0.03127m	(13090524)
452800.00	4614400.00	0.03190m	(13090524)	452900.00	4614400.00	0.02817m	(13090524)
453000.00	4614400.00	0.02784	(16103024)	453100.00	4614400.00	0.03148	(12100224)

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        453200.00   4614400.00        0.04277  (12071024)              453300.00
4614400.00        0.05482  (12071024)
        453400.00   4614400.00        0.05706  (15100524)              453500.00
4614400.00        0.06415  (15112824)
        453600.00   4614400.00        0.05571  (15060524)              453700.00
4614400.00        0.05545  (13063024)
        453800.00   4614400.00        0.04142  (14020124)              453900.00
4614400.00        0.04713c (15011224)
        454000.00   4614400.00        0.04626  (14030224)              454100.00
4614400.00        0.04955  (14121024)
        454600.00   4614400.00        0.07699  (13120724)              454700.00
4614400.00        0.08881  (13120724)
        454800.00   4614400.00        0.08295  (13120724)              454900.00
4614400.00        0.06604  (13120724)
        455000.00   4614400.00        0.05513  (14010824)              455100.00
4614400.00        0.05071  (14010824)
        455200.00   4614400.00        0.04484  (14010824)              455300.00
4614400.00        0.04033  (13032124)
        455400.00   4614400.00        0.03749  (13110224)              455500.00
4614400.00        0.03531  (13110224)
        455600.00   4614400.00        0.03282  (13110224)              455700.00
4614400.00        0.03067  (14021024)
        455800.00   4614400.00        0.02925  (14021024)              455900.00
4614400.00        0.02810  (14021024)
        456000.00   4614400.00        0.02703  (14021024)              456100.00
4614400.00        0.02598  (14021024)
        456200.00   4614400.00        0.02497  (14021024)              456300.00
4614400.00        0.02394  (14021024)
        456400.00   4614400.00        0.02291  (14021024)              456500.00
4614400.00        0.02184  (14021024)
        456600.00   4614400.00        0.02079  (14021024)              452000.00
4614500.00        0.03063  (15072624)
        452100.00   4614500.00        0.02725  (15072624)              452200.00
4614500.00        0.02443  (13082324)
        452300.00   4614500.00        0.02722  (12040624)              452400.00
4614500.00        0.03086  (12040624)
        452500.00   4614500.00        0.03329  (12040624)              452600.00
4614500.00        0.03271  (12040624)
        452700.00   4614500.00        0.03034m (13090524)              452800.00
4614500.00        0.03368m (13090524)
        452900.00   4614500.00        0.03326m (13090524)              453000.00
4614500.00        0.02844m (13090524)
        453100.00   4614500.00        0.03057  (16103024)              453200.00
4614500.00        0.03709  (12100224)
        453300.00   4614500.00        0.05477  (12071024)              453400.00
4614500.00        0.05995  (12071024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 247
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453500.00	4614500.00	0.07223	(15112824)	453600.00	4614500.00	0.06194	(15060524)
453700.00	4614500.00	0.06339	(13063024)	453800.00	4614500.00	0.04661	(14020124)
453900.00	4614500.00	0.05227c	(15011224)	454000.00	4614500.00	0.04787	(13121924)
454100.00	4614500.00	0.06242	(14121024)	454600.00	4614500.00	0.11078	(13120724)
454700.00	4614500.00	0.10067	(13120724)	454800.00	4614500.00	0.07464	(14010824)
454900.00	4614500.00	0.06473	(14010824)	455000.00	4614500.00	0.05543	(14010824)
455100.00	4614500.00	0.04725	(13032124)	455200.00	4614500.00	0.04280	(13110224)
455300.00	4614500.00	0.03968	(13110224)	455400.00	4614500.00	0.03728	(14021024)
455500.00	4614500.00	0.03527	(14021024)	455600.00	4614500.00	0.03339	(14021024)
455700.00	4614500.00	0.03163	(14021024)	455800.00	4614500.00	0.03000	(14021024)
455900.00	4614500.00	0.02843	(14021024)	456000.00	4614500.00	0.02690	(14021024)
456100.00	4614500.00	0.02540	(14021024)	456200.00	4614500.00	0.02405	(14021024)
456300.00	4614500.00	0.02275	(14021024)	456400.00	4614500.00	0.02153	(14021024)
456500.00	4614500.00	0.02036	(14021024)	456600.00	4614500.00	0.01920	(14021024)
452000.00	4614600.00	0.03125	(15072624)	452100.00	4614600.00	0.02787	(15072624)
452200.00	4614600.00	0.02459	(13082324)	452300.00	4614600.00	0.02578	(15121224)
452400.00	4614600.00	0.02869	(15121224)	452500.00	4614600.00	0.03253	(12020324)

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        452600.00   4614600.00        0.03428  (12040624)              452700.00
4614600.00        0.03642  (12040624)
        452800.00   4614600.00        0.03410  (12040624)              452900.00
4614600.00        0.03417  (12032924)
        453000.00   4614600.00        0.03452  (15100424)              453100.00
4614600.00        0.03167  (15100424)
        453200.00   4614600.00        0.03334  (16103024)              453300.00
4614600.00        0.04472  (12071024)
        453400.00   4614600.00        0.06799  (12071024)              453500.00
4614600.00        0.07371  (15112824)
        453600.00   4614600.00        0.07098  (15112824)              453700.00
4614600.00        0.07245  (13063024)
        453800.00   4614600.00        0.05040  (15020824)              453900.00
4614600.00        0.06018  (13121924)
        454000.00   4614600.00        0.07277  (13121924)              454100.00
4614600.00        0.07835  (13121924)
        454600.00   4614600.00        0.12667  (13120724)              454700.00
4614600.00        0.09735  (14010824)
        454800.00   4614600.00        0.07458  (14010824)              454900.00
4614600.00        0.05683  (13032124)
        455000.00   4614600.00        0.05134  (14021024)              455100.00
4614600.00        0.04720  (14021024)
        455200.00   4614600.00        0.04386  (14021024)              455300.00
4614600.00        0.04078  (14021024)
        455400.00   4614600.00        0.03791  (14021024)              455500.00
4614600.00        0.03527  (14021024)
        455600.00   4614600.00        0.03286  (14021024)              455700.00
4614600.00        0.03063  (14021024)
        455800.00   4614600.00        0.02857  (14021024)              455900.00
4614600.00        0.02670  (14021024)
        456000.00   4614600.00        0.02493  (14021024)              456100.00
4614600.00        0.02323  (14021024)
        456200.00   4614600.00        0.02182  (14021024)              456300.00
4614600.00        0.02051  (14021024)
        456400.00   4614600.00        0.02014  (13032724)              456500.00
4614600.00        0.01984  (13032724)
        456600.00   4614600.00        0.02010  (13032724)              452000.00
4614700.00        0.03115  (15072624)
        452100.00   4614700.00        0.02730  (15072624)              452200.00
4614700.00        0.02736  (14062224)
        452300.00   4614700.00        0.02798  (16031224)              452400.00
4614700.00        0.03102  (16031224)
        452500.00   4614700.00        0.02935  (16031224)              452600.00
4614700.00        0.03284  (16082624)
        452700.00   4614700.00        0.03490  (14010124)              452800.00
4614700.00        0.03838  (12040624)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 248
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452900.00	4614700.00	0.03920	(12040624)	453000.00	4614700.00	0.03893	(12032924)
453100.00	4614700.00	0.03963	(15100424)	453200.00	4614700.00	0.03864	(15100424)
453300.00	4614700.00	0.03809	(15012524)	453400.00	4614700.00	0.06090	(12071024)
453500.00	4614700.00	0.07436	(12071024)	453600.00	4614700.00	0.08725	(15112824)
453700.00	4614700.00	0.08195	(13063024)	453800.00	4614700.00	0.05560	(14101524)
453900.00	4614700.00	0.06650	(14120924)	454000.00	4614700.00	0.07264	(13121924)
454100.00	4614700.00	0.10700	(13121924)	454600.00	4614700.00	0.12488	(14010824)
454700.00	4614700.00	0.07920	(14021024)	454800.00	4614700.00	0.06577	(14021024)
454900.00	4614700.00	0.05681	(14021024)	455000.00	4614700.00	0.05101	(14021024)
455100.00	4614700.00	0.04642	(14021024)	455200.00	4614700.00	0.04228	(14021024)
455300.00	4614700.00	0.03856	(14021024)	455400.00	4614700.00	0.03525	(14021024)
455500.00	4614700.00	0.03228	(14021024)	455600.00	4614700.00	0.02962	(14021024)
455700.00	4614700.00	0.02726	(14021024)	455800.00	4614700.00	0.02516	(14021024)
455900.00	4614700.00	0.02377	(13032724)	456000.00	4614700.00	0.02360	(13032724)
456100.00	4614700.00	0.02321	(13032724)	456200.00	4614700.00	0.02305	(13032724)
456300.00	4614700.00	0.02277	(13032724)	456400.00	4614700.00	0.02237	(13032724)
456500.00	4614700.00	0.02181	(13032724)	456600.00	4614700.00	0.02171	(13032724)

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        452000.00   4614800.00        0.03061  (15072624)              452100.00
4614800.00        0.02665  (15072624)
        452200.00   4614800.00        0.02607  (14062224)              452300.00
4614800.00        0.03035  (16041624)
        452400.00   4614800.00        0.02929  (16041624)              452500.00
4614800.00        0.02963  (14080724)
        452600.00   4614800.00        0.03184  (16082624)              452700.00
4614800.00        0.03521  (14010124)
        452800.00   4614800.00        0.03928  (14010124)              452900.00
4614800.00        0.04155  (14010124)
        453000.00   4614800.00        0.04254  (12040624)              453100.00
4614800.00        0.04225  (12020324)
        453200.00   4614800.00        0.04614  (15100424)              453300.00
4614800.00        0.04639  (15100424)
        453400.00   4614800.00        0.04451  (16093024)              453500.00
4614800.00        0.07998  (12071024)
        453600.00   4614800.00        0.09337  (15112824)              453700.00
4614800.00        0.08835  (13063024)
        453800.00   4614800.00        0.06147  (16102024)              453900.00
4614800.00        0.06820  (12101224)
        454000.00   4614800.00        0.09843  (12110724)              454600.00
4614800.00        0.07776  (14010824)
        454700.00   4614800.00        0.06240  (14021024)              454800.00
4614800.00        0.05451  (14021024)
        454900.00   4614800.00        0.04998  (14021024)              455000.00
4614800.00        0.04543  (14021024)
        455100.00   4614800.00        0.04085  (14021024)              455200.00
4614800.00        0.03667  (14021024)
        455300.00   4614800.00        0.03295  (14021024)              455400.00
4614800.00        0.02970  (14021024)
        455500.00   4614800.00        0.02762  (13032724)              455600.00
4614800.00        0.02742  (13032724)
        455700.00   4614800.00        0.02712  (13032724)              455800.00
4614800.00        0.02675  (13032724)
        455900.00   4614800.00        0.02630  (13032724)              456000.00
4614800.00        0.02578  (13032724)
        456100.00   4614800.00        0.02499  (13032724)              456200.00
4614800.00        0.02430  (13032724)
        456300.00   4614800.00        0.02371  (13032724)              456400.00
4614800.00        0.02300  (13032724)
        456500.00   4614800.00        0.02290  (13011524)              456600.00
4614800.00        0.02306  (13011524)
        452000.00   4614900.00        0.03019  (15072624)              452100.00
4614900.00        0.02783  (14052424)
        452200.00   4614900.00        0.02788  (16080124)              452300.00
4614900.00        0.02870  (16080124)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 249
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452400.00	4614900.00	0.02939	(16080124)	452500.00	4614900.00	0.03142	(14080724)
452600.00	4614900.00	0.03342	(14080724)	452700.00	4614900.00	0.03626	(12020424)
452800.00	4614900.00	0.03810	(12020424)	452900.00	4614900.00	0.04266	(16092424)
453000.00	4614900.00	0.04782	(16092424)	453100.00	4614900.00	0.04936	(14010124)
453200.00	4614900.00	0.05381	(15100324)	453300.00	4614900.00	0.05836	(15100324)
453400.00	4614900.00	0.05379	(15100424)	453500.00	4614900.00	0.05806	(14042624)
453600.00	4614900.00	0.08454	(12070824)	453700.00	4614900.00	0.08440	(15060524)
453800.00	4614900.00	0.06723	(15082624)	453900.00	4614900.00	0.07593	(12110724)
454000.00	4614900.00	0.09917	(12110724)	454600.00	4614900.00	0.08767	(13011524)
454700.00	4614900.00	0.06760	(13011524)	454800.00	4614900.00	0.05739	(14010824)
454900.00	4614900.00	0.04380	(14021024)	455000.00	4614900.00	0.03796	(14022424)
455100.00	4614900.00	0.03645	(14022424)	455200.00	4614900.00	0.03471	(14022424)
455300.00	4614900.00	0.03285	(14022424)	455400.00	4614900.00	0.03096	(14022424)
455500.00	4614900.00	0.02997	(13032724)	455600.00	4614900.00	0.02929	(13032724)
455700.00	4614900.00	0.02842	(13032724)	455800.00	4614900.00	0.02748	(13032724)
455900.00	4614900.00	0.02651	(13032724)	456000.00	4614900.00	0.02552	(13032724)
456100.00	4614900.00	0.02457	(13032724)	456200.00	4614900.00	0.02392	(13011524)

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        456300.00   4614900.00        0.02441  (13011524)              456400.00
4614900.00        0.02512  (13011524)
        456500.00   4614900.00        0.02515  (13011524)              456600.00
4614900.00        0.02479  (13011524)
        452000.00   4615000.00        0.02998  (15072624)              452100.00
4615000.00        0.03213  (14052424)
        452200.00   4615000.00        0.03231  (14052424)              452300.00
4615000.00        0.03050  (14052424)
        452400.00   4615000.00        0.02922  (15113024)              452500.00
4615000.00        0.03090  (15113024)
        452600.00   4615000.00        0.03230  (15113024)              452700.00
4615000.00        0.03421  (13071424)
        452800.00   4615000.00        0.03682  (14080724)              452900.00
4615000.00        0.03999  (14080724)
        453000.00   4615000.00        0.04218  (14080724)              453100.00
4615000.00        0.05196  (16092424)
        453200.00   4615000.00        0.06109  (16092424)              453300.00
4615000.00        0.06206  (16092424)
        453400.00   4615000.00        0.07993  (15100324)              453500.00
4615000.00        0.06658  (15100224)
        453600.00   4615000.00        0.06913  (14042624)              453700.00
4615000.00        0.08893  (12050524)
        453800.00   4615000.00        0.07177  (15082624)              453900.00
4615000.00        0.07783  (16022524)
        454000.00   4615000.00        0.08457  (13011024)              454600.00
4615000.00        0.13948  (14010824)
        454700.00   4615000.00        0.06273  (14111424)              454800.00
4615000.00        0.05053  (16112524)
        454900.00   4615000.00        0.04736  (16112524)              455000.00
4615000.00        0.04466  (16112524)
        455100.00   4615000.00        0.04211  (16112524)              455200.00
4615000.00        0.03965  (16112524)
        455300.00   4615000.00        0.03729  (16112524)              455400.00
4615000.00        0.03504  (16112524)
        455500.00   4615000.00        0.03292  (16112524)              455600.00
4615000.00        0.03093  (16112524)
        455700.00   4615000.00        0.02908  (16112524)              455800.00
4615000.00        0.02736  (16112524)
        455900.00   4615000.00        0.02691  (13011524)              456000.00
4615000.00        0.02730  (13011524)
        456100.00   4615000.00        0.02754  (13011524)              456200.00
4615000.00        0.02771  (13011524)
        456300.00   4615000.00        0.02743  (13011524)              456400.00
4615000.00        0.02766  (13011524)
        456500.00   4615000.00        0.02703  (13011524)              456600.00
4615000.00        0.02631  (13011524)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 250
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4615100.00	0.03070	(14052424)	452100.00	4615100.00	0.03303	(14052424)
452200.00	4615100.00	0.03314	(14052424)	452300.00	4615100.00	0.03184	(14052424)
452400.00	4615100.00	0.03106	(15113024)	452500.00	4615100.00	0.03435	(15113024)
452600.00	4615100.00	0.03805	(15113024)	452700.00	4615100.00	0.04217	(15113024)
452800.00	4615100.00	0.04659	(15113024)	452900.00	4615100.00	0.05103	(15113024)
453000.00	4615100.00	0.05482	(15113024)	453100.00	4615100.00	0.05658	(15113024)
453200.00	4615100.00	0.05381	(15113024)	453300.00	4615100.00	0.05419	(16092424)
453400.00	4615100.00	0.06210	(16092424)	453500.00	4615100.00	0.06900	(12080824)
453600.00	4615100.00	0.07488	(12080824)	453700.00	4615100.00	0.06528	(12050524)
453800.00	4615100.00	0.05200	(14092224)	453900.00	4615100.00	0.07346	(13012624)
454000.00	4615100.00	0.06952	(15101324)	454100.00	4615100.00	0.09790	(13012124)
454600.00	4615100.00	0.08777c	(13123124)	454700.00	4615100.00	0.06873	(16112524)
454800.00	4615100.00	0.06249	(16112524)	454900.00	4615100.00	0.05689	(16112524)
455000.00	4615100.00	0.05189	(16112524)	455100.00	4615100.00	0.04743	(16112524)
455200.00	4615100.00	0.04347	(16112524)	455300.00	4615100.00	0.03994	(16112524)
455400.00	4615100.00	0.03681	(16112524)	455500.00	4615100.00	0.03403	(16112524)
455600.00	4615100.00	0.03154	(16112524)	455700.00	4615100.00	0.02955	(13011524)

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        455800.00   4615100.00        0.03015  (13011524)              455900.00
4615100.00        0.03060  (13011524)
        456000.00   4615100.00        0.03081  (13011524)              456100.00
4615100.00        0.03065  (13011524)
        456200.00   4615100.00        0.03036  (13011524)              456300.00
4615100.00        0.02976  (13011524)
        456400.00   4615100.00        0.02947  (13011524)              456500.00
4615100.00        0.02848  (13011524)
        456600.00   4615100.00        0.02723  (13011524)              452000.00
4615200.00        0.03046  (15072624)
        452100.00   4615200.00        0.03035  (14052424)              452200.00
4615200.00        0.03040  (14052424)
        452300.00   4615200.00        0.02790  (14052424)              452400.00
4615200.00        0.02897b (16051924)
        452500.00   4615200.00        0.03270b (16051924)              452600.00
4615200.00        0.03578b (16051924)
        452700.00   4615200.00        0.03635b (16051924)              452800.00
4615200.00        0.04021  (15113024)
        452900.00   4615200.00        0.04559  (15113024)              453000.00
4615200.00        0.05187  (15113024)
        453100.00   4615200.00        0.05898  (15113024)              453200.00
4615200.00        0.06642  (15113024)
        453300.00   4615200.00        0.07194  (15113024)              453400.00
4615200.00        0.06795  (15113024)
        453500.00   4615200.00        0.06452  (14052224)              453600.00
4615200.00        0.06946  (16051124)
        453700.00   4615200.00        0.04335  (13050824)              453800.00
4615200.00        0.03778  (13012624)
        453900.00   4615200.00        0.06427  (13012624)              454000.00
4615200.00        0.07045  (16051224)
        454100.00   4615200.00        0.09953m (16120824)              454200.00
4615200.00        0.09584m (16120824)
        454600.00   4615200.00        0.07816  (12011024)              454700.00
4615200.00        0.06148  (16112524)
        454800.00   4615200.00        0.05696  (16112524)              454900.00
4615200.00        0.05234  (16112524)
        455000.00   4615200.00        0.04785  (16112524)              455100.00
4615200.00        0.04370  (16112524)
        455200.00   4615200.00        0.03997  (16112524)              455300.00
4615200.00        0.03666  (16112524)
        455400.00   4615200.00        0.03373  (16112524)              455500.00
4615200.00        0.03113  (16112524)
        455600.00   4615200.00        0.03032  (13011524)              455700.00
4615200.00        0.03125  (13011524)
        455800.00   4615200.00        0.03195  (13011524)              455900.00
4615200.00        0.03234  (13011524)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 251
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456000.00	4615200.00	0.03239	(13011524)	456100.00	4615200.00	0.03205	(13011524)
456200.00	4615200.00	0.03146	(13011524)	456300.00	4615200.00	0.03045	(13011524)
456400.00	4615200.00	0.02964	(13011524)	456500.00	4615200.00	0.02828	(13011524)
456600.00	4615200.00	0.02677	(13011524)	452000.00	4615300.00	0.03085	(15072624)
452100.00	4615300.00	0.02751	(16092024)	452200.00	4615300.00	0.03178	(16092024)
452300.00	4615300.00	0.03263	(16092024)	452400.00	4615300.00	0.03314	(15102724)
452500.00	4615300.00	0.03632	(15102724)	452600.00	4615300.00	0.03997	(15102724)
452700.00	4615300.00	0.04456	(15102724)	452800.00	4615300.00	0.04946	(15102724)
452900.00	4615300.00	0.05493	(15102724)	453000.00	4615300.00	0.06096	(15102724)
453100.00	4615300.00	0.06766	(15102724)	453200.00	4615300.00	0.07398	(15102724)
453300.00	4615300.00	0.07858	(15102724)	453400.00	4615300.00	0.08128	(14042824)
453500.00	4615300.00	0.06278	(14042824)	453600.00	4615300.00	0.07461	(12082924)
453700.00	4615300.00	0.04158	(14082324)	453800.00	4615300.00	0.04224	(14060624)
453900.00	4615300.00	0.07056	(12063024)	454000.00	4615300.00	0.08516	(13022324)
454100.00	4615300.00	0.10417	(16120124)	454200.00	4615300.00	0.09016	(16120124)
454300.00	4615300.00	0.07706	(13110124)	454400.00	4615300.00	0.06734	(13110124)
454500.00	4615300.00	0.06818	(12011024)	454600.00	4615300.00	0.06939	(12011024)

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        454700.00   4615300.00        0.05405c (14013124)              454800.00
4615300.00        0.04086  (16112524)
        454900.00   4615300.00        0.03836  (16112524)              455000.00
4615300.00        0.03600  (16112524)
        455100.00   4615300.00        0.03369  (16112524)              455200.00
4615300.00        0.03147  (16112524)
        455300.00   4615300.00        0.03050  (13011524)              455400.00
4615300.00        0.03174  (13011524)
        455500.00   4615300.00        0.03267  (13011524)              455600.00
4615300.00        0.03333  (13011524)
        455700.00   4615300.00        0.03373  (13011524)              455800.00
4615300.00        0.03382  (13011524)
        455900.00   4615300.00        0.03360  (13011524)              456000.00
4615300.00        0.03306  (13011524)
        456100.00   4615300.00        0.03226  (13011524)              456200.00
4615300.00        0.03117  (13011524)
        456300.00   4615300.00        0.02975  (13011524)              456400.00
4615300.00        0.02867  (13011524)
        456500.00   4615300.00        0.02664  (13011524)              456600.00
4615300.00        0.02517  (13011524)
        452000.00   4615400.00        0.03118  (15072624)              452100.00
4615400.00        0.03280  (16092024)
        452200.00   4615400.00        0.03626  (16092024)              452300.00
4615400.00        0.03613  (16092024)
        452400.00   4615400.00        0.03439  (16092024)              452500.00
4615400.00        0.03549  (15102724)
        452600.00   4615400.00        0.03806  (15102724)              452700.00
4615400.00        0.04075  (15102724)
        452800.00   4615400.00        0.04329  (15102724)              452900.00
4615400.00        0.04652  (15102724)
        453000.00   4615400.00        0.04801  (15102724)              453100.00
4615400.00        0.04793  (15102724)
        453200.00   4615400.00        0.04901  (13120224)              453300.00
4615400.00        0.05388  (13011024)
        453400.00   4615400.00        0.06994  (13011024)              453500.00
4615400.00        0.06628  (14122224)
        453600.00   4615400.00        0.07552  (14100124)              453700.00
4615400.00        0.07737  (12102124)
        453800.00   4615400.00        0.08719  (16092224)              453900.00
4615400.00        0.09097  (14070624)
        454000.00   4615400.00        0.08149  (15081424)              454100.00
4615400.00        0.11790  (13010424)
        454200.00   4615400.00        0.10045  (13022324)              454300.00
4615400.00        0.08171  (13022324)
        454400.00   4615400.00        0.06352  (14020624)              454500.00
4615400.00        0.05092  (14020624)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 252
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454600.00	4615400.00	0.05815	(12011024)	454700.00	4615400.00	0.04839c	(14013124)
454800.00	4615400.00	0.03801c	(14013124)	454900.00	4615400.00	0.03301	(13032824)
455000.00	4615400.00	0.03319	(13032824)	455100.00	4615400.00	0.03269	(13032824)
455200.00	4615400.00	0.03153	(13032824)	455300.00	4615400.00	0.03332	(13011524)
455400.00	4615400.00	0.03508	(13011524)	455500.00	4615400.00	0.03615	(13011524)
455600.00	4615400.00	0.03656	(13011524)	455700.00	4615400.00	0.03640	(13011524)
455800.00	4615400.00	0.03577	(13011524)	455900.00	4615400.00	0.03477	(13011524)
456000.00	4615400.00	0.03349	(13011524)	456100.00	4615400.00	0.03203	(13011524)
456200.00	4615400.00	0.03043	(13011524)	456300.00	4615400.00	0.02857	(13011524)
456400.00	4615400.00	0.02722	(13011524)	456500.00	4615400.00	0.02534	(13011524)
456600.00	4615400.00	0.02325	(13011524)	452000.00	4615500.00	0.03143	(15072624)
452100.00	4615500.00	0.03246	(16092024)	452200.00	4615500.00	0.03474	(16092024)
452300.00	4615500.00	0.03258	(16092024)	452400.00	4615500.00	0.02899	(16092024)
452500.00	4615500.00	0.02774	(15102724)	452600.00	4615500.00	0.02988	(13111924)
452700.00	4615500.00	0.03212	(13120224)	452800.00	4615500.00	0.03682	(13120224)
452900.00	4615500.00	0.04243	(13120224)	453000.00	4615500.00	0.04590	(13120224)
453100.00	4615500.00	0.04657	(13120224)	453200.00	4615500.00	0.05607	(16112224)

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        453300.00   4615500.00        0.06814  (14122224)              453400.00
4615500.00        0.06732  (14122224)
        453500.00   4615500.00        0.06553  (15111724)              453600.00
4615500.00        0.08500  (15111724)
        453700.00   4615500.00        0.08538  (12052424)              453800.00
4615500.00        0.11790  (13043024)
        453900.00   4615500.00        0.12467  (14112224)              454000.00
4615500.00        0.07905  (13112524)
        454100.00   4615500.00        0.07234  (12020924)              454200.00
4615500.00        0.09453  (12020924)
        454300.00   4615500.00        0.07715  (12020924)              454400.00
4615500.00        0.06587  (13022324)
        454500.00   4615500.00        0.05774  (13022324)              454600.00
4615500.00        0.04832  (14020624)
        454700.00   4615500.00        0.04404  (12011024)              454800.00
4615500.00        0.03527c (14013124)
        454900.00   4615500.00        0.03115  (13022424)              455000.00
4615500.00        0.02916  (13022424)
        455100.00   4615500.00        0.02981  (13011524)              455200.00
4615500.00        0.03134  (13011524)
        455300.00   4615500.00        0.03322  (13011524)              455400.00
4615500.00        0.03480  (13011524)
        455500.00   4615500.00        0.03586  (13011524)              455600.00
4615500.00        0.03625  (13011524)
        455700.00   4615500.00        0.03597  (13011524)              455800.00
4615500.00        0.03512  (13011524)
        455900.00   4615500.00        0.03383  (13011524)              456000.00
4615500.00        0.03225  (13011524)
        456100.00   4615500.00        0.03032  (13011524)              456200.00
4615500.00        0.02869  (13011524)
        456300.00   4615500.00        0.02655  (13011524)              456400.00
4615500.00        0.02523  (13011524)
        456500.00   4615500.00        0.02360  (13011524)              456600.00
4615500.00        0.02202  (13011524)
        452000.00   4615600.00        0.03161  (15072624)              452100.00
4615600.00        0.02773  (16092024)
        452200.00   4615600.00        0.02975  (12082724)              452300.00
4615600.00        0.02721  (12082724)
        452400.00   4615600.00        0.02590  (14071024)              452500.00
4615600.00        0.02877  (13120224)
        452600.00   4615600.00        0.03238  (13120224)              452700.00
4615600.00        0.03643  (13120224)
        452800.00   4615600.00        0.03905  (13120224)              452900.00
4615600.00        0.04019  (13120224)
        453000.00   4615600.00        0.04713  (16112224)              453100.00
4615600.00        0.05172  (16112224)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 253
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453200.00	4615600.00	0.06139	(14122224)	453300.00	4615600.00	0.06226	(14100124)
453400.00	4615600.00	0.05752	(14101224)	453500.00	4615600.00	0.09133	(15111724)
453600.00	4615600.00	0.10200	(12012224)	453700.00	4615600.00	0.09033	(12052424)
453800.00	4615600.00	0.10155	(13043024)	453900.00	4615600.00	0.11128	(16030824)
454000.00	4615600.00	0.10196	(13111424)	454100.00	4615600.00	0.06617	(13112524)
454200.00	4615600.00	0.07257	(14121324)	454300.00	4615600.00	0.07262	(12020924)
454400.00	4615600.00	0.06848	(12020924)	454500.00	4615600.00	0.05524	(12020924)
454600.00	4615600.00	0.04489	(13022324)	454700.00	4615600.00	0.04248	(14020324)
454800.00	4615600.00	0.03867	(14020324)	454900.00	4615600.00	0.03266	(14020624)
455000.00	4615600.00	0.03152	(13011524)	455100.00	4615600.00	0.03197	(13011524)
455200.00	4615600.00	0.03191	(13011524)	455300.00	4615600.00	0.03200	(13011524)
455400.00	4615600.00	0.03218	(13011524)	455500.00	4615600.00	0.03228	(13011524)
455600.00	4615600.00	0.03210	(13011524)	455700.00	4615600.00	0.03156	(13011524)
455800.00	4615600.00	0.03068	(13011524)	455900.00	4615600.00	0.02950	(13011524)
456000.00	4615600.00	0.02811	(13011524)	456100.00	4615600.00	0.02628	(13011524)
456200.00	4615600.00	0.02496	(13011524)	456300.00	4615600.00	0.02355	(13011524)
456400.00	4615600.00	0.02214	(13011524)	456500.00	4615600.00	0.02079	(13011524)

456600.00 4615600.00 0.01954 (13011524) 452000.00
4615700.00 0.03170 (15072624)
452100.00 4615700.00 0.02687 (12082724) 452200.00
4615700.00 0.02823 (12082724)
452300.00 4615700.00 0.02732 (14071024) 452400.00
4615700.00 0.02821 (13120224)
452500.00 4615700.00 0.03062 (13120224) 452600.00
4615700.00 0.03291 (13120224)
452700.00 4615700.00 0.03386 (13120224) 452800.00
4615700.00 0.03845 (16112224)
452900.00 4615700.00 0.04243 (16112224) 453000.00
4615700.00 0.04634 (14122224)
453100.00 4615700.00 0.05243 (14100124) 453200.00
4615700.00 0.05551 (14100124)
453300.00 4615700.00 0.05316 (14101224) 453400.00
4615700.00 0.07533 (15111724)
453500.00 4615700.00 0.08593 (12012224) 453600.00
4615700.00 0.07925 (14082924)
453700.00 4615700.00 0.08027 (16101124) 453800.00
4615700.00 0.08220 (15091624)
453900.00 4615700.00 0.09476 (15110524) 454000.00
4615700.00 0.09006 (14112224)
454100.00 4615700.00 0.07292 (14092024) 454200.00
4615700.00 0.05584 (14121324)
454300.00 4615700.00 0.06913 (14121324) 454400.00
4615700.00 0.06185 (14121324)
454500.00 4615700.00 0.05595 (12020924) 454600.00
4615700.00 0.04972 (12020924)
454700.00 4615700.00 0.04288 (14020324) 454800.00
4615700.00 0.04177 (14020324)
454900.00 4615700.00 0.03680 (14020324) 455000.00
4615700.00 0.03330 (13011524)
455100.00 4615700.00 0.03401 (13011524) 455200.00
4615700.00 0.03298 (13011524)
455300.00 4615700.00 0.03129 (13011524) 455400.00
4615700.00 0.02959 (13011524)
455500.00 4615700.00 0.02812 (13011524) 455600.00
4615700.00 0.02680 (13011524)
455700.00 4615700.00 0.02557 (13011524) 455800.00
4615700.00 0.02436 (13011524)
455900.00 4615700.00 0.02317 (13011524) 456000.00
4615700.00 0.02201 (13011524)
456100.00 4615700.00 0.02094 (13011524) 456200.00
4615700.00 0.01987 (13011524)
456300.00 4615700.00 0.01930 (13032824) 456400.00
4615700.00 0.01908 (13032824)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 254
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456500.00	4615700.00	0.01878	(13032824)	456600.00	4615700.00	0.01843	(13032824)
452000.00	4615800.00	0.03170	(15072624)	452100.00	4615800.00	0.02768c	(13091524)
452200.00	4615800.00	0.02639	(12082724)	452300.00	4615800.00	0.02651	(14122924)
452400.00	4615800.00	0.02883	(13120224)	452500.00	4615800.00	0.03011	(13120224)
452600.00	4615800.00	0.03244	(16112224)	452700.00	4615800.00	0.03529	(16112224)
452800.00	4615800.00	0.03650	(16112224)	452900.00	4615800.00	0.04100	(14100124)
453000.00	4615800.00	0.04835	(14100124)	453100.00	4615800.00	0.04920	(14100124)
453200.00	4615800.00	0.04895	(13112024)	453300.00	4615800.00	0.05946	(15111724)
453400.00	4615800.00	0.06111	(12012224)	453500.00	4615800.00	0.07929	(12012224)
453600.00	4615800.00	0.06366	(14082924)	453700.00	4615800.00	0.07786	(16101124)
453800.00	4615800.00	0.08868	(16010624)	453900.00	4615800.00	0.07771	(15110224)
454000.00	4615800.00	0.07617	(14112224)	454100.00	4615800.00	0.07308	(13100124)
454200.00	4615800.00	0.05869	(14092024)	454300.00	4615800.00	0.05445	(14121324)
454400.00	4615800.00	0.06225	(14121324)	454500.00	4615800.00	0.05648	(14121324)
454600.00	4615800.00	0.04739	(12010624)	454700.00	4615800.00	0.04278m	(13090424)
454800.00	4615800.00	0.04147	(14020324)	454900.00	4615800.00	0.04014	(14020324)
455000.00	4615800.00	0.03578	(14020324)	455100.00	4615800.00	0.03323	(13011524)

455200.00 4615800.00 0.03232 (13011524) 455300.00
4615800.00 0.02997 (13011524)
455400.00 4615800.00 0.02716 (13011524) 455500.00
4615800.00 0.02463 (14020324)
455600.00 4615800.00 0.02443 (14020324) 455700.00
4615800.00 0.02407 (14020324)
455800.00 4615800.00 0.02348 (14020324) 455900.00
4615800.00 0.02271 (14020324)
456000.00 4615800.00 0.02178 (14020324) 456100.00
4615800.00 0.02069 (14020324)
456200.00 4615800.00 0.01961 (14020324) 456300.00
4615800.00 0.01843 (14020324)
456400.00 4615800.00 0.01724 (14020324) 456500.00
4615800.00 0.01612 (13032824)
456600.00 4615800.00 0.01611 (13032824) 452000.00
4615900.00 0.03157 (15072624)
452100.00 4615900.00 0.02977c (13091524) 452200.00
4615900.00 0.02845 (15010324)
452300.00 4615900.00 0.02973 (14122924) 452400.00
4615900.00 0.02832 (14122924)
452500.00 4615900.00 0.03010 (16112224) 452600.00
4615900.00 0.03110 (16112224)
452700.00 4615900.00 0.03135 (14122224) 452800.00
4615900.00 0.03841 (14100124)
452900.00 4615900.00 0.04330 (14100124) 453000.00
4615900.00 0.04330 (14100124)
453100.00 4615900.00 0.04487 (13112024) 453200.00
4615900.00 0.05151 (13112024)
453300.00 4615900.00 0.05399 (15111724) 453400.00
4615900.00 0.06485 (12012224)
453500.00 4615900.00 0.06268 (12012224) 453600.00
4615900.00 0.05316 (16101124)
453700.00 4615900.00 0.07174 (16101124) 453800.00
4615900.00 0.08759 (16010624)
453900.00 4615900.00 0.06414 (15110224) 454000.00
4615900.00 0.06626 (15110224)
454100.00 4615900.00 0.06260 (13100124) 454200.00
4615900.00 0.06036 (13100124)
454300.00 4615900.00 0.04574 (16110524) 454400.00
4615900.00 0.05040 (14121324)
454500.00 4615900.00 0.05521 (14121324) 454600.00
4615900.00 0.05081 (14121324)
454700.00 4615900.00 0.04252 (14121324) 454800.00
4615900.00 0.04182m (13090424)
454900.00 4615900.00 0.04051 (14020324) 455000.00
4615900.00 0.03957 (14020324)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 255
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455100.00	4615900.00	0.03628	(14020324)	455200.00	4615900.00	0.03260	(14020324)
455300.00	4615900.00	0.02984	(14020324)	455400.00	4615900.00	0.02806	(14020324)
455500.00	4615900.00	0.02687	(14020324)	455600.00	4615900.00	0.02594	(14020324)
455700.00	4615900.00	0.02503	(14020324)	455800.00	4615900.00	0.02401	(14020324)
455900.00	4615900.00	0.02283	(14020324)	456000.00	4615900.00	0.02152	(14020324)
456100.00	4615900.00	0.02010	(14020324)	456200.00	4615900.00	0.01870	(14020324)
456300.00	4615900.00	0.01729	(14020324)	456400.00	4615900.00	0.01590	(14020324)
456500.00	4615900.00	0.01574	(13072524)	456600.00	4615900.00	0.01537	(13072524)
452000.00	4616000.00	0.03247	(13050524)	452100.00	4616000.00	0.03191c	(13091524)
452200.00	4616000.00	0.02852m	(16092324)	452300.00	4616000.00	0.03237	(14122924)
452400.00	4616000.00	0.03036	(16100124)	452500.00	4616000.00	0.02842c	(15021624)
452600.00	4616000.00	0.03197	(14121024)	452700.00	4616000.00	0.03481	(14100124)
452800.00	4616000.00	0.03840	(14100124)	452900.00	4616000.00	0.03723	(14100124)
453000.00	4616000.00	0.04040	(13112024)	453100.00	4616000.00	0.04641	(13112024)
453200.00	4616000.00	0.04954	(16121624)	453300.00	4616000.00	0.04912	(12012224)
453400.00	4616000.00	0.05814	(12012224)	453500.00	4616000.00	0.05646m	(12082524)
453600.00	4616000.00	0.05313	(16101124)	453700.00	4616000.00	0.06779	(16010624)

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        453800.00   4616000.00        0.08494  (16010624)              453900.00
4616000.00        0.06258  (15110424)
        454000.00   4616000.00        0.06080  (15110224)              454100.00
4616000.00        0.05711  (15011124)
        454200.00   4616000.00        0.05744  (13100124)              454300.00
4616000.00        0.04831  (16110524)
        454400.00   4616000.00        0.04061  (16110524)              454500.00
4616000.00        0.04572  (14121324)
        454600.00   4616000.00        0.04884  (14121324)              454700.00
4616000.00        0.04550  (14121324)
        454800.00   4616000.00        0.04051m (13090424)              454900.00
4616000.00        0.03957m (13090424)
        455000.00   4616000.00        0.04037  (14020324)              455100.00
4616000.00        0.03941  (14020324)
        455200.00   4616000.00        0.03670  (14020324)              455300.00
4616000.00        0.03366  (14020324)
        455400.00   4616000.00        0.03106  (14020324)              455500.00
4616000.00        0.02890  (14020324)
        455600.00   4616000.00        0.02701  (14020324)              455700.00
4616000.00        0.02529  (14020324)
        455800.00   4616000.00        0.02365  (14020324)              455900.00
4616000.00        0.02203  (14020324)
        456000.00   4616000.00        0.02040  (14020324)              456100.00
4616000.00        0.01875  (14020324)
        456200.00   4616000.00        0.01802  (12010824)              456300.00
4616000.00        0.01789  (12010824)
        456400.00   4616000.00        0.01758  (12010824)              456500.00
4616000.00        0.01731  (12010824)
        456600.00   4616000.00        0.01691  (12010824)              452000.00
4616100.00        0.03469  (13050524)
        452100.00   4616100.00        0.03395c (13091524)              452200.00
4616100.00        0.03292  (14122924)
        452300.00   4616100.00        0.03438  (14122924)              452400.00
4616100.00        0.03186  (16100124)
        452500.00   4616100.00        0.03352  (14121024)              452600.00
4616100.00        0.03584  (14121024)
        452700.00   4616100.00        0.03410  (14100124)              452800.00
4616100.00        0.03385  (13012624)
        452900.00   4616100.00        0.03615  (13112024)              453000.00
4616100.00        0.04152  (13112024)
        453100.00   4616100.00        0.04545  (16121624)              453200.00
4616100.00        0.04252  (16121624)
        453300.00   4616100.00        0.04850  (12012224)              453400.00
4616100.00        0.04932m (12082524)
        453500.00   4616100.00        0.04913m (12082524)              453600.00
4616100.00        0.05721  (12111924)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 256
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453700.00	4616100.00	0.06448	(12111924)	453800.00	4616100.00	0.07782	(16010624)
453900.00	4616100.00	0.06012	(15110424)	454000.00	4616100.00	0.05408	(15110224)
454100.00	4616100.00	0.05396	(16121924)	454200.00	4616100.00	0.04916	(13100124)
454300.00	4616100.00	0.04729	(13100124)	454400.00	4616100.00	0.04343	(16110524)
454500.00	4616100.00	0.03583	(16110524)	454600.00	4616100.00	0.04120	(14121324)
454700.00	4616100.00	0.04332	(14121324)	454800.00	4616100.00	0.04078	(14121324)
454900.00	4616100.00	0.03779m	(13090424)	455000.00	4616100.00	0.03843	(14020324)
455100.00	4616100.00	0.03920	(14020324)	455200.00	4616100.00	0.03766	(14020324)
455300.00	4616100.00	0.03500	(14020324)	455400.00	4616100.00	0.03225	(14020324)
455500.00	4616100.00	0.02958	(14020324)	455600.00	4616100.00	0.02717	(14020324)
455700.00	4616100.00	0.02488	(14020324)	455800.00	4616100.00	0.02272	(14020324)
455900.00	4616100.00	0.02072	(14020324)	456000.00	4616100.00	0.01935	(13072524)
456100.00	4616100.00	0.01882	(13072524)	456200.00	4616100.00	0.01890	(12010824)
456300.00	4616100.00	0.01882	(12010824)	456400.00	4616100.00	0.01858	(12010824)
456500.00	4616100.00	0.01826	(12010824)	456600.00	4616100.00	0.01781	(12010824)
452000.00	4616200.00	0.03685c	(13091524)	452100.00	4616200.00	0.03590c	(13091524)
452200.00	4616200.00	0.03757	(14122924)	452300.00	4616200.00	0.03698	(16100124)

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        452400.00   4616200.00        0.03359  (14121024)              452500.00
4616200.00        0.03966  (14121024)
        452600.00   4616200.00        0.03872  (14121024)              452700.00
4616200.00        0.03319  (13012624)
        452800.00   4616200.00        0.03390  (13012624)              452900.00
4616200.00        0.03752  (16121624)
        453000.00   4616200.00        0.04151  (16121624)              453100.00
4616200.00        0.04008  (16121624)
        453200.00   4616200.00        0.03877  (12012224)              453300.00
4616200.00        0.04367  (12012224)
        453400.00   4616200.00        0.04647m (12082524)              453500.00
4616200.00        0.04264  (13091824)
        453600.00   4616200.00        0.05879  (12111924)              453700.00
4616200.00        0.06180  (16010624)
        453800.00   4616200.00        0.07352  (16010624)              453900.00
4616200.00        0.05646  (15110424)
        454000.00   4616200.00        0.05147  (15110324)              454100.00
4616200.00        0.04961  (12100824)
        454200.00   4616200.00        0.04749  (13082024)              454300.00
4616200.00        0.04377  (13100124)
        454400.00   4616200.00        0.04503  (14122024)              454500.00
4616200.00        0.03840  (16110524)
        454600.00   4616200.00        0.03168  (16110524)              454700.00
4616200.00        0.03709  (14121324)
        454800.00   4616200.00        0.03860  (14121324)              454900.00
4616200.00        0.03668  (14121324)
        455000.00   4616200.00        0.03463  (14020324)              455100.00
4616200.00        0.03604  (14020324)
        455200.00   4616200.00        0.03530  (14020324)              455300.00
4616200.00        0.03313  (14020324)
        455400.00   4616200.00        0.03054  (14020324)              455500.00
4616200.00        0.02800  (14020324)
        455600.00   4616200.00        0.02565  (14020324)              455700.00
4616200.00        0.02347  (14020324)
        455800.00   4616200.00        0.02188  (13072524)              455900.00
4616200.00        0.02123  (13072524)
        456000.00   4616200.00        0.02045  (13072524)              456100.00
4616200.00        0.01956  (13072524)
        456200.00   4616200.00        0.01866  (13072524)              456300.00
4616200.00        0.01847  (12010824)
        456400.00   4616200.00        0.01829  (12010824)              456500.00
4616200.00        0.01812  (12010824)
        456600.00   4616200.00        0.01774  (12010824)              452000.00
4616300.00        0.04125c (13091524)
        452100.00   4616300.00        0.03728c (13091524)              452200.00
4616300.00        0.04192  (14122924)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 257
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452300.00	4616300.00	0.03954	(16100124)	452400.00	4616300.00	0.04188	(14121024)
452500.00	4616300.00	0.04488	(14121024)	452600.00	4616300.00	0.03907	(14121024)
452700.00	4616300.00	0.03348	(13012624)	452800.00	4616300.00	0.03560	(14020224)
452900.00	4616300.00	0.03797	(16121624)	453000.00	4616300.00	0.03756	(15111024)
453100.00	4616300.00	0.03398	(15111024)	453200.00	4616300.00	0.03733	(12012224)
453300.00	4616300.00	0.03908m	(12082524)	453400.00	4616300.00	0.04202m	(12082524)
453500.00	4616300.00	0.04226	(12111924)	453600.00	4616300.00	0.05950	(12111924)
453700.00	4616300.00	0.05928	(16010624)	453800.00	4616300.00	0.06798	(16010624)
453900.00	4616300.00	0.05449	(15110424)	454000.00	4616300.00	0.05150	(15110324)
454100.00	4616300.00	0.04724	(12100824)	454200.00	4616300.00	0.04344	(13082024)
454300.00	4616300.00	0.04272	(13082024)	454400.00	4616300.00	0.04403	(14122024)
454500.00	4616300.00	0.04139	(14122024)	454600.00	4616300.00	0.03396	(16110524)
454700.00	4616300.00	0.02941	(13070924)	454800.00	4616300.00	0.03347	(14121324)
454900.00	4616300.00	0.03460	(14121324)	455000.00	4616300.00	0.03313	(14121324)
455100.00	4616300.00	0.03103m	(13090424)	455200.00	4616300.00	0.03077m	(13090424)
455300.00	4616300.00	0.02889	(14020324)	455400.00	4616300.00	0.02664	(14020324)
455500.00	4616300.00	0.02440	(14020324)	455600.00	4616300.00	0.02348	(13072524)

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        455700.00   4616300.00        0.02289  (13072524)              455800.00
4616300.00        0.02215  (13072524)
        455900.00   4616300.00        0.02127  (13072524)              456000.00
4616300.00        0.02028  (13072524)
        456100.00   4616300.00        0.01924  (13072524)              456200.00
4616300.00        0.01814  (13072524)
        456300.00   4616300.00        0.01706  (13072524)              456400.00
4616300.00        0.01690  (12010824)
        456500.00   4616300.00        0.01688  (12010824)              456600.00
4616300.00        0.01682  (12010824)
        452000.00   4616400.00        0.04596c (13091524)              452100.00
4616400.00        0.04188  (14122924)
        452200.00   4616400.00        0.04499  (14122924)              452300.00
4616400.00        0.04162  (14121024)
        452400.00   4616400.00        0.05047  (14121024)              452500.00
4616400.00        0.04770  (14121024)
        452600.00   4616400.00        0.03634  (14121024)              452700.00
4616400.00        0.03984  (14020224)
        452800.00   4616400.00        0.03740  (14020224)              452900.00
4616400.00        0.04000  (15111024)
        453000.00   4616400.00        0.03659  (14121824)              453100.00
4616400.00        0.03539  (14121824)
        453200.00   4616400.00        0.03396  (12012224)              453300.00
4616400.00        0.03757m (12082524)
        453400.00   4616400.00        0.03715m (12082524)              453500.00
4616400.00        0.04411  (12111924)
        453600.00   4616400.00        0.05630  (12111924)              453700.00
4616400.00        0.05540  (16010624)
        453800.00   4616400.00        0.06262  (16010624)              453900.00
4616400.00        0.05126  (15110424)
        454000.00   4616400.00        0.04933  (15110324)              454100.00
4616400.00        0.04507  (15110324)
        454200.00   4616400.00        0.03935  (12100824)              454300.00
4616400.00        0.04166  (13082024)
        454400.00   4616400.00        0.04017  (14122024)              454500.00
4616400.00        0.04232  (14122024)
        454600.00   4616400.00        0.03701  (14122024)              454700.00
4616400.00        0.03017  (16110524)
        454800.00   4616400.00        0.02752  (13070924)              454900.00
4616400.00        0.03032  (14121324)
        455000.00   4616400.00        0.03120  (14121324)              455100.00
4616400.00        0.03007  (14121324)
        455200.00   4616400.00        0.02781m (13090424)              455300.00
4616400.00        0.02806m (13090424)
        455400.00   4616400.00        0.02688m (13090424)              455500.00
4616400.00        0.02468m (13090424)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 258
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
455600.00	4616400.00	0.02278	(13072524)	455700.00	4616400.00	0.02191	(13072524)
455800.00	4616400.00	0.02099	(13072524)	455900.00	4616400.00	0.02003	(13072524)
456000.00	4616400.00	0.01901	(13072524)	456100.00	4616400.00	0.01800	(13072524)
456200.00	4616400.00	0.01691	(13072524)	456300.00	4616400.00	0.01587	(13072524)
456400.00	4616400.00	0.01485	(13072524)	456500.00	4616400.00	0.01488	(12010824)
456600.00	4616400.00	0.01508	(12010824)	452000.00	4616500.00	0.05039c	(13091524)
452100.00	4616500.00	0.04976	(14122924)	452200.00	4616500.00	0.04914	(16100124)
452300.00	4616500.00	0.05382	(14121024)	452400.00	4616500.00	0.05736	(14121024)
452500.00	4616500.00	0.04650	(14121024)	452600.00	4616500.00	0.04442	(14020224)
452700.00	4616500.00	0.04300	(14020224)	452800.00	4616500.00	0.04301	(15111024)
452900.00	4616500.00	0.04064	(14121824)	453000.00	4616500.00	0.03843	(14121824)
453100.00	4616500.00	0.03309	(14121824)	453200.00	4616500.00	0.03462	(16100324)
453300.00	4616500.00	0.03587	(16112124)	453400.00	4616500.00	0.03442	(16112124)
453500.00	4616500.00	0.04480	(12111924)	453600.00	4616500.00	0.05365	(12111924)
453700.00	4616500.00	0.05182	(16010624)	453800.00	4616500.00	0.05787	(16010624)
453900.00	4616500.00	0.04731	(15110424)	454000.00	4616500.00	0.05069	(15110324)
454100.00	4616500.00	0.04378	(15110324)	454200.00	4616500.00	0.03858	(12100824)

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        454300.00   4616500.00        0.03872  (13082024)              454400.00
4616500.00        0.03727  (13082024)
        454500.00   4616500.00        0.03993  (14122024)              454600.00
4616500.00        0.03904  (14122024)
        454700.00   4616500.00        0.03265  (14122024)              454800.00
4616500.00        0.02694  (16110524)
        454900.00   4616500.00        0.02572  (13070924)              455000.00
4616500.00        0.02775  (13070924)
        455100.00   4616500.00        0.02829  (14121324)              455200.00
4616500.00        0.02745  (14121324)
        455300.00   4616500.00        0.02660  (14062424)              455400.00
4616500.00        0.02567m (13090424)
        455500.00   4616500.00        0.02513m (13090424)              455600.00
4616500.00        0.02359m (13090424)
        455700.00   4616500.00        0.02164  (12091624)              455800.00
4616500.00        0.02006  (14090224)
        455900.00   4616500.00        0.01930  (14090224)              456000.00
4616500.00        0.01828  (14090224)
        456100.00   4616500.00        0.01704  (14090224)              456200.00
4616500.00        0.01561  (14090224)
        456300.00   4616500.00        0.01493  (15101024)              456400.00
4616500.00        0.01468  (15101024)
        456500.00   4616500.00        0.01483  (15101024)              456600.00
4616500.00        0.01472  (15101024)
        452000.00   4616600.00        0.05451c (13091524)              452100.00
4616600.00        0.05716  (14122924)
        452200.00   4616600.00        0.05299  (14121024)              452300.00
4616600.00        0.06659  (14121024)
        452400.00   4616600.00        0.05960  (14121024)              452500.00
4616600.00        0.04906  (14020224)
        452600.00   4616600.00        0.04963  (14020224)              452700.00
4616600.00        0.04545  (15111024)
        452800.00   4616600.00        0.04505  (14121824)              452900.00
4616600.00        0.04259  (14121824)
        453000.00   4616600.00        0.03526  (14121824)              453100.00
4616600.00        0.03750  (16112124)
        453200.00   4616600.00        0.03706  (16112124)              453300.00
4616600.00        0.03417  (13030324)
        453400.00   4616600.00        0.03637  (13030324)              453500.00
4616600.00        0.04465  (12111924)
        453600.00   4616600.00        0.05091  (12111924)              453700.00
4616600.00        0.04861  (16010624)
        453800.00   4616600.00        0.05379  (16010624)              453900.00
4616600.00        0.04541  (16010624)
        454000.00   4616600.00        0.04822  (15110424)              454100.00
4616600.00        0.04314  (15110324)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 259
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454200.00	4616600.00	0.03543	(12100824)	454300.00	4616600.00	0.03501	(16111424)
454400.00	4616600.00	0.03641	(13082024)	454500.00	4616600.00	0.03595	(12111524)
454600.00	4616600.00	0.03829	(14122024)	454700.00	4616600.00	0.03540	(14122024)
454800.00	4616600.00	0.02869	(14122024)	454900.00	4616600.00	0.02478	(13072524)
455000.00	4616600.00	0.02403	(13070924)	455100.00	4616600.00	0.02564	(13070924)
455200.00	4616600.00	0.02582	(14121324)	455300.00	4616600.00	0.02578	(14062424)
455400.00	4616600.00	0.02542	(14062424)	455500.00	4616600.00	0.02349	(14062424)
455600.00	4616600.00	0.02342m	(13090424)	455700.00	4616600.00	0.02252	(12091624)
455800.00	4616600.00	0.02239	(15101024)	455900.00	4616600.00	0.02181	(15101024)
456000.00	4616600.00	0.02070	(15101024)	456100.00	4616600.00	0.01956	(15101024)
456200.00	4616600.00	0.01844	(15101024)	456300.00	4616600.00	0.01740	(15101024)
456400.00	4616600.00	0.01650	(15101024)	456500.00	4616600.00	0.01607	(15101024)
456600.00	4616600.00	0.01537	(15101024)	452000.00	4616700.00	0.05999c	(15011224)
452100.00	4616700.00	0.06312	(16100124)	452200.00	4616700.00	0.07218	(14121024)
452300.00	4616700.00	0.07575	(14121024)	452400.00	4616700.00	0.05435	(14121024)
452500.00	4616700.00	0.05764	(14020224)	452600.00	4616700.00	0.04833	(14020224)
452700.00	4616700.00	0.04943	(14121824)	452800.00	4616700.00	0.04622	(14121824)

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        452900.00   4616700.00        0.03849  (16112124)              453000.00
4616700.00        0.04107  (16112124)
        453100.00   4616700.00        0.03932  (12062824)              453200.00
4616700.00        0.03911  (13030324)
        453300.00   4616700.00        0.03854  (13030324)              453400.00
4616700.00        0.03708  (12082124)
        453500.00   4616700.00        0.04394  (12111924)              453600.00
4616700.00        0.04815  (12111924)
        453700.00   4616700.00        0.04564  (16010624)              453800.00
4616700.00        0.05007  (16010624)
        453900.00   4616700.00        0.04322  (16010624)              454000.00
4616700.00        0.04559  (15110424)
        454100.00   4616700.00        0.04429  (15110324)              454200.00
4616700.00        0.03671  (15110324)
        454300.00   4616700.00        0.03089  (16111424)              454400.00
4616700.00        0.03291  (13082024)
        454500.00   4616700.00        0.03496  (12111524)              454600.00
4616700.00        0.03547  (14122024)
        454700.00   4616700.00        0.03572  (14122024)              454800.00
4616700.00        0.03169  (14122024)
        454900.00   4616700.00        0.02623  (15101024)              455000.00
4616700.00        0.02553  (15101024)
        455100.00   4616700.00        0.02417  (15101024)              455200.00
4616700.00        0.02377  (13070924)
        455300.00   4616700.00        0.02366  (14121324)              455400.00
4616700.00        0.02328  (14062424)
        455500.00   4616700.00        0.02293  (14062424)              455600.00
4616700.00        0.02233  (15101024)
        455700.00   4616700.00        0.02321  (15101024)              455800.00
4616700.00        0.02370  (15101024)
        455900.00   4616700.00        0.02348  (15101024)              456000.00
4616700.00        0.02271  (15101024)
        456100.00   4616700.00        0.02157  (15101024)              456200.00
4616700.00        0.02031  (15101024)
        456300.00   4616700.00        0.01893  (15101024)              456400.00
4616700.00        0.01755  (15101024)
        456500.00   4616700.00        0.01655  (15101024)              456600.00
4616700.00        0.01603  (15091024)
        452000.00   4616800.00        0.06932  (14030224)              452100.00
4616800.00        0.06950  (14121024)
        452200.00   4616800.00        0.09255  (14121024)              452300.00
4616800.00        0.07480  (14121024)
        452400.00   4616800.00        0.06716  (14020224)              452500.00
4616800.00        0.05676  (14020224)
        452600.00   4616800.00        0.05554  (13120624)              452700.00
4616800.00        0.05147  (13120624)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 260
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452800.00	4616800.00	0.04473	(13032124)	452900.00	4616800.00	0.04719	(12062824)
453000.00	4616800.00	0.04589	(12062824)	453100.00	4616800.00	0.04302	(14082324)
453200.00	4616800.00	0.03983	(14082324)	453300.00	4616800.00	0.03927	(12082124)
453400.00	4616800.00	0.04048	(12082124)	453500.00	4616800.00	0.04285	(12111924)
453600.00	4616800.00	0.04537	(12111924)	453700.00	4616800.00	0.04290	(16010624)
453800.00	4616800.00	0.04675	(16010624)	453900.00	4616800.00	0.04115	(16010624)
454000.00	4616800.00	0.04294	(15110424)	454100.00	4616800.00	0.04277	(15110324)
454200.00	4616800.00	0.03699	(15110324)	454300.00	4616800.00	0.03081	(12100824)
454400.00	4616800.00	0.03327	(16111424)	454500.00	4616800.00	0.03068	(13082024)
454600.00	4616800.00	0.03395	(12111524)	454700.00	4616800.00	0.03395	(14122024)
454800.00	4616800.00	0.03279	(14122024)	454900.00	4616800.00	0.02941	(15101024)
455000.00	4616800.00	0.02930	(15101024)	455100.00	4616800.00	0.02818	(15101024)
455200.00	4616800.00	0.02647	(15101024)	455300.00	4616800.00	0.02472	(15101024)
455400.00	4616800.00	0.02329	(15101024)	455500.00	4616800.00	0.02245	(15101024)
455600.00	4616800.00	0.02225	(15101024)	455700.00	4616800.00	0.02244	(15101024)
455800.00	4616800.00	0.02275	(15101024)	455900.00	4616800.00	0.02274	(15101024)
456000.00	4616800.00	0.02231	(15101024)	456100.00	4616800.00	0.02185	(12091624)

456200.00 4616800.00 0.02050 (12091624) 456300.00
4616800.00 0.01908 (15101024)
456400.00 4616800.00 0.01796 (15091024) 456500.00
4616800.00 0.01813 (15091024)
456600.00 4616800.00 0.01817 (15091024) 452000.00
4616900.00 0.08135 (14122924)
452100.00 4616900.00 0.10230 (14121024) 452200.00
4616900.00 0.10343 (14121024)
452300.00 4616900.00 0.07796 (14020224) 452400.00
4616900.00 0.06730 (14020224)
452500.00 4616900.00 0.06817 (13120624) 452600.00
4616900.00 0.06122 (13120624)
452700.00 4616900.00 0.05396 (12062824) 452800.00
4616900.00 0.05736 (12062824)
452900.00 4616900.00 0.05283 (14082324) 453000.00
4616900.00 0.04850 (14082324)
453100.00 4616900.00 0.04351 (13110224) 453200.00
4616900.00 0.04180 (12082124)
453300.00 4616900.00 0.04101 (12082124) 453400.00
4616900.00 0.04019 (12082124)
453500.00 4616900.00 0.04162 (12111924) 453600.00
4616900.00 0.04283 (12111924)
453700.00 4616900.00 0.04040 (12111424) 453800.00
4616900.00 0.04364 (16010624)
453900.00 4616900.00 0.03907 (16010624) 454000.00
4616900.00 0.04036 (15110424)
454100.00 4616900.00 0.04107 (15110324) 454200.00
4616900.00 0.03684 (15110324)
454300.00 4616900.00 0.02951 (12100824) 454400.00
4616900.00 0.03152 (16111424)
454500.00 4616900.00 0.03155 (16111424) 454600.00
4616900.00 0.03152 (12111524)
454700.00 4616900.00 0.03100 (12111524) 454800.00
4616900.00 0.03214 (14122024)
454900.00 4616900.00 0.03070 (15101024) 455000.00
4616900.00 0.03062 (15101024)
455100.00 4616900.00 0.02977 (15101024) 455200.00
4616900.00 0.02812 (15101024)
455300.00 4616900.00 0.02606 (15101024) 455400.00
4616900.00 0.02468 (13102724)
455500.00 4616900.00 0.02320 (13102724) 455600.00
4616900.00 0.02114 (13102724)
455700.00 4616900.00 0.02049 (15091024) 455800.00
4616900.00 0.02024 (15091024)
455900.00 4616900.00 0.01997 (15091024) 456000.00
4616900.00 0.02106 (12091624)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 261
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
456100.00	4616900.00	0.02185	(12091624)	456200.00	4616900.00	0.02158	(12091624)
456300.00	4616900.00	0.02065	(12091624)	456400.00	4616900.00	0.02001	(15091024)
456500.00	4616900.00	0.01999	(15091024)	456600.00	4616900.00	0.01975	(15091024)
452000.00	4617000.00	0.09631	(13030124)	452100.00	4617000.00	0.13731	(14121024)
452200.00	4617000.00	0.08946	(14121024)	452300.00	4617000.00	0.08158	(13120624)
452400.00	4617000.00	0.08565	(13120624)	452500.00	4617000.00	0.07334	(13120624)
452600.00	4617000.00	0.07070	(12062824)	452700.00	4617000.00	0.06779	(12062824)
452800.00	4617000.00	0.06026	(14082324)	452900.00	4617000.00	0.05379	(13110224)
453000.00	4617000.00	0.04838	(13110224)	453100.00	4617000.00	0.04293	(12082124)
453200.00	4617000.00	0.04042	(12082124)	453300.00	4617000.00	0.03802	(13101224)
453400.00	4617000.00	0.03466	(13101224)	453500.00	4617000.00	0.03991	(12111924)
453600.00	4617000.00	0.04034	(12111924)	453700.00	4617000.00	0.03850	(12111424)
453800.00	4617000.00	0.04092	(16010624)	453900.00	4617000.00	0.03714	(16010624)
454000.00	4617000.00	0.03786	(15110424)	454100.00	4617000.00	0.03923	(15110324)
454200.00	4617000.00	0.03636	(15110324)	454300.00	4617000.00	0.02979	(15110324)
454400.00	4617000.00	0.02897	(16111424)	454500.00	4617000.00	0.03122	(16111424)
454600.00	4617000.00	0.02884	(12111524)	454700.00	4617000.00	0.03134	(12111524)

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        454800.00   4617000.00        0.03022  (14122024)              454900.00
4617000.00        0.03004  (14122024)
        455000.00   4617000.00        0.02882  (15101024)              455100.00
4617000.00        0.02823  (15101024)
        455200.00   4617000.00        0.02702  (15101024)              455300.00
4617000.00        0.02501  (15101024)
        455400.00   4617000.00        0.02457  (13102724)              455500.00
4617000.00        0.02395  (13102724)
        455600.00   4617000.00        0.02265  (15091024)              455700.00
4617000.00        0.02220  (15091024)
        455800.00   4617000.00        0.02180  (15091024)              455900.00
4617000.00        0.02148  (15091024)
        456000.00   4617000.00        0.02123  (15091024)              456100.00
4617000.00        0.02120  (15091024)
        456200.00   4617000.00        0.02121  (12091624)              456300.00
4617000.00        0.02122  (12091624)
        456400.00   4617000.00        0.02109  (15091024)              456500.00
4617000.00        0.02084  (15091024)
        456600.00   4617000.00        0.02037  (15091024)              452000.00
4617100.00        0.15376  (14121024)
        452100.00   4617100.00        0.14136  (14121024)              452200.00
4617100.00        0.10477  (13120624)
        452300.00   4617100.00        0.11043  (13120624)              452400.00
4617100.00        0.08757  (13120624)
        452500.00   4617100.00        0.09100  (12062824)              452600.00
4617100.00        0.07722  (14082324)
        452700.00   4617100.00        0.06781  (13110224)              452800.00
4617100.00        0.05997  (13110224)
        452900.00   4617100.00        0.05080  (13110224)              453000.00
4617100.00        0.04362  (16082124)
        453100.00   4617100.00        0.03864  (13101224)              453200.00
4617100.00        0.03572  (13101224)
        453300.00   4617100.00        0.03377  (13072524)              453400.00
4617100.00        0.03522  (15091024)
        453500.00   4617100.00        0.03820  (12111924)              453600.00
4617100.00        0.03943  (15091024)
        453700.00   4617100.00        0.03935  (15091024)              453800.00
4617100.00        0.03843  (16010624)
        453900.00   4617100.00        0.03669  (15091024)              454000.00
4617100.00        0.03571  (15091024)
        454100.00   4617100.00        0.03730  (15110324)              454200.00
4617100.00        0.03563  (15110324)
        454300.00   4617100.00        0.03388  (15091024)              454400.00
4617100.00        0.03293  (15091024)
        454500.00   4617100.00        0.03152  (15091024)              454600.00
4617100.00        0.02925  (15091024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
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PAGE 262
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454700.00	4617100.00	0.03011	(12111524)	454800.00	4617100.00	0.02909	(15091024)
454900.00	4617100.00	0.02892	(14122024)	455000.00	4617100.00	0.02784	(15091024)
455100.00	4617100.00	0.02724	(15091024)	455200.00	4617100.00	0.02656	(15091024)
455300.00	4617100.00	0.02568	(15091024)	455400.00	4617100.00	0.02469	(15091024)
455500.00	4617100.00	0.02378	(15091024)	455600.00	4617100.00	0.02301	(15091024)
455700.00	4617100.00	0.02239	(15091024)	455800.00	4617100.00	0.02190	(15091024)
455900.00	4617100.00	0.02159	(15091024)	456000.00	4617100.00	0.02132	(15091024)
456100.00	4617100.00	0.02127	(15091024)	456200.00	4617100.00	0.02117	(15091024)
456300.00	4617100.00	0.02128	(15091024)	456400.00	4617100.00	0.02085	(12091624)
456500.00	4617100.00	0.02054	(12091624)	456600.00	4617100.00	0.01971	(15091024)
452000.00	4617200.00	0.21937	(14121024)	452100.00	4617200.00	0.13586	(13120624)
452200.00	4617200.00	0.14563	(13120624)	452300.00	4617200.00	0.12355	(12062824)
452400.00	4617200.00	0.10976	(12062824)	452500.00	4617200.00	0.08827	(13110224)
452600.00	4617200.00	0.07593	(13110224)	452700.00	4617200.00	0.06413	(16082124)
452800.00	4617200.00	0.05436	(16082124)	452900.00	4617200.00	0.04598	(12072124)
453000.00	4617200.00	0.04125	(12072124)	453100.00	4617200.00	0.04071	(15091024)
453200.00	4617200.00	0.04306	(15091024)	453300.00	4617200.00	0.04540	(15091024)

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        453400.00   4617200.00        0.04789  (15091024)              453500.00
4617200.00        0.04849  (15091024)
        453600.00   4617200.00        0.04851  (15091024)              453700.00
4617200.00        0.04732  (15091024)
        453800.00   4617200.00        0.04509  (15091024)              453900.00
4617200.00        0.04271  (15091024)
        454000.00   4617200.00        0.03993  (15091024)              454100.00
4617200.00        0.03848  (15091024)
        454200.00   4617200.00        0.03710  (15091024)              454300.00
4617200.00        0.03565  (15091024)
        454400.00   4617200.00        0.03410  (15091024)              454500.00
4617200.00        0.03248  (15091024)
        454600.00   4617200.00        0.03037  (15091024)              454700.00
4617200.00        0.03055  (15091024)
        454800.00   4617200.00        0.02947  (15091024)              454900.00
4617200.00        0.02851  (15091024)
        455000.00   4617200.00        0.02761  (15091024)              455100.00
4617200.00        0.02665  (15091024)
        455200.00   4617200.00        0.02571  (15091024)              455300.00
4617200.00        0.02456  (15091024)
        455400.00   4617200.00        0.02334  (15091024)              455500.00
4617200.00        0.02228  (15091024)
        455600.00   4617200.00        0.02155  (13102724)              455700.00
4617200.00        0.02087  (13102724)
        455800.00   4617200.00        0.02028  (15091024)              455900.00
4617200.00        0.02005  (15091024)
        456000.00   4617200.00        0.01989  (15091024)              456100.00
4617200.00        0.01990  (15091024)
        456200.00   4617200.00        0.02016  (15091024)              456300.00
4617200.00        0.01964  (15091024)
        456400.00   4617200.00        0.01941  (12091624)              456500.00
4617200.00        0.01989  (12091624)
        456600.00   4617200.00        0.02033  (12091624)              452000.00
4617300.00        0.20079  (16022524)
        452100.00   4617300.00        0.19513  (16020924)              452200.00
4617300.00        0.17572  (12062824)
        452300.00   4617300.00        0.11653  (13110224)              452400.00
4617300.00        0.10173  (16082124)
        452500.00   4617300.00        0.08624  (16082124)              452600.00
4617300.00        0.06955  (16082124)
        452700.00   4617300.00        0.05760  (12072124)              452800.00
4617300.00        0.05325  (13032724)
        452900.00   4617300.00        0.05440  (15091024)              453000.00
4617300.00        0.05547  (15091024)
        453100.00   4617300.00        0.05552  (15091024)              453200.00
4617300.00        0.05531  (15091024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 263
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
453300.00	4617300.00	0.05523	(15091024)	453400.00	4617300.00	0.05622	(15091024)
453500.00	4617300.00	0.05468	(15091024)	453600.00	4617300.00	0.05253	(15091024)
453700.00	4617300.00	0.04958	(15091024)	453800.00	4617300.00	0.04602	(15091024)
453900.00	4617300.00	0.04295	(15091024)	454000.00	4617300.00	0.04054	(15091024)
454100.00	4617300.00	0.03836	(15091024)	454200.00	4617300.00	0.03626	(15091024)
454300.00	4617300.00	0.03423	(15091024)	454400.00	4617300.00	0.03226	(15091024)
454500.00	4617300.00	0.03043	(15091024)	454600.00	4617300.00	0.02750	(15091024)
454700.00	4617300.00	0.02742	(15091024)	454800.00	4617300.00	0.02766	(12111524)
454900.00	4617300.00	0.02681	(12111524)	455000.00	4617300.00	0.02605	(14122024)
455100.00	4617300.00	0.02570	(14122024)	455200.00	4617300.00	0.02353	(14122024)
455300.00	4617300.00	0.02084	(15091024)	455400.00	4617300.00	0.02184	(12091824)
455500.00	4617300.00	0.02207	(12091824)	455600.00	4617300.00	0.02065	(12091824)
455700.00	4617300.00	0.02000	(13102724)	455800.00	4617300.00	0.01932	(13102724)
455900.00	4617300.00	0.01807	(13102724)	456000.00	4617300.00	0.01728	(15091024)
456100.00	4617300.00	0.01737	(15091024)	456200.00	4617300.00	0.01723	(15091024)
456300.00	4617300.00	0.01677	(15091024)	456400.00	4617300.00	0.01681	(12091624)
456500.00	4617300.00	0.01860	(12091624)	456600.00	4617300.00	0.01969	(12091624)

449000.00	4609000.00	0.00653	(13052524)	449500.00	4609000.00	0.00713	(14062524)
450000.00	4609000.00	0.00845	(12050524)	450500.00	4609000.00	0.00870	(12050524)
451000.00	4609000.00	0.00860	(16112124)	451500.00	4609000.00	0.00860	(16112124)
452000.00	4609000.00	0.01006	(13081824)	452500.00	4609000.00	0.00923	(14061024)
453000.00	4609000.00	0.01154	(15012124)	453500.00	4609000.00	0.01233	(15012124)
454000.00	4609000.00	0.00898	(15012124)	454500.00	4609000.00	0.00778	(13050524)
455000.00	4609000.00	0.00709b	(16051824)	455500.00	4609000.00	0.00691	(14122924)
456000.00	4609000.00	0.00730	(16100124)	456500.00	4609000.00	0.00669	(14121024)
457000.00	4609000.00	0.00818	(14121024)	457500.00	4609000.00	0.00799	(14052524)
458000.00	4609000.00	0.01049	(16121724)	458500.00	4609000.00	0.01287	(13121624)
459000.00	4609000.00	0.01347	(13121624)	459500.00	4609000.00	0.01061	(15111024)
460000.00	4609000.00	0.01193	(15111024)	449000.00	4609500.00	0.00586	(13052524)
449500.00	4609500.00	0.00720	(13052524)	450000.00	4609500.00	0.00842	(12050524)
450500.00	4609500.00	0.00949	(12050524)	451000.00	4609500.00	0.00932	(15100524)
451500.00	4609500.00	0.00975	(16112124)	452000.00	4609500.00	0.01039	(13081824)
452500.00	4609500.00	0.01036	(14061024)	453000.00	4609500.00	0.01196	(15012124)
453500.00	4609500.00	0.01320	(15012124)	454000.00	4609500.00	0.00981	(15012124)
454500.00	4609500.00	0.00867	(15012124)	455000.00	4609500.00	0.00720b	(16051824)
455500.00	4609500.00	0.00781	(14122924)	456000.00	4609500.00	0.00795	(16100124)
456500.00	4609500.00	0.00835	(14121024)	457000.00	4609500.00	0.00902	(14121024)
457500.00	4609500.00	0.01016	(16121724)	458000.00	4609500.00	0.01258	(13121624)
458500.00	4609500.00	0.01517	(13121624)	459000.00	4609500.00	0.01125	(15111024)
459500.00	4609500.00	0.01300	(15111024)	460000.00	4609500.00	0.01017	(13120724)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 264
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
449000.00	4610000.00	0.00646	(13121924)	449500.00	4610000.00	0.00649	(13052524)
450000.00	4610000.00	0.00824	(13052524)	450500.00	4610000.00	0.01010	(12050524)
451000.00	4610000.00	0.00998	(12050524)	451500.00	4610000.00	0.01025	(16112124)
452000.00	4610000.00	0.00991	(13081824)	452500.00	4610000.00	0.01140	(14061024)
453000.00	4610000.00	0.01214	(15012124)	453500.00	4610000.00	0.01424	(15012124)
454000.00	4610000.00	0.01084	(15012124)	454500.00	4610000.00	0.00983	(15012124)
455000.00	4610000.00	0.00788	(16100124)	455500.00	4610000.00	0.00862	(14122924)
456000.00	4610000.00	0.00857	(13082324)	456500.00	4610000.00	0.01001	(14121024)
457000.00	4610000.00	0.00920	(16121724)	457500.00	4610000.00	0.01308	(16121724)
458000.00	4610000.00	0.01659	(13121624)	458500.00	4610000.00	0.01187	(15111024)
459000.00	4610000.00	0.01426	(15111024)	459500.00	4610000.00	0.01136	(13120724)
460000.00	4610000.00	0.01146	(13120724)	449000.00	4610500.00	0.00732	(13121924)
449500.00	4610500.00	0.00709	(13121924)	450000.00	4610500.00	0.00765	(14062524)
450500.00	4610500.00	0.00971	(14053024)	451000.00	4610500.00	0.01109	(12050524)
451500.00	4610500.00	0.01127	(15100524)	452000.00	4610500.00	0.01092	(16112124)
452500.00	4610500.00	0.01213	(14061024)	453000.00	4610500.00	0.01223	(15012124)
453500.00	4610500.00	0.01531	(15012124)	454000.00	4610500.00	0.01220	(15012124)

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        454500.00   4610500.00        0.01118  (15012124)              455000.00
4610500.00        0.00893  (16100124)
        455500.00   4610500.00        0.00979  (16100124)              456000.00
4610500.00        0.01028  (14121024)
        456500.00   4610500.00        0.01111  (14121024)              457000.00
4610500.00        0.01375  (16121724)
        457500.00   4610500.00        0.01758  (13121624)              458000.00
4610500.00        0.01352  (13121624)
        458500.00   4610500.00        0.01574  (15111024)              459000.00
4610500.00        0.01257  (13120724)
        459500.00   4610500.00        0.01257  (13120724)              460000.00
4610500.00        0.01126  (13120724)
        449000.00   4611000.00        0.00698  (13121924)              449500.00
4611000.00        0.00854  (13121924)
        450000.00   4611000.00        0.00752  (13121924)              450500.00
4611000.00        0.00967  (14053024)
        451000.00   4611000.00        0.01162  (15072624)              451500.00
4611000.00        0.01295  (15072624)
        452000.00   4611000.00        0.01244  (15100524)              452500.00
4611000.00        0.01239  (14061024)
        453000.00   4611000.00        0.01200  (15090424)              453500.00
4611000.00        0.01659  (15012124)
        454000.00   4611000.00        0.01400  (15012124)              454500.00
4611000.00        0.01264  (15012124)
        455000.00   4611000.00        0.01062  (14122924)              455500.00
4611000.00        0.01069  (16100124)
        456000.00   4611000.00        0.01281  (14121024)              456500.00
4611000.00        0.01328  (16121724)
        457000.00   4611000.00        0.01735  (13121624)              457500.00
4611000.00        0.01637  (13121624)
        458000.00   4611000.00        0.01750  (15111024)              458500.00
4611000.00        0.01423  (13120724)
        459000.00   4611000.00        0.01372  (13120724)              459500.00
4611000.00        0.01196  (13120724)
        460000.00   4611000.00        0.01214  (16100324)              449000.00
4611500.00        0.00746  (15012724)
        449500.00   4611500.00        0.00789  (13121924)              450000.00
4611500.00        0.00969  (13121924)
        450500.00   4611500.00        0.00919  (14053024)              451000.00
4611500.00        0.01154  (15092524)
        451500.00   4611500.00        0.01644  (15072624)              452000.00
4611500.00        0.01300  (15100524)
        452500.00   4611500.00        0.01256  (15112824)              453000.00
4611500.00        0.01407  (14061024)
        453500.00   4611500.00        0.01822  (15012124)              454000.00
4611500.00        0.01622  (15012124)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
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PAGE 265
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
454500.00	4611500.00	0.01415	(15012124)	455000.00	4611500.00	0.01258	(14122924)
455500.00	4611500.00	0.01337	(14121024)	456000.00	4611500.00	0.01436	(14121024)
456500.00	4611500.00	0.01853	(12121724)	457000.00	4611500.00	0.01887	(13121624)
457500.00	4611500.00	0.01956	(15111024)	458000.00	4611500.00	0.01584	(13120724)
458500.00	4611500.00	0.01489	(13120724)	459000.00	4611500.00	0.01292	(14010824)
459500.00	4611500.00	0.01288	(14010824)	460000.00	4611500.00	0.01128	(13011524)
449000.00	4612000.00	0.00926	(15012724)	449500.00	4612000.00	0.00900	(15012724)
450000.00	4612000.00	0.00868	(13121924)	450500.00	4612000.00	0.01109	(13121924)
451000.00	4612000.00	0.01174	(14053024)	451500.00	4612000.00	0.01722	(15072624)
452000.00	4612000.00	0.01745	(15072624)	452500.00	4612000.00	0.01554	(15100524)
453000.00	4612000.00	0.01658	(14061024)	453500.00	4612000.00	0.02040	(15012124)
454000.00	4612000.00	0.01939	(15012124)	454500.00	4612000.00	0.01579	(15012124)
455000.00	4612000.00	0.01473	(16100124)	455500.00	4612000.00	0.01760	(14121024)
456000.00	4612000.00	0.01964	(12121724)	456500.00	4612000.00	0.02124	(13121624)
457000.00	4612000.00	0.02210	(15111024)	457500.00	4612000.00	0.01763	(13120724)
458000.00	4612000.00	0.01602	(13120724)	458500.00	4612000.00	0.01477	(14010824)
459000.00	4612000.00	0.01334	(14010824)	459500.00	4612000.00	0.01517	(13011524)

460000.00 4612000.00 0.01654 (13011524) 449000.00
4612500.00 0.00917 (13121924)
449500.00 4612500.00 0.00974 (15012724) 450000.00
4612500.00 0.01039 (15012724)
450500.00 4612500.00 0.00983 (13121924) 451000.00
4612500.00 0.01249 (13121924)
451500.00 4612500.00 0.01709 (15092524) 457000.00
4612500.00 0.02015 (14121824)
457500.00 4612500.00 0.01705 (13120724) 458000.00
4612500.00 0.01590 (14010824)
458500.00 4612500.00 0.01532 (13011524) 459000.00
4612500.00 0.01809 (13011524)
459500.00 4612500.00 0.01664 (13011524) 460000.00
4612500.00 0.01447 (13011524)
449000.00 4613000.00 0.01079 (13052524) 449500.00
4613000.00 0.01034 (13121924)
450000.00 4613000.00 0.01186 (12040624) 450500.00
4613000.00 0.01166 (15012724)
451000.00 4613000.00 0.01232 (15090424) 451500.00
4613000.00 0.01764 (15072624)
457000.00 4613000.00 0.01973 (14010824) 457500.00
4613000.00 0.01730 (14010824)
458000.00 4613000.00 0.01984 (13011524) 458500.00
4613000.00 0.01785 (14020324)
459000.00 4613000.00 0.01779 (14020324) 459500.00
4613000.00 0.01474 (14020324)
460000.00 4613000.00 0.01213 (13011524) 449000.00
4613500.00 0.01713 (13052524)
449500.00 4613500.00 0.01314 (13052524) 450000.00
4613500.00 0.01160 (15121224)
450500.00 4613500.00 0.01410 (12040624) 451000.00
4613500.00 0.01481 (15090424)
451500.00 4613500.00 0.01936 (15072624) 457000.00
4613500.00 0.02126 (13011524)
457500.00 4613500.00 0.02204 (14020324) 458000.00
4613500.00 0.02092 (14020324)
458500.00 4613500.00 0.01532 (14020324) 459000.00
4613500.00 0.01283 (13011524)
459500.00 4613500.00 0.01280 (13011524) 460000.00
4613500.00 0.01082 (13011524)
449000.00 4614000.00 0.01750 (14092624) 449500.00
4614000.00 0.01670 (13052524)
450000.00 4614000.00 0.01515 (15050624) 450500.00
4614000.00 0.01645 (16082924)
451000.00 4614000.00 0.02048 (15090424) 451500.00
4614000.00 0.02347 (15072624)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
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PAGE 266
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
457000.00	4614000.00	0.02249	(14020324)	457500.00	4614000.00	0.01619	(14021024)
458000.00	4614000.00	0.01418	(13011524)	458500.00	4614000.00	0.01515	(13011524)
459000.00	4614000.00	0.01429	(13011524)	459500.00	4614000.00	0.01148	(13011524)
460000.00	4614000.00	0.01007	(15091024)	449000.00	4614500.00	0.01375c	(14092724)
449500.00	4614500.00	0.02578	(14092624)	450000.00	4614500.00	0.01839	(14092624)
450500.00	4614500.00	0.01698	(15050624)	451000.00	4614500.00	0.01944	(16041624)
451500.00	4614500.00	0.02639	(15072624)	457000.00	4614500.00	0.01915	(13011524)
457500.00	4614500.00	0.02002	(13011524)	458000.00	4614500.00	0.01782	(13011524)
458500.00	4614500.00	0.01620	(15091024)	459000.00	4614500.00	0.01511	(15091024)
459500.00	4614500.00	0.01412	(15091024)	460000.00	4614500.00	0.01305	(15091024)
449000.00	4615000.00	0.01424	(13121924)	449500.00	4615000.00	0.01639c	(14092724)
450000.00	4615000.00	0.02866	(14092624)	450500.00	4615000.00	0.02375	(14053124)
451000.00	4615000.00	0.02060	(13061924)	451500.00	4615000.00	0.02752	(15090424)
457000.00	4615000.00	0.02131	(13011524)	457500.00	4615000.00	0.01543	(13011524)
458000.00	4615000.00	0.01502	(14010824)	458500.00	4615000.00	0.01472	(12082024)
459000.00	4615000.00	0.01381	(12082024)	459500.00	4615000.00	0.01315	(12082024)
460000.00	4615000.00	0.01243	(12082024)	449000.00	4615500.00	0.01900	(13071524)

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        449500.00   4615500.00        0.02027  (12110724)              450000.00
4615500.00        0.02238  (12110724)
        450500.00   4615500.00        0.02396  (12110724)              451000.00
4615500.00        0.02632  (12110724)
        451500.00   4615500.00        0.03539  (15090424)              457000.00
4615500.00        0.01731  (16080724)
        457500.00   4615500.00        0.01463  (14010824)              458000.00
4615500.00        0.01403  (14010824)
        458500.00   4615500.00        0.01271  (12020224)              459000.00
4615500.00        0.01295  (12020224)
        459500.00   4615500.00        0.01237  (12020224)              460000.00
4615500.00        0.01187  (13011524)
        449000.00   4616000.00        0.02005  (15121224)              449500.00
4616000.00        0.02829  (13071524)
        450000.00   4616000.00        0.02259  (13071524)              450500.00
4616000.00        0.02312c (14092724)
        451000.00   4616000.00        0.03435  (15100524)              451500.00
4616000.00        0.04134  (15090424)
        457000.00   4616000.00        0.01523  (12010824)              457500.00
4616000.00        0.01467  (12020224)
        458000.00   4616000.00        0.01493  (12020224)              458500.00
4616000.00        0.01372  (12020224)
        459000.00   4616000.00        0.01418  (13011524)              459500.00
4616000.00        0.01553  (13011524)
        460000.00   4616000.00        0.01454  (13011524)              449000.00
4616500.00        0.02396  (16031224)
        449500.00   4616500.00        0.02696  (15121224)              450000.00
4616500.00        0.03000  (13071524)
        450500.00   4616500.00        0.03595  (13071524)              451000.00
4616500.00        0.03345  (15092524)
        451500.00   4616500.00        0.04997  (15112824)              457000.00
4616500.00        0.01559  (12010824)
        457500.00   4616500.00        0.01287  (12010824)              458000.00
4616500.00        0.01136  (15070424)
        458500.00   4616500.00        0.01205  (13011524)              459000.00
4616500.00        0.01151  (13011524)
        459500.00   4616500.00        0.00960  (13011524)              460000.00
4616500.00        0.00977  (12082824)
        449000.00   4617000.00        0.02805  (16080124)              449500.00
4617000.00        0.03538  (16041624)
        450000.00   4617000.00        0.04167  (16041624)              450500.00
4617000.00        0.04158  (16031224)
        451000.00   4617000.00        0.07547  (13071524)              451500.00
4617000.00        0.12662  (12071024)
        457000.00   4617000.00        0.01759  (15091024)              457500.00
4617000.00        0.01394  (15091024)
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*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

PAGE 267
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
458000.00	4617000.00	0.01212	(14020324)	458500.00	4617000.00	0.01104	(14020324)
459000.00	4617000.00	0.00925	(12010824)	459500.00	4617000.00	0.00874	(12010824)
460000.00	4617000.00	0.00821	(15091024)	449000.00	4617500.00	0.03458	(16041724)
449500.00	4617500.00	0.04003	(16041724)	450000.00	4617500.00	0.04923	(16041724)
450500.00	4617500.00	0.06501	(16080324)	451000.00	4617500.00	0.09844	(16080324)
451500.00	4617500.00	0.25481	(13071424)	452000.00	4617500.00	0.37902m	(16120824)
452500.00	4617500.00	0.10882	(16112524)	453000.00	4617500.00	0.04946	(16112524)
453500.00	4617500.00	0.03620	(12122224)	454000.00	4617500.00	0.02757	(15110424)
454500.00	4617500.00	0.02681	(13063024)	455000.00	4617500.00	0.02501	(12111524)
455500.00	4617500.00	0.02213	(12091824)	456000.00	4617500.00	0.01703	(13102724)
456500.00	4617500.00	0.01491	(15110824)	457000.00	4617500.00	0.01820	(12091624)
457500.00	4617500.00	0.01379	(12091624)	458000.00	4617500.00	0.01317	(12092924)
458500.00	4617500.00	0.01244	(12092924)	459000.00	4617500.00	0.01150	(12092924)
459500.00	4617500.00	0.01045	(12092924)	460000.00	4617500.00	0.00933	(12092924)
449000.00	4618000.00	0.03325	(12051724)	449500.00	4618000.00	0.04158	(13082924)
450000.00	4618000.00	0.06254	(13082924)	450500.00	4618000.00	0.07888	(13082924)
451000.00	4618000.00	0.07904b	(16071824)	451500.00	4618000.00	0.11232	(16090424)

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        452000.00   4618000.00        0.17127  (13082024)              452500.00
4618000.00        0.08624m (13090424)
        453000.00   4618000.00        0.03986  (16071924)              453500.00
4618000.00        0.03442  (12082824)
        454000.00   4618000.00        0.03555  (12082824)              454500.00
4618000.00        0.05500  (15112824)
        455000.00   4618000.00        0.05310  (16022524)              455500.00
4618000.00        0.03554  (16020924)
        456000.00   4618000.00        0.01960  (14111324)              456500.00
4618000.00        0.01454  (13012124)
        457000.00   4618000.00        0.01239  (12082824)              457500.00
4618000.00        0.01558  (12091624)
        458000.00   4618000.00        0.01516  (12091624)              458500.00
4618000.00        0.01128  (12092924)
        459000.00   4618000.00        0.01113  (12092924)              459500.00
4618000.00        0.01060  (12092924)
        460000.00   4618000.00        0.00996  (12092924)              449000.00
4618500.00        0.03958  (13082924)
        449500.00   4618500.00        0.03490  (13082924)              450000.00
4618500.00        0.03527  (12082924)
        450500.00   4618500.00        0.04220b (16071824)              451000.00
4618500.00        0.05521  (16090424)
        451500.00   4618500.00        0.06525  (13101124)              452000.00
4618500.00        0.08953  (15110324)
        452500.00   4618500.00        0.06266  (16082724)              453000.00
4618500.00        0.04847  (12091624)
        453500.00   4618500.00        0.03565  (12091624)              454000.00
4618500.00        0.03530  (14042724)
        454500.00   4618500.00        0.16997  (15122824)              455000.00
4618500.00        0.11946  (13013124)
        455500.00   4618500.00        0.04318m (16120824)              456000.00
4618500.00        0.02067m (16120824)
        456500.00   4618500.00        0.01601  (16112524)              457000.00
4618500.00        0.01391  (12082824)
        457500.00   4618500.00        0.01319  (12082824)              458000.00
4618500.00        0.01279  (12091624)
        458500.00   4618500.00        0.01449  (12091624)              459000.00
4618500.00        0.01187  (12091624)
        459500.00   4618500.00        0.00980  (15011924)              460000.00
4618500.00        0.00810  (14020324)
        449000.00   4619000.00        0.02380  (12082924)              449500.00
4619000.00        0.02901b (16071824)
        450000.00   4619000.00        0.03042  (12111824)              450500.00
4619000.00        0.03306  (16121624)
        451000.00   4619000.00        0.03193  (12081224)              451500.00
4619000.00        0.04644  (12111924)
```

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
452000.00	4619000.00	0.05363	(15110424)	452500.00	4619000.00	0.04409	(16111424)
453000.00	4619000.00	0.03373	(16082724)	453500.00	4619000.00	0.02687	(12091624)
454000.00	4619000.00	0.04101	(12091624)	454500.00	4619000.00	0.05543	(12012224)
455000.00	4619000.00	0.07638	(13111424)	455500.00	4619000.00	0.04037	(13010424)
456000.00	4619000.00	0.02228	(13022324)	456500.00	4619000.00	0.01700	(12010824)
457000.00	4619000.00	0.01281	(12010824)	457500.00	4619000.00	0.01161	(13032824)
458000.00	4619000.00	0.01128	(13032824)	458500.00	4619000.00	0.01063	(12082824)
459000.00	4619000.00	0.01284	(12091624)	459500.00	4619000.00	0.01219	(12091624)
460000.00	4619000.00	0.01065	(15011924)	449000.00	4619500.00	0.02133	(12111824)
449500.00	4619500.00	0.02130	(12111824)	450000.00	4619500.00	0.02295	(16121624)
450500.00	4619500.00	0.02269	(13073024)	451000.00	4619500.00	0.02427	(13101124)
451500.00	4619500.00	0.03681	(12111924)	452000.00	4619500.00	0.03463	(15110424)
452500.00	4619500.00	0.03298	(15072424)	453000.00	4619500.00	0.02909	(12111524)
453500.00	4619500.00	0.02395	(13102724)	454000.00	4619500.00	0.02539	(15111724)
454500.00	4619500.00	0.03494	(12091624)	455000.00	4619500.00	0.04103	(16030824)
455500.00	4619500.00	0.02151	(15072424)	456000.00	4619500.00	0.01998	(12020924)
456500.00	4619500.00	0.01593	(14020324)	457000.00	4619500.00	0.01589	(12010824)

457500.00 4619500.00 0.01377 (12010824) 458000.00
4619500.00 0.01280 (12010824)
458500.00 4619500.00 0.01182 (12010824) 459000.00
4619500.00 0.00946 (12010824)
459500.00 4619500.00 0.01107 (12091624) 460000.00
4619500.00 0.01157 (12091624)
449000.00 4620000.00 0.01640 (12111824) 449500.00
4620000.00 0.01738 (13061524)
450000.00 4620000.00 0.01788 (13073024) 450500.00
4620000.00 0.01769 (12081224)
451000.00 4620000.00 0.02135 (13101124) 451500.00
4620000.00 0.02846 (12111424)
452000.00 4620000.00 0.02862 (12111524) 452500.00
4620000.00 0.02591 (14021224)
453000.00 4620000.00 0.02853 (12111524) 453500.00
4620000.00 0.02233 (16110624)
454000.00 4620000.00 0.01936 (13102724) 454500.00
4620000.00 0.02042 (12111624)
455000.00 4620000.00 0.03522 (12091624) 455500.00
4620000.00 0.03111 (12091624)
456000.00 4620000.00 0.01869 (12091624) 456500.00
4620000.00 0.01547 (12010924)
457000.00 4620000.00 0.01524 (14020324) 457500.00
4620000.00 0.01304 (14020324)
458000.00 4620000.00 0.01173 (12010824) 458500.00
4620000.00 0.01219 (12010824)
459000.00 4620000.00 0.01203 (12010824) 459500.00
4620000.00 0.01023 (12010824)
460000.00 4620000.00 0.00947 (12091624) 449000.00
4620500.00 0.01520 (12020124)
449500.00 4620500.00 0.01600 (13061524) 450000.00
4620500.00 0.01563 (13073024)
450500.00 4620500.00 0.01524 (16101424) 451000.00
4620500.00 0.01841 (15110924)
451500.00 4620500.00 0.02356 (12111424) 452000.00
4620500.00 0.02461 (12111524)
452500.00 4620500.00 0.02272 (12111624) 453000.00
4620500.00 0.02012 (16111424)
453500.00 4620500.00 0.02486 (12111524) 454000.00
4620500.00 0.01748 (16110624)
454500.00 4620500.00 0.02059 (14020824) 455000.00
4620500.00 0.02668 (15110424)
455500.00 4620500.00 0.02643 (12091624) 456000.00
4620500.00 0.02380 (12091624)
456500.00 4620500.00 0.01838 (12091624) 457000.00
4620500.00 0.01429 (12091624)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions ***
*** AERMET - VERSION 18081 *** ***

PAGE 269
*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): RTO , V1 , V2 , V3 , V4 ,
V5 , V6 , V7 , V8 , V9 , V10 , V11 , V12 ,
V13 , VN1 , VN2 , VN3 , VN4 , VN5 , VN6 , DC1 ,
AB_0001 , AB_0002 , AB_0003 , AB_0004 , AB_0005 , AB_0006 , AB_0007 , . . . ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
457500.00	4620500.00	0.01373	(14020324)	458000.00	4620500.00	0.01265	(14020324)
458500.00	4620500.00	0.01042	(13102724)	459000.00	4620500.00	0.01000	(12010824)
459500.00	4620500.00	0.01083	(12010824)	460000.00	4620500.00	0.01007	(12010824)

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

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*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE SUMMARY OF MAXIMUM ANNUAL RESULTS AVERAGED OVER 5 YEARS ***

** CONC OF OTHER IN MICROGRAMS/M**3
**

NETWORK GROUP ID	AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG)	OF TYPE	GRID-ID
ALL	1ST HIGHEST VALUE IS	0.03536 AT (452000.00, 4617500.00, 186.46, 186.46, 0.00)	DC	
	2ND HIGHEST VALUE IS	0.02668 AT (454091.00, 4614865.50, 177.21, 177.21, 0.00)	DC	
	3RD HIGHEST VALUE IS	0.02209 AT (454595.80, 4615044.40, 178.19, 178.19, 0.00)	DC	
	4TH HIGHEST VALUE IS	0.02157 AT (452000.00, 4618000.00, 179.69, 179.69, 0.00)	DC	
	5TH HIGHEST VALUE IS	0.02153 AT (454096.80, 4614766.40, 177.99, 177.99, 0.00)	DC	
	6TH HIGHEST VALUE IS	0.01992 AT (454093.90, 4614816.00, 177.63, 177.63, 0.00)	DC	
	7TH HIGHEST VALUE IS	0.01853 AT (451500.00, 4617500.00, 178.94, 178.94, 0.00)	DC	
	8TH HIGHEST VALUE IS	0.01745 AT (454088.00, 4614915.00, 176.78, 176.78, 0.00)	DC	
	9TH HIGHEST VALUE IS	0.01732 AT (454595.80, 4614995.60, 178.19, 178.19, 0.00)	DC	
	10TH HIGHEST VALUE IS	0.01729 AT (454600.00, 4615000.00, 178.19, 178.19, 0.00)	DC	

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE SUMMARY OF HIGHEST 8-HR RESULTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

NETWORK GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG)	OF TYPE	GRID-ID
ALL	HIGH 1ST HIGH VALUE IS	0.71677	ON 12072124: AT (452000.00, 4617500.00, 186.46, 186.46, 0.00)	DC	

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR

*** AERMOD - VERSION 19191 *** *** IEPA Audit Run2 - General III HAP (Mn) Emissions
*** 05/23/20
*** AERMET - VERSION 18081 *** ***
*** 12:35:28

*** MODELOPTs: RegDFAULT CONC ELEV NODRYDPLT NOWETDPLT RURAL ADJ_U*

*** THE SUMMARY OF HIGHEST 24-HR RESULTS ***

** CONC OF OTHER IN MICROGRAMS/M**3 **

NETWORK GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG)	OF TYPE	GRID-ID
ALL	HIGH 1ST HIGH VALUE IS	0.37902m	ON 16120824: AT (452000.00, 4617500.00, 186.46, 186.46, 0.00)	DC	

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR

```
 *** AERMOD - VERSION  19191 ***   *** IEPA Audit Run2 - General III HAP (Mn) Emissions
***        05/23/20
 *** AERMET - VERSION  18081 ***   ***
***        12:35:28

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 *** MODELOPTs:    RegDFAULT  CONC  ELEV  NODRYDPLT  NOWETDPLT  RURAL  ADJ_U*

 *** Message Summary : AERMOD Model Execution ***

  --------- Summary of Total Messages --------

 A Total of            0 Fatal Error Message(s)
 A Total of            2 Warning Message(s)
 A Total of          352 Informational Message(s)

 A Total of        43848 Hours Were Processed

 A Total of           86 Calm Hours Identified

 A Total of          266 Missing Hours Identified (  0.61 Percent)


    ******** FATAL ERROR MESSAGES ********
               ***  NONE  ***


    ********   WARNING MESSAGES   ********
 ME W186    3634       MEOPEN: THRESH_1MIN 1-min ASOS wind speed threshold used
0.50
 ME W187    3634       MEOPEN: ADJ_U* Option for Stable Low Winds used in AERMET

    ***********************************
    *** AERMOD Finishes Successfully ***
    ***********************************
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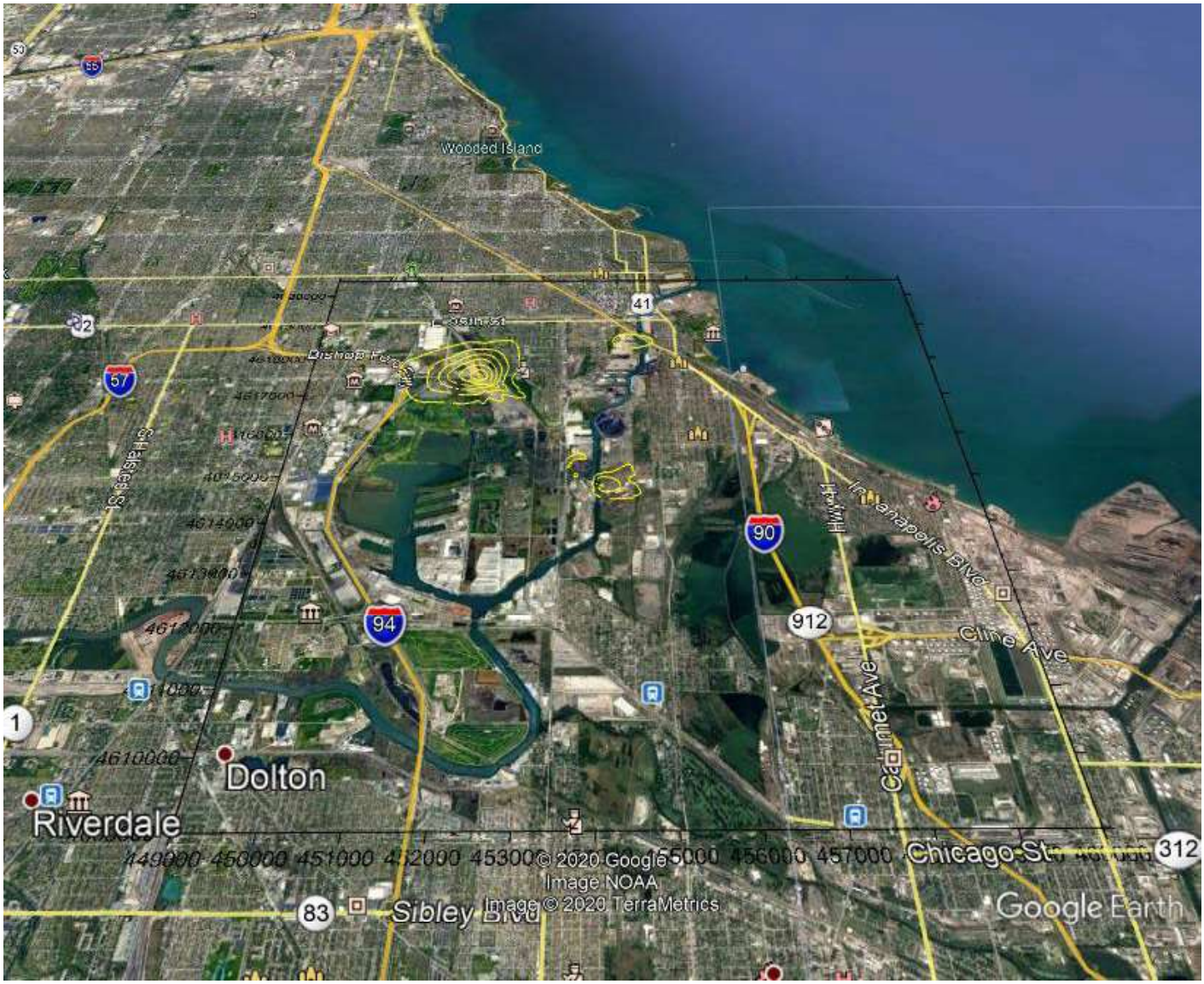
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NO ECHO

CO STARTING
CO TITLEONE IEPA Audit Run2 - General III HAP (Mn) Emissions
CO MODELOPT DFAULT CONC NODRYDPLT NOWETDPLT
CO AVERTIME 8 24 ANNUAL
CO POLLUTID OTHER
CO RUNORNOT RUN
CO FINISHED

SO STARTING
SO ELEVUNIT METERS
SO LOCATION RTO POINT 454280.579 4614874.64 178.19
SO SRCPARAM RTO 2.507357823E-04 12.4968 314.26 12.914194 1.8288
SO BUILDHGT RTO             18.29    18.29    18.29     0.00     0.00     0.00
SO BUILDHGT RTO              0.00     0.00     0.00    18.29    18.29    18.29
SO BUILDHGT RTO             18.29    18.29    18.29    18.29    18.29    18.29
SO BUILDHGT RTO             18.29    18.29    18.29     0.00     0.00     0.00
SO BUILDHGT RTO              0.00     0.00     0.00    18.29    18.29    18.29
SO BUILDHGT RTO             18.29    18.29    18.29    18.29    18.29    18.29
SO BUILDWID RTO             39.01    39.78    39.35     0.00     0.00     0.00
SO BUILDWID RTO              0.00     0.00     0.00    36.02    34.83    32.58
SO BUILDWID RTO             29.68    28.31    26.07    29.85    33.96    37.05
SO BUILDWID RTO             39.01    39.78    39.35     0.00     0.00     0.00
SO BUILDWID RTO              0.00     0.00     0.00    36.02    34.83    32.58
SO BUILDWID RTO             29.68    28.31    26.07    29.85    33.96    37.05
SO BUILDLEN RTO             36.02    34.83    32.58     0.00     0.00     0.00
SO BUILDLEN RTO              0.00     0.00     0.00    39.01    39.78    39.35
SO BUILDLEN RTO             37.72    34.94    31.11    33.05    35.12    36.12
SO BUILDLEN RTO             36.02    34.83    32.58     0.00     0.00     0.00
SO BUILDLEN RTO              0.00     0.00     0.00    39.01    39.78    39.35
SO BUILDLEN RTO             37.72    34.94    31.11    33.05    35.12    36.12
SO XBADJ    RTO              6.90     3.87     0.73     0.00     0.00     0.00
SO XBADJ    RTO              0.00     0.00     0.00   -40.62   -44.68   -47.38
SO XBADJ    RTO            -48.63   -48.42   -46.73   -47.44   -47.36   -45.83
SO XBADJ    RTO            -42.92   -38.70   -33.30     0.00     0.00     0.00
SO XBADJ    RTO              0.00     0.00     0.00     1.61     4.89     8.03
SO XBADJ    RTO             10.92    13.47    15.62    14.39    12.24     9.72
SO YBADJ    RTO             21.11    24.78    27.70     0.00     0.00     0.00
SO YBADJ    RTO              0.00     0.00     0.00    24.91    21.29    17.01
SO YBADJ    RTO             12.05     5.52    -1.19    -6.80   -11.98   -16.80
SO YBADJ    RTO            -21.11   -24.78   -27.70     0.00     0.00     0.00
SO YBADJ    RTO              0.00     0.00     0.00   -24.91   -21.29   -17.01
SO YBADJ    RTO            -12.05    -5.52     1.19     6.80    11.98    16.80
SO LOCATION V1 VOLUME 454297.692 4614928.02 178.19
SO SRCPARAM V1 1.066446061E-04 0.6096 0.70884288 0.5670804
SO LOCATION V2 VOLUME 454259.682 4614907.47 178.19
SO SRCPARAM V2 1.28643836E-05 9.144 5.95423752 8.5060536
SO LOCATION V3 VOLUME 454235.875 4614892.42 178.19
SO SRCPARAM V3 3.898374424E-05 0.6096 0.42528744 0.5670804
SO LOCATION V4 VOLUME 454226.98 4614887.08 178.19
SO SRCPARAM V4 3.341463792E-06 3.81 3.54418392 3.54418392
SO LOCATION V5 VOLUME 454218.08 4614878.54 178.19
SO SRCPARAM V5 5.237731895E-05 3.81 1.41768576 3.54418392
SO LOCATION V6 VOLUME 454225.909 4614867.5 178.19
SO SRCPARAM V6 4.627902153E-05 5.334 4.2530268 4.96186968
SO LOCATION V7 VOLUME 454197.08 4614871.06 178.19
SO SRCPARAM V7 4.059651711E-05 4.572 1.41768576 4.2530268
SO LOCATION V8 VOLUME 454193.521 4614874.62 178.19
SO SRCPARAM V8 6.793805719E-06 4.572 1.41768576 4.2530268
SO LOCATION V9 VOLUME 454213.452 4614885.66 178.19
SO SRCPARAM V9 9.114686679E-06 3.81 1.7721072 3.54418392
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SO LOCATION V10 VOLUME 454173.38 4614858.04 178.19
SO SRCPARAM V10 6.716947012E-05 0.9144 1.41768576 0.85060536
SO LOCATION V11 VOLUME 454170.92 4614872.75 178.19
SO SRCPARAM V11 5.557766511E-05 5.334 8.5060536 4.96186968
SO LOCATION V12 VOLUME 454179.64 4614840.61 178.19
SO SRCPARAM V12 5.557766511E-05 5.334 8.5060536 4.96186968
SO LOCATION V13 VOLUME 454094.65 4614815.89 177.72
SO SRCPARAM V13 1.580013422E-04 0.9144 1.41768576 0.85060536
SO LOCATION VN1 VOLUME 454294.913 4614781.55 178.19
SO SRCPARAM VN1 4.309127515E-04 6.096 7.08836784 5.67071256
SO LOCATION VN2 VOLUME 454328.547 4614797.57 178.19
SO SRCPARAM VN2 1.196475874E-04 6.096 7.08836784 5.67071256
SO LOCATION VN3 VOLUME 454345.365 4614834.4 178.19
SO SRCPARAM VN3 2.450658777E-04 3.81 7.08836784 3.54418392
SO LOCATION VN4 VOLUME 454300.519 4614814.38 178.19
SO SRCPARAM VN4 1.055610243E-05 3.81 7.08836784 3.54418392
SO LOCATION VN5 VOLUME 454338.158 4614842.41 178.19
SO SRCPARAM VN5 6.94122324E-06 3.81 7.08836784 3.54418392
SO LOCATION VN6 VOLUME 454383.003 4614853.62 178.19
SO SRCPARAM VN6 9.771135637E-05 3.81 2.83534104 3.54418392
SO LOCATION DC1 POINT 454378.438 4614823.04 178.19
SO SRCPARAM DC1 1.140532815E-04 14.3256 295.37 19.404171 0.6096
SO BUILDHGT DC1             13.72    13.72    13.72    13.72    13.72    13.72
SO BUILDHGT DC1             13.72    13.72    13.72    13.72    13.72    13.72
SO BUILDHGT DC1             13.72    13.72    13.72    13.72    13.72    13.72
SO BUILDHGT DC1             13.72    13.72    13.72    13.72    13.72    13.72
SO BUILDHGT DC1             13.72    13.72    13.72    13.72    13.72    13.72
SO BUILDHGT DC1             13.72    13.72    13.72    13.72    13.72    13.72
SO BUILDWID DC1             66.64    68.61    68.49    66.29    62.07    55.97
SO BUILDWID DC1             60.44    65.23    68.04    68.78    67.44    64.04
SO BUILDWID DC1             58.70    51.57    42.88    49.14    56.76    62.65
SO BUILDWID DC1             66.64    68.61    68.49    66.29    62.07    55.97
SO BUILDWID DC1             60.44    65.23    68.04    68.78    67.44    64.04
SO BUILDWID DC1             58.70    51.57    42.88    49.14    56.76    62.65
SO BUILDLEN DC1             68.78    67.44    64.04    58.70    51.57    42.88
SO BUILDLEN DC1             49.14    56.76    62.65    66.64    68.61    68.49
SO BUILDLEN DC1             66.29    62.07    55.97    60.44    65.23    68.04
SO BUILDLEN DC1             68.78    67.44    64.04    58.70    51.57    42.88
SO BUILDLEN DC1             49.14    56.76    62.65    66.64    68.61    68.49
SO BUILDLEN DC1             66.29    62.07    55.97    60.44    65.23    68.04
SO XBADJ    DC1            -55.37   -56.48   -55.86   -53.55   -49.61   -44.17
SO XBADJ    DC1            -45.52   -46.90   -46.86   -45.39   -42.55   -38.41
SO XBADJ    DC1            -33.11   -26.80   -19.67   -18.08   -17.02   -15.45
SO XBADJ    DC1            -13.41   -10.96    -8.18    -5.15    -1.96     1.29
SO XBADJ    DC1             -3.62    -9.86   -15.79   -21.25   -26.06   -30.08
SO XBADJ    DC1            -33.18   -35.28   -36.30   -42.36   -48.21   -52.59
SO YBADJ    DC1             12.07     8.24     4.17    -0.04    -4.24    -8.32
SO YBADJ    DC1            -12.14   -15.59   -18.57   -20.98   -22.76   -23.84
SO YBADJ    DC1            -24.20   -23.83   -22.73   -20.95   -18.52   -15.53
SO YBADJ    DC1            -12.07    -8.24    -4.17     0.04     4.24     8.32
SO YBADJ    DC1             12.14    15.59    18.57    20.98    22.76    23.84
SO YBADJ    DC1             24.20    23.83    22.73    20.95    18.52    15.53
SO LOCATION AB_0001 VOLUME 454569.7 4615033.84 178.19
SO SRCPARAM AB_0001 1.644902331E-05 2.59 5.58 2.41
SO LOCATION AB_0002 VOLUME 454557.7 4615033.84 178.19
SO SRCPARAM AB_0002 1.644902331E-05 2.59 5.58 2.41
SO LOCATION AB_0003 VOLUME 454545.7 4615033.84 178.19
SO SRCPARAM AB_0003 1.644902331E-05 2.59 5.58 2.41
SO LOCATION AB_0004 VOLUME 454533.7 4615033.84 178.19
SO SRCPARAM AB_0004 1.644902331E-05 2.59 5.58 2.41
SO LOCATION AB_0005 VOLUME 454521.7 4615033.84 178.19
SO SRCPARAM AB_0005 1.644902331E-05 2.59 5.58 2.41
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SO LOCATION AB_0006 VOLUME 454509.7 4615033.84 178.19
SO SRCPARAM AB_0006 1.644902331E-05 2.59 5.58 2.41
SO LOCATION AB_0007 VOLUME 454497.7 4615033.84 178.19
SO SRCPARAM AB_0007 1.644902331E-05 2.59 5.58 2.41
SO LOCATION AB_0008 VOLUME 454485.7 4615033.84 178.19
SO SRCPARAM AB_0008 1.644902331E-05 2.59 5.58 2.41
SO LOCATION AB_0009 VOLUME 454473.7 4615033.84 178.19
SO SRCPARAM AB_0009 1.644902331E-05 2.59 5.58 2.41
SO LOCATION AB_0010 VOLUME 454461.7 4615033.84 178.19
SO SRCPARAM AB_0010 1.644902331E-05 2.59 5.58 2.41
SO LOCATION CDE_0001 VOLUME 454449.996 4615030.05 178.19
SO SRCPARAM CDE_0001 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0002 VOLUME 454440.148 4615023.19 178.19
SO SRCPARAM CDE_0002 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0003 VOLUME 454430.299 4615016.34 178.19
SO SRCPARAM CDE_0003 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0004 VOLUME 454420.675 4615009.19 178.19
SO SRCPARAM CDE_0004 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0005 VOLUME 454411.484 4615001.47 178.19
SO SRCPARAM CDE_0005 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0006 VOLUME 454402.292 4614993.76 178.19
SO SRCPARAM CDE_0006 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0007 VOLUME 454394.404 4614984.73 178.19
SO SRCPARAM CDE_0007 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0008 VOLUME 454386.594 4614975.62 178.19
SO SRCPARAM CDE_0008 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0009 VOLUME 454380.888 4614965.12 178.19
SO SRCPARAM CDE_0009 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0010 VOLUME 454375.67 4614954.32 178.19
SO SRCPARAM CDE_0010 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0011 VOLUME 454370.542 4614943.47 178.19
SO SRCPARAM CDE_0011 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0012 VOLUME 454366.572 4614932.28 178.19
SO SRCPARAM CDE_0012 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0013 VOLUME 454364.926 4614920.39 178.19
SO SRCPARAM CDE_0013 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0014 VOLUME 454361.686 4614909.6 178.19
SO SRCPARAM CDE_0014 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0015 VOLUME 454351.165 4614903.83 178.19
SO SRCPARAM CDE_0015 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0016 VOLUME 454340.644 4614898.06 178.19
SO SRCPARAM CDE_0016 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0017 VOLUME 454330.123 4614892.29 178.19
SO SRCPARAM CDE_0017 3.435206215E-06 2.59 5.58 2.41
SO LOCATION CDE_0018 VOLUME 454319.602 4614886.52 178.19
SO SRCPARAM CDE_0018 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0019 VOLUME 454309.08 4614880.75 178.19
SO SRCPARAM CDE_0019 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0020 VOLUME 454298.559 4614874.97 178.19
SO SRCPARAM CDE_0020 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0021 VOLUME 454288.038 4614869.2 178.19
SO SRCPARAM CDE_0021 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0022 VOLUME 454277.517 4614863.43 178.19
SO SRCPARAM CDE_0022 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0023 VOLUME 454266.996 4614857.66 178.19
SO SRCPARAM CDE_0023 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0024 VOLUME 454256.475 4614851.89 178.19
SO SRCPARAM CDE_0024 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0025 VOLUME 454245.953 4614846.12 178.19
SO SRCPARAM CDE_0025 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0026 VOLUME 454235.432 4614840.35 178.19
SO SRCPARAM CDE_0026 4.853564357E-06 2.59 5.58 2.41
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SO LOCATION CDE_0027 VOLUME 454224.911 4614834.58 178.19
SO SRCPARAM CDE_0027 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0028 VOLUME 454214.39 4614828.81 178.19
SO SRCPARAM CDE_0028 4.853564357E-06 2.59 5.58 2.41
SO LOCATION CDE_0029 VOLUME 454203.869 4614823.03 178.19
SO SRCPARAM CDE_0029 4.853564357E-06 2.59 5.58 2.41
SO LOCATION I_0001 VOLUME 454452.749 4615028.45 178.19
SO SRCPARAM I_0001 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0002 VOLUME 454447.62 4615017.6 178.19
SO SRCPARAM I_0002 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0003 VOLUME 454442.491 4615006.75 178.19
SO SRCPARAM I_0003 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0004 VOLUME 454437.363 4614995.9 178.19
SO SRCPARAM I_0004 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0005 VOLUME 454432.234 4614985.05 178.19
SO SRCPARAM I_0005 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0006 VOLUME 454427.105 4614974.21 178.19
SO SRCPARAM I_0006 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0007 VOLUME 454421.976 4614963.36 178.19
SO SRCPARAM I_0007 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0008 VOLUME 454416.847 4614952.51 178.19
SO SRCPARAM I_0008 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0009 VOLUME 454411.718 4614941.66 178.19
SO SRCPARAM I_0009 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0010 VOLUME 454406.589 4614930.81 178.19
SO SRCPARAM I_0010 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0011 VOLUME 454401.46 4614919.96 178.19
SO SRCPARAM I_0011 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0012 VOLUME 454396.332 4614909.11 178.19
SO SRCPARAM I_0012 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0013 VOLUME 454391.203 4614898.26 178.19
SO SRCPARAM I_0013 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0014 VOLUME 454386.074 4614887.42 178.19
SO SRCPARAM I_0014 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0015 VOLUME 454380.945 4614876.57 178.19
SO SRCPARAM I_0015 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0016 VOLUME 454375.816 4614865.72 178.19
SO SRCPARAM I_0016 7.462728467E-07 2.59 5.58 2.41
SO LOCATION I_0017 VOLUME 454370.687 4614854.87 178.19
SO SRCPARAM I_0017 7.462728467E-07 2.59 5.58 2.41
SO LOCATION H_0001 VOLUME 454569.74 4615048.61 178.19
SO SRCPARAM H_0001 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0002 VOLUME 454557.74 4615048.58 178.19
SO SRCPARAM H_0002 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0003 VOLUME 454545.74 4615048.55 178.19
SO SRCPARAM H_0003 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0004 VOLUME 454533.74 4615048.51 178.19
SO SRCPARAM H_0004 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0005 VOLUME 454521.74 4615048.48 178.19
SO SRCPARAM H_0005 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0006 VOLUME 454509.74 4615048.45 178.19
SO SRCPARAM H_0006 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0007 VOLUME 454497.74 4615048.41 178.19
SO SRCPARAM H_0007 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0008 VOLUME 454485.74 4615048.38 178.19
SO SRCPARAM H_0008 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0009 VOLUME 454473.826 4615049.52 178.19
SO SRCPARAM H_0009 4.800015258E-06 2.59 5.58 2.41
SO LOCATION H_0010 VOLUME 454462.408 4615052.96 178.19
SO SRCPARAM H_0010 4.800015258E-06 2.59 5.58 2.41
SO LOCATION FG_0001 VOLUME 454450.378 4615031.43 178.19
SO SRCPARAM FG_0001 3.260447155E-06 2.59 5.58 2.41
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SO LOCATION FG_0002 VOLUME 454439.841 4615025.69 178.19
SO SRCPARAM FG_0002 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0003 VOLUME 454429.304 4615019.95 178.19
SO SRCPARAM FG_0003 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0004 VOLUME 454418.767 4615014.21 178.19
SO SRCPARAM FG_0004 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0005 VOLUME 454408.23 4615008.46 178.19
SO SRCPARAM FG_0005 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0006 VOLUME 454397.693 4615002.72 178.19
SO SRCPARAM FG_0006 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0007 VOLUME 454387.156 4614996.98 178.19
SO SRCPARAM FG_0007 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0008 VOLUME 454376.619 4614991.24 178.19
SO SRCPARAM FG_0008 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0009 VOLUME 454366.082 4614985.5 178.19
SO SRCPARAM FG_0009 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0010 VOLUME 454355.545 4614979.75 178.19
SO SRCPARAM FG_0010 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0011 VOLUME 454345.008 4614974.01 178.19
SO SRCPARAM FG_0011 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0012 VOLUME 454334.471 4614968.27 178.19
SO SRCPARAM FG_0012 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0013 VOLUME 454323.934 4614962.53 178.19
SO SRCPARAM FG_0013 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0014 VOLUME 454313.397 4614956.79 178.19
SO SRCPARAM FG_0014 3.260447155E-06 2.59 5.58 2.41
SO LOCATION FG_0015 VOLUME 454301.708 4614955.36 178.19
SO SRCPARAM FG_0015 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0016 VOLUME 454289.711 4614955.09 178.19
SO SRCPARAM FG_0016 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0017 VOLUME 454277.714 4614954.82 178.19
SO SRCPARAM FG_0017 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0018 VOLUME 454266.978 4614949.96 178.19
SO SRCPARAM FG_0018 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0019 VOLUME 454256.532 4614944.06 178.19
SO SRCPARAM FG_0019 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0020 VOLUME 454246.087 4614938.15 178.19
SO SRCPARAM FG_0020 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0021 VOLUME 454235.642 4614932.24 178.19
SO SRCPARAM FG_0021 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0022 VOLUME 454225.196 4614926.34 178.19
SO SRCPARAM FG_0022 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0023 VOLUME 454214.751 4614920.43 178.19
SO SRCPARAM FG_0023 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0024 VOLUME 454204.305 4614914.52 178.19
SO SRCPARAM FG_0024 4.293629776E-06 2.59 5.58 2.41
SO LOCATION FG_0025 VOLUME 454193.86 4614908.61 178.19
SO SRCPARAM FG_0025 4.293629776E-06 2.59 5.58 2.41
** Boiler #3
SO LOCATION 031036AAA1 POINT 454809. 4610011. 178.19
SO SRCPARAM 031036AAA1 1.915167784E-07 7.62 422.038889 4.450023 0.6096
** Boiler #2
SO LOCATION 031036AAA2 POINT 454809. 4610011. 178.19
SO SRCPARAM 031036AAA2 7.421275165E-08 7.62 422.038889 4.450023 0.6096
** Boiler stack #1
SO LOCATION 031036AAA3 POINT 454809. 4610011. 178.19
SO SRCPARAM 031036AAA3 7.421275165E-08 28.956 377.594444 1.372812 1.0668
** 2 Natural gas fired hot water heaters
SO LOCATION 031600AAR4 POINT 453419. 4612420. 178.71
SO SRCPARAM 031600AAR4 1.292738254E-07 25.908 455.927778 8.19492 1.12776
** 4 Big foot air houses (19.4 million BTU/hr each)
SO LOCATION 031600AAR5 POINT 453419. 4612420. 178.71
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SO SRCPARAM 031600AAR5 3.207906039E-07 11.2776 500.927778 6.26426 0.536448
** 2 Hot water stations
SO LOCATION 031600AAR6 POINT 453419. 4612420. 178.71
SO SRCPARAM 031600AAR6 1.292738254E-07 11.2776 494.261111 6.304522 0.560832
** Paint line water heater
SO LOCATION 031600AAR7 POINT 453419. 4612420. 178.71
SO SRCPARAM 031600AAR7 3.351543623E-08 11.2776 494.261111 6.304522 0.560832
** Other natural gas combustion (curing ovens, oxidizers, space heaters)
SO LOCATION 031600AAR8 POINT 453419. 4612420. 178.71
SO SRCPARAM 031600AAR8 5.036891273E-06 11.8872 398.705556 8.527224 0.585216
** Emergency generator
SO LOCATION 031600AAR9 POINT 453419. 4612420. 178.71
SO SRCPARAM 031600AAR9 9.395031964E-07 10.9728 639.816667 20.543579 0.615696
** Kiln #2
SO LOCATION 031600AFV1 POINT 453769.8 4615223.5 178.29
SO SRCPARAM 031600AFV1 0.0082877415476 31.089 355.927778 0.3543 2.6416
** Boiler
SO LOCATION 031600ALC POINT 454085. 4613531. 178.19
SO SRCPARAM 031600ALC 1.168252348E-06 34.1376 516.48 9.852144 0.762
** Natural gas combustion
SO LOCATION 031600AOL POINT 450256. 4617392. 179.77
SO SRCPARAM 031600AOL 3.73457718E-07 9.144 435.372222 14.196714 1.03632
** Boiler #1
SO LOCATION 031600BIY1 POINT 451612. 4613129. 178.39
SO SRCPARAM 031600BIY1 2.202442952E-07 27.432 569.261111 2.062017 1.524
** Boiler #3
SO LOCATION 031600BIY2 POINT 451612. 4613129. 178.39
SO SRCPARAM 031600BIY2 2.633355704E-07 8.5344 474.816667 7.981582 0.6096
** Gas heater
SO LOCATION 031600BRA POINT 454528. 4618594. 179.41
SO SRCPARAM 031600BRA 2.154563757E-07 10.668 449.816667 0.724422 0.762
** Silo loading
SO LOCATION 031600DPK POINT 454722. 4619060. 180.66
SO SRCPARAM 031600DPK 6.362892968E-05 9.7536 318.15 16.603128 0.67056
** Centrifuge Boilers #1 and #2
SO LOCATION 031600DQO POINT 450146. 4613049. 179.53
SO SRCPARAM 031600DQO 1.746633019E-07 14.0208 505.372222 3.959365 0.557784
** 2 Steam generators
SO LOCATION 031600FDK POINT 453577. 4617978. 183.41
SO SRCPARAM 031600FDK 1.86728859E-07 10.3632 477.594444 9.57E-04 0.79248
** Cement silo loading
SO LOCATION 031600FGT1 POINT 451809. 4617532. 180.08
SO SRCPARAM 031600FGT1 0.002386084863 10.9728 299.816667 8.469525 0.8534
** Mixer and/or truck loading
SO LOCATION 031600FGT2 POINT 451809. 4617532. 180.08
SO SRCPARAM 031600FGT2 0.0046266421739 9.7536 299.82 7.860112 0.88392
** Natural gas combustion
SO LOCATION 031600FGT3 POINT 451809. 4617532. 180.08
SO SRCPARAM 031600FGT3 4.309127515E-07 15.24 444.816667 7.860153 0.823
** Portland cement terminal: Cement silo loading
SO LOCATION 031600FHQ1 POINT 452496.4 4612239.7 178.07
SO SRCPARAM 031600FHQ1 1.272578594E-05 61.7728 294.261111 3.81 0.6878
** Portland cement terminal: Truck loading/unloading
SO LOCATION 031600FHQ2 POINT 452461. 4612136. 180.83
SO SRCPARAM 031600FHQ2 7.635471562E-05 36.576 294.261111 0.9525 1.3757
** Slag dryer
SO LOCATION 031600FHQ5 POINT 452468. 4612141. 180.19
SO SRCPARAM 031600FHQ5 1.474679194E-06 47.8536 357.038889 17.007482 1.624584
** Product collector from shaft dryers (T51-HG1), Cyclone (T51-CN1), and Separator
(T61-SR1)
SO LOCATION 031600FLD1 POINT 454330. 4617602. 178.19
SO SRCPARAM 031600FLD1 8.378859057E-10 27.432 369.261111 26.727508 0.6706
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** Polymers (Y-Chutes, top of T61-RP2 bin and T61-RP2), and Aux. dryers (T71-HG2 and
T71-HG7)
SO LOCATION 031600FLD2 POINT 454330. 4617602. 178.19
SO SRCPARAM 031600FLD2 2.106684563E-10 27.432 369.261111 4.458148 0.67056
** Natural gas combustion
SO LOCATION 031600FWM POINT 453740. 4613979. 179.34
SO SRCPARAM 031600FWM 7.37339597E-07 17.6784 497.594444 8.426379 1.0363
** Natural gas combustion
SO LOCATION 031600GFX POINT 450418. 4617336. 179.79
SO SRCPARAM 031600GFX 7.804308722E-07 14.9352 439.26 9.79607 0.752856
** Turbine CT-01
SO LOCATION 031600GHA1 POINT 453654. 4614792. 178.4
SO SRCPARAM 031600GHA1 0.0134396899272 27.432 809.261111 26.810096 6.096
** Turbine CT-02
SO LOCATION 031600GHA3 POINT 453697. 4614792. 178.47
SO SRCPARAM 031600GHA3 0.0126312875255 27.432 809.261111 26.810096 6.096
** 2 Boilers
SO LOCATION 031600GHV1 POINT 452774. 4612395. 178.49
SO SRCPARAM 031600GHV1 6.846724829E-07 10.668 438.705556 13.511052 0.4572
** 2 Boilers
SO LOCATION 031600GHV2 POINT 452774. 4612395. 178.49
SO SRCPARAM 031600GHV2 5.937020132E-07 10.668 438.705556 13.511052 0.4572
** Turbine CTG-5
SO LOCATION 031600GKE1 POINT 454621. 4618643. 179.06
SO SRCPARAM 031600GKE1 0.0054112435759 25.6032 838.705556 26.814992 3.7003
** Backup generator EDG A
SO LOCATION 031600GKE2 POINT 454708. 4618584. 178.35
SO SRCPARAM 031600GKE2 0.0019704606943 3.6576 752.594444 11.642503 0.9144
** Backup generator EDG B
SO LOCATION 031600GKE3 POINT 454708. 4618571. 178.35
SO SRCPARAM 031600GKE3 0.0019704606943 3.6576 752.594444 11.642502 0.9144
** Backup generator EDG C
SO LOCATION 031600GKE4 POINT 454708. 4618559. 178.35
SO SRCPARAM 031600GKE4 0.0019704606943 3.6576 752.594444 11.642503 0.9144
** Turbine CTG-6
SO LOCATION 031600GKE5 POINT 454621. 4618616. 179.02
SO SRCPARAM 031600GKE5 0.0053485923898 25.6032 838.705556 26.814992 3.700272
** Turbine CTG-7
SO LOCATION 031600GKE6 POINT 454621. 4618590. 179.09
SO SRCPARAM 031600GKE6 0.0053890125099 25.6032 838.705556 26.814992 3.700272
** Turbine CTG-8
SO LOCATION 031600GKE7 POINT 454621. 4618564. 179.18
SO SRCPARAM 031600GKE7 0.0054698527501 25.6032 838.705556 26.814992 3.700272
** Turbine CTG-9
SO LOCATION 031600GKE8 POINT 454672. 4618643. 178.67
SO SRCPARAM 031600GKE8 0.0052889727127 25.6032 838.705556 26.814992 3.700272
** Turbine CTG-10
SO LOCATION 031600GKE9 POINT 454672. 4618617. 178.61
SO SRCPARAM 031600GKE9 0.0052950357307 25.6032 838.705556 26.814992 3.700272
** Turbine CTG-11
SO LOCATION 031600GKE10 POINT 454672. 4618590. 178.59
SO SRCPARAM 031600GKE10 0.0053182772998 25.6032 838.705556 26.814992 3.700272
** Turbine CTG-12
SO LOCATION 031600GKE11 POINT 454672. 4618564. 178.6
SO SRCPARAM 031600GKE11 0.0053010987487 25.6032 838.71 26.814992 3.700272
** Combined boilers stack
SO LOCATION 031600GKU POINT 451623. 4617728. 180.35
SO SRCPARAM 031600GKU 6.224295299E-07 9.144 449.82 3.701166 0.9144
** Boliler
SO LOCATION 031600GWV POINT 454218. 4613685. 178.19
SO SRCPARAM 031600GWV 1.610857703E-05 22.5552 486.483333 8.935881 1.152144
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0 0 0
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1 1 1
SO EMISFACT V2 HRDOW 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0
SO EMISFACT V3 HRDOW 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 1 1
1 1 1
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0 0 0
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1 1 1
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0 0 0
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1 1 1
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0 0 0
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0 0 0
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1 1 1 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684
0.0684 1 1 1 1 1
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0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684
0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684 0.0684
SO EMISFACT V4 HRDOW 0.1000 0.1000 0.1000 0.1000 0.1000 0.1000 0.1000 1 1 1 1 1 1 1 1 1
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0.1000 1 1 1 1 1
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0.1000 0.1000 0.1000 0.1000 0.1000 0.1000 0.1000 0.1000 0.1000 0.1000 0.1000
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1 1 1 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195
0.0195 1 1 1 1 1
SO EMISFACT V9 HRDOW 1 1 1 1 1 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195
0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195
0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195 0.0195
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0.2650 0.2650 0.2650 0.2650 1 1 1 1 1
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0.2650
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0.2650
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0 0 0
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SO EMISFACT VN1 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103 0.000103
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SO EMISFACT VN4 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567 0.0567
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SO EMISFACT VN5 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438 0.1438
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SO EMISFACT VN6 HRDOW 1 1 1 1 1 1 1 1 1 1 1 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095 0.0095
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Appendix D. Individual Acute, 8-Hour, and Chronic Reference Exposure Level Summaries

D.1 Summaries using this version of the Hot Spots Risk Assessment guidelines

D.2 Acute RELs and toxicity summaries using the previous version of the Hot Spots Risk Assessment guidelines (OEHHA 1999)

D.3 Chronic RELs and toxicity summaries using the previous version of the Hot Spots Risk Assessment guidelines (OEHHA 2000)

(Revised July 2014 to reflect adoption of additional new or revised RELs)

Appendix D.1 Summaries using this version of the Hot Spots Risk Assessment guidelines

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Acrolein Reference Exposure Levels 47

Inorganic Arsenic Reference Exposure Levels..... 75

Benzene Reference Exposure Levels 139

1,3-Butadiene Reference Exposure Levels 212

Caprolactam Reference Exposure Levels 315

Formaldehyde Reference Exposure Levels 384

Manganese and Compounds Reference Exposure Levels 429

Mercury Reference Exposure Levels 476

Nickel and Nickel Compounds, including Nickel Oxide.
Reference Exposure Levels..... 502

Substance	Inhalation REL ($\mu g/m^3$)		Oral REL ($\mu g/kg$ BW-day)	Hazard Index Target Organs	Species
Acetaldehyde (75-07-0)	**A**	470		Eyes; respiratory system (sensory irritation)	H
	8	300		Respiratory system	R
	C	140		Respiratory system	R
Acrolein (107-02-8)	**A**	2.5		Eyes; respiratory system (sensory irritation)	H
	8	0.7		Respiratory system	R
	C	0.35		Respiratory system	R
Arsenic (7440-38-2) **& inorganic arsenic compounds (including arsine)**	**A**	0.20		Development; cardiovascular system; nervous system	M
	8	0.015		Development; cardiovascular system; nervous system; respiratory system; skin	H
	C	0.015	0.0035	*Inhalation and Oral:* Development; cardiovascular system; nervous system; respiratory system; skin	H
Benzene (71-43-2)	**A**	27		Developmental; Immune System; Hematologic System	M
	8	3		Hematologic System	H
	C	3		Hematologic System	H
Butadiene (106-99-0)	**A**	660		Development	M
	8	9		Reproductive system	M
	C	2		Reproductive system	M
Caprolactam (105-60-2)	**A**	50		Eyes (sensory irritation)	H
	8	7		Respiratory system	R
	C	2.2		Respiratory system	R
Formaldehyde (50-00-0)	**A**	55		Sensory irritation; eyes	H
	8	9		Respiratory system	H
	C	9		Respiratory system	H
Manganese (7439-96-5) **& manganese compounds**	**A**	--			
	8	0.17		Nervous system	H
	C	0.09		Nervous system	H
Mercury (7439-97-6) **& inorganic mercury compounds**	**A**	0.6		Nervous system, development	R
	8	0.06		Nervous system	H
	C	0.03	0.16	Nervous system	H
Nickel & nickel compounds (except nickel oxide for chronic inhalation exposures) (Inhalation concentrations as µg Ni/m^3: oral dose as µg Ni/kg-day)	**A**	0.2		Immune system	M
	8	0.06		Respiratorysystem, immune system	R
	C	0.014	11	*Inhalation:* Respiratory system; hematologic system *Oral:* Development	R R

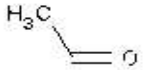
Substance	Inhalation REL (μg/m^3)		Oral REL (μg/kg BW-day)	Hazard Index Target Organs	Species
Nickel oxide (1313-99-1) (Inhalation concentration as μg Ni/m^3: oral dose as μg Ni/kg-day)	**C**	0.02	11	*Inhalation:* Respiratory system *Oral:* Development	M R

Species: H = Human M = Mouse R = Rat

Acetaldehyde Reference Exposure Levels

(ethanal; acetic aldehyde; acetylaldehyde; ethylaldehyde; diethylacetyl)

CAS: 75-07-0



1. Summary

Based on acute and chronic inhalation studies conducted mostly in experimental animals, the target tissue for acetaldehyde has consistently been at the portal of entry with effects occurring primarily in the upper respiratory tract at lowest concentrations. The major noncancer health effects of acute exposure in humans to acetaldehyde vapors consist of irritation to the eyes, skin, and respiratory tract. Low to moderate air concentrations (25 ppm to 200 ppm) cause eye and upper respiratory tract irritation. Moderate concentrations (~ 300 ppm or greater) also cause bronchoconstriction in asthmatics as measured by a greater than 20% drop in forced expiratory volume (FEV_1). Signs of acute toxicity in animals at high concentrations (~10,000 ppm) include labored respiration, mouth breathing, weight loss, and liver damage. The studies described in this document include those published through the Spring of 2008.

OEHHA used the critical effect of bronchoconstriction in asthmatics as the basis for determination of the acute Reference Exposure Level (REL).

Subchronic and chronic exposure to acetaldehyde causes inflammation and injury to the respiratory tract (e.g. lesions including hyperplasia and metaplasia of the olfactory mucosa). Exposure to acetaldehyde, as seen in experimental animal studies, causes histopathological changes in the nose, larynx, and trachea including degeneration, hyperplasia, and metaplasia. Chronic toxicity to rats and hamsters following inhalation exposure to acetaldehyde includes increased mortality and growth retardation. OEHHA used degenerative, inflammatory and hyperplastic changes of the nasal mucosa in rats as the basis for the 8-hour and chronic REL.

Children, especially those with diagnosed asthma, may be more likely to show impaired pulmonary function and symptoms of asthma than are adults following exposure to acetaldehyde. Acetaldehyde is identified as a Toxic Air Contaminant (TAC); this report presents evidence that it should also be listed as having the potential to differentially impact infants and children due to its effects as a respiratory irritant and possible exacerbation of asthma. In addition, acetaldehyde has high California Hot Spots and mobile source emissions, and secondary formation in the atmosphere (OEHHA, 2001).

1.1 Acetaldehyde Acute REL

Reference Exposure Level	**470 μg/m^3 (260 ppb)**
Critical effect(s)	Sensory irritation, broncoconstriction, eye redness and swelling
Hazard index target(s)	Bronchi, eyes, nose, throat

1.2 Acetaldehyde 8-Hour REL

Reference Exposure Level	**300 μg/m^3 (160 ppb)**
Critical effect(s)	Degeneration of olfactory nasal epithelium
Hazard index target(s)	Respiratory system

1.3 Acetaldehyde Chronic REL

Reference Exposure Level	140 □g/m3 (80 ppb)
Critical effect(s)	Degenerative, inflammatory and hyperplastic changes of the nasal mucosa in animals
Hazard index target(s)	Respiratory system

2. Physical & Chemical Properties

Description	Colorless liquid or gas (above 21°C)
Molecular formula	C_2H_4O
Molecular weight	44.05 g/mol
Density	0.79 g/cm^3
Boiling point	21 °C
Melting point	-123.5 °C
Vapor pressure	755 mm Hg @ 20°C
Odor threshold	0.09 mg/m^3
Solubility	Miscible in all proportions with water and the most common organic solvents.
Conversion factor	1.8 mg/m^3 = 1 ppm @ 25°C

3. Occurrence and Major Uses

Acetaldehyde is used as an intermediate for the manufacture of a number of other chemicals, including acetic acid, acetic anhydride, ethyl acetate, peracetic acid, pentaerythritol, chloral, alkylamines, and pyridines (HSDB, 2004). Sources of acetaldehyde emissions include interior finish materials such as sheet vinyl flooring and carpets, and wood-based building products such as fiberboard and particleboard. Some consumer products also emit acetaldehyde, including adhesives and glues, coatings, lubricants, inks, nail polish removers, liquid wax for wood preservation, detergent and cleansers, deodorants, fuels, and mold inhibitors (Beall and Ulsamer, 1981; CARB, 1993). Emissions of acetaldehyde also occur during combustion processes such as cigarette smoking, automobile exhaust, and use of fireplaces and woodstoves, although long-term indoor concentrations tend to be dominated by non-combustion sources.

An emissions study of new building materials found that samples of carpet, fiberboard, particleboard, and non-rubber resilient flooring emitted acetaldehyde (Burt et al., 1996; IWMB, 2003). Air concentrations based on the acetaldehyde emission rates from these various building products, when modeled to standard State office and classroom dimensions, ranged from 4.6 to 26 µg/m^3 (2.6 to 14 ppb).

Indoor concentrations of acetaldehyde often greatly exceed outdoor levels and appear to dictate personal exposures, which is consistent with the more significant and widespread indoor sources of this aldehyde. In 2002, the annual average outdoor concentration of acetaldehyde in the South Coast Air Basin was 2.5 µg/m^3 (1.4 ppb). In Brazil, which has a high usage of ethanol as a transportation fuel, outdoor acetaldehyde concentrations have been measured as high as 63 µg/m^3 (35 ppb) while a highway tunnel had measured levels of acetaldehyde of 430 µg/m^3 (240 ppb). The mean acetaldehyde concentrations in U.S. homes range from 15 to 36 µg/m^3 (8.3 to 20 ppb), but reached as high as 103 µg/m^3 (57.2 ppb) in newly manufactured homes (Zweidinger et al., 1990; Lindstrom et al., 1995; Hodgson et al., 2002; Kinney et al., 2002). Acetaldehyde concentrations measured in Southern California portable classrooms ranged from 5.7 to 12.8 µg/m^3 (3.2 to 7.1 ppb) with a mean of 9.8 µg/m^3 (5.4 ppb) (Hodgson et al., 2004) Similar concentrations were found in classrooms of the main buildings. Measured concentrations of acetaldehyde in public/office buildings range from 3 to 16 µg/m^3 (1.7 to 8.9 ppb).

Environmental tobacco smoke (ETS) has been found to be a source of environmental acetaldehyde. Although long-term acetaldehyde levels in smoking and non-smoking homes tend to be similar, acetaldehyde concentrations in homes as a result of exposure from ETS for nonsmoking Californians has been estimated at 11-15 µg/m^3 (6.1 to 8.3 ppb) (Miller et al., 1998). Concentrations of acetaldehyde measured over a 72-hour period in 57 homes ranged from 3 to 23 µg/m^3 (1.7 to 12.8 ppb). However, no significant difference was observed between the homes of smokers and nonsmokers (Brown et al., 1994). A 48-hour integrated measurement of breathing-zone concentrations revealed that people who work in garages (9 smokers and 13 nonsmokers) had significantly higher levels of breath acetaldehyde than controls (4

smokers and 11 nonsmokers), and the smokers had significantly higher levels of breath acetaldehyde than the nonsmokers.

The concentration of breath acetaldehyde (endogenous level) in non-alcoholic, non-smokers range from 0.7 to 11.0 μg/m^3(0.4 to 6.1 ppb), but can be somewhat higher in smokers (16 ± 3 μg/m^3 = 8.9ppb). The higher concentrations are seen in the breath of smokers after they ingest alcohol. With alcohol consumption, the concentrations of acetaldehyde produced vastly exceed the trace amounts generated from microorganisms or other possible endogenous substrates. When subjects with normal aldehyde dehydrogenase (ALDH) activity drink small amounts of alcohol (0.4-0.8 g/kg), the concentrations of breath acetaldehyde may reach between 200 and 2200 μg/m^3 (111 to 1222 ppb) (Shaskan and Dolinsky, 1985; Jones, 1995).

In a controlled human study, five healthy nonsmoking adults inhaled low doses of ethanol (ETOH) and concentrations of ETOH and acetaldehyde were measured in the alveolar air using only the last portion of air in the sampling bag after forced expiration through a three-way valve (Tardif et al., 2004). Exposures were for six consecutive hours to 25, 100, or 1000 ppm ETOH. After two hours of exposure at 25 ppm, acetaldehyde and ETOH were measured in the alveolar air at 0.06 and 7.5 ppm, respectively.

In Asian subjects with a genetic deficiency of the enzyme aldehyde dehydrogenase (ALDH), the concentration of acetaldehyde in the breath after drinking can reach 8.8-22 mg/m^3 (4.9 to 12.2 ppm). Higher concentrations of acetaldehyde have been shown to activate mast cells, which then induce histamine release. In one case study, a patient had a severe bronchial asthma attack after ingesting food containing small amounts of alcohol, and was found to be homozygous for the ALDH-2 mutant genotype. Both acetaldehyde and ethanol inhalation tests were performed on the patient. The ethanol inhalation test was negative, but acetaldehyde inhalation (5, 10, 20, or 40 mg/ml) decreased $FEV_{1.0}$ by 33.5% at 20 mg/ml (Saito et al., 2001).

4. Disposition

Acetaldehyde is readily absorbed through the lungs into the blood following inhalation exposure. Acetaldehyde is rapidly exchanged and equilibrated between blood entering the lungs and alveolar air. Male Sprague-Dawley rats exposed to acetaldehyde vapor concentrations in air ranging from 9 to 1000 mg/l (0.009 to 1 mg/m^3 or 500 to 555 ppb) for one hour had higher levels of acetaldehyde in the blood than liver (Watanabe et al., 1986). Levels in the arterial blood were also higher than in peripheral venous blood.

Two studies were performed using humans and dogs to determine the percent retention of inhaled acetaldehyde in the respiratory tract (Egle Jr, 1970; Egle Jr., 1972a; 1972b). In humans, the total respiratory tract retention of acetaldehyde was 45-70% when inhaled either orally or nasally (Egle Jr, 1970). Physiological respiratory total retention in multiple breath experiments was independent of tidal volume, and uptake was controlled by frequency and duration of ventilation. Total respiratory tract retention of acetaldehyde in dogs was found to be very close to human retention values and

inversely related to ventilatory rate in the same manner as humans (Egle Jr., 1972b). Uptake was also found to be higher in the upper than the lower respiratory tract and unrelated to changes in concentration inhaled or tidal volume (Egle Jr., 1972b).

Acetaldehyde deposition efficiency is strongly dependent on the inspired concentration, with deposition being less efficient at high compared to low concentrations. Species differences have been observed in uptake efficiency with uptake being significantly higher in the mouse, rat, and hamster compared to the guinea pig at 100 ppm, but at 10 ppm the rat had the lowest uptake (Morris, 1997a).

Following oral administration, acetaldehyde is readily absorbed from the gastrointestinal tract and undergoes extensive first pass metabolism in the liver; only 5% remains unchanged (Morris, 1997b).

Acetaldehyde rapidly diffuses through cellular membranes and is distributed to various organs for metabolism. The half-life in rats after inhalation of actetaldehyde was 10 minutes, and the time to total body clearance was 40 minutes (Shiohara et al., 1984). Inhaled acetaldehyde does not undergo a first pass effect and is distributed to all tissues including the liver. Inhaled acetaldehyde undergoes extrahepatic metabolism and is metabolized by aldehyde dehydrogenase in the lungs to acetate. Aldehyde dehydrogenase is found in both the cytosol and the mitochondria. Inhaled acetaldehyde undergoes extrahepatic metabolism by the respiratory-olfactory epithelium, kidneys, blood, brain, and spleen, and only small amounts reach the liver. Acetaldehyde also crosses the blood-brain barrier. Protons (H^+) are a by-product of acetaldehyde metabolism (to acetate), which under high exposure conditions, have the potential to acidify cells and cause cytotoxicity, if cellular buffering systems and proton pumps are overwhelmed (Bogdanffy et al., 2001).

Various isoenzymes of alcohol dehydrogenase transform ethanol into acetaldehyde, which in turn is rapidly oxidized by aldehyde dehydrogenase (ALDH) into acetate. Both pathways for acetaldehyde metabolism (low-affinity (cytosolic ALDH1) and high-affinity (mitochondrial ALDH2) are present and have been described in rodent nasal olfactory and respiratory tissues (Casanova-Schmitz et al., 1984; Morris, 1997a; 1997b; Bogdanffy et al., 1998).

Functional genetic polymorphisms and ethnic variation exist at various genes encoding these enzyme proteins which all act to alter the rate of synthesis of the toxic metabolite acetaldehyde, or decrease its further oxidation. About 50% of the Asian population are alcohol-sensitive, having a deficiency or low activity in aldehyde dehydrogenase enzymes that are important in ethanol metabolism. This can result in high acetaldehyde levels in blood and breath following alcohol consumption.

A small amount of acetaldehyde is produced in the body during normal intermediary metabolism and is also a product of microbial fermentation of sugars in the gut. However, based on studies in animals, the critical effects of exposure to exogenous acetaldehyde occur at the site of initial contact (i.e., the respiratory tract following inhalation).

At least two isozymes of aldehyde dehydrogenase were found in the rodent nasal mucosa, differing with respect to their apparent Vmax and Km values (Morris, 1997a). Male F344 rats were exposed to 1500 ppm acetaldehyde for 6 hours/day for 5 days. Oxidation of acetaldehyde occurred more rapidly in the homogenates of the respiratory than the olfactory mucosa (Morris, 1997a). The nasal tissue is the first to contact acetaldehyde vapors upon inhalation. The aldehyde dehydrogenase acts as a defense mechanism helping to minimize or prevent toxic injury to nasal tissues exposed to airborne compounds. Pretreatment with an ALDH inhibitor reduced nasal acetaldehyde deposition rates (Morris, 1997a).

Acetaldehyde can be eliminated unchanged in urine, expired air, and skin (Baselt and Cravey, 1989) and is metabolized by aldehyde dehydrogenase to acetate which is readily excreted in the urine.. Acetaldehyde is highly reactive and can bind to amino acids and blood and membrane proteins, and act as a hapten (Mohammad et al., 1949; Eriksson et al., 1977; Gaines et al., 1977; Donohue Jr. et al., 1983; Tuma and Sorrell, 1985; Dellarco, 1988; Hoffmann et al., 1993; Wickramasinghe et al., 1994; Tyulina et al., 2006). Antibodies against acetaldehyde conjugates have been detected in human and rabbit serum (Gaines et al., 1977). Acetaldehyde is a weak clastogen that induces sister chromatid exchanges and reacts with DNA to form DNA-protein and DNA-DNA cross-links (Dellarco, 1988). Acetaldehyde causes lipid peroxidation, which can lead to adduct formation and free radical-induced cell injury.

5. Acute Toxicity of Acetaldehyde

5.1 Acute Toxicity to Adult Humans

Several studies in human volunteers are available, including several recent studies in asthmatics where subjects inhaled aerosolized acetaldehyde. The ability to determine a one-hour reference exposure level (REL) is limited due to the extremely short exposure period of only 2-4 minutes that was used in these studies. However, inhalation experiments with human volunteers in which exposure lasted longer are old and of limited design. The major acute effects of human exposure to acetaldehyde vapors consist of irritation to the eyes, skin and respiratory tract, and bronchoconstriction in asthmatics. The key study used to determine the acute Reference Exposure Level (REL) was a study performed in human volunteers investigating bronchoconstriction in response to inhaled aerosolized acetaldehyde (Prieto et al., 2000). The Prieto et al. (2000) study determined the mean acetaldehyde concentration causing a 20% decrease in Force Expiratory Volume (FEV_1) in asthmatic human volunteers.

Silverman et al. (1946) exposed human volunteers to acetaldehyde to determine the sensory response limit for solvent concentrations when estimating ventilation requirements for comfortable working conditions (Silverman et al., 1946). The sensory limits were reported and compared to the maximum allowable concentration, which was stated as 200 ppm for acetaldehyde at the time of the study. Twelve volunteer human subjects of both sexes were used for each solvent exposure. During the 15 minute exposure period, motion pictures were shown to occupy the subjects' attention and divert their thoughts from the atmospheric exposure in the chamber. The results,

though described in a limited way, are useful because the analysis was performed in human subjects and the concentrations tested were as low as 25 ppm. At 50 ppm, the majority of subjects experienced eye irritation (number not specified). The subjects that did not report eye irritation had reddened eyelids and bloodshot eyes after exposure at 200 ppm. Several subjects reported unspecified irritation at 25 ppm and "objected strenuously." Finally, nose and throat irritation were reported as occurring at concentrations greater than 200 ppm (Silverman et al., 1946).

A second acute human study was found in the historical literature, where fourteen male subjects were exposed to 134 ppm acetaldehyde in a chamber for 30 minutes (Sim and Pattle, 1957). Subjects reported mild upper respiratory tract irritation (Sim and Pattle, 1957). However, a major confounder with this study appears in the methods section, which stated that subjects were permitted to smoke inside the "chamber" during the 30 minutes.

Acetaldehyde provocation tests have been conducted with asthmatic and non-asthmatic human subjects using aerosolized acetaldehyde solutions. As mentioned previously, aldehyde dehydrogenase plays an important part in the metabolism of ethanol in making possible the conversion of acetaldehyde (previously formed from ethanol by alcohol dehydrogenase) to acetic acid. Lower activity of aldehyde dehydrogenase leads to elevated concentrations of acetaldehyde in the blood, which in asthmatic subjects may produce bronchoconstriction. There are indications that enhanced release of histamine from pre-activated airway mast cells plays an important role (Myou et al., 1993). As a result of the polymorphism of ALDH-2, nearly half of the Japanese patients with asthma show bronchoconstriction after drinking alcohol, a phenomenon that is also known to occur in other Asian populations (Myou et al., 1993; Myou et al., 1994; Fujimura et al., 1999). In several studies in asthmatic volunteers, inhaled acetaldehyde aerosol has been tested for its bronchoconstrictive effect, first in three studies in Japanese subjects (Myou et al., 1993; Myou et al., 1994; Fujimura et al., 1999) and subsequently in several studies in Caucasian subjects (Prieto et al., 2000; Prieto et al., 2002a; Prieto et al., 2002b). In these studies, subjects inhaled aerosolized acetaldehyde for very short periods; exposure was (2-4 minutes).

Myou et al. (1993) exposed a group of nine asthmatic volunteers (age 39.2 $\pm$ 5.4 yr) and nine age- and sex- matched controls to aerosolized acetaldehyde for 2 minutes immediately followed by measurement of Force Expiratory Volume in one second (FEV_1). The solutions of 5, 10, 20, or 40 mg/ml of acetaldehyde were in saline and were inhaled from a nebulizer for 2 minutes by mouth tidal breathing wearing a noseclip. The aerosol was produced using a DeVilbiss 646 nebulizer operated by compressed air at 5 liters per minute. Nebulizer output was not reported but probably was the same as in later studies by this group, i.e. 0.14 ml/minute. No measurements of acetaldehyde concentration in air were made. The dose response study showed significant reductions in FEV_1 at all acetaldehyde test concentrations in asthmatics whereas no effect was seen in normal subjects (Myou et al., 1993).

In further experiments with the same group of volunteers, the influence of oral terfenadine, a histamine H1 blocker, was examined as was the bronchial

responsiveness to methacholine (challenge with methacholine is a common asthma identification test). The response seen after inhalation of acetaldehyde was completely suppressed by pretreatment with terfenadine, which supports the hypothesis that bronchial hyper-responsiveness is a precondition of acetaldehyde induced bronchoconstriction, which is caused indirectly via histamine release in asthmatics (Myou et al., 1993). A rough estimate from the dose response curve as presented in the paper, suggests a PC_{20} for acetaldehyde (acetaldehyde concentration producing a 20% reduction in FEV_1) of about 20 mg/ml (Myou et al., 1993). The acetaldehyde aerosol concentration as mg/m^3 in this study can be estimated as follows. The nebulizer was operated at 5 liters air/minute for 2 minutes with an acetaldehyde solution output of 0.14 ml/minute. When given at this rate a 20 mg acetaldehyde/ml solution (the estimated PC_{20}) corresponds to a concentration in air of approximately 560 mg/m^3 (about 314 ppm).

In a subsequent acute human study, nine asthmatic subjects of Japanese origin were used to determine whether bronchial responsiveness to inhaled methacholine (STET: a standard test used to identify agents that potentially exacerbate asthma) was altered when asthmatic subjects inhaled a sub threshold concentration of aerosolized acetaldehyde which did not cause bronchoconstriction, and whether any increase in bronchial hyper-responsiveness after acetaldehyde was mediated by histamine release (Myou et al., 1994). For each subject, the concentration of acetaldehyde producing a 20% fall in FEV_1 was determined (PC_{20}) using ascending doses (5, 10, 20, or 40 mg/ml) of acetaldehyde. The mean concentration of PC_{20} for the nine subjects was 23.3 mg/ml of acetaldehyde (Myou et al., 1994). The nebulizer was operated at 5 liters air/minute for 4 minutes with an acetaldehyde solution output of 0.14 ml/minute. Therefore, a 23.3 mg acetaldehyde/ml solution corresponds to a concentration in air of approximately 652 mg/m^3 (about 362 ppm).

In part two of this study, nine subjects inhaled a sub threshold concentration of 0.8 mg/ml acetaldehyde at 0.14 ml/minute for four minutes or saline followed by provocation with a range of increasing methacholine concentrations (Myou et al., 1994). FEV_1 was measured before and after treatment. Acetaldehyde potentiated bronchial hyper-responsiveness to provocation by methacholine (Myou et al., 1994) producing a marked reduction in PC_{20}-MCH (0.48 mg/ml versus 0.85 mg/ml after saline treatment) (Myou et al., 1994).

Myou et al. (1995) examined tachyphylaxis occurring in response to repeated inhalation of histamine or acetaldehyde in nine asthmatic subjects. The mean acetaldehyde concentration causing a 20% decrease in FEV_1 increased significantly from a geometric mean of 18.4 mg/ml (with a geometic standard error (GSEM) of 0.14) to 45.2 mg/ml (GSEM 0.14) over a period of one hour ($p<0.002$). The mean histamine concentrations causing a 20% decrease in FEV_1 were no different.

In a later study in asthmatics of Japanese origin, the hypothesis was tested that asthmatics that are sensitive to alcohol (showing bronchoconstriction after drinking alcohol) also have increased airway responsiveness to inhaled acetaldehyde when compared to asthmatics not sensitive to alcohol (Fujimura et al., 1999). Ten alcohol-

sensitive asthmatics and 16 alcohol insensitive asthmatics (20-65 years) of Japanese origin inhaled acetaldehyde aerosol for 2 minutes by tidal mouth breathing and FEV_1 was measured. Increasing concentrations of acetaldehyde solutions in saline (0.04 to 80 mg acetaldehyde/ml) were inhaled until FEV_1 showed a fall of 20%. In the alcohol-sensitive group the geometric mean PC_{20} was 21.0 mg/ml (range not reported), whereas in the alcohol-insensitive group this was 31.7 mg/ml (range not reported). The difference between the groups, however, was not statistically significant (Fujimura et al., 1999). The aerosol was produced using a DeVilbiss 646 nebulizer operated by compressed air at 5 liters/minute with a nebulizer output of 0.14 ml/minute. The nebulizer was operated at 5 liters air/minute for 2 minutes with a acetaldehyde solution output of 0.14 ml/minute. At this rate, inhalation of acetaldehyde solutions of 0.04 to 80 mg/ml corresponds to concentrations in air of approximately 1.12 to 2240 mg/m^3. Similarly, the geometric mean PC_{20} in the alcohol-sensitive group corresponds to approximately 588 mg/m^3 (about 330 ppm) and the geometric mean PC_{20} in the alcohol-insensitive group to approximately 888 mg/m^3 (about 500 ppm).

In the key study (Prieto et al., 2000) used for the acute REL determination, the responses to methacholine and acetaldehyde challenges were measured in 81 non-smoking adults to determine differences in airway responsiveness between asthmatics and healthy subjects and to examine the relationship between acetaldehyde responsiveness and the variability of peak expiratory flow (PEF). Prieto et al. (2000) examined whether the bronchoconstriction seen in Japanese asthmatics after inhalation of acetaldehyde also occurred in Caucasian subjects. They exposed 61 mildly asthmatic subjects and 20 healthy subjects (control group) to aerosolized acetaldehyde (5 to 40 mg acetaldehyde/ml) for two minutes using a two-minute tidal breathing-method and FEV_1 was measured 60 to 90 seconds after inhalation of each concentration until FEV_1 dropped by more than 20%. In this study, the PC_{20} values for acetaldehyde ranged from 1.96 to 40 mg/mL with a geometric mean value of 17.55 mg/mL and the 95% confidence interval of the geometric mean (95% CI 4.72-38.3 mg/ml). Therefore, the lower limit of the geometric 95% CI was 4.72 mg/ml (Prieto, 2008). Effectively, the data are for the geometric mean (antilog of the mean PC20 acetaldehide) and the 95% CI is for the antilog of this value also. This is the traditional way these type of data are presented for acetaldehyde, methacholine or AMP (Prieto 2008). In the asthma group 56/61 subjects showed bronchoconstriction compared to 0/20 in the control group. Inhaled acetaldehyde was much less potent as a bronchoconstrictor than methacholine in asthmatic patients. Peak expiratory flow variation was significantly but weakly related to acetaldehyde responsiveness ($p = 0.004$). The results obtained by Prieto et al. (2000) indicate that airway hyper-responsiveness to acetaldehyde is a sensitive and specific indicator for separating normal and asthmatic subjects.

In the Prieto et al. (2000) study, aqueous solutions containing acetaldehyde were nebulized in a Hudson 1720 nebulizer operated by compressed air at 6 liters/minute with a nebulizer output of 0.18 ml/minute. Flow rates were reported in a National Advisory Committee document from the U.S. EPA, based on a personal communication from the Prieto group (NAS, 2004). The nebulizer was operated at 6 liters air/minute for 2 minutes with an acetaldehyde solution output of 0.18 ml/minute. At this rate, inhalation of acetaldehyde solutions of 5 to 40 mg/ml corresponds to concentrations in

air of approximately 150 to 1200 mg/m^3. The observed geometric mean PC_{20} of 17.55 mg/ml corresponds to 527 mg/m^3 (about 293 ppm) and the lower 95% confidence interval of 4.72 mg/ml corresponds to approximately 142 mg/m^3 (about 79 ppm).

In a follow-up study, Prieto et al. (2002a) exposed mildly asthmatic subjects (age 18-58 years) to 2.5 to 80 mg acetaldehyde/ml using a Hudson 1720 nebulizer with an output of 5 liters/minute. In the first group, 16 subjects were measured for their response to acetaldehyde which was compared to that of methacholine and adenosine-5'-monophosphate (two bronchoconstrictive agents of known potency). In the second group of 14 subjects, repeatability and side effects of acetaldehyde inhalation were examined. For acetaldehyde the PC_{20} ranged from 8.4 to 80 mg/ml with a geometric mean of 38.9 mg/ml (geometric mean values for methacholine and AMP were 0.6 and 17.4 mg/ml, respectively). The response to acetaldehyde was found to be moderately repeatable. For the group in which repeatability was examined, for acetaldehyde concentrations producing a >20% fall in FEV_1, most subjects had cough (64%), dyspnea (57%) or throat irritation (43%) (Prieto et al., 2002a). The nebulizer was operated at 5 liters air/minute for 2 minutes with an acetaldehyde solution output of 0.16 ml/minute. At this rate, inhalation of acetaldehyde solutions of 2.5 to 80 mg/ml corresponds to concentrations in air of approximately 80 to 2560 mg/m^3. The observed geometric mean PC_{20} of 38.9 mg/ml corresponds to approximately 1245 mg/m^3 (about 692 ppm).

In a further volunteer study, Prieto et al. (2002b) studied comparative airway responsiveness to acetaldehyde (2.5 mg to 80 mg/ml) in subjects with allergic rhinitis (n=43), asthmatics (n=16), and healthy subjects (n=19). The number of subjects with a fall in FEV_1 >20% was 8/43 in the group with allergic rhinitis, 13/16 in the asthmatic group and 0/19 in the healthy subjects group. PC_{20} values in the group with allergic rhinitis ranged from 15.5 to 80.0 mg/ml with a geometric mean of 67.7 mg/ml whereas in the asthmatic group PC_{20} ranged from 8.4 to 80.0 mg/ml with a geometric mean of 35.5 mg/ml ($p < 0.001$) (Prieto et al., 2002b). The PC_{20} values in the allergic rhinitis group were also significantly lower than in the healthy control group ($p = 0.04$) (Prieto et al., 2002b). The nebulizer was operated at 5 liters air/minute for 2 minutes with an acetaldehyde solution output of 0.16 ml/minute. Thus, inhalation of acetaldehyde solutions (2.5 to 80 mg/ml) corresponds to concentrations in air of 80 to 2560 mg/m^3. The observed geometric mean of 67.7 mg/ml corresponds to approximately 2166 mg/m^3 (about 1210 ppm) and the geometric mean of 35.5 mg/ml to approximately 1136 mg/m^3 (about 631 ppm).

As indicated above, the provocation tests involved acetaldehyde solutions that were aerosolized, and then inhaled by mouth. Aerosolized acetaldehyde solutions have been shown to be about 265 times less potent than methacholine in constricting the airways of asthmatic subjects, with aerosolized acetaldehyde solutions of 80 mg/ml resulting in cough, dyspnea, and throat irritation in the asthmatic subjects (Myou et al., 1993). In addition, the exposure times were very short (several minutes) and the concentrations eliciting a response in FEV_1 were much higher. However, it is important to note that in the Myou et al. (1994) study, aerosolized acetaldehyde potentiated bronchial hyper-responsiveness to provocation by methacholine at concentration equivalents in the air of about 22.4 mg/m^3 (or 12.5 ppm) similar to the concentration that produced eye

irritation (25 ppm) in human volunteers as seen in the Silverman et al. (1946) study. This response is of concern and an experimental analog to asthma. This may be indicative that the same chemo-sensory response triggered both the reactiveness in the airways and eye irritation. The potentiation of methacholine-induced bronchoconstriction shows the potential of acetaldehyde at concentrations of approximately 12.5 ppm or higher to exacerbate asthma. It should be noted that the model of nebulizer used was shown to have inconsistent delivery; thus the estimate of concentration of acetaldehyde that potentiated methacholine-induced bronoconstriction is uncertain.

In summary, exposure to acetaldehyde, at concentrations as low as 25 ppm, resulted in sensory irritation in human volunteers (Silverman et al., 1946). Aerosolized acetaldehyde at concentrations equivalent to approximately 12.5 ppm potentiated bronchial hyper-responsiveness to provocation by methacholine (Myou et al., 1994). Adult asthmatics showed large inter-individual variation in PC_{20} values (59 ppm to 1200 ppm) (Prieto et al., 2000). Finally, adult asthmatics that inhaled aerosolized solutions of acetaldehyde showed increased irritation and bronchoconstriction at 293 ppm (Prieto et al., 2000). Table 5.1.1 summarizes the aerosolized acetaldehyde provocation studies in adult human volunteers.

Table 5.1.1. Summary of Aerosolized Acetaldehyde Provocation Studies in Adult Human Volunteers

Human Volunteers	Concentration in aerosol	(PC_{20})*	Reference
Japanese asthmatics	5, 10, 20, 40 mg/ml	314 ppm	Myou et al., 1993
Japanese asthmatics	5, 10, 20, or 40 mg/ml	362 ppm	Myou et al., 1994
Alcohol-sensitive Japanese asthmatics	0.04, 0.08, 0.16, 0.31, 0.63, 1.25, 2.5, 5, 10, 20, 40, 80 mg/ml	327 ppm	Fujimura et al., 1999
Alcohol-tolerant Japanese asthmatics	0.04, 0.08, 0.16, 0.31, 0.63, 1.25, 2.5, 5, 10, 20, 40, 80 mg/ml	500 ppm	Fujimura et al., 1999
Japanese asthmatics	0.04, 0.08, 0.16, 0.31, 0.63, 1.25, 2.5, 5, 10, 40, 80 mg/ml	286 ppm	Myou et al., 1995
Caucasian asthmatics	5-40 mg/ml	293 ppm	Prieto et al., 2000
Caucasian asthmatics	2.5-80 mg/ml	692 ppm	Prieto et al., 2002a
Caucasian asthmatics	2.5-80 mg/ml	631 ppm	Prieto et al., 2002b

* Values for PC_{20}, which are geometric means are converted from mg/mL of aerosolized acetaldehyde to approximate concentration in air (ppm).

5.2 Acute Toxicity to Infants and Children

No studies on the effects of acute exposure to acetaldehyde in non-adult humans were located. However, as noted above for adults, there is some evidence that following acute exposure to acetaldehyde, asthmatics are more sensitive to acetaldehyde exposure and are likely to show symptoms such as wheezing, shortness of breath, bronchoconstriction, and/or decrements in pulmonary function consistent with

immediate and/or delayed bronchoconstriction. Furthermore, some asthmatics may respond with significant reductions in lung function due to the irritant effects, sensitized or not. The potential association between acetaldehyde exposure and asthma is of special concern for children because they have higher prevalence rates of asthma than adults, and their asthma episodes can be more severe due to their smaller airways. Hospitalization rates of children for asthma, especially for the first four years of life, are higher than for other age groups (Mannino et al., 1998). In addition, infants and children may have qualitatively different responses due to different target tissue sensitivities during windows of susceptibility in the developmental process.

Findings also support the view that toxic air contaminants, such as acetaldehyde, in communities in proximity to major emission sources, including both industrial and traffic sources, have adverse effects on asthma in children (Delfino et al., 2003). The average daily residential exposure to acetaldehyde in high school students living in inner-city neighborhoods of New York City and Los Angeles and living with a smoker was evaluated. The exposure concentration range measured in juveniles living with smokers was 6.3 to 14 $\mu g/m^3$ (Nazaroff, 2004). This study estimated that approximately 16 million juveniles are exposed to environmental tobacco smoke, and hence acetaldehyde by living with smokers.

5.3 Acute Toxicity to Experimental Animals

Acetaldehyde causes sensory irritation in experimental animals. Male B6C3F1 or Swiss-Webster mice were exposed to acetaldehyde in a head-only exposure chamber for 10 minutes and sensory irritation was quantified by measuring respiratory rate depression during the exposures (Steinhagen and Barrow, 1984). The respiratory rates were recorded with a plethysmograph and the average maximum decrease in respiratory rate for one minute was computed from the response of each group of animals. Five concentrations (750 to 4200 ppm) were used to construct a concentration-response curve and the RD_{50} was calculated (the concentration eliciting a 50% decrease in respiratory rate). RD_{50} values were 2932 and 2845 ppm for B6C3F1 and Swiss-Webster mice, respectively (Steinhagen and Barrow, 1984).

In a study using young adult albino male Wistar rats, acetaldehyde (nose-only) exposure resulted in an initial rapid decrease in breathing frequency during the first minutes of exposure (Cassee et al., 1996a). The minimum decrease in respiratory rate considered significant was 12%. The animals were exposed to acetaldehyde vapors for thirty minutes. The exposure concentrations were reported as 2800, 4600, and 6500 ppm for acetaldehyde. The RD_{50} for acetaldehyde in the single-compound study was calculated to be 3046 ppm (Cassee et al., 1996a).

Similarly, male F-344 rats were exposed in a head-only inhalation chamber to acetaldehyde (approximately 800 to 10,000 ppm though exact concentrations from the graph were not provided in the paper) for 10 minutes and experienced sensory irritation as measured by reduction in respiratory rate (Babiuk et al., 1985). The RD_{50} (the level inducing a 50% reduction in respiratory breathing rate) was 2991 ppm (95% CI 2411-3825) for this study (Babiuk et al., 1985).

In addition to sensory irritation, histopathological effects have been observed after exposure to acetaldehyde. Albino, male Wistar rats, 8 weeks old, were exposed for 6 hours a day, to either one or three day exposures on consecutive days, in a nose-only inhalation chamber to acetaldehyde (750 or 1500 ppm) (Cassee et al., 1996b). Acetaldehyde exposure resulted in histopathological nasal changes with the three-day exposure group consisting of increased incidence and severity of "single-cell necrosis" in olfactory epithelium with increasing concentration. Biochemical changes consisted of concentration-dependent increases of nonprotein sulfhydryl groups in nasal respiratory epithelium with one- and three-day exposure, which was statistically significant with exposure to 1500 ppm. Activities of biotransformation enzymes (glutathione peroxidase, glutathione S-transferase, glutathione reductase, formaldehyde dehydrogenase, and nonspecific aldehyde dehydrogenase) were not affected by any of the exposures (Cassee et al., 1996b).

Acute lethality studies have also been performed with acetaldehyde. In an historical acute inhalation study in rats, groups of eight per dose were exposed to acetaldehyde vapors 7,778 to 31,667 mg/m^3 (14,000 to 57,000 ppm) for thirty minutes (Skog, 1950). The acute LD_{50} value (reported as LD_{50}) for acetaldehyde inhalation was 20,600 ppm (37,000 mg/m^3) (Skog, 1950).

Appelman et al. (1982) determined the LC_{50} for acetaldehyde using twenty male and twenty female albino Wistar rats. The animals were exposed for 4 hours in horizontally placed glass exposure cylinders with a total airflow through the cylinder of 8 l/min. Concentrations were given as the mean of 10 to 15 determinations and were as follows: 10,436, 12,673, 15,683, and 16,801 ppm. Within the first half-hour of the four-hour LC_{50} study, rats exhibited restlessness, closed eyes and labored breathing to acetaldehyde concentrations as low as 10,436 ppm. In the subacute portion of the study, rats exhibited severe dyspnoea and excitation within the first half-hour of exposure to 5000 ppm. The behavior of animals exposed to 2200 ppm or lower for six hours was unremarkable. The four-hour LC_{50} and the 95% confidence limits were calculated to be 13,300 ppm (95% CL: 11,200, 15,400) (Appelman et al., 1982).

Syrian Golden hamsters were exposed to acetaldehyde vapors for 4 hours at doses ranging from 14,450 to 17,600 ppm (26,010 to 31, 680 mg/m^3) (Kruysse et al., 1975). After one to two hours of exposure at all concentrations, the animals showed severe lacrimation, salivation, and nasal discharge. The 4-hour LC_{50} was determined to be 17,000 ppm (30,600 mg/m^3) for this study. In all exposure groups, the animals that died during exposure had convulsions. Some animals survived at all concentrations, but only after a deep narcosis and apnea (Kruysse et al., 1975).

Aldehyde dehydrogenase 2 (ALDH2) is an important enzyme that oxidizes acetaldehyde. Isse et al. (2005) compared the acute acetaldehyde toxicity between wild-type (Aldh2+/+) and Aldh2-inactive transgenic (Aldh2-/-) mice after inhalation. The null aldehyde dehydrogenase 2 (ALDH2) transgenic mice (-/-) or wild type (+/+) mice were exposed by inhalation to 5000 ppm acetaldehyde for four hours. Mice were observed at 0, 2, 20, 40, 60, 120, and 240 minutes after administration. Within the first twenty minutes, hypoactivity, crouching, bradypnea, closed eyes, and piloerection were

observed in both the wild type and the knockout mice. By one hour, the ADLH (-/-) mice were showing a staggering gait (Isse et al., 2005). This study concluded that acute acetaldehyde toxicity after inhalation is higher in aldehyde dehydrogenase 2 knockout than in wild-type mice (Isse et al., 2005).

Female CD1 mice were exposed in inhalation chambers to a target acetaldehyde exposure of 200 ppm (actual mean of 5 exposures was 180 ± 35 ppm), twice the threshold limit value, for single and multiple three-hour exposures, and then evaluated for changes in their susceptibility to experimentally induced *Streptococcus* aerosol infection and pulmonary bactericidal activity to inhaled *Klebsiella* pneumoniae after one or five days (Aranyi et al., 1986). The results showed increased pulmonary bactericidal activity in response to 200 ppm of acetaldehyde possibly by a pollutant-induced recruitment of unexposed alveolar macrophages. This study suggests that inhaled toxicants such as acetaldehyde may alter susceptibility to or severity of respiratory infection (Aranyi et al., 1986).

Table 5.3.1 summarizes the acute animal data for acetaldehyde inhalation. The data indicate that humans may be more sensitive to the acute effects of acetaldehyde than animals. For the endpoint of sensory irritation, measured as reduction in respiratory rate, the lowest RD_{50} for mice and rats were 2845 and 2991 ppm, respectively. With respect to histopathological changes, effects were observed at 1500 ppm. In the acute lethality studies, the lowest LC_{50} was 13,300 ppm in rats. In contrast, the LOAEL for human sensory irritation was reported to be 25 ppm in one historical study (Silverman et al., 1946). In addition, potentiation of methacholine-induced bronchoconstriction was shown in one study at approximately 12.5 ppm.

Table 5.3.1 Summary of Acute Studies in Experimental Animals

Endpoint	Strain/Species	Exposure	Response	Reference
Sensory irritation	B6C3F1 mice	750 to 4200 ppm for10 min	RD_{50} = 2932 ppm	(Steinhagen and Barrow 1984)
	Swiss Webster mice	750 to 4200 ppm for10 min	RD_{50} = 2845 ppm	(Steinhagen and Barrow 1984)
	F-344 rats	~800 to 10,000 ppm for 10 min	RD_{50} = 2991 ppm	Babiuk et al., 1985
	Wistar rats	2800, 4600, or 6500 ppm for 30 min	RD_{50} = 3046 ppm	Cassee et al., 1996a
Histopathological	Wistar rats	750 or 1500 ppm for 1 and 3 days	Olfactory epithelial lesions at 1500 ppm	Cassee et al., 1996b
Lethality	Rats	14,000 to 57,000 ppm for 30 min	LD_{50} = 20,600 ppm	Skog, 1950
	Wistar rats	10,436 to16,801 ppm for 4 hours	LC_{50} = 13,300 ppm	Appelman et al., 1982
	Syrian Golden hamsters	14,450 to 17,600 ppm for 4 hours	LC_{50} = 17,000 ppm	Kruysse et al., 1975
Behavioral/Other effects	Syrian Golden hamsters	14,450 for one to 2 hours	lacrimation, salivation, and nasal discharges	Kruysse et al., 1975
	Wistar rats	10,436 ppm within first 30 min	restlessness, closed eyes and labored breathing	Appelman et al., 1982
	Wistar rats	5000 ppm for 30 min	severe dyspnoea and excitation	Appelman et al., 1982
		5000 ppm for 20 minutes	crouching, brady-pnea, closed eyes, and piloerection	Isse et al., 2005a
	CD1 mice	200 ppm for 3 hours	increased pulmonary bactericidal activity	Aranyi et al., 1986

6. Chronic Toxicity of Acetaldehyde

6.1 Chronic Toxicity to Adult Humans

No studies were found for human chronic exposures. Therefore the chronic REL was based on an animal study. However, as mentioned previously, it is important to note that acetaldehyde can be produced endogenously after food intake and ethanol consumption. Therefore, certain segments of the population may be at higher risk for chronic exposure due to alcoholism or frequent drinking or smoking. Those members of the population who smoke or are consistently exposed to ETS may be at increased risk of problems related to chronic toxicity of acetaldehyde.

6.2 Chronic Toxicity to Infants and Children

No studies were found on chronic exposure of infants and children to acetaldehyde. However, we anticipate that chronic exposure to acetaldehyde may exacerbate breathing problems in infants and children with asthma.

6.3 Chronic Toxicity to Experimental Animals

Exposure to inhaled acetaldehyde produces non-carcinogenic injury including degeneration and hyperplasia in the rat respiratory tract. The nasal cavity is the primary target with nasal olfactory mucosa being more sensitive than respiratory mucosa to the effects of acetaldehyde (Morris, 1997a; b). Deposition efficiency of inhaled acetaldehyde is highly dependent on airflow rate and on the inspired concentration in rodents (Morris, 1997a; b). Pretreatment with an ALDH inhibitor reduces nasal acetaldehyde deposition rates in anesthetized rodents (Morris and Blanchard, 1992).

In a subchronic study, male and female rats were exposed to acetaldehyde (6 hr/day, 5 days/week) for four weeks to concentrations of 400, 1000, 2200, or 5000 ppm, which resulted in degeneration of olfactory nasal tissues at all concentrations. Therefore a lowest observable adverse effect level (LOAEL) for this study was 400 ppm (Table 6.3.1) (Appelman et al., 1982). Nasal respiratory tissue lesions were seen at the three highest concentrations, tracheal and laryngeal lesions were observed only at the two highest concentrations, and mild injury to the lower respiratory tract was observed only at the highest concentration. Respiratory distress (dyspnea) was noted at 5000 ppm. Subsequent 4-week exposure studies in males of the same rat species at 150 and 500 ppm, resulted in observed degeneration of olfactory nasal tissues at 500 ppm, but not in the 150 ppm exposure group (Appelman et al., 1986). Therefore, 150 ppm was designated the no observable adverse effect level (NOAEL).

Table 6.3.1: Incidence of Nasal Olfactory Tissue Effects in Rats

Degeneration of nasal olfactory epithelium	Exposure Group (ppm)						
	0	150	400	500	1000	2200	5000
Number examined	40	10	20	10	20	20	20
Number affected	2	0	16	10	20	19	20

(Appelman *et al.*, 1982)

Exposure of rats to 243 ppm (442 mg/m^3) acetaldehyde for 8 hr/day, 5 days/week for 5 weeks resulted in an "intense" nasal inflammatory reaction with olfactory epithelium hyperplasia and polymorphonuclear and mononuclear infiltration of the submucosa (Saldiva et al., 1985). Changes in pulmonary mechanics, including increased functional residual capacity, residual volume, total lung capacity, and respiratory frequency was observed, but may have been the result of mechanical damage during pulmonary function testing.

In a subchronic study, male F344 rats were exposed to acetaldehyde (6 hr/day, 5 days/week) for 13 weeks to concentrations of 0, 50, 150, 500, or 1500 ppm, which resulted in degeneration of olfactory and respiratory epithelium (Dorman et al., 2008). The lowest observable adverse effect level (LOAEL) for the endpoint of degeneration of olfactory nasal epithelium was 150 ppm for the 65-day observation (Table 6.3.2). The no observable adverse effect level (NOAEL) for degeneration of olfactory nasal epithelium was 50 ppm. For the incidence of respiratory epithelial hyperplasia (Table 6.3.3), the LOAEL was 500 ppm and the NOAEL was 150 ppm.

Table 6.3.2: Incidence of Nasal Olfactory Tissue Effects in F344 Rats at 65 Days

Degeneration of nasal olfactory epithelium	Exposure Group (ppm)				
	0	50	150	500	1500
Number examined	12	12	12	12	12
Number affected	0	0	12	12	12

From Dorman *et al.,* 2008 (supplemental data Table IV. provided by author)

Table 6.3.3. Incidence of Respiratory Epithelial Hyperplasia in F344 Rats at 65 Days

Degeneration of respiratory epithelium	Exposure Group (ppm)				
	0	50	150	500	1500
Number examined	12	12	12	12	12
Number affected	0	0	1	11	12

Dorman *et al.*, 2008 (supplemental data Table II. provided by author)

This study also examined the endpoints of incidence of respiratory epithelial inflammation and squamous metaplasia using the same dose groups and time-points (data not shown), however the degeneration of olfactory and respiratory nasal epithelia were the endpoints of interest.

In a subchronic exposure of hamsters to 0, 390, 1340, or 4560 ppm acetaldehyde 6 hr/day, 5 days/week for 90 days resulted in growth retardation, and ocular and nasal irritation in the high dose group. Histopathological changes were observed only in the respiratory tract and consisted of necrosis and inflammatory changes of the epithelium in the nasal cavity, larynx, bronchi and lungs in the high dose animals, and mild tracheal epithelial lesions in the mid-dose group. No adverse effects were observed at 390 ppm (Kruysse et al., 1975).

In a subsequent study, 36 hamsters per dose group were chronically exposed in a whole body inhalation chamber to 0, 1500, or 2500 ppm acetaldehyde for 7 hr/day, 5 days/week for 52 weeks resulting in growth retardation and hyperplasia and metaplasia of the nasal and tracheal epithelium in exposed animals (Feron et al., 1982). Rhinitis and epithelial lesions of the larynx were also noted at the highest exposure. The average concentration in the high exposure group (2500 ppm) was lowered several times during the study due to severe growth retardation to a final concentration of 1650 ppm. The authors noted that the nasal lesions were very similar to those previously seen in hamsters repeatedly exposed to 4560 ppm in the 13-week study Kruysse et al. (1975) study. Following a 26-week recovery period, the upper respiratory tract lesions were still present in high exposure animals, but were nearly or completely absent at the low exposure animals (Feron et al., 1982). However, the authors note that the acetaldehyde-induced hyperplasia and metaplasia of the nasal and laryngeal epithelium persisted and was irreversible (Feron et al., 1982).

In chronic inhalation studies, rats were exposed to 0, 750, 1500, or 3000 ppm acetaldehyde for 6 hr/day, 5 days/week for up to 28 months (Woutersen et al., 1984; Woutersen et al., 1986; Woutersen and Feron, 1987). The concentration in the high-dose group was gradually lowered over 15 months to 1000 ppm due to early mortality, respiratory distress (dyspnea) and severe growth retardation. Nasal olfactory tissue degeneration, hyperplasia, and metaplasia were seen at all exposure levels including the LOAEL of 750 ppm. A NOAEL was not determined for this study. Larynx and nasal respiratory epithelium lesions were observed at the two highest concentrations (1500 and 3000 ppm), and slight to severe rhinitis and sinusitis was observed at the highest concentration (3000 ppm). Growth retardation occurred in males of each test group and in females of the two highest concentration groups.

In a pulmonary immune response study, groups (n = 8) of non-sensitized and ovalbumin (OA)-sensitized guinea pigs were exposed to 0 or 200 ppb (360 $\mu g/m^3$) acetaldehyde or 0 or 600 ppb benzaldehyde for 6 hr/day, 5 days/week for four weeks (Lacroix et al., 2002). Two animals from each group were examined histologically and 6 animals from each group underwent bronchoalveolar lavage. Analyses of protein, PGE2 and leokotriene content, and cellularity of the BALF were reported. In sensitized animals, acetaldehyde exposure did not modify the inflammatory and allergic response to subsequent challenge

with ovalbumin (OA) aerosol relative to that induced by sensitization alone. Interestingly, benzaldehyde exposure suppressed the response of sensitized guinea pigs to OA challenge. In nonsensitized guinea pigs, acetaldehyde exposure resulted in "slight irritation" (n = 2) of the lung, trachea and nasal respiratory epithelium, and induced a significant increase in the number of alveolar macrophages, but not eosinophils or neutrophils, in bronchoalveolar lavage fluid (n = 6)(Lacroix et al., 2002). There was no increase in total protein, PGE2, or leukotriene content in the BALF. Acetaldehyde exposure did not change any of these parameters in OA-sensitized animals. Limitations of the LaCroix et al. (2000) study include a lack of quantitative data for irritation and reported large variability in the concentration of acetaldehyde in the chamber atmosphere. In addition, there was no acetaldehyde-induced exacerbation of response to OA challenge in the sensitized animals. If the slight irritation seen in non-sensitized animals was exposure related, the effect would be expected to be greater in the sensitized animals than the non-sensitized animals, but there was no increase in response in acetaldehyde-exposed sensitized animals beyond sensitization alone. Finally, human data indicate exacerbation of methacholine induced bronchoconstriction after acetaldehyde exposure, yet acetaldehyde exposure did not exacerbate OA challenge in this study. Given the lack of quantitative data on irritation, lack of exacerbation of response by acetaldehyde in OA-sensitized animals, and the inconsistency of this study with other rodent studies vis-à-vis irritation NOAELs, we decided against using this study for the 8-hour or chronic REL.

Inhaled acetaldehyde is genotoxic and is a clastogen, and induced sister chromatid exchange (Dellarco, 1988). *In vivo* and *in vitro* studies have shown that acetaldehyde can form DNA-DNA and DNA-protein crosslinks (Morris, 1997a). Acetaldehyde vapor causes chronic tissue injury and tumor formation in nasal tissues at exposure concentrations of 750 ppm or higher (Feron et al., 1982; Woutersen et al., 1986). Acetaldehyde is a Proposition 65 listed carcinogen. Carcinogenicity of acetaldehyde is discussed in the health effects assessment for identification of acetaldehyde as a Toxic Air Contaminant.

7. Developmental and Reproductive Toxicity

Both clinical and experimental studies have shown that ethyl alcohol causes developmental and reproductive toxicity. Acetaldehyde, the primary metabolite of ethyl alcohol, has been suggested as a possible etiologic agent in fetal alcohol syndrome (FAS) (Pratt, 1980; West, 1994; Eriksson, 2001). Current studies suggest that ethyl alcohol and acetaldehyde work through different mechanisms, but it is still unknown if one or both are the basis for FAS. As a small lipid soluble molecule, acetaldehyde is able to cross membranes by simple diffusion (Zorzano and Herrera, 1989a). Acetaldehyde has been shown to cross the placenta in mice and distribute to embryos (Blakley and Scott Jr., 1984b). Placental transfer occurred when acetaldehyde was administered via i.p. injection to pregnant CD-1 mice at 200 mg/kg on day 10 of gestation, and acetaldehyde was detected within the embryo within 5 minutes (Blakley and Scott Jr., 1984a; b). Maximal concentrations of acetaldehyde were also reached in the maternal blood, liver, and yolk sac in the first five minutes.

Acetaldehyde also freely crosses the placenta of Wistar rats (Zorzano and Herrera, 1989b). Following i.v. injection of acetaldehyde (10 mg/kg) to pregnant rats on gestation day 21, acetaldehyde concentrations reached peak levels within five minutes in the maternal blood, fetal blood, and amniotic fluid. Indeed, after just two minutes of maternal intravenous administration of acetaldehyde at high concentrations, it freely crosses the placenta.

Acetaldehyde has been shown to cause adverse developmental effects in some rodent species when administered in high doses via i.p. or i.v. injection. Rats were exposed 50, 75, or 100 mg/kg acetaldehyde by i.p. on gestation day 10, 11, or 12 and then sacrificed on day 21. Significant fetal resorptions and malformations were observed including: edema, microcephaly, micrognathia, micromelia, hydrocephaly, exencephaly, and hemorrhages. Somatometric measurements of fetus, crown rump length, transumbilical distance, and tail length notes severe growth retardation (Sreenathan et al., 1982). In another study in rats, after a single i.p. injection of 50, 75, or 100 mg/kg, teratogenicity, embryolethality, and growth retardation were observed (Blakley and Scott Jr., 1984a).

In vitro models have found that acetaldehyde was teratogenic to C_3H mouse embryos between 8 and 10 days of gestation after 28 hours of exposure (Thompson and Folb, 1982). Morphological parameters and DNA synthesis were measured and correlated. Eight and nine-day embryos were exposed to doses of 7.4, 19.7, or 39.4 mg/l acetaldehyde in incubation medium. The 39.4 mg/l dose group at eight days showed a significant effect on somite count, neural tube fusion, CNS development (size and symmetry), and significant reduction in DNA synthesis. The nine-day embryos at 39.4 mg/l had increased somite count, absent heart beat, and a significant increase in limb development, while the 19.7 mg/l group had significant abnormalities in development of visceral arches, CNS development, and reduction in DNA synthesis.

Acetaldehyde significantly induced cytotoxicity *in vitro* in cultured rat embryonic midbrain cells. The levels of p53, bcl-2, and 8-OHdG were also changed by acetaldehyde treatment (Lee et al., 2005). The purpose of this study was to elucidate the molecular mechanisms involved in alcohol-induced Fetal Alcohol Syndrome (FAS) during embryo and fetal development. It is not clear whether the observed toxicity associated with FAS is due to direct exposure to ethanol, to its metabolite(s) (e.g. acetaldehyde) or to both.

Both acetaldehyde and ethanol significantly inhibited the gonadotropin-stimulated biosynthesis of testosterone, and acetaldehyde and was 4,000 times more potent than ethanol *in vitro* in enzymatically dispersed cells. Testicular steroidogenesis was blocked by acetaldehyde selectively, specifically inhibiting the conversion of androstenedione to testosterone (Cicero and Bell, 1980; Cicero et al., 1980a; Cicero et al., 1980b). As little as 50 μM acetaldehyde was effective in suppressing testicular steroidogenesis; however, cell viability was unaffected.

8. Derivation of Reference Exposure Levels

8.1 Acetaldehyde Acute Reference Exposure Level

Acute Reference Exposure Levels are levels at which intermittent one-hour exposures are not expected to result in adverse health effects (see Section 5 in the Technical Support Document).

Numerous studies on adult humans with and without asthma, investigated provocation with acetaldehyde solutions in saline (Table 5.1.1), which resulted in significant pulmonary decrements and more so in asthmatics. The study by Prieto et al. (2000) was selected for development of the acute REL as it investigated short-term exposure of human volunteers to aerosolized acetaldehyde solutions.

Study	Prieto et al., 2000
Study population	61 adult asthmatic human volunteers
Exposure method	Inhalation by nebulizer
Exposure continuity	
Exposure duration	2-4 minutes
Critical effects	Bronchoconstriction, PC_{20} >20% drop in FEV_1
LOAEL	142 mg/m^3 (79 ppm)
NOAEL	not observed
Benchmark concentration	not derived
Time-adjusted exposure	not applied
Human Equivalent Concentration	not applied
LOAEL uncertainty factor (UF_L)	10 (severe effect, no NOAEL)
Subchronic uncertainty factor (UFs)	not applied
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default, human study)
Toxicodynamic (UF_{A-d})	1 (default, human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (inter-individual variation)
Toxicodynamic (UF_{H-d})	30 (asthma exacerbation in children, hyper-responsiveness to methacholine)
Cumulative uncertainty factor	300
Reference Exposure Level	**470 μg/m^3 (260 ppb)**

Sixty-one asthmatic subjects were used to determine the concentration of acetaldehyde producing a 20% fall (PC_{20}) in Forced Expiratory Volume in one second (FEV_1) using ascending doses (5 to 40 mg/ml) of aerosolized acetaldehyde solutions. The geometric mean concentration of PC_{20} for the sixty-one subjects was 17.55 mg/ml of acetaldehyde and the values ranged from 1.96 to 40 mg/mL (Prieto et al., 2000). The 95% confidence interval of the geometric mean was (4.72-38.3 mg/ml) (Prieto, 2008). Therefore, the

lower bound of the geometric 95% CI was 4.72 mg/ml, which was converted to ppm, and was the value used as the point of departure for the acute REL derivation (Prieto, 2008). The Hudson 1720 nebulizer was operated at 6 liters air/minute for 2 to 4 minutes with an acetaldehyde solution output of 0.18 ml/minute. Therefore, the lower 95% confidence interval of 4.72 mg/ml corresponds to approximately 142 mg/m^3 (about 79 ppm).which was used as the LOAEL for the acute REL determination.

An uncertainty factor of ten is associated with the use of a LOAEL for severe effects in the absence of a NOAEL (see Section 4.4.5 of the TSD). The key study used to determine the acute REL was a human study, therefore the interspecies uncertainty factor, toxicokinetic (UF_{A-k}) and toxicodynamic (UF_{A-d}) components were each assigned the default value of one.

For the toxicokinetic component of the intraspecies uncertainty factor (UF_{H-k}) a value of one was used since sensory irritation is not expected to involve large toxicokinetic differences among individuals, and the effects are largely confined to the site of contact, in this case, the eyes, nose, and upper respiratory tract, with negligible or no systemic effects. The deposition kinetics of reactive gases is generally thought not to be greatly different between adults and children. Because of this, a value of one is used for the kinetic component of the intraspecies uncertainty factor (UF_{H-k}), rather than a more extended values of $\sqrt{10}$ or ten used where metabolic processes also contribute to inter-individual variability.

The toxicodynamic component of the intraspecies uncertainty factor UF_{H-d} was assigned an increased value of 30 for the acute REL determination due to multiple lines of evidence. A portion of the UF_{H-d} is applied to account for the potential greater susceptibility of children. The respiratory irritant effect of acetaldehyde, with documented potential to exacerbate asthma, is an effect with the potential to differentially impact infants and children. Myou et al., 1994 demonstrated hyper-responsiveness to methacholine after provocation with a sub-threshold dose of aerosolized acetaldehyde at concentrations equivalent to approximately 12.5 ppm. Additional studies have also shown that adult asthmatics are more sensitive to the irritative properties of inhaled aerosolized acetaldehyde solutions, which significantly decreased their forced expiratory volume in one second (FEV_1) by more than 20% (Myou et al., 1993; Myou et al., 1994, Fujimura et al., 1999, Prieto et al., 2002a; Prieto et al., 2002b). Finally, alcohol sensitive asthmatics had a selective hyper-responsiveness to acetaldehyde (Myou et al., 1993; Myou et al., 1994; Fujimura et al., 1999).

Myou et al. (1994) also observed that aerosolized acetaldehyde potentiated bronchial hyper-responsiveness to provocation by methacholine at concentration equivalents in the air (22.4 mg/m^3 or 12.5 ppm) similar to the concentration that produced eye irritation (25 ppm) in human volunteers as seen in the Silverman et al. (1946) study. This response is of concern and an experimental analog to asthma. This may be indicative that the same chemo-sensory response triggered both the reactivity in the airways and eye irritation. The potentiation of methacholine-induced bronchoconstriction shows the potential of acetaldehyde at concentrations of approximately 12.5 ppm or higher to exacerbate asthma. Of note however, some uncertainty

is associated with the use of a DeVillbis nebulizer, which has been shown to have considerable variability in aerosol output and delivered dose (Hollie et al., 1991).

In conclusion, using the LOAEL of 142 mg/m^3 (79 ppm) for bronchoconstriction from Prieto et al. (2000), divided by the cumulative uncertainty factor of 300, an acute reference exposure level (REL) for acetaldehyde was determined to be 470 μg/m^3 (260 ppb). This level is considered safe for infants and children during an acute exposure period.

Strengths of the Prieto et al. (2000) study include: the study was performed in human subjects, had good experimental design, and a large sample size (n = 61 adult asthmatics) compared to the other aerosolized acetaldehyde provocation studies, and had an endpoint (bronchoconstriction) of interest and concern. Limitations of the Prieto et al. (2000) study include very short exposure periods of 2-4 minutes and the use of aerosolized acetaldehyde solutions in saline. In view of possible but unquantified differences between deposition from an aqueous aerosol and from the gas phase, and resulting differences in dose received by bronchial tissues, there is uncertainty involved in converting the concentration values from mg acetaldehyde/ml solution to an equivalent concentration in air. In provocation studies by other groups, a DeVilbiss nebulizer was used, which has been shown to have considerable variability in aerosol output (Hollie et al., 1991). However, the Prieto study used a Hudson 1720 nebulizer, which is considered to be more consistent.

In a supporting study, Silverman et al. (1946) investigated eye irritation in non-asthmatic adults after acetaldehyde whole body exposure. Upper respiratory tract, nose, throat, and bronchial irritation typically followed that effect closely. Exposure to 50 ppm for 15 minutes caused moderate eye irritation in all subjects, whereas 25 ppm caused complaints of slight eye irritation in an unspecified number of volunteers. Nose and throat irritation and transient conjunctivitis were seen at concentrations of 200 ppm or greater. The Silverman et al. (1946) study had a LOAEL of 25 ppm for slight eye irritation, but a NOAEL was not determined.

In this supporting study, the output (acetaldehyde vapor) is sent generally into an environmental chamber in an effort to mimic real-life exposures and the subject's nose, respiratory tract, eyes, and uncovered skin are concomitantly exposed to the chemical stimulus (Silverman et al., 1946). Generally speaking, the lowest concentration of an irritant that can be discerned by sniffing or by ocular exposure is considered to be the threshold for irritation (Doty et al., 2004). As a general rule, most volatile chemicals that are capable of eliciting irritative sensations (e.g., via the trigeminal nerve) can also elicit an odor (via CN I); furthermore, the odor is often evoked at concentrations one or more orders of magnitude below those that evoke irritation. For most volatile chemicals, ocular irritation is equivalent in sensitivity to nasal irritation in humans with thresholds of equivalent magnitude (Cometto-Muniz and Cain, 1995; 1998; Cometto-Muniz et al., 1998; Cometto-Muniz et al., 1999; 2001; 2002; Doty et al., 2004).

Study	Silverman et al., 1946
Study population	24 adult human volunteers
Exposure method	Whole body
Exposure continuity	
Exposure duration	15 minutes
Critical effects	Eye and upper respiratory tract irritation
LOAEL	45 mg/m^3 (25 ppm)
NOAEL	not observed
Benchmark concentration	not derived
Time-adjusted exposure	not applied (sensory irritation, no Haber's Law adjustment)
Human Equivalent Concentration	not applied
LOAEL uncertainty factor (UF_L)	6 (default: mild effect, no NOAEL)
Subchronic uncertainty factor (UFs)	not applied
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default, human study)
Toxicodynamic (UF_{A-d})	1 (default, human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (site of contact; no systemic effects)
Toxicodynamic (UF_{H-d})	10 (asthma exacerbation in children)
Cumulative uncertainty factor	60
Reference Exposure Level	**750 μg/m^3 (420 ppb)**

The trigeminal nerve, which gathers sensory signals from the nasal mucosa amongst several other places, appears to be the only sensory nerve pathway directly involved with the respiratory response to inhaled irritants. In rodents, a reflex decrease in respiratory rate is observed after the initial sensory irritation (Bos et al., 2002); the human response is more complex in its expression although similar in neurological mechanism.

A default uncertainty factor of six is associated with the use of a LOAEL for mild effects in the absence of a NOAEL (see Section 4.4.5 of the TSD). The study was performed in humans, therefore the interspecies uncertainty factor, toxicokinetic (UF_{A-k}) and toxicodynamic (UF_{A-d}) components were each assigned the default value of one. Eye irritancy appears to be more a function of concentration rather than duration of exposure (Yang et al., 2001), so no time correction factor was applied.

For the toxicokinetic component of the intraspecies uncertainty factor (UF_{H-k}) a value of one was used since sensory irritation is not expected to involve large toxicokinetic differences among individuals, and the effects are largely confined to the site of contact, in this case, the eyes, nose, and upper respiratory tract, with negligible or no systemic effects. The deposition kinetics of reactive gases is generally thought not to be greatly different between adults and children. Because of this, a value of one is used for the kinetic component of the intraspecies uncertainty factor (UF_{H-k}), rather than a more

extended values of √10 or ten used where metabolic processes also contribute to inter-individual variability.

A toxicodynamic uncertainty factor (UF_{H-d}) of ten was used to account for the potential greater susceptibility of children. While ocular irritation is not expected to be substantially different between children and adults, the respiratory irritant effect, with documented potential to exacerbate asthma, is clearly an effect with the potential to differentially impact infants and children. The toxicodynamic component of the intraspecies uncertainty factor UF_{H-d} is therefore assigned an increased value of ten to account for potential asthma exacerbation. As mentioned earlier, asthmatics are more sensitive to the irritative properties of inhaled aerosolized acetaldehyde solutions, which significantly decreased their forced expiratory volume in one second (FEV_1) by more than 20% (Prieto et al., 2000; Prieto et al., 2002b). And, alcohol sensitive asthmatics had a selective hyper-responsiveness to acetaldehyde (Myou et al., 1993; Myou et al., 1994; Fujimura et al., 1999). These considerations are applied equally to the acute, 8-hour and chronic REL.

Limitations with the Silverman et al. (1946) study include: small sample size, subjective and non-quantitative measure of irritation, absence of a clear description of exposure method and experimental procedure, which was further unsubstantiated by lack of a clear experimental procedure.

In conclusion, using the LOAEL of 45 mg/m^3 (25 ppm) for eye irritation from Silverman et al. (1946), divided by the cumulative uncertainty factor of 60, an acute reference exposure level (REL) for acetaldehyde was determined to be 750 $\mu g/m^3$ or 420 ppb for the endpoint of eye irritation. Therefore, the acute REL calculated using the key study of Preito et al. (2000) of 470 $\mu g/m^3$ or 260 ppb would also be protective for eye irritation.

8.2 Acetaldehyde 8-Hour Reference Exposure Level

The 8-hour Reference Exposure Level is a concentration at or below which adverse noncancer health effects would not be anticipated for repeated 8-hour exposures (see Section 6 in the Technical Support Document).

Bronchoconstriction, eye irritation and nasal mucosal histopathology are all legitimate concerns for the 8-hour REL and occur in a broadly similar concentration range over the relevant time scale. The repeated nature of an 8-hour REL makes use of the acute studies inappropriate. Therefore, the 8-hour REL was derived using the subchronic animal study (Appelman et al., 1982; 1986) in rats exposed to acetaldehyde six hours per day, five days per week for four weeks. Incidence of degeneration of nasal olfactory epithelium was the most sensitive end-point. These data are supported by Dorman et al. (2008) who reported endpoints of degeneration of the nasal olfactory and respiratory epithelia.

Study	Appelman et al., 1982; 1986
Study population	Wistar rats (10-40 animals/group)
Exposure method	Inhalation exposure to 0, 273, 728, 910, 1820, 4004, 9100 mg/m^3 (0, 150, 400, 500, 1000, 2200, or 5000 ppm)
Exposure continuity	6 hours per day, 5 days/week
Exposure duration	4 weeks
Critical effects	Degeneration of olfactory epithelium
LOAEL	720 mg/m^3 (400 ppm)
NOAEL	270 mg/m^3 (150 ppm)
Benchmark Concentration (BMC_{05}) (using continuous model)	178 mg/m^3 (99 ppm)
Human equivalent concentration	242.1 mg/ m^3 (134.6 ppm)(99 ppm* 1.36 (DAF) Teeguarden et al. (2008)
Time-adjusted exposure	86.5 mg/m^3 (48.1 ppm) = (134.6*6/24*20/10*5/7)
LOAEL uncertainty factor (UF_L)	1
Subchronic uncertainty factor (UFs)	√10 (exposure 8-12% of lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (interspecies PBPK model for acetaldehyde)
Toxicodynamic (UF_{A-d})	√10 (default: no interspecies toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	√10 (inter-individual variation)
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	300
Reference Exposure Level	**300 µg/m^3 (160 ppb)**

The animal studies by Appelman et al. (1982; 1986) used subchronic exposure of Wistar rats to acetaldehyde for six hours per day, 5 days per week, for four weeks. Incidence of degeneration of nasal olfactory epithelium was the most sensitive end-point. The animal study has a histopathological endpoint for which there is a presumption of Haber's law (C x t) cumulation, at least over moderate timeframes. The time adjustment for an 8-hour REL used is 6 h/24 h x 20 m3/10 m3, rather than 6 h/8 h, because we assume that the 8 hours includes the active waking period when an adult inhales 10 m3 of air, i.e. half the daily total intake of 20 m3.

The 8-hour REL was determined using the Benchmark Dose (BMDS) program developed by the U.S. EPA (2003). The BMC_{05} is defined as the 95% lower confidence limit of the concentration expected to produce a response rate of 5%. The animal data from the Appelman et al. (1982; 1986) studies were used to develop a BMC_{05} for acetaldehyde.

The male and female data were analyzed both together and separately (Table 8.2.1). The study with exposure concentrations of 150 and 500 ppm used only males. Data on incidence of degeneration of olfactory epithelium were converted to a continuous data set ranked by severity of effect (Table 8.2.1). The means and standard deviations at each dose-group are shown, which were calculated from the severity grading of individual animals in each dose group. Each severity category had a name and a corresponding value assigned: no effect = zero, minimal = one, slight = two, moderate = three, marked = 4, moderate with hyperplasia = 5, severe with hyperplasia = 6, and very severe with hyperplasia =7. The means and standard deviations for each dose group were entered into the BMDS program using continuous modeling. The Hill and Polynomial models in the BMDS program gave the best fit to the data (Table 8.2.2). The mean of the three models that best fit the data was calculated to be 99 $\pm$ 1.20 ppm and used as the BMC_{05}.

Table 8.2.1. Incidence of Degeneration of Olfactory Epithelium using Weighted Means by Severity[1].

	Males			**Females**[2]		
Dose (ppm)	Number	Mean	Stdev	Number	Mean	Stdev
0	30	0.07	0.25	10	0	0
150	10	0	0			
400	10	2.6	1.17	10	0.9	0.74
500	10	2.5	0.97			
1000	10	2.8	0.63	10	3.6	0.70
2200	10	5.3	2.21	10	5.1	1.91
5000	10	6.7	0.67	10	6.9	0.32

[1]Severity categories: no effect=0; minimal=1; slight=2; moderate=3; marked=4; moderate w/ hyperplasia=5; severe w/ hyperplasia=6; and very severe w/ hyperplasia=7.
[2] In the 150 and 500 ppm dose groups, only male animals were used.

Table 8.2.2. BMDS Results Modeling Incidence of Degeneration of Nasal Olfactory Epithelium Using Weighted Means by Severity in Rats Using a Continuous Model.

Method	BMC_{05}*	BMC*	P-value	AIC
Hill Model	100	205	0.07	55.96
Polynomial (2°)	101	126	0.02	56.18
Polynomial (3°)	97	165	0.03	55.95

* BMC_{05} and BMC are in units of ppm. Source data from Appelman et al. (1982; 1986)

The standard Human Equivalent Concentration (HEC) adjustment using an RGDR was not used for the dosimetric interspecies extrapolation. Instead, species information based on pharmacokinetic modeling for toxicants that result in specific nasal olfactory tissue damage was applied for interspecies extrapolation of acetaldehyde toxicity (Teeguarden et al., 2008). Dosimetry data for the nasal olfactory epithelium shows that the rat is more efficient in scrubbing organic vapors in this region of the nasal cavity than humans (Frederick et al., 1998; Frederick et al., 2001). Consequently, rats receive a similar, or greater, tissue dose of inhaled organic vapors than humans in the olfactory epithelium. Sensitivity to acetaldehyde of the rat olfactory epithelium is a major factor for olfactory tissue damage, even though the specific activity of aldehyde dehydrogenase is greater in the respiratory epithelium (Bogdanffy et al., 1998; Stanek and Morris, 1999). The interspecies adjustment also takes into account differences in the deposition of inhaled vapors and breathing rates. While rodents are obligate nose breathers, humans are not, which has implications for exposure of nasal tissues. Other factors when extrapolating toxicity findings from rodents to humans include dosimetry, nasal anatomy and airflow dynamics, target tissue metabolism, species differences in gross anatomy, distribution of nasal airway epithelia, and distribution and composition of mucous secretory products (Feron et al., 2001).

The dosimetric adjustment factor (DAF) was derived based on a physiologically based pharmacokinetic (PBPK) model of rat and human nasal tissues constructed for acetaldehyde (see Section 4.4.7.2.2 of the TSD). The rodent model was developed using published metabolic constants and calibrated using upper-respiratory-tract acetaldehyde extraction data (Teeguarden et al., 2008). The human nasal model incorporated previously published tissue volumes, blood flows, and acetaldehyde metabolic constants. The acetaldehyde upper airway PBPK model is structurally the same as the inhalation vinyl acetate model consisting of the nasal cavity, nasopharynx, and larynx (Plowchalk et al., 1997; Bogdanffy et al., 1999; Bogdanffy et al., 2001). The computational fluid dynamic model compartmentalizes the nasal cavity by specific tissue type and location. The rat nasal cavity model has five major compartments, and the human model structure has four. Equations for acetaldehyde concentration, flux, and pH in rats and humans were provided with the model (Teeguarden et al., 2008) . In addition a sensitivity analysis was performed to incorporate humans with ALDH2 polymorphisms into the model. The respiratory and olfactory epithelial tissue acetaldehyde concentrations were determined to be largely linear functions in both species. The impact of the ALDH2 polymorphisms was deemed negligible and not a

significant contributor to acetaldehyde metabolism in the nasal tissues (Teeguarden et al., 2008).

OEHHA determined the DAF using the acetaldehyde concentration metric by calculating the ratio of acetaldehyde concentration values reported for the rat (8.41) and human (6.20), which equaled 1.36. This ratio was then multiplied by the NOAEL to obtain a human equivalent concentration (HEC) (see REL summary table for calculation) (Teeguarden et al., 2008).

Since a PBPK model specifically for acetaldehyde was used, the toxicokinetic component of the interspecies uncertainty factor UF_{A-k} was assigned a value of one. In addition, since acetaldehyde exerts mainly a localized effect on nasal olfactory epithelium, toxicokinetics including distribution and metabolism play less of a key role, the extent of likely interspecies variation is likely less than the default of $\sqrt{10}$.

The LOAEL uncertainty factor (UF_L) of one was chosen, since both a LOAEL and NOAEL were determined in the key studies (Appelman et al., 1982; Appelman et al., 1986), and the benchmark approach was used to determine the 8-hour REL. In addition, the subchronic uncertainty factor (UFs) was assigned a value of $\sqrt{10}$ since the 8-hour REL is based on anticipated repeated exposures over a longer period of time than the study duration of four weeks.

The toxicodynamic portion of the interspecies uncertainty factor (UF_{A-d}) is $\sqrt{10}$ because the key studies are in non-primates and data on toxicodynamic interspecies differences are not available.

An uncertainty factor (UF_{H-k}) of $\sqrt{10}$ was used to account for intra-individual toxicokinetic variation. The intraspecies uncertainy factor was selected because acetaldehyde is a reactive substance that produces lesions at the point of contact with the tissue, therefore there would be less variability to take into account for children versus adults. However, data are not available for the impact of ALDH2 deficiency on olfactory tissue lesions. One study does indicate that in Japanese alcohol-sensitive asthmatics versus alcohol-insensitive asthmatics, PC_{20} geometric mean values were 330 ppm versus 500 ppm, respectively, but their ALDH2 status was unknown (Fujimura et al., 1999).

The toxicodynamic uncertainty factor (UF_{H-d}) of 10 was used to account for the potentially greater susceptibility of children and asthmatics. The resulting cumulative uncertainty factor was calculated as 300 and used to determine the 8-hour REL of the experimental animal study. The 8-hour REL with the endpoint of degeneration of olfactory epithelium in rats was calculated to be 300 $\mu g/m^3$ (160 ppb).

Dorman et al. (2008) conducted a 13-week study in male F344 rats (n=12 per group) with acetaldehyde exposures of 0, 50, 150, 500, or 1500 ppm. They reported degeneration of olfactory and respiratory epithelium (Dorman et al., 2008). The LOAEL and NOAEL for the endpoint of degeneration of olfactory nasal epithelium were 150 and 50 ppm, respectively for the observations at 65 days (Table 6.3.2). Benchmark concentration analysis was performed on the data and several models provided a

BMC_{05} in close agreement with the NOAEL (quantal linear BMC_{05} = 45.3 ppm and probit BMC_{05} = 48.3 ppm), but statistically were not as reliable due to the small sample size and dose spacing. Adjusting the NOAEL using the dosimetric adjustment factor (DAF) of 1.36, as described previously, based on the PBPK model for acetaldehyde (Teeguarden et al., 2008), yielded a NOAEL of 68 ppm. Thus the BMC_{05} value from the Dorman study and also the LOAEL and NOAEL values from the same study are supportive of the 8-hour REL determined from the data of Appelman et al. (1982; 1986).

For the incidence of another endpoint reported by Dorman et al. (2008), respiratory epithelial hyperplasia, benchmark concentration modeling was performed on the 65-day exposure data (Table 6.3.3). The Probit model yielded the best result with a BMC_{05} of 100 ppm, which is in good agreement with the BMC_{05} of 99 ppm from the Appelman study and is therefore also supportive of the derived 8-hour REL.

The Dorman et al (2008) study was not used for determination of the 8-hour REL due to its small sample size and the response rate rising from 0% to 100% in the olfactory epithelium data. This creates uncertainty in determination of a "true NOAEL" and an inability to use benchmark dose modeling in determination of the REL due to lack of an adequate fit of the model to the data. Another limitation of the Dorman study was the length of the study was 12.5% of the test animal's lifetime, which borders the criteria for subchronic and chronic (12% of lifetime). With the Appelman studies, not only could the benchmark dose be determined for incidence, but also the provision of severity grading data for each individual animal allowed for continuous BMDS analysis, which provided a better dose-response and low-end extrapolation of the data.

Eye irritation and nasal mucosal histopathology are both legitimate concerns for the 8-hour REL for acetaldehyde and occur in a broadly similar concentration range over the relevant time scale. However, repeated 8-hour exposures could result in tissue damage. Therefore, the REL (300 $\mu g/m^3$ (160 ppb)) using the animal study with a histopathological endpoint was used. The experimental animal study used as the basis for the 8-hour REL, with an endpoint of degeneration of nasal olfactory epithelium, would also be protective of the human sensory response since the acute REL derived from the Silverman et al. (1946) human study is higher. The animal study was chosen because it was a well-conducted study with adequate dose groups and a time-period relevant for the 8-hour REL. In addition, using benchmark dose and PBPK modeling decreased the uncertainty associated with the REL derivation compared with using the traditional NOAEL/LOAEL and HEC (with an RGDR) procedures.

8.3 Acetaldehyde Chronic Reference Exposure Level

The chronic Reference Exposure Level is a concentration at which adverse noncancer health effects would not be expected from chronic exposures (see Section 7 in the Technical Support Document).

Study	Appelman et al., 1982; 1986
Study population	Wistar rats (10-40 animals/group)
Exposure method	Inhalation exposure to 0, 273, 728, 910, 1820, 4004, 9100 mg/m3 (0, 150, 400, 500, 1000, 2200, or 5000 ppm)
Exposure continuity	6 hours per day, 5 days/week
Exposure duration	*4 weeks*
Critical effects	Degeneration of olfactory epithelium
LOAEL	720 mg/m^3 (400 ppm)
NOAEL	270 mg/m^3 (150 ppm)
Benchmark Concentration (BMC_{05}) (using continuous model)	178 mg/m^3 (99 ppm)
Human equivalent concentration	242.1 mg/ m^3 (134.6 ppm)(= 99 * 1.36 (DAF) Teeguarden et al. (2008)
Time-adjusted exposure	43.2 mg/m^3 (24 ppm) = (134.6*6/24*5/7)
LOAEL uncertainty factor (UF_L)	1
Subchronic uncertainty factor (UFs)	√10 (exposure 8-12% of lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (intraspecies PBPK model for acetaldehyde)
Toxicodynamic (UF_{A-d})	√10 (default: no interspecies toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	√10 (inter-individual variation)
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	300
Reference Exposure Level	**140 μg/m^3 (80 ppb)**

The chronic REL was based on four-week exposure data in rats from Appelman et al., (1982, 1986), and supported by Saldiva et al., (1985); Woutersen et al., (1986, 1984); and (Woutersen and Feron, 1987), which included a 28-month chronic study in rats. Incidence of degeneration of nasal olfactory epithelium was the most sensitive end-point. The proposed chronic REL was estimated by a benchmark concentration modeling approach using the continuous polynomial and Hill models of analysis (U.S. EPA, 2003) as previously described in detail in Section 8.2. The average experimental exposure data were adjusted to reflect chronic exposure. Table 8.2.1 shows the data expressed as the mean and standard deviation of the degeneration of nasal olfactory epithelium by severity for each dose group, which were the data used for the BMDS model. As shown in Table 8.2.2, three models were selected that best fit the data and their mean and standard deviation was 99 ± 1.20 ppm and therefore used as the BMC_{05}.

As described in detail in Section 8.2, OEHHA used a dosimetric adjustment factor (DAF) for acetaldehyde of 1.36 based on the PBPK model for acetaldehyde developed by Teeguarden et al. (2008). The limited uncertainty associated with this assumption is reflected in the use of the toxicokinetic component of the interspecies uncertainty factor UF_{A-k} equaling one since the model was specific for acetaldehyde.

The animal studies by Appelman et al. (1982; 1986) used subchronic exposure of Wistar rats to acetaldehyde for six hours per day, 5 days per week, for four weeks. Incidence of degeneration of nasal olfactory epithelium was the most sensitive endpoint.

The LOAEL uncertainty factor (UF_L) of one was chosen, since both a LOAEL and NOAEL were determined in the key studies (Appelman et al., 1982; Appelman et al., 1986), and the benchmark approach was used to determine the chronic REL.

The subchronic uncertainty factor (UFs) was assigned a value of $\sqrt{10}$ since the chronic REL is representative of exposures over a lifetime, and because the supporting chronic study (Woutersen et al., 1986) didn't give a dramatic increase in injury compared to the four-week studies by Appelman et al., (1982; 1986). In addition, Saldiva et al., (Saldiva et al., 1985) observed "intense" nasal lesions in rats exposed to 442 mg/m^3 (243 ppm) for slightly longer exposure durations than that used by Appelman et al., (1982; 1986).

The value of one was chosen for the toxicokinetic component of the interspecies uncertainty factor (UF_{A-k}) since a DAF from a PBPK model for acetaldehyde was used, which adequately incorporates the differences between humans and rodents (Teeguarden et al., 2008). The toxicodynamic portion of the interspecies uncertainty factor (UF_{A-d}) is $\sqrt{10}$ because the key studies are in non-primates and data on toxicodynamic interspecies differences are not available.

Intraspecies variability can be as much as a factor of 1,000-fold for VOCs measured in human subjects (Fenske and Paulson, 1999). An uncertainty factor (UF_{H-k}) of $\sqrt{10}$ was used to account for intra-individual toxicokinetic variation. The intraspecies uncertainty factor was selected because acetaldehyde is a reactive substance that produces lesions at the point of contact with the tissue, therefore there would be less kinetic variability to take into account for children versus adults. The toxicodynamic uncertainty factor (UF_{Hd}) of 10 was used to account for the potentially greater susceptibility of children and asthmatics.

The resulting cumulative uncertainty factor was calculated to be 300 and used to determine the chronic REL of the experimental animal study. The chronic REL with the endpoint of degeneration of olfactory epithelium in rats was calculated to be 140 $\mu g/m^3$ (80 ppb).

The current chronic RfC for acetaldehyde determined by the U.S. EPA and based on Appelman et al. (1982; 1986) is 9 $\mu g/m^3$ (5 ppb) and is within the range of normal human breath acetaldehyde concentrations of 0.7 to 11.0 $\mu g/m^3$ (0.4 to 6.1 ppb). OEHHA's proposed chronic REL of 140 $\mu g/m^3$ (76 ppb) is above the range of human breath concentrations of acetaldehyde, but is mostly exceeded when humans consume

significant amounts of alcohol, resulting in human breath concentrations ranging from 200 to 2200 μg/m^3. Thus, frequent alcohol use and abuse by humans is a major source of acetaldehyde exposure to the airway tissue that can exceed the chronic REL.

The LOAEL of 750 ppm from the chronic exposure data by Woutersen et al., (1984, 1986) and Woutersen and Feron (1987) produced similar injuries and was confined to the nasal olfactory epithelium as the LOAEL of 400 ppm from the 4-week Appelman studies. Thus, the subchronic UF was kept at √10, to account for similar findings from the chronic studies.

Analyses were also performed on the incidence of respiratory epithelial changes using the LOAEL from the chronic rat studies, although it was a less sensitive end-point (Woutersen et al., 1984, 1986; Woutersen and Feron 1987). The 100% response rate at the LOAEL combined with the lack of a NOAEL prevented the chronic studies from becoming the basis of the REL.

Significant strengths for the chronic REL include: (1) the use of a well conducted repeated exposure study with histopathological analysis and (2) independent studies demonstrating comparable key effects (nasal lesions) in experimental animals. However, major areas of uncertainty are the lack of adequate human chronic inhalation dose-response data in adults and children, and inadequate long-term inhalation animal data, therefore a subchronic animal study was used.

8.4 Acetaldehyde as a Toxic Air Contaminant

Acetaldehyde was identified by the ARB as a toxic air contaminant (TAC) in accordance with section 39657(b) of the California Health and Safety Code (Title 17, California Code of Regulations, section 93001) (CCR, 2007). In view of the potential of acetaldehyde to exacerbate asthma (Section 5.1, 5.2), and the differential impacts of asthma on children including higher prevalence rates, coupled with widespread exposure (e.g., indoors from exposure to environmental tobacco smoke, and outdoors due to numerous emissions sources), OEHHA recommends that acetaldehyde be identified as a toxic air contaminant (TAC) that may disproportionately impact children pursuant to Health and Safety Code, Section 39669.5(c).

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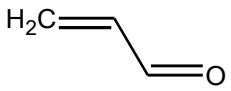
Acrolein Reference Exposure Levels

(2-propenal, acrylic aldehyde, acryladehyde, acraldehyde)

CAS 107-02-8



1. Summary

Acrolein is a powerful irritant. Due to its highly reactive nature, the effects of acrolein are generally limited to the site of contact; skin, eyes and mucous membranes. Inhalation exposure to low levels (≤ 1 ppm) causes irritation of the eyes, nose and throat. Acute exposures to levels above 1 ppm result in mucous hypersecretion and exacerbation of allergic airway response in animal models. Moderately higher exposures may result in severe lacrimation, and irritation of the mucous membranes of the respiratory tract. Death due to respiratory failure has been associated with high level exposures. Long term exposure to acrolein may result in structural and functional changes in the respiratory tract, including lesions in the nasal mucosa, and pulmonary inflammation. The studies reviewed for this document include those published through Spring, 2008.

1.1 Acrolein Acute REL

Reference Exposure Level	**2.5 μg/m³ (1.1 ppb)**
Critical effect(s)	Subjective ocular irritation
Hazard Index target(s)	Eyes

1.2 Acrolein 8-Hour REL

Reference Exposure Level	**0.70 μg/m³ (0.30 ppb)**
Critical effect(s)	Lesions in respiratory epithelium
Hazard Index target(s)	Respiratory

1.3 Acrolein Chronic REL

Reference Exposure Level	**0.35 μg/m³ (0.15 ppb)**
Critical effect(s)	Lesions in respiratory epithelium
Hazard Index target(s)	Respiratory

2. Physical & Chemical Properties

Description	Colorless or yellow liquid with piercing disagreeable odor
Molecular formula	C_3H_4O
Molecular weight	56.1 g/mol
Density	0.843 g/cm^3 @ 20° C
Boiling point	53° C
Melting point	-87° C
Vapor pressure	220 mm Hg @ 20° C
Flashpoint	-26° C
Explosive limits	2.8% - 31% by volume
Solubility	soluble in ethanol, diethyl ether, and up to 20% w/v in water
Odor threshold	0.5 ppm
Metabolites	glycidaldehyde, acrylic acid
Conversion factor	1 ppm in air = 2.3 mg/m^3 @ 25° C

3. Occurrence and Major Uses

Acrolein is principally used as a chemical intermediate in the production of acrylic acid and its esters. Acrolein is used directly as an aquatic herbicide and algicide in irrigation canals, as a microbiocide in oil wells, liquid hydrocarbon fuels, cooling-water towers and water-treatment ponds, and as a slimicide in the manufacture of paper (IARC, 1995). Combustion of fossil fuels, tobacco smoke, and pyrolyzed animal and vegetable fats contribute to the environmental prevalence of acrolein. Acrolein is a byproduct of fires and is one of several acute toxicants to which firefighters are exposed. It is also formed from atmospheric reactions of 1,3-butadiene. The annual statewide emissions of acrolein from mobile, stationary and natural sources (not including atmospheric transformation) reported in the California Toxics Inventory for 2004 were estimated to be 2,242 tons contributing to a statewide ambient level of 0.53 ppb (CARB, 2005b).

4. Metabolism

The metabolism of acrolein comprises several pathways. It rapidly reacts with sulfhydryl groups, especially protein cysteine residues and glutathione. The glutathione conjugate may be oxidized or reduced to mercapturic acids (N-acetyl –S-2-carboxyethylcysteine and N-acetyl-S-3-hydroxypropylcysteine, respectively), with the reduction pathway predominating, followed by urinary elimination. Alternatively, acrolein may be epoxidized to glycidaldehyde, which is in turn attacked by glutathione and oxidatively processed to the mercapturic acid, N-acetyl-S-2-carboxy-2-hydroxyethylcysteine. In a third pathway, the Michael addition of water to acrolein is followed by oxidation to malonic and finally oxalic acids (Parent et al., 1998). The formation of homopolymers of acrolein is thought to occur but appears to be limited to the gut. Acrolein may also be oxidized to acrylic acid, mainly in the liver. Following inhalation exposure, the predominant metabolites are the 3-hydroxypropyl and 2-carboxyethyl mercapturic acids mentioned above (Linhart et al., 1996).

5. Acute Toxicity of Acrolein

5.1 Acute Toxicity to Adult Humans

Sensory irritation is the primary adverse effect associated with acute, low level exposures to acrolein. The irritative effects of acrolein are noticeable at low levels of exposure (≤0.25 ppm) and rapidly become more pronounced with increasing concentration; brief exposure (1.5 min) to 0.3 ppm (0.7 mg/m³) causes irritation of the eyes and nose (Weber-Tschopp et al., 1977). The powerful irritant and lacrimator properties of acrolein led to its use in gas grenades and artillery shells by the French in 1916. At a concentration of 7 mg/m³, acrolein caused severe lacrimation and irritation of the mucous membranes of the respiratory tract (Prentiss, 1937). A case report of respiratory failure and death in individuals exposed to vapors from overheated frying pans containing fat and food items implicated acrolein as the principal toxicant (Gosselin et al., 1979).

Ocular irritation is one of the most sensitive responses to acrolein. In a study by Darley et al. (1960), 36 human volunteers were exposed to 0.06, 1.3-1.6, and 2.0-2.3 ppm for 5 minutes. Acrolein was dissolved in water and delivered to the eyes in a stream of oxygen through face masks. Carbon-filter respirators were worn during exposure so that only the eyes were exposed to the test material. The subjects, who were without a history of chronic upper respiratory or eye problems, rated the degree of eye irritation every 30 seconds during exposure as none (0), medium (1), or severe (2). The individuals' maximum values were used in the analysis that revealed a concentration-dependent incidence of eye irritation (Table 5.1.1). The lowest observed adverse effect level (LOAEL) for eye irritation in human volunteers was estimated by an unspecified method to be 0.06 ppm (0.14 mg/m³) acrolein during the five minute exposures. A NOAEL was not observed in this study.

TABLE 5.1.1 OCULAR IRRITATION WITH ACROLEIN (FROM DARLEY ET AL., 1960)

Acrolein concentration	Irritation score
Filtered air	0.283
0.06 ppm	0.471
1.3-1.6 ppm	1.182
2.0-2.3 ppm	1.476

Ocular and upper respiratory tract irritation were also examined in a chamber study by Weber-Tschopp et al. (1977) involving healthy volunteers. Thirty one men and 22 women were exposed to increasing acrolein levels (0-0.60 ppm) for 40 min, while 21 men and 25 women were exposed to a constant 0.3 ppm for 60 min. Subjective reports of irritation and annoyance, and objective measures of eye-blink and respiratory rates were taken during the exposure periods. During exposure to increasing levels of acrolein, eye irritation, as measured by subjective report and blink frequency, was a more sensitive measure of irritation than nasal irritation. By comparison, for less

reactive volatile compounds in studies surveyed by Doty et al. (2004), the thresholds for ocular and intranasal irritation were of the same magnitude. In the Weber-Tschopp study of acrolein, significantly ($p<0.01$) higher eye irritation was first observed at 0.07 ppm, and nasal irritation at 0.26 ppm compared to controls. Significant depression of respiratory rates was observed at 0.60 ppm ($p<0.05$). With continuous exposure to 0.3 ppm acrolein, subjective eye and nasal irritation increased rapidly during the first 20 minutes and tended to plateau by 40 min. After 10 min of continuous exposure, a decrease in respiratory rate of 10% was evident in 47% of the subjects, while eye blink rate doubled in 66%. The authors suggest a threshold for adverse effects in the range of 0.09-0.30 ppm.

The effects of irritants such as acrolein may be accentuated in individuals with prior sensitization. Roux et al. (1999) investigated the interaction between passive sensitization of human isolated airways and exposure to pollutants (specifically, ozone and acrolein). Lung tissue from nonatopic, nonasthmatic patients was immunologically sensitized by incubation in sera from atopic asthmatic patients. Roux et al. reported that *in vitro* passive sensitization of the isolated tissues and exposure to acrolein act in a synergistic manner on human bronchial smooth muscle reactivity in response to both specific and nonspecific agonists. In tissues sensitized by incubation in sera from asthmatic patients, preexposure to 0.3 μM acrolein for 10 or 20 minutes significantly increased the maximal contractile response to a specific antigen of the dust mite, *Dermatophagoides pteronyssinus*, by 20.5 ± 6.5 % and 34.9 ± 7.4%, respectively. In addition, in sensitized tissue pre-exposed to 0.3 μM acrolein for 10 minutes, contractile response was increased by 33.5 ± 6.2% and 32.5 ± 5.1% for carbachol and histamine, respectively. Thus acrolein exposure potentially exacerbates asthma.

Mucus hypersecretion is one of the hallmarks of inflammatory airway disorders, including asthma. Borchers et al. (1999b) examined the effect of 0.01-100 nM acrolein on mucus glycoprotein (mucin) gene expression in cultured human airway epithelial cells. After a 4 hour exposure to acrolein in vitro, epithelial cells were found to have elevated mucin mRNA levels. It is not clear whether acrolein acts directly on epithelial cells or indirectly through inflammatory mediators released after acrolein exposure, however, asthma exacerbation is a likely result of acrolein exposure in susceptible individuals.

Persons with pre-existing eye, skin, respiratory, allergic, asthmatic or heart conditions might be at increased risk due to acrolein exposure. As a respiratory irritant, there is evidence that acrolein exacerbates asthma via the induction of bronchial hyper-responsiveness (Leikauf et al., 1989a; Leikauf et al., 1989b; Borchers et al., 1998; Borchers et al., 1999a; Borchers et al., 1999b). Acrolein has been listed as a TAC that may disproportionately impact children due to concerns related to asthma exacerbation.

Cancer patients treated with cyclophosphamide could be at increased risk because acrolein is a metabolite of cyclophosphamide (NTIS, 1981).

The effects of acrolein as an ocular irritant may be enhanced among those who wear contact lenses. Although no data specific to acrolein in this context were located,

observations of ocular irritation following exposure to formaldehyde in an anatomy dissecting laboratory may be germane. Tanaka et al. (2003) reported that formaldehyde levels in an anatomy lab peaked at 0.62 ppm shortly after the exposure of cadavers for dissection, with a gradual decrease to 0.11 ppm. Formaldehyde-related irritation of the eyes, nose, throat, airways and skin was reported by 59% of the students. Ocular irritation was significantly ($p < 0.001$) higher among wearers of contact lenses compared with students without contacts. The ability of contact lenses to trap and concentrate volatile compounds, and to extend the exposure time by limiting the eye's normal self-cleansing, may make contact lens wearers more susceptible to ocular exposure and irritation by acrolein.

5.2 Acute Toxicity to Infants and Children

The literature specifically examining the effects of acrolein inhalation in infants and children is limited and comprises case studies of accidental exposure, and exposures to multiple substances. The most frequent sources of acrolein in childhood exposures are environmental tobacco smoke (ETS) and acrolein formed from overheated cooking oils. Mahut et al. (1993) describe the case of a 27 month-old boy hospitalized for acute respiratory failure following exposure for about an hour to acrid smoke from vegetable oil burning on an electric hot plate. The child was reportedly cyanotic with labored, crackling breathing, and was experiencing severe respiratory acidosis. Eighteen months following exposure, X-ray and CT scans showed bronchial thickening, massive over-inflation, patchy emphysema and diffuse bronchiectasis. In this case, and in cases of exposure to ETS, infants may be more susceptible to the adverse effects of acrolein in part due to an inability to escape exposure. Children also may be more susceptible to the effects of respiratory irritants due to the immature state of their airways.

As noted in OEHHA (2001): "*OEHHA considers asthma to impact children more than adults. Children have higher prevalence rates of asthma than do adults (Mannino et al., 1998). In addition, asthma episodes can be more severe due to the smaller airways of children, and result in more hospitalizations in children, particularly from the ages of 0 to 4 years, than in adults (Mannino et al., 1998; CDHS, 2000).*" "*Thus, on a population-wide basis, children are more impacted by asthma than adults, and since acrolein exacerbates asthma, children may be more impacted by acrolein toxicity than adults.*" Data strongly suggesting that acrolein exacerbates asthma derive from studies using human tissue *in vitro* (Roux et al., 1999; Borchers et al., 1999a) and in animals *in vivo* (Leikauf et al., 1989a; 1989b; Borchers et al., 1998; Borchers et al., 1999b).

5.3 Acute Toxicity to Experimental Animals

Experimental exposures of rodents to acrolein at and above levels that are irritating to the eyes and respiratory tract in humans provide evidence for several adverse effects and their possible mechanisms. Acrolein prompts a proliferative response in nasal epithelium as shown by increased DNA synthesis (Roemer et al., 1993) and expression of mucin genes (Borchers et al., 1998). The latter effect in turn is associated with the hyper-secretion of mucus that may contribute to chronic obstructive pulmonary disease and asthma (Borchers et al., 1998). Bronchial hyper-responsiveness, a hallmark of

asthma, increases with acrolein exposure (Leikauf et al., 1989a) supporting a connection between acrolein exposure and exacerbation of asthma in humans. The dose-dependent decreases in protective epithelial enzyme activities (Cassee et al., 1996b) and levels of sulfhydryls (Lam et al., 1985; McNulty et al., 1984) are likely to be involved in the observed formation of lesions in the nasal epithelium (Cassee et al., 1996b).

TABLE 5.3.1 ACROLEIN EFFECTS IN EXPERIMENTAL ANIMALS

Study	Model	Exposure	Outcome
Roemer et al. 1993	Proliferation of rat nasal and tracheal epithelium	0, 0.2, 0.6 ppm 6 h/d, 1 or 3 d	Increased DNA synthesis at 0.2 ppm (LOAEL)
Borchers et al. 1998	Mucus hyper-secretion, mucin gene expression in rat trachea and lungs	0.3, 0.75, 1.5, 3.0 ppm 6 h/d, 5 d/w	Hyper-secretion and gene expression at 0.75 ppm. (NOAEL = 0.3 ppm)
Leikauf et al. 1989a	Bronchial hyper-responsiveness and airway resistance in guinea pigs	1.3 ppm, 2 h	Resistance increased from 0.86 to 1.29 ml·cm H_2O/ml. Acetylcholine to double airway resistance dropped from 114 to 44.7 µg/kg/min
Buckley et al. 1984	Nasal histopathology at (RD_{50}) in mice;	1.7 ppm, 6 h/d, 5d	Exfoliation and squamous metaplasia of epithelium
Morris et al. 2003	Decrease in respiratory rate (RD_{50}) in mice	0.3, 1.6, 3.9 ppm, 10 min	Control RD_{50} at 1.50 ppm vs 0.82 ppm in allergic mice
Kane et al. 1979	Decrease in respiratory rate (RD_{50}) in mice	15 min	RD_{50} 1.7 ppm
Cassee et al. 1996b	Histopathology of rat nasal epithelium	0, 0.25, 0.67, 1.4 ppm, 6 h/d, 1-3 d	Dose-dependent lesions and decreased enzyme activities in nasal epithelium
Lam et al. 1985	Sulfhydryl depletion in rat respiratory mucosa	0, 0.1, 0.5, 1.0, 2.5 ppm 3 h	Dose-dependent depletion of non-protein sulfhydryls
McNulty et al. 1984	Sulfhydryl depletion in rat respiratory mucosa and liver	0.1, 0.3, 1, 2.5, 5 ppm 3 h	Dose-dependent depletion of non-protein sulfhydryls in nasal mucosa but not liver

Roemer et al. (1993) exposed Male Sprague Dawley rats by inhalation to 0, 0.2 or 0.6 ppm acrolein for 6 hours per day on one or three successive days. Nasal and tracheal epithelial and free lung cells were analyzed for proliferative responses using 5-bromodeoxyuridine (BrdU) labeling to identify DNA synthesizing cells. A single exposure to acrolein increased the DNA synthesizing cells 3-fold. After three exposures the increase was distinctly lower. All sites analyzed showed approximately the same concentration/response pattern. Since significant changes in cell proliferation were detected at 0.2 ppm (0.46 mg/m^3) acrolein, it is a LOAEL for this experiment.

Enhanced mucus secretion is a normal airway response to inhaled irritants. However, mucus hypersecretion is involved in the development of chronic obstructive pulmonary diseases; as such, it is considered an adverse effect. Borchers et al. (1998) exposed male rats to 3.0 ppm acrolein for 6 hours/day, 5 days/week for up to 12 days and examined the lungs and trachea for mucin cell metaplasia and expression of the mucin genes MUC2 and MUC5ac. The effects of acrolein concentration on mucin mRNA levels were further examined in rats exposed daily to 0.3, 0.75, 1.5, 3.0 ppm. Acrolein exposure resulted in a time-dependent increase in mucous cell differentiation and mucus hypersecretion in rat lungs. These changes were accompanied by increases in lung MUC5ac mRNA to levels 3-fold higher than in controls, and readily immunohistochemically detectable levels of MUC5ac. MUC5ac mRNA was elevated by concentrations as low as 0.75 ppm while MUC2 mRNA was not affected by any of the levels tested. Thus 0.3 ppm (0.69 mg/m^3) is a NOEL for this effect. The trachea of treated animals showed sloughing of the epithelium accompanied by excessive mucus and inflammatory cells in the lumen.

Bronchial hyper-responsiveness is a hallmark of reactive airway diseases such as asthma, and may be induced by inhaled irritants. Leikauf et al. (1989a) exposed guinea pigs to 1.3 ppm acrolein for 2 hours and measured the induction of bronchial hyperresponsiveness by the amount of infused acetylcholine necessary to double specific airway resistance 1, 2, 6, and 24 hours after exposure compared to baseline. The dose of acetylcholine required to double airway resistance decreased from 114.0 ± 6.6 to 44.7 ± 4.2 µg/kg/min ($p < 0.001$) at 2 hours following acrolein exposure and remained low for at least 24 hours. Acrolein exposure was found to increase levels of the bronchoconstrictor leukotriene C_4 (LTC_4) in bronchoalveolar lavage fluids prior to the observation of bronchial hyperresponsiveness. This hyperresponsiveness was prevented by treatment with an inhibitor of LTC_4 synthesis or an LTC_4 receptor antagonist. Acrolein was thus shown to induce bronchial hyperresponsiveness, an effect apparently mediated by LTC_4.

Buckley et al. (1984) investigated whether lesions occur in the respiratory tract of Swiss-Webster mice after exposure to the RD_{50} concentrations of ten sensory irritants including acrolein. After exposure of mice for 6 hr/day for 5 days to 1.7 ppm acrolein, the respiratory tract was examined for histopathologic changes. Acrolein (and all other irritants) produced lesions in the nasal cavity with a distinct anterior-posterior severity gradient. Acrolein specifically caused severe exfoliation and squamous metaplasia of

the respiratory epithelium and moderate ulceration of the olfactory epithelium. Acrolein did not induce lesions in the lower respiratory tract.

Morris et al. (2003) compared the respiratory responses to acrolein in healthy mice with those in mice previously sensitized to ovalbumin. Inhalation exposure to ovalbumin prior to acrolein exposure elicited an allergic response in the sensitized mice that was characteristic of allergic airway disease. Upon subsequent acrolein exposure, the RD_{50}, a measure of the dose required to reduce the respiratory rate by 50%, was 1.50 ppm in naïve mice and 0.82 ppm in the mouse model of allergic airway disease. Thus in sensitized animals, a lower concentration of acrolein is required to elicit the same changes in breathing rate observed in non-allergic animals. In both intact mice and in isolated mouse upper respiratory tracts, acrolein exposure caused a significant ($P < 0.05$) increase in flow resistance, an effect that was immediate and not exposure time dependent. Pretreatment with capsaicin to defunctionalize sensory neurons significantly attenuated the breathing rate and obstructive responses supporting the role of sensory neuron stimulation in the response to acrolein. For comparison, Kane et al. (1979) also used the RD_{50} as a measure of sensory irritation and estimated an RD_{50} of 1.7 ppm in mice during 15 minutes of acrolein exposure.

Cassee et al. (1996b) exposed male Wistar rats to 0, 0.25, 0.67, or 1.4 ppm acrolein for 6 hours per day on one or three successive days. Immediately following the last exposure, the rats were killed. Mucosae from the respiratory or olfactory parts of the nose were collected from 3 rats per group for biochemical analyses. The skulls of the other rats in each group were prepared for histopathology and cell proliferation measurements. Nasal epithelium, examined microscopically, showed dose-dependent evidence of disarrangement, necrosis, thickening, and desquamation of the respiratory/transitional epithelium (Table 5.3.2). Significant basal cell hyperplasia, observed at the lowest dose (0.25 ppm), increased with exposure. The activity of glutathione reductase (GR) was reduced after one-day exposure to acrolein, while the activities of GR, glutathione-S-transferase and aldehyde dehydrogenase were reduced following the three-day exposures. These results and those mentioned below suggest that acrolein interferes with enzyme systems involved in its detoxification.

TABLE 5.3.2 NASAL LESIONS IN RATS WITH ACROLEIN EXPOSURE

(from Cassee et al., 1996b)

Site and type of lesion	Extent	Incidence	
		Low	Medium
Noses examined		5	6
Disarrangement, necrosis, desquamation of respiratory, transitional epithelium	Slight (mainly disarrangement)	4	3
	Moderate	1	3
	Severe and extensive	0	0
Basal cell hyperplasia and/or increased mitotic figures	Slight (focal)	3	2
	Moderate	0	4
	Severe (extensive)	0	0

Pronounced and possibly irreversible biochemical changes occur with acrolein levels that are extremely irritating. Acrolein depletes glutathione (GSH) and other free thiol groups both in vitro and in vivo (McNulty et al., 1984; Lam et al., 1985; Grafstrom et al., 1987; U.S.EPA, 2003; Yang et al., 2004). Inhalation exposure of rats to a concentration of 5 ppm (11.4 mg/m³) for 3 hours caused irreversible depletion of non-protein sulfhydryls in the nasal mucosa (Lam et al., 1985). Under similar exposure conditions, 5 ppm (11.5 mg/m³) for 3 hours, McNulty et al. (1984) reported a 63% decrease in glutathione in nasal mucosal but not in liver. In addition, ^{14}C-labeled acrolein has been shown to bind irreversibly to sulfhydryl groups on cytochrome P450 in rats (Gurtoo et al., 1981). The binding of acrolein to sulfhydryl groups is localized to the area of contact (e.g., nasal membranes or lung epithelium), and is not a systemic effect (Lam et al., 1985).

The pulmonary immunological defense against a bacterial challenge using *Staphylococcus aureus* in mice was impaired in a dose-dependent manner following a single exposure to acrolein at concentrations of 3 and 6 ppm (6.9 and 13.8 mg/m^3) for 8 hours (Astry and Jakab, 1983). In this study, the control exposure was not described.

The efficiency with which acrolein enters cells of the respiratory tract in large part determines the inspired levels at which toxic effects are observed. Struve et al. (2008) measured the uptake efficiency of 0.6, 1.8 or 3.6 ppm acrolein in isolated upper respiratory tracts of anesthetized, naïve rats under constant velocity, unidirectional flow rates of 100 or 300 ml/min for up to 80 min. Similar studies were also performed on rats with previous exposure to 0.6 or 1.8 ppm acrolein for 6 hours per day, 5 days per week for 14 exposure days prior to nasal uptake studies with 1.8 or 3.6 ppm at 100 ml/min flow rate. Acrolein levels entering and exiting the isolated respiratory tract were measured to determine uptake efficiency. At the end of the exposure period, the animals were killed and the nasal respiratory and olfactory mucosa isolated for measurements of protein, and total and oxidized glutathione. The efficiency of acrolein uptake by the rat nose was dependent on the concentration, flow rate, and duration of acrolein exposure. Uptake efficiency was significantly higher at the lowest exposure than at the higher levels ($0.6 > 1.8 \approx 3.6$; $p < 0.0001$), and at the lower flow rate ($100 > 300$; $p < 0.0061$). At both flow rates, the efficiency of uptake significantly declined over the 80 min exposure period ($p < 0.001$), with a significant interaction between concentration and time ($p = 0.01$). In naïve rats, glutathione levels dropped in respiratory epithelium but remained largely the same in olfactory epithelium. By comparison, in pre-exposed rats, the acrolein uptake efficiency was higher than in naïve rats. However, the GSH levels at the end of exposure were also higher, perhaps suggesting an adaptive response.

6. Chronic Toxicity of Acrolein

6.1 Chronic Toxicity to Adult Humans

Information regarding the chronic toxicity of acrolein in humans is limited. There is inadequate direct evidence for carcinogenicity of acrolein in humans or experimental animals. However, a metabolite of acrolein, the reactive epoxide glycidaldehyde, has been shown to be mutagenic and carcinogenic in mice and rats (IARC, 1985). Therefore, acrolein has been designated a Group C substance, with possible human carcinogenic potential by the U.S.EPA (1987). In addition, acrolein-DNA adducts have been found in aortic tissue following 6 hour inhalation exposure to 1 and 10 ppm acrolein (Penn et al., 2001).

A source of chronic acrolein exposure for some individuals is tobacco smoking. Much of the pulmonary irritancy associated with tobacco smoke has been attributed to acrolein and research in this area suggests mechanisms for some of acrolein's pulmonary effects. As part of a defense response, pulmonary neutrophils release oxidants, proteases and cytokines such as IL-8, all of which may promote inflammation and potentiate tissue damage. To limit tissue damage and resolve the inflammation, neutrophils normally undergo constitutive apoptosis. Experiments with isolated human neutrophils exposed to acrolein at levels achievable during active smoking (1-50 µM) found that acrolein inhibited neutrophil apoptosis, increased IL-8 production, and activated mitogen-activated protein kinases (MAPK) (Finkelstein et al., 2001). At acrolein concentrations up to 10 µM, inhibition of apoptosis was accompanied by increased cell viability. At higher acrolein levels, cell viability decreased as necrotic cell death increased. While the mechanisms behind acrolein's concentration-dependent effects on neutrophils are not clear, the effects observed at the lower exposure levels suggest that acrolein may contribute to pulmonary inflammation and exacerbate allergic responses by prolonging the survival of neutrophils, and stimulating the production of inflammation-related cytokines and enzymes. At higher levels, frank cellular toxicity becomes more prominent.

6.2 Chronic Toxicity to Infants and Children

No data addressing the effects of chronic acrolein exposure among infants and children were located. Inasmuch as acrolein is one of the major irritants in environmental tobacco smoke (Takabe et al., 2001) at relatively high concentrations in smokers' homes (1.6-3.6 µg/m^3; 0.70-1.57 ppb (Nazaroff and Singer, 2004)), children living with smokers may be disproportionately exposed to acrolein as they are less able to avoid exposure than are adult nonsmokers. To the extent that respiratory irritants such as acrolein elicit bronchoconstriction and excessive mucus secretion characteristic of asthma, children, with their smaller airways and greater prevalence of asthma, may experience more diminution of pulmonary function and more episodes of asthma with chronic exposure.

6.3 Chronic Toxicity to Experimental Animals

Long-term exposure to acrolein causes structural and functional changes in the respiratory tract. Nasal and pulmonary effects following acrolein exposure for 13 weeks (6 hours/day, 5 days/week) were described by Dorman et al. (2008) in 360 male F344 rats. The whole-body exposures were to air concentrations of 0, 0.02, 0.06, 0.2, 0.6, and 1.8 ppm acrolein, with evaluation of respiratory tract histopathology after 4, 14, 30 and 65 days of exposure, and at 60 days following the end of the 13 week exposure. Body weights of all acrolein exposed rats were depressed but there were reportedly no other significant increases in clinical signs. Formalin-fixed noses were sectioned transversely providing six sections of the nasal cavity at standard levels. Larynx, trachea and lungs were fixed, stained with hematoxylin and eosin, and examined histologically. The study examined both respiratory and olfactory epithelia with the former being the more sensitive as evidenced by inflammation, hyperplasia and squamous metaplasia. Mild hyperplasia of the respiratory epithelia was first observed after 4 days of exposure to ≥ 0.6 ppm. The NOAEL for pathology of nasal respiratory epithelia was 0.2 ppm in the lateral walls of level II, and for olfactory epithelia, 0.6 ppm. At the highest concentration, 1.8 ppm, mild squamous metaplasia was also observed in the larynx and trachea, but no treatment related effects were seen in the lungs. Two months following cessation of exposure, only partial recovery of the olfactory epithelium was observed; primarily in caudal areas where lesions developed more slowly and were less severe.

Schroeter et al. (2008) used data from the above study by Dorman et al. (2008) for the development of a physiological computational fluid dynamics (CFD) model of acrolein nasal dosimetry. The CFD models of Kimbell et al. (1997) and Subramaniam et al. (1998) were modified to estimate kinetic parameters of acrolein flux in rat nasal passages, and allow a cross-species prediction of acrolein flux in humans associated with histopathology. Based on a NOAEL of 0.6 ppm and a LOAEL of 1.8 ppm for olfactory neuronal loss from Dorman et al. (2008), the CFD model predicted a threshold acrolein flux of 72 pg/cm^2-s at region 11, comprising portions of the third ethmoturbinate. Assuming equal tissue doses of acrolein elicit similar responses in the olfactory epithelium of rats and human, an exposure level that may be expected to represent the threshold for olfactory neuronal loss in humans may be estimated. The 99th percentile olfactory flux value that is equal to the threshold of 72 pg/cm^2-s was estimated to be 45 ppb. The authors use this concentration to estimate a human equivalent NOAEL of 8 ppb, and a reference concentration (RfC) of 0.27 ppb. However, the threshold acrolein flux associated with the lower NOAEL of 0.2 ppm, reported by Dorman et al. (2008) for respiratory epithelium, was not estimated, and an equivalent human threshold and NOAEL is not available. The rationale for this, presented in Dorman et al. (2008), is *"Our CFD modeling efforts have revealed that although the observed NOAEL for the respiratory epithelium is lower than that seen for the olfactory epithelium (i.e., 0.2 vs. 0.6 ppm), in actuality the olfactory epithelial lesion arises at an appreciably lower delivered tissue dose suggesting that the olfactory epithelium is more sensitive to the effects of inhaled acrolein than is the respiratory epithelium (Schroeter et al. (2008)."* The RfC of 0.27 ppb estimated by the authors is thus based on lesion formation at the lowest modeled tissue dose rather than on the

more relevant value of the lowest applied acrolein concentration associated with an adverse effect.

Structural and functional changes in the respiratory tract were also examined in male Fischer-344 rats exposed for 6 hours/day, 5 days/week for 62 days to acrolein at concentrations of 0, 0.4, 1.4, and 4.0 ppm (0, 0.92, 3.2, and 9.2 mg/m^3)(Kutzman, 1981; Kutzman et al., 1985). Each group of 24 animals was assessed for pulmonary function immediately prior to the end of the experiment. Pulmonary function tests included lung volumes, forced respiratory capacity, pulmonary resistance, dynamic compliance, diffusing capacity of carbon monoxide, and multi-breath nitrogen washout. At the end of the experiment, animals were killed and histopathological changes in the lungs were recorded. Eight additional rats were designated for histopathology and 8 rats were used for reproductive testing only. All analyses were performed at 6 days post-exposure to minimize the acute effects of acrolein. Mortality was high (56%) in rats exposed to 4.0 ppm (9.2 mg/m^3). The observed mortality was due to acute bronchopneumonia in these cases. The animals from this group that survived had reduced body weight. No histological changes were observed in extra-respiratory tissues in any group. There was a concentration-dependent increase in histological changes to the nasal turbinates (increased submucosal lymphoid aggregates), beginning at 0.4 ppm. Concentration-dependent damage to the peribronchiolar and bronchiolar regions included epithelial necrosis and sloughed cells lying free in the lumen. No lung lesions were observed in the 0.4 ppm group. The LOAEL for nasal lesions (squamous epithelial metaplasia and neutrophil infiltration) in this study was 0.4 ppm.

Feron et al. (1978) exposed groups of 20 Syrian golden hamsters, 12 SPF Wistar rats and 4 Dutch rabbits (of both sexes) to acrolein vapor at 0, 0.4, 1.4 and 4.9 ppm (0, 0.92, 3.2, and 11.3 mg/m^3) 6 hours/day, 5 days/week for 13 weeks. The most prominent effects at the highest level included mortality in rats (3 of each sex), and ocular and nasal irritation, growth depression, and histopathological changes of the respiratory tract in each species. The changes in the airways induced by acrolein consisted of destruction, and hyperplasia and metaplasia of the lining epithelium accompanied by inflammatory alterations. Rats were the most susceptible species examined and showed treatment-related histopathological abnormalities in the nasal cavity down to 0.4 ppm (LOAEL), whereas this level was a NOAEL in hamsters and rabbits. The results for individual rats at 0.4 ppm were not given.

Bouley et al. (1975; 1976) exposed male SPF OFA rats continuously to 0.55 ppm (1.3 mg/m^3) of acrolein for up to 63 days. This level of acrolein led to a greater susceptibility to airborne *Salmonella enteritidis* infection during the first three weeks compared to control rats but it disappeared spontaneously when exposure was continued beyond three weeks. The general toxic effect of diminished weight gain (due to reduced feeding) compared to the control group lasted as long as exposure and disappeared only after acrolein was discontinued. Sneezing, a sign of nasal irritation, was consistently observed in the exposed animals on days 7 through 21 but ceased thereafter. No histopathology of the nasal cavity of or any other tissue was reported.

In one of the few chronic studies reported, Feron and Kruysse (1977) exposed hamsters (18/gender) to 4 ppm (9.2 mg/m^3) acrolein for 7 hours/day, 5 days/week, for 52 weeks. Mild to moderate histological changes were observed in the upper and lower respiratory tract. No evidence of toxicity to other organs was apparent at necropsy, although body weight was decreased. Hematology, urinalysis, and serum enzymes were not affected by exposure. Thus 4 ppm is a chronic LOAEL for hamsters. As noted above, hamsters appear to be a less sensitive species than rats (Feron et al., 1978).

Exposures of rodents have generally formed the basis for the determination of acrolein's chronic effects. However, an interspecies comparison was conducted by Lyon and associates (Lyon et al., 1970) who investigated the effects of repeated or continuous exposures of acrolein on Sprague-Dawley rats (n = 15/exposure group), guinea pigs (n = 15), beagle dogs (n = 2), and male squirrel monkeys (n = 9). Animals were exposed to 0.7 or 3.7 ppm (1.6 or 8.5 mg/m^3) acrolein for 8 hours/day, 5 days/week, for 6 weeks, or continuously to 0.22, 1.0, or 1.8 ppm (0.5, 2.3, or 4.1 mg/m^3) for 90 days. The results below suggest that dogs and monkeys were more susceptible to acrolein's effects than were the rodents.

Two monkeys in the 3.7 ppm intermittent exposure group died within 9 days. Monkeys and dogs salivated excessively during the first week. Squamous metaplasia and basal cell hyperplasia of the trachea were observed in monkeys and dogs; 7 of the 9 monkeys repeatedly exposed to 3.7 ppm also exhibited bronchiolitis obliterans with squamous metaplasia in the lungs. Bronchopneumonia was noted in the dogs. Inflammation in the lung interstitiae was more prominent in the dogs than in the monkeys. Rats and guinea pigs did not exhibit signs of toxicity when exposed intermittently to 3.7 ppm. Continuous exposure to 1.0 and 1.8 ppm, but not 0.22 ppm acrolein, resulted in salivation and ocular discharge in the monkeys and dogs. Rats and guinea pigs appeared normal at all concentrations. Rats exhibited significant weight loss in the 1.0 and 1.8 ppm continuous exposure groups. Nonspecific inflammatory changes were observed in sections of brain, heart, lung, liver and kidney from all species exposed to 1.8 ppm. The lungs from the dogs showed confluent bronchopneumonia. Focal histological changes in the bronchiolar region and the spleen were detected at 0.22 ppm in dogs. Nonspecific inflammatory changes at the 0.22 ppm level were apparent in liver, lung, kidney and heart from monkeys, guinea pigs and dogs. Unfortunately the nasal cavity was not examined in this study. While there were no unexposed control animals for any species, the cross-species comparison shows substantial interspecies variability in susceptibility.

7. Developmental and Reproductive Toxicity

There are no reports of reproductive or developmental toxicity following inhalation exposure to acrolein in humans. Kutzman (1981) studied reproductive fitness in male and female rats following acrolein inhalation for 6 hours/day, 5 days/week for 62 days. Treated males were mated with untreated females, and treated females with untreated males. No treatment-related differences were found in the parameters assessed including pregnancy rate, number of corpora lutea, embryo viability, early and late deaths, and preimplantation losses. Similarly, the morphology of sperm collected from

the epididymides of treated males was examined and reportedly not affected. Bouley et al. (1975; 1976) exposed three male and 21 female SPF-OFA rats continuously to 0.55 ppm (1.26 mg/m^3) acrolein vapor for 25 days. The rats were allowed to mate on day 4 of the exposure. The number of acrolein-exposed pregnant rats and the number and mean body weight of their fetuses were similar to controls.

In rats, acrolein can induce teratogenic and embryotoxic effects when administered directly into the amniotic fluid, or when added to cultured rat embryos (Slott and Hales, 1986). Additionally, acrolein injected into chicken embryos resulted in embryotoxicity and some teratogenic effects at moderate to high doses (0.001-0.1 mg/egg) (Chhibber and Gilani, 1986). However, intravenous injection of acrolein in pregnant rabbits showed no developmental effects in the offspring (Claussen et al., 1980). Based on this latter study, the World Health Organization (1992) concluded that human exposure to acrolein was unlikely to affect the developing embryo.

8. Derivation of Reference Exposure Levels

8.1 Acrolein Acute Reference Exposure Level

Study	Darley et al., 1960
Study population	36 healthy human volunteers
Exposure method	5 min exposure: carbon-filter respirators worn
Exposure continuity	Single exposure
Exposure duration	5 min
Critical effects	subjective ocular irritation
LOAEL	0.06 ppm
NOAEL	not observed
Benchmark concentration	not derived
Time-adjusted exposure	not applied
Human Equivalent Concentration	n/a
LOAEL uncertainty factor (UF_L)	6 (default: mild effect, no NOAEL)
Subchronic uncertainty factor (UFs)	not applied
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default: human study)
Toxicodynamic (UF_{A-d})	1 (default: human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (site of contact; no systemic effects)
Toxicodynamic (UF_{H-d})	10 (greater susceptibility of children to asthma exacerbation)
Cumulative uncertainty factor	60
Reference Exposure Level	2.3 μg/m³ (1.0 ppb)

Acute Reference Exposure Levels are levels at which intermittent one-hour exposures are not expected to result in adverse health effects (see Section 5 of the Technical Support Document).

The study by Darley et al. (1960) was selected as the best available acute exposure study employing human subjects. In addition, the ocular mucosa and the nasal mucosa are both innervated by cranial nerve V (trigeminal nerve). As noted by Doty et al. (2004), numerous studies employing n-alcohols, ketones, alkylbenzenes, terpenes, butyl acetate and toluene, report thresholds for ocular and intranasal irritation to be of the same magnitude suggesting that for most volatiles, tests of ocular and nasal irritancy are of equivalent sensitivity. Thus the endpoint of ocular irritancy used in this study is expected to also reflect irritancy of the upper respiratory tract. Confidence in this REL calculation is moderate as the LOAEL used is based on an estimated LOAEL of 0.06 ppm rather than a measured level. A default uncertainty factor of 6 is associated with the use of a LOAEL for mild effects in the absence of a NOAEL in acute REL derivations (see Section 4.4.5 of the TSD). Due to its high reactivity, the effects of exposure to acrolein in the air are largely confined to the site of contact, in this case the eyes, with negligible or no systemic effects. This localization of effects to the site of contact is supported by the confinement of acrolein's effects to the upper respiratory tract in the animal studies of acute inhalation exposure. Based on modeling of adults and 3-month old children that takes into account age-related ventilation rates and respiratory tract surface area, the deposition kinetics of reactive gases are generally thought not to be greatly different between adults and children (Ginsberg et al., 2005). Because of this, a value of 1 is used for the kinetic component of the intraspecies uncertainty factor (UF_{H-k}), rather than a more extended value of $\sqrt{10}$ or 10 which are used where metabolic processes also contribute to inter-individual variability. While ocular irritation is not expected to be substantially different between children and adults, the respiratory irritant effect, with documented potential to exacerbate asthma, is clearly an effect with the potential to differentially impact infants and children. The toxicodynamic component of the intraspecies uncertainty factor UF_{H-d} is therefore assigned an increased value of 10 to account for potential asthma exacerbation. These considerations are applied equally to the acute, 8-hour and chronic REL. Based on this study, an acute REL for acrolein exposure is calculated to be 2.3 $\mu g/m^3$ (1.0 ppb).

As noted in Section 5.1, contact lens wearers may be at greater risk for ocular irritation with acrolein exposure. However, since contact lens users, and infants and children are generally mutually exclusive groups, it is expected that with the ten-fold toxicodynamic UF_{H-d} described above, the acute REL should be adequately protective of these individuals as well.

The acute REL above is supported by a study in humans by Weber-Tschopp et al. (1977). During a 40 minute exposure to increasing concentrations of acrolein, significant ocular irritation was first reported at 0.07 ppm. This represents the LOAEL for this effect and is similar to the LOAEL of 0.06 ppm in Darley et al. (1960). The same uncertainty and adjustment factors, and rationale apply as in Darley, giving an acute REL of 2.7 $\mu g/m^3$ (1.2 ppb).

Study	Weber-Tschopp et al. (1977)
Study population	54 healthy human volunteers
Exposure method	Exposure chamber
Exposure continuity	Increasing concentration (0-0.6 ppm)
Exposure duration	40 min
Critical effects	subjective ocular irritation
LOAEL	0.07 ppm
NOAEL	not observed
Benchmark concentration	not derived
Time-adjusted exposure	not applied
Human Equivalent Concentration	n/a
LOAEL uncertainty factor (UF_L)	6 (no NOAEL)
Subchronic uncertainty factor (UFs)	not applied
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default: human study)
Toxicodynamic (UF_{A-d})	1 (default: human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (site of contact; no systemic effects)
Toxicodynamic (UF_{H-d})	10 (asthma exacerbation in children)
Cumulative uncertainty factor	60
Reference Exposure Level	2.7 μg/m³ (1.2 ppb)

Sensory irritancy is the critical response to acute acrolein exposure. For this effect both the Darley and Weber-Tschopp studies found similar effect levels resulting in similar estimates for the acute REL. In consideration of this, we took the geometric mean of the REL values from these studies to derive the acute REL of **2.5 µg/m^3 (1.1 ppb).**

A similar acute REL was calculated as shown below based on lesions in nasal epithelium in rats exposed to acrolein for 6 hours/day for 3 days (Cassee et al., 1996b). There were sufficient data in this study to permit the application of the BMD method in preference to the NOAEL/LOAEL approach. A $BMCL_{05}$ of 56 µg/m^3 was derived based on the incidence of moderate to severe lesions at each exposure level. Irritancy was not the endpoint in this study so a time adjustment was applied using $C^n * T = K$ (n = 3) to adjust the 18 hours of exposure to 1 hour that gave 147 µg/m^3 (see Section 5.6.1 of the TSD). Interspecies uncertainty factors of 2 for toxicokinetic differences with use of a dosimetric adjustment factor (DAF) of 0.85 (dosimetric adjustment factor – described below and in Section 4.4.7.2.2 of the TSD), and √10 for toxicodynamic variability were combined with a combined intraspecies UF of 10 (1 for kinetic and 10 for dynamic variability, reflecting the expectation of greater toxicodynamic variability) for a cumulative UF of 60 and an acute REL of 0.91 ppb.

Study	Cassee et al., 1996b
Study population	11 rats
Exposure method	Nose-only inhalation
Exposure continuity	6 hr/day
Exposure duration	3 days
Critical effects	lesions of the respiratory epithelium
LOAEL	0.25 ppm (0.58 mg/m^3)
NOAEL	not observed
Benchmark concentration ($BMCL_{05}$)	56 µg/m^3
Time-adjusted exposure	C^n*T n = 3
Extrapolated concentration	147 µg/m^3 (56^3*6/1*3/1)$^{1/3}$
Human concentration adjustment	125 µg/m^3 = 147*0.85 (DAF)
LOAEL uncertainty factor (UF_L)	not applied
Subchronic uncertainty factor (UFs)	not applied
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	2 (DAF adjustment with analogue chemical)
Toxicodynamic (UF_{A-d})	√10 (default: no interspecies toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1
Toxicodynamic (UF_{H-d})	10 (asthma exacerbation in children)
Cumulative uncertainty factor	60
Reference Exposure Level	2.1 µg/m^3 (0.91 ppb)

The DAF is a factor derived by OEHHA based on the modeled comparative flux of formaldehyde in the upper respiratory tracts of rats, rhesus monkeys and humans by Kimbell et al. (2001) (see Section 4.4.7.2.2 of the TSD). Kimbell et al. used three-dimensional, anatomically realistic, computational flow dynamic models to estimate mass flux across 20 consecutive bins representing the nasal passages. The mean flux at each bin was weighted by the percent of non-squamous epithelium in that bin to derive a weighted average flux for each bin. Averaging across all 20 bins provides an overall estimate of the flux for comparison between species (rat, 13.63 pmol/mm^2; human, 30.80 pmol/mm^2). Peak flux values were also estimated for the rat (2620 pmol/mm^2) and human (2082 pmol/mm^2), and averaged with the mean flux values to estimate the DAF (0.85). The DAF is the ratio of this value for the rat to that for humans. Although acrolein is more reactive than formaldehyde, both compounds appear to have their effects primarily on the respiratory (vs. olfactory) epithelium (Cassee et al., 1996a). This supports the assumption that in applying the DAF to acrolein, acrolein and formaldehyde deposit similarly in the nasal passages. In the absence of acrolein-specific modeling data, any residual uncertainty associated with this assumption is reflected in the use of an interspecies UF_{A-k} of 2.

8.2 Acrolein 8-Hour Reference Exposure Level

Study	Dorman et al., 2008
Study population	360 adult Fischer-344 rats
Exposure method	Discontinuous whole body 0.02 – 1.8 ppm
Exposure continuity	6 hr/day, 5 days/week
Exposure duration	65 days
Critical effects	Lesions in the respiratory epithelium
LOAEL	0.6 ppm
NOAEL	0.2 ppm
Benchmark concentration	not derived
Time-adjusted exposure	C * T = K
Extrapolated 8 hour concentration	71 ppb = (0.2*6 /24*5/7*20/10)
Human concentration adjustment	60 ppb = 71*0.85 (DAF)
LOAEL uncertainty factor (UF_L)	1 (NOAEL observed)
Subchronic uncertainty factor (UFs)	√10
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	2 (DAF adjustment with analogue chemical)
Toxicodynamic (UF_{A-d})	√10 (default: no interspecies toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	200
Reference Exposure Level	**0.70 μg/m³ 0.30 ppb)**

The 8-hour Reference Exposure Level is a concentration at or below which adverse non-cancer health effects would not be anticipated for repeated 8-hour exposures (see Section 6 in the TSD).

The 8-hour and chronic RELs are based on the observation of lesions in rat respiratory epithelium by Dorman et al. (2008). In this study, a LOAEL of 0.6 ppm and a NOAEL of 0.2 ppm were observed for respiratory lesions in rats. The observation of a NOAEL eliminates the need for a UF for the LOAEL to NOAEL conversion. The critical effect of lesion formation is not a sensory irritancy effect so a time (T) adjustment was applied using C*T = K to extrapolate from the 6 to 24 hours and from 5 to 7 days. This chronic exposure was converted to an 8 hour exposure with the 8-hr breathing rate conversion of 20/10 and yields an extrapolated 8 hour concentration of 71 ppb. A human concentration of 60 ppb was estimated using a DAF of 0.85. Although the use of the DAF is expected to correct for pharmacokinetic differences between species, an interspecies kinetic UF of 2 was used because the DAF is based on an analogue (formaldehyde). The default interspecies UF_{A-d} of √10 was applied to compensate for the absence of data on pharmacodynamic differences between species. An intraspecies UF_{H-k} of 1 was used since, although the data are only for adult animals, the pharmacokinetic differences between adult and young animals are not expected to be great based on the similar inhalation dosimetry associated with reactive gases in adults

and infants (Ginsberg et al., 2005). The potential pharmacodynamic differences among individuals (especially those with and without asthma) and between adults and infants (due to the immaturity of the infants respiratory tract) are expected to be greater. For example, irritant gases more readily stimulate the hyper-reactive airways of asthmatics while enhanced mucus production in response to irritant gases may more easily block the infant's narrower airways. As described in Section 5.2, exacerbation of asthma by acrolein is expected to disproportionately affect children. For these reasons, an intraspecies UF_{H-d} of 10 was employed. The UF_{H-d} of 10 is the default in the absence of human kinetic data. This resulted in a cumulative UF of 200 and an 8-hour REL of 0.70 μg/m³ (0.30 ppb).

These results are supported by studies of Kutzman et al. (1985) and Feron et al. (1978) following exposure of rats to acrolein for 6 hours/day, 5 days/week for 62 days. In these studies, a LOAEL of 0.4 ppm was observed for nasal lesion formation.

Study	Kutzman et al., 1985; Feron et al. (1978)
Study population	96 adult Fischer-344 rats
Exposure method	Discontinuous whole body 0.4 – 4.0 ppm
Exposure continuity	6 hr/day, 5 days/week
Exposure duration	62 days
Critical effects	Lesions in the respiratory epithelium
LOAEL	0.4 ppm
NOAEL	not observed
Benchmark concentration	not derived
Time-adjusted exposure	$C^n * T = K$, where n =1.2
Extrapolated 8 hour concentration	143 ppb = (0.4*6 /24*5/7*20/10)
Human concentration adjustment	122 ppb = 143*0.85 (DAF)
LOAEL uncertainty factor (UF_L)	3 (mild effect; no NOAEL)
Subchronic uncertainty factor (UFs)	√10
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	2 (DAF adjustment with analogue chemical)
Toxicodynamic (UF_{A-d})	√10 (default: no interspecies toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	600
Reference Exposure Level	0.46 μg/m³ (0.20 ppb)

The experimental designs and results from these two studies were essentially identical. As above, the critical effect of lesion formation is not a sensory irritancy effect so a time (T) adjustment was applied using C*T = K to extrapolate to an 8 hour concentration of 143 ppb. A UF of 3 for the use of a LOAEL reflects the expectation that the NOAEL, while not reported in either of these studies, will not be far from the LOAEL. This is based on the steepness of the dose-response in a plot of the nasal histopathology

scoring vs acrolein concentration in the Feron paper, and the observation of a NOAEL three-fold lower than the LOAEL in the Dorman study (0.2 vs 0.6 ppm). An adjusted human concentration of 122 ppb was estimated using a DAF of 0.85. The rest of the uncertainty factors were the same as for the crtitical Dorman study This resulted in a cumulative UF of 600 and an 8-hour REL of 0.46 μg/m³ (0.20 ppb). Thus, this derivation is supportive of the REL derived from Dorman et al. (2008).

8.3 Acrolein Chronic Reference Exposure Level

Study	Dorman et al., 2008
Study population	360 adult Fischer-344 rats
Exposure method	Discontinuous whole body 0.02 – 1.8 ppm
Exposure continuity	6 hr/day, 5 days/week
Exposure duration	65 days
Critical effects	Lesions in the respiratory epithelium
LOAEL	0.6 ppm
NOAEL	0.2 ppm
Benchmark concentration	not derived
Time-adjusted exposure	36 ppb = (0.2*6/24*5/7)
Human concentration adjustment	30 ppb = 36*0.85 (DAF)
LOAEL uncertainty factor (UF_L)	1 (NOAEL observed)
Subchronic uncertainty factor (UFs)	√10 (exposure 8-12% of lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	2 (DAF adjustment based on analogue chemical)
Toxicodynamic (UF_{A-d})	√10 (default: no interspecies toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	200
Reference Exposure Level	**0.35 μg/m³ (0.15 ppb)**

The chronic Reference Exposure Level is a concentration at which adverse noncancer health effects would not be expected from continuous chronic exposures (see Section 7 in the Technical Support Document).

The chronic REL was developed using the same study as the 8-hr REL but with a time extrapolation to continuous exposure since the endpoint was not trigeminal irritancy (see Section 1.2.3 in the TSD). It is based on the observed NOAEL of 0.2 ppm for respiratory lesions in rats. The observation of a NOAEL eliminates the need for a UF for the LOAEL to NOAEL conversion. Time adjustment from the experimental to continuous exposure gave 36 ppb (0.2*6 hr/24 hr*5 days/7 days). A DAF of 0.85 gave an equivalent human exposure of 30 ppb. Use of the DAF for an analogue chemical entails an uncertainty factor of 2 as described previously. The same UFs and rationale as used in the derivation of the 8-hour REL are applied to the chronic REL. The

resulting cumulative UF of 200 gave an estimated reference exposure level of 0.35 μg/m³ (0.15 ppb).

These results were supported by those of Kutzman et al. (1985) and Feron et al. (1978)

Study	Kutzman et al., 1985; Feron et al. (1978)
Study population	96 adult Fischer-344 rats
Exposure method	Discontinuous whole body to 0 – 4.0 ppm
Exposure continuity	6 hr/day, 5 days/week
Exposure duration	62 days
Critical effects	Lesions in the respiratory epithelium
LOAEL	0.4 ppm
NOAEL	not observed
Benchmark concentration	not derived
Time adjusted exposure	0.071 ppm = 0.4*6/24*5/7
Human concentration adjustment	60 ppb = 0.071 * 0.85 (DAF)
LOAEL uncertainty factor (UF_L)	3 (no NOAEL)
Subchronic uncertainty factor (UFs)	√10 (exposure 8-12% of lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	2 (with DAF adjustment)
Toxicodynamic (UF_{A-d})	√10 (default: no interspecies toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	600
Reference Exposure Level	**0.10 μg/m³ (0.04 ppb)**

The LOAEL of 0.4 ppm was adjusted to a continuous exposure of 0.071 ppm (0.4*6 hr/24 hr*5 days/7 days). Application of a DAF of 0.85 gave a human equivalent concentration of 60 ppb (138 μg/m^3). The UFs applied here are the same as those for the Dorman study with the inclusion of a LOAEL to NOAEL UF of 3. The cumulative UF of 600 gives a chronic REL of 0.10 μg/m³ (0.04 ppb). The study by Dorman et al. was selected in preference to these studies because it identified a NOAEL for the critical effect.

The U.S. EPA (2003) based its RfC of 0.02 μg/m^3 on the study by Feron et al. (1978) from which a HEC of 0.02 mg/m^3 was derived based on a regional gas dosimetric ratio (RGDR) of 0.14 and an adjusted LOAEL of 0.16 mg/m^3 (0.14 * 0.16 = 0.02). U.S. EPA applied a total uncertainty factor of 1,000 (3 for interspecies extrapolation from a dosimetrically adjusted dose; 10 for intra-human variability; 3 for the use of a LOAEL; 10 for subchronic to chronic extrapolation). In contrast to the RGDR of 0.14, to better account for differences in rat and human exposures to reactive gases, OEHHA used a DAF of 0.85 based on comparative modeling of gas flux in human and rat nasal passages described above. This, combined with UFs of 6 for interspecies uncertainty (2 for use of the DAF, √10 for toxicodynamic differences), √10 for the use of a

subchronic study, and 3 for the use of a LOAEL (vs US EPA's 3, 3, and 10, respectively) account for the difference between the REL and the U.S. EPA RfC.

For comparison, the state of Minnesota Department of Health reports a subchronic Health Risk Value (HRV) for acrolein of 0.2 μg/m^3, a level thought to be without significant risk following inhalation exposure for 13 weeks (MDH, 2002).

8.4 Acrolein as a Toxic Air Contaminant

Acrolein was identified by the ARB as a toxic air contaminant (TAC) in accordance with section 39657(b) of the California Health and Safety Code on April 8, 1993 (Title 17, California Code of Regulations, Section 93001)(CCR, 2007). In view of the differential impacts on infants and children identified in Section 6.2 (more severe effects associated with bronchoconstriction and asthma exacerbation, less ability to escape or avoid exposure), OEHHA listed acrolein as a TAC which may disproportionately impact children pursuant to Health and Safety Code, Section 39669.5(c) .

9. References

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Inorganic Arsenic Reference Exposure Levels

1. Summary

Acute, 8-hour and chronic reference exposure levels (RELs) were derived for inorganic arsenic including arsine. Inorganic arsenic causes a wide variety of toxic effects in humans and experimental animals including effects on development, the vascular system, the nervous system, blood, lung, and skin. The most sensitive acute effects were seen in mice (fetal development) whereas the most sensitive 8-hour and chronic effects were decreased intellectual function in children. The relevant literature evaluated in this assessment was published before April 1, 2008. The key values are summarized below.

1.1 Inorganic Arsenic Acute REL

Reference Exposure Level	**0.2 μg As/m³**
Critical effect(s)	Decreased fetal weight in mice
Hazard Index target(s)	Development (teratogenicity); cardiovascular system; nervous system

1.2 Inorganic Arsenic 8-Hour REL

Reference Exposure Level	**0.015 μg/ As/m³**
Critical effect(s)	Decreased intellectual function in 10 year old children
Hazard Index target(s)	Development; cardiovascular system; nervous system; lung; skin

1.3 Inorganic Arsenic Chronic REL

Reference Exposure Level	**0.015 μg As/m³**
Oral Reference Exposure Level	0.0035 μg/kg bw-day
Critical effect(s)	Decreased intellectual function in 10 year old children
Hazard Index target(s)	Development; cardiovascular system; nervous system; lung; skin

2. Physical & Chemical Properties

Table 2.1 Arsenic and Arsenic Species*

Molecular formula	Molecular weight	Percent As by weight	Synonyms	CAS Registry Number
As	74.92	100%	Arsenic black, metallic arsenic	7440-38-2
As_2O_3 As_4O_6	197.82 395.68	75.7%	Arsenious oxide, arsenic (III) trioxide, arsenic oxide, arsenous acid, arsenous acid anhydride, Crude Arsenic, White Arsenic	1327-53-3
$AsCl_3$	181.28	41.3%	Arsenic butter, trichloroarsine, arsenious chloride	7784-34-1
As_2O_5	229.82	65.2%	Arsenic pentoxide, arsenic anhydride, arsenic oxide, arsenic acid anhydride	1303-28-2
$AsHNa_2O_4$	185.91	40.3%	Arsenic acid disodium salt, disodium arsenate, sodium arsenate dibasic	7778-43-0
$AsHNa_2O_3$	130.92	57.2%	Arsenous acid disodium salt, arsenious acid sodium salt	7784-46-5
AsH_3	77.94	96.12	Arsine, arsane, arsenic hydride, arsenous hydride, hydrogen arsenide, arsenic trihydride	7784-42-1
$As(OH)_3$	125.94	59.49	Arsenous acid	13464-58-9
$AsO(OH)_3$	141.93	52.78	Arsenic acid, orthoarsenic acid	7778-39-4
As_4S_4	427.92	70.03	Arsenic disulfide, realgar, red arsenic sulfide	
$CH_3AsO(OH)_2$	139.97	53.51	Monomethylarsonic acid	124-58-3
$CH_3As(OH)_2$	123.77	60.41	Monomethylarsonous acid	25400-23-1
$(CH_3)_2AsO(OH)$	137.99	54.28	Dimethylarsinic acid, cacodylic acid	75-60-5
$(CH_3)_2AsOH$	121.99	61.40	Dimethylarsinous acid	55094-22-9
$(CH_3)_3AsO$	136.02	55.06	Trimethylarsine oxide	4964-14-1

*Note: Methylated arsenic species occurring naturally and as metabolites (IARC, 2004)

2.1 Arsenic (Metallic) (ATSDR, 2000)

Description	Yellow, black or gray solid
Molecular formula	see Table 2.1
Molecular weight	see Table 2.1
Specific gravity (water = 1)	5.778 g/cm^3 @ 25°C
Boiling point	613°C (sublimes) at 760 mm Hg
Vapor pressure	7.5 x 10^{-3} mmHg at 280 °C
Flashpoint	not applicable
Explosive limits	not applicable
Solubility	soluble in nitric acid, insoluble in water
Odor threshold	not applicable
Odor description	odorless
Metabolites	dimethylarsinic acid, methylarsonic acid
Conversion factor	not applicable for As

2.2 Arsenic Trioxide (ATSDR, 2000)

Description	As_2O_3: White solid, glassy, amorphous lumps or crystal
Molecular formula	See Table 2.1
Molecular weight	197.84
Density	As_2O_3: 3.865 g/cm^3
Boiling point	As_2O_3: 460°C
Melting point	As_2O_3: 274°C
Solubility	Oxides: slightly soluble in water 17g/L, insoluble in alcohol, chloroform, ether.
Metabolites	Dimethylarsinic acid, methylarsonic acid

2.3 Arsine (U.S. EPA, 2006a)

Description	Colorless gas
Molecular formula	AsH_3
Molecular weight	77.93
Specific gravity (Water = 1)	1.689 @ 84.9°C
Boiling point	-62.55°C
Melting point	-117°C
Vapor pressure	Greater than 1 atm
Vapor density (Air = 1)	2.695
Solubility	soluble in chloroform and benzene, slightly soluble in water (20 mL/100 mL at 20 C), ethyl alcohol and in alkalis
Odor threshold	0.5 ppm
Odor description	garlic-like or fishy odor
Metabolites	oxidation to arsenite, arsenate, other unidentified (Landrigan *et al*., 1982; Carter *et al*., 2003)
Conversion factor	1 ppm = 3.19 mg/m³ @ 25°C

3. Occurrence and Major Uses

Arsenic is ubiquitous and is found in small amounts in soils and water throughout the world and also in foods, particularly seafood (NIOSH, 1975). Ore refining processes, including the smelting of copper and lead, are the major sources of release of arsenic dust and inorganic arsenic compounds. Arsenic trioxide is the form of inorganic arsenic most commonly produced. It is used as a raw material for the production of other inorganic arsenic compounds (Asi), alloys, and organic arsenic compounds (Grayson, 1978).

Pesticides have historically constituted the largest single use (50%) of arsenic compounds (HSDB, 1995). The major arsenic herbicides manufactured are monosodium methyl arsonate (MSMA), disodium methyl arsonate (DSMA), and dimethyl arsenic acid (cacodylic acid). Inorganic arsenic compounds are also used as herbicides (arsenite), insecticides (arsenic trioxide, calcium and other arsenates), or rodenticides (sulfides) (ACGIH, 1992). Arsenic trichloride, for example, is used mainly as a chemical intermediate in the production of insecticides, but has other applications in the ceramics and pharmaceutical industries (HSDB, 1995). Arsenic was used as a pesticide to treat tobacco; thus, cigarette smoke was another common source of exposure (U.S.EPA, 1984). The use of arsenic compounds in agriculture has reduced in recent years and U.S. EPA is considering ending their uses under the pesticide reregistration program (U.S. EPA, 2006b).

Arsenic-based wood preservatives have constituted the next largest use (40%) of arsenic compounds (HSDB, 1995). In December 2003 the U.S. EPA terminated all residential uses of wood preservatives containing arsenic limiting such products to restricted use by certified pesticide applicators (U.S. EPA, 2002).

The highly toxic trivalent arsenic compounds, such as arsenic trioxide, are typically introduced into the environment as a result of industrial processes including the smelting of metal ores. Pentavalent arsenic compounds are generally considered to be less toxic and are most frequently found naturally.

Processes such as smelting, galvanizing, soldering, and etching, that require the treatment of metal with strong acids, are possible sources of arsine gas. Acid treatment of metals contaminated with arsenic can result in the release of arsine gas. Arsine is used to provide arsenic as an ingredient in semiconductor manufacture. Combustion of fossil fuels may produce arsine gas.

4. Toxicokinetics

A knowledge of the metabolism of inorganic arsenic has long been thought to be essential to understanding the mode(s) of action of inorganic arsenic toxicity. Trivalent (+3, As^{III}) arsenic species (e.g., arsenite) have often exhibited greater acute toxicity than pentavalent (+5, As^{V}) species (e.g., arsenate). The terms arsenite and arsenate refer to the ionized anions of arsenous acid and arsenic acid, respectively, as they exist in aqueous solution at physiological pH. Since the metabolism of inorganic arsenic in

mammalian species generally proceeds via alternate reductive and oxidative methylation steps to mono- (MMA) and dimethyl (DMA) arsenic acids, it was believed that methylation represented detoxication of inorganic arsenic. However, recent evidence supports the idea that trivalent methylated species are in some cases more toxic than inorganic precursors and may play a key role in arsenic toxicity for selected endpoints. The metabolism of arsine (As^{-III}), while less studied, appears to progress similarly after its oxidation to arsenite (As^{V}) and is in part the basis for including arsine in the RELs for inorganic arsenic.

Several comprehensive reviews of the absorption, distribution, metabolism and elimination of arsenic have been published (Vahter, 1983; Thompson, 1993; ATSDR, 2000; NRC, 2001). Most information on the toxicokinetics of arsenic derives from oral exposure studies. The kinetics of arsenic varies depending on the chemical form of arsenic and on the animal species. The following discussion is limited to the oxidized forms found in water and air and forms that are ingested via the aquatic food chain. These include the inorganic, soluble forms of arsenite (As^{III}) and arsenate (As^{V}), as well as the organic monomethylarsonate (MMA), dimethylarsinic acid (DMA), trimethylarsine (TMA), and or arsenobetaine (in fish).

4.1 Inorganic Arsenic Oxides

Owen (1990) reported inhalation absorption of 32 percent (range 30 to 34 %) from arsenic containing aerosols, however it is uncertain if this figure included the gastrointestinal absorption of arsenic particles from the upper respiratory tract. The International Commission on Radiological Protection Human Respiratory Tract Model (ICRP, 1994) gives total deposition fractions for 10 yr old children inhaling 1 μm activity median thermodynamic diameter particles at 0.31 to 2.03 m^3/hr of 0.42 to 0.58. There are relatively few data on the kinetics of airborne arsenic excretion. Mann *et al*. (1996a) modeled inhalation exposures based on the occupational data of Vahter *et al*. (1986) and Offergelt *et al*. (1992). For simulated occupational exposures of 10 μg/m^3 of arsenic aerosol of MMAD of 5.0 μm, GSD of 2.1, 1.2 L tidal volume and a breathing rate of 16 /min, urinary excretion increased over the work week's exposure from 7 to 25 μg As/g creatinine.

The MMAD refers to the mass median aerodynamic diameter and GSD the geometric standard deviation. These values characterize a distribution of particles in an aerosol. The units refer to the first order rate constant for the absorption of arsenic into the blood plasma from the model lung compartments. The model has separate compartments for the nasopharynx, tracheobroncheal, and pulmonary regions of the lung. Deposition of particles in these lung compartments, in units of μg/hr, depends on breathing rate, tidal volume, concentration of particles in the air, and their aerodynamic diameters. Absorption of deposited particles into blood plasma is first order but depends upon the surface area of the region in question, hence the units of /cm^2-hr.

Model predictions of arsenic metabolites (Asi, MMA, DMA) in postshift urine generally fell within the range of observations for 18 workers in the exposure range of 10-1000 μg As/m^3. After daily inhalation exposure of 100 μg As (III)/m^3 for three weeks, the model

predictions for urinary metabolite distribution closely matched observed values (predicted/observed means: Asi, 1.05; MMA, 1.0; DMA, 1.0). From the model, Mann *et al*. (1996b) derived a fitted lung absorption first order rate constant for arsenic trioxide dust of 0.01/cm^2-hr.

In general, investigations that have monitored arsenic excretion of experimental animals following parenteral administration have demonstrated that only a small fraction of the administered arsenic is excreted in the feces. Thus, to estimate the amount of inorganic arsenic absorbed following oral administration, most kinetic and metabolic studies have monitored the urine. Soluble compounds of inorganic arsenic, whether in the trivalent or pentavalent form, are readily absorbed (80-90 percent) in most animal species following oral administration (Charbonneau *et al*., 1978; Vahter, 1981; Hughes *et al*., 1994; Freeman *et al*., 1995). However, only about 40-50 percent absorption has been reported in hamsters (Yamauchi and Yamamura, 1985; Marafante and Vahter, 1987). Absorption of orally administered inorganic arsenic in humans has been shown to range between 54-80 percent (Tam *et al*., 1979; Buchet *et al*., 1981b; a; Kurttio *et al*., 1998).

Inorganic arsenic compounds are poorly absorbed through the skin (Ca.1-5%); the trivalent is more rapidly absorbed than the pentavalent (Wester *et al*., 1993; Wester *et al*., 2004).

Organic forms of arsenic are also extensively absorbed from the gastrointestinal tract. Experimental studies examining the absorption of MMA, DMA, TMA and arsenobetaine in humans have demonstrated 75-92 percent absorption. At low-level exposures, excretion of arsenic and its metabolites seems to balance absorption of inorganic arsenic. With increasing arsenic intake, there is suggestive evidence that methylation appears less complete. Studies, which examine the effect of dose on excretion patterns, have been conducted in mice and humans (Buchet *et al*., 1981b; a; Vahter, 1981). As the dose of inorganic arsenic increases, the percent of arsenic excreted as DMA decreases, accompanied by an increased excretion in the percent as inorganic arsenic. The percent excreted as MMA remains virtually unchanged. *In vitro* metabolism studies on the methylation of inorganic arsenic have demonstrated that the liver is the site of methylating activity and that S-adenosylmethionine and reduced glutathione are required as methyl donors (Buchet and Lauwerys, 1985; 1987).

While absorption from the gastrointestinal tract is the most important route of exposure for waterborne arsenic, some potential for dermal absorption has been reported. Rahman *et al*. (1994) conducted *in vitro* studies with sodium [^{74}As] arsenate and clipped full-thickness mouse skin in a flow-through system. Doses of 5, 50, 500, or 5000 ng were applied to 0.64 cm^2 of skin as a solid, in aqueous vehicle, or in soil. Absorption of sodium arsenate increased linearly with applied dose from all vehicles. The maximum absorption of 62 percent of applied dose was obtained with the aqueous vehicle and the least (0.3 percent) with soil. Wester *et al*. (1993) evaluated the percutaneous absorption of [^{73}As] arsenate from soil or water *in vivo* in Rhesus monkeys and *in vitro* in human cadaver skin. Water solutions of [^{73}As] arsenate at low (0.024 ng/cm^2) or high (2.1 μg/cm^2) surface concentrations were compared. With topical administration for 24 hr, *in vivo* absorption in the Rhesus monkey was 6.4 $\pm$ 3.9 (SD) percent from the low

dose and 2.0 ± 1.2 (SD) percent from the high dose. *In vitro* percutaneous absorption of the low dose from water in human skin was 0.93 ± 1.1 percent in receptor fluid and 0.98 ± 0.96 percent in the washed skin; the total was about 1.9 percent. Absorption from soil (0.4 ng/cm^2) was less, at 6.4 percent in the monkey *in vivo* and 0.8 percent in human skin *in vitro*.

The retention and distribution patterns of arsenic are in part determined by its chemical properties. Arsenite (As^{III}) reacts and binds to sulfhydryl groups while arsenate (As^{V}) has chemical properties similar to those of phosphate. As^{V} also has affinity for sulfhydryl groups; however, its affinity is approximately 10-fold less than As^{III} (Jacobson-Kram and Montalbano, 1985). The distribution and retention patterns of As^{III} and As^{V} are also affected by species, dose level, methylation capacity, valence form, and route of administration.

Vahter *et al*. (1984) studied tissue distribution and retention of ^{74}As-DMA in mice and rats. About 80 percent of an oral dose of 0.4 mg As/kg was absorbed from the gastrointestinal tract. In mice >99 percent of the dose was excreted within 3 d compared to only 50 percent in rats, due largely to accumulation in blood, which delayed excretion. Tissue distribution in mice showed the highest initial (0.5-6 hr) concentrations in kidneys, lungs, intestinal mucosa, stomach, and testes. Tissues with the longest retention times were lungs, thyroid, intestinal walls, and lens.

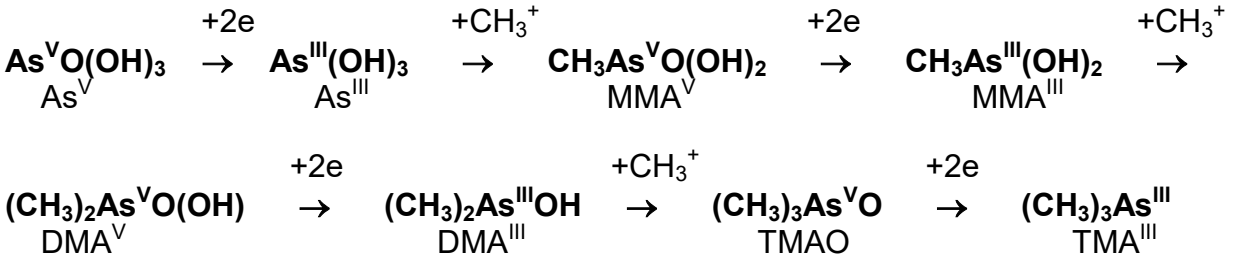
The effect of dose on arsenate disposition was evaluated in adult female B6C3F$_1$ mice dosed orally with 0.5 to 5000 μg/kg [^{73}As]-arsenate in water (Hughes *et al*., 1994). Urine was collected at several time points over a 48-hr period, and feces at 24 and 48 hr post-exposure. The recovery of As-derived radioactivity in excreta and tissues ranged from 83.1 to 89.3 percent of dose. As-derived radioactivity was detected in several tissues (urinary bladder, gall bladder, kidney, liver, lung) although the sum for each exposure level was very low (<0.5 percent of dose). The principal depot was the liver, followed by the kidneys. As the dose of arsenate increased there was a significant increase in the accumulation of radioactivity in the urinary bladder, kidney, liver, and lungs. The greatest concentration of As radioactivity was in the urinary bladder.

Most studies of arsenic metabolism have involved administration of inorganic arsenic (Asi) as arsenate (As^{V}) or arsenite (As^{III}) to an experimental animal or a human, and detection of Asi and the methylated metabolites methylarsonic acid (MMA^{V}) and dimethylarsinic acid (DMA^{V}) in urine, feces, and tissues.

Thompson (1993) conducted an extensive review and analysis of the mammalian metabolic data on arsenic. The metabolism of arsenate can be viewed as a cascade of reductive and oxidative methylation steps leading successively to As^{III}, MMA^{V}, MMA^{III}, DMA^{V}, DMA^{III}, $TMAO^{V}$, and TMA as outlined in Scheme 1. Recently Hayakawa *et al*. (2005) proposed a new metabolic pathway for arsenite, which does not involve oxidative methylation but rather is mediated by As-glutathione complexes, S-adenosylmethionine (SAM) and human arsenic methyltransferase Cyt19. In this pathway arsenic triglutathione ($As(SG)_3$) is converted to monomethyl-(MADG) and dimethyl-(DMAG) conjugates which are hydrolyzed to MMA^{III} and DMA^{III}, respectively. Thus pentavalent

methylated metabolites might arise via oxidation of their trivalent forms rather than the reverse as shown in Scheme 1.

Scheme 1. Biomethylation of Arsenic Involving Alternate Reduction of Pentavalent Arsenic to Trivalent Arsenic Followed by Oxidative Addition of a Methyl Group (after Jiang et al. (2003))



MMA^{III} and DMA^{III} have only recently been detected as stable urinary metabolites in human subjects (Aposhian *et al*., 2000a; Aposhian *et al*., 2000b; Le *et al*., 2000a; Le *et al*., 2000b), and trimethylarsine oxide (TMAO) and trimethylarsine (TMA) are rarely seen and are very minor metabolites in most mammals if found at all. Few data are available on the tissue concentrations of trivalent methylated As species (Kitchin, 2001). Gregus *et al*. (2000) found that in bile duct-cannulated rats, As^{III} and its metabolites were preferentially excreted into bile (22 percent) versus eight percent into urine in two hr. Arsenite appeared in bile rapidly and constituted the large majority in the first 20 min. Thereafter As^{III} declined and MMA^{III} output gradually increased. From 40 min after i.v. As^{III} administration, MMA^{III} was the dominant form of biliary arsenic. Within two hr 9.2 percent of the dose was excreted in the bile as MMA^{III}. Injection of arsenate produced a mixture of As^{V}, As^{III} and MMA^{III} in the bile. Curiously, rats injected with MMA^{V} did not excrete MMA^{III}.

The metabolism results of Styblo *et al*. (1995) in rat liver cytosol *in vitro* seem to support the overall metabolic scheme noted above; MMA^{III} and MMA^{III}-diglutathione complex are more rapidly methylated to the dimethyl forms than MMA^{V}. Thompson also suggests that the data support the presence of two inhibitory loops: (1) competitive inhibition by MMA^{III} of the $As^{III} \rightarrow MMA^{V}$ step catalyzed by monomethyltransferase (MMTase); and (2) possibly noncompetitive inhibition by As^{III} of the $MMA^{III} \rightarrow DMA^{V}$ step catalyzed by dimethyltransferase (DMTase).

Styblo *et al*. (1996) observed 50 μM arsenite inhibition of DMA^{V} production in rat liver cytosol *in vitro*. Healy *et al*. (1998) studied the activity of MMTase in tissues of mice. The activity was determined with sodium arsenite and *S*-[methyl-^{3}H]-adenosyl-L-methionine by measuring the formation of [methyl-^{3}H] monomethylarsonate. The mean MMTase activities (units/mg $\pm$ SEM) measured in cytosol of mouse tissues were: liver, 0.40 $\pm$ 0.06; testis, 1.45 $\pm$ 0.08; kidney, 0.70 $\pm$ 0.06; and lung, 0.22 $\pm$ 0.01. When mice were given arsenate in drinking water for 32 or 92 days at 25 or 2500 μg As/L, the MMTase activities were not significantly increased compared to controls. MMTases and DMTases have been partially purified from the livers of rabbits (Zakharyan *et al*., 1995), Rhesus monkeys (Zakharyan *et al*., 1996) and hamsters (Wildfang *et al*., 1998). All of

the enzyme preparations exhibited Michaelis-Menten enzyme kinetics with Km values ranging from $8x10^{-4}$ *M* for hamster DMTase to $1.8x10^{-6}$ *M* for hamster MMTase. Vmax values ranged from 0.007 pmol/mg protein/hr for hamster DMTase to 39.6 pmol/mg protein/hr for rabbit MMTase. Comparative studies have shown several species to be deficient in methyltransferase activities, notably New World monkeys, marmosets, tamarin, squirrel, chimpanzee, and guinea pig (Vahter *et al*., 1995b; Aposhian, 1997). While comparisons with human arsenic methyl transferase are limited by lack of a purified human enzyme, based on excretion profiles of urinary metabolites the rabbit and hamster appear most pharmacokinetically similar to humans than the other species studied. Walton *et al*. (2003) compared the methylation of arsenite by rat and human primary hepatocytes in vitro (control values in their Tables 1 and 2). For the rat the methylation rate after a 3 hr incubation with 0.1 μM arsenite was 99.3 ± 1.87 pmol CH_3/hr/10^6 cells (mean ± SD, N =4). The human hepatocytes similarly exposed for 24 hr had a methylation rate of 1.68 ± 0.24 pmol CH_3/hr/10^6 cells, over a 50-fold difference in apparent methylation rate.

While the reduction of arsenate and MMA^V can be accomplished nonenzymatically *in vitro*, and arsenate reduction by glutathione occurs in mammalian blood *in vivo* (Vahter and Envall, 1983; Winski and Carter, 1995), these reductive steps are most likely enzymatically mediated *in vivo*. An arsenate reductase has been partially purified from human liver and described (Radabaugh and Aposhian, 2000). The approximate mass of the enzyme was 72,000. It was specific for arsenite (i.e., did not reduce [^{14}C] MMA^V) and exhibited substrate saturation at about 300 μM. The human arsenate reductase requires a thiol and a heat-stable cofactor and is apparently distinct from those isolated from bacteria (Ji and Silver, 1992; Gladysheva *et al*., 1994; Krafft and Macy, 1998).

Monomethyl arsonate (MMA^V) reductases have been isolated and described for rabbit (Zakharyan and Aposhian, 1999) and hamster (Sampayo-Reyes *et al*., 2000). In the latter study the distribution of MMA^V reductase activity was 91.4 nmol MMA^{III}/mg protein/hr in brain and 61.8 nmol MMA^{III}/mg protein/hr in bladder. Skin, kidney and testis all had less than 15 nmol/mg/hr. Spleen, liver, lung, and heart were all between 15 and 62 nmol/mg/hr. The high activity of MMA^V reductase in brain is curious and may help explain some of the neurotoxic effects of arsenic. Due to relatively low affinity of the MMA^V reductase (K_M = $2.2x10^{-3}$ M) compared to the methyl transferases (K_M = 5-$9x10^{-6}$ M), the MMA^V reduction is thought to be the rate-limiting step in arsenic metabolism (Zakharyan and Aposhian, 1999). The partially purified human liver MMA^V reductase has been shown to be identical with human glutathione S-transferase Omega class hGSTO 1-1 (Zakharyan *et al*., 2001).

DMA is the main metabolite found in the tissues and urine of most experimental animals administered inorganic arsenic. Humans are also somewhat unique in that MMA has been found to be an important metabolite of inorganic arsenic in addition to DMA. Studies conducted on human volunteers given a single oral dose of inorganic arsenic demonstrated that within 4-7 days, 46-62 percent of the dose was excreted in the urine (Tam *et al*., 1979; Pomroy *et al*., 1980; Buchet *et al*., 1981b; a). Approximately 75 percent of the excreted arsenic is methylated, about one-third as MMA and two-thirds as DMA.

The possibility of genetic polymorphism in arsenic metabolism has been suggested by Vahter *et al*. (1995a), who studied native Andean women in northwestern Argentina who were exposed to a wide range of As concentrations in drinking water (2.5 to 200 μg As/L). The women exposed to the highest As concentration in water exhibited surprisingly low levels of MMA in their urine (2.3 percent of metabolites). The percentage of arsenic urinary metabolites as MMA in typical human urine ranges from 12 to 20. Chiou *et al*. (1997a) studied the relationships among arsenic methylation capacity, body retention, and genetic polymorphisms of glutathione-*S*-transferase (GST) M1 and T1 in 115 human subjects. Percentages of As species in urine (mean ± SE) were: Asi, 11.8 ± 1.0; MMA, 26.9 ± 1.2; and DMA, 61.3 ± 1.4. Genetic polymorphisms of GST M1 and T1 were significantly associated with As methylation. Subjects with the null genotype of GST M1 had an increased percentage of Asi in urine, while those with the null genotype GST T1 had elevated DMA in their urine samples.

Marnell *et al*. (2003) reported six polymorphisms in the MMA^V reductase hGSTO1 gene in DNA isolated from peripheral blood of 75 Mexican subjects. Two subjects with the same polymorphism showed 5 to 10 fold higher concentrations (μg/g creatinine) of Asi in their urine than other subjects.

Yu *et al*. (2003) screened DNA of 22 subjects of European ancestry (EA) and 24 of indigenous American ancestry (IA) for polymorphisms in arsenate reductase and MMA^V reductase genes. For the arsenate reductase gene (hPNP) 48 polymorphic sites were identified while 33 were found in the MMA^V reductase gene (hGSTO1-1). For the EA individuals the MMA^V reductase gene showed greater polymorphism than the arsenate reductase gene whereas the reverse was seen in the IA individuals. In the latter group only one polymorphism had a frequency of > 10%. Meza *et al*. (2005) screened 135 As-exposed subjects from Sonora, Mexico for polymorphisms in arsenic metabolism genes: arsenate reductase (hPNP); MMA^V reductase (hGSTO); and arsenic 3 methyltransferase (CYT19). The subjects were exposed to drinking water with 5.5 to 43.3 ppb arsenic. The screening was based on urinary DMA^V/MMA^V (D/M) ratios. The analysis revealed that all of the variation was due to a very strong association between CYT19 and D/M in children only (7-11 yr). With children removed no significant association was seen in adults (18-79 yr). This developmentally regulated association between CYT19 and arsenic metabolism raises questions about the adequacy of arsenic risk assessment for children.

Several authors have studied the kinetics of As excretion in humans. Tam *et al*. (1979) administered ^{74}As arsenic acid (0.01 μg, ca. 6 μCi) to six adult males (age: 28-60; body weight: 64-84 kg) following an overnight fast. The urine was analyzed at 24 hr intervals for five days following As administration. In the first 24 hr period Asi excretion exceeded that of the methylated metabolites but thereafter the usual DMA > MMA > Asi pattern persisted, with DMA increasing in percentage of cumulative excretion at the later time points. A follow up study (Pomroy *et al*., 1980) followed ^{74}As excretion for periods up to 103 days using a whole body counter, with measurement of excreta for the first seven days. Their results indicate that the excretion data were best represented by a three-component exponential function. The coefficients for the pooled data accounted for 65.7 percent of excretion with a half-life of 2.09 days, 30.4 percent with a half-life of

9.5 days, and 3.7 percent with a half-life of 38.4 days. A four-exponent function showed a better fit to one of the six subjects (half-lives: 0.017, 1.42, 7.70 and 44.1 days).

Physiologically-based pharmacokinetic (PBPK) models employ data from various sources to mathematically simulate the uptake, distribution, metabolism and excretion of toxic chemicals in species of interest. Such models are used in risk assessment to estimate target tissue doses and to facilitate route-to-route and interspecies extrapolations. By contrast, pharmacodynamic (PD) models simulate biological responses to chemical exposures. A number of PBPK models for arsenic disposition and metabolism have been developed for experimental animals and humans (Mann *et al*., 1994; Menzel *et al*., 1994; Mann *et al*., 1996a; 1996b; Yu, 1999; Gentry *et al*., 2004). Although these models are based on somewhat different principles, they all seem to do a fair job in predicting the overall disposition of arsenic in animals and man. However, while the models often incorporate the latest ideas on the metabolism of inorganic arsenic with respect to oxidation state, methylated metabolites, and enzyme inhibition, due to limitations in our understanding of the modes of action of arsenic toxicity, they have yet to include representations of biological responses or pharmacodynamic (PD) capabilities, such as dosimetry linked alterations of DNA methylation, cell signaling pathways, DNA repair inhibition or generation of reactive oxygen species.

As an example of the complexity of arsenic action, Gentry *et al*. (2004) observed that pharmacodynamic changes occurred in mice without changes in PBPK predicted arsenic tissue dosimetry. These authors used the PBPK model of Mann *et al*. (1996a,b) extended to mice to evaluate possible dosimetry differences between mouse a strain susceptible to arsenic induced tumors (C57Bl/6J) and those that lacked susceptibility (e.g., Swiss CD-1, Swiss CD: NIH(S), C57Bl/6p53 (+/-)). The model was parameterized using published acute mouse data for arsenate, arsenite, MMA and DMA and validated with acute exposure data from the C57Black mouse strain. Model predictions for acute exposure were then compared with data from acute (24 hr) and chronic exposures (26 weeks). No differences were seen in the volume of distribution or tissue-plasma concentration ratios between acute and chronic exposures. Comparison of metabolite profiles in blood, liver and urine also showed little difference between acute and chronic exposures. Model predictions compared well with observed values. The authors concluded "… that pharmacokinetic factors do not provide an explanation for the difference in outcomes across the various mouse bioassays." This conclusion may be overly broad since all the metabolites of arsenic and its metabolic pathways were not included in the PBPK modeling.

Liao et al. (2008) employed PBPK models with age-specific parameters to estimate urinary excretion of methylated arsenic metabolites in children. The results were coupled with skin lesion data from West Bengal, Bangladesh and Taiwan to derive dose-response relationships based on MMA^{III} in urine and concentration and duration of exposure to inorganic arsenic in drinking water using the Weibull (dose and time) model. While MMA^{III} was not specifically modeled a ratio of 7.4/2.8% MMA^{III}/MMA^{V} in total urinary MMA excretion was assumed. Age-specific risks at the $ED_{0.1}$ level (10^{-3} risk) were calculated for 0 -<1, 1-6, 7-12, and 13-18 yr age groups. Hyperpigmentation was a more sensitive endpoint than keratosis and males gave lower $ED_{0.1}$ values than

females with values of 2.82, 1.51, 1.08, and 0.91 μg As/L for hyperpigmentation in males in the respective age groups. Age specific median daily drinking water consumption rates of 0.65, 1.29, 1.75, and 2.22 L/d, respectively, were used. Although the authors claim these concentrations as "Recommended Safe" levels, they are specific for 1/1000 risk and the skin lesion endpoint, which is not the most sensitive adverse effect for arsenic in exposed children.

4.2 Arsine

Although most studies of arsenic metabolism have centered on arsenate and arsenite, other forms of arsenic are also metabolized in humans. Apostoli *et al*. (1997) reported on the metabolism of arsine gas ($As^{-III}H_3$) in an occupationally exposed worker. Arsenic species were analyzed in urine over a five-day post-exposure period by liquid chromatography and inductively coupled plasma mass spectroscopy. The As species most excreted were MMA, DMA, As^{III}, arsenobetaine (AsB), and to a lesser extent As^{V}. The data indicate a capability to oxidize As^{-III} to As^{V} species probably via arsenite $As(OH)_3$. Arsenobetaine, an important form of arsenic in food, does not undergo subsequent biotransformation and is excreted via the urine. Curiously, arsenobetaine does not appear to be a metabolite of arsine in rats exposed for 1 hour to 4 to 80 mg/m^3 arsine (Buchet *et al*., 1998). The apparent similarity of the metabolism of arsine and arsenite is important and supports the use of the inorganic arsenic RELs for arsine.

Carter *et al*. (2003) have reviewed the metabolism of arsenic oxides, gallium arsenide and arsine. These authors describe three reactions that appear to occur in aqueous solutions of arsine (-III): (1) the formation of elemental As^0 and hydrogen; (2) reaction of AsH_3 with oxidized thiols to form diarsine AsH_2-AsH_2 (proposed) and reduced thiol RSH; and (3) possible reaction between arsine and oxygen species, producing arsine hydroperoxide H_2AsOOH (Hatlelid *et al*., 1995; 1996). Relatively few studies of arsine metabolism have been conducted in experimental animals. In vitro studies indicate that arsine was rapidly distributed to red blood cells. In plasma arsine appeared to decompose over a few hours. Arsine apparently undergoes rapid oxidative metabolism although the intermediary metabolites have not been identified and apparently are not identical with those shown above for arsenite metabolism (Scheme 1) (Carter *et al*., 2003). A hypothetical scheme based on the same alternate application of oxidative methylation and reduction steps might look as follows with double arrows indicating four electron oxidation steps and single arrows two electron reduction steps:

$$\underset{\text{Arsine}}{As^{-III}H_3} \rightarrow\!\!\rightarrow H_2As^{I}(O)CH_3 \rightarrow H_2As^{-I}CH_3 \rightarrow\!\!\rightarrow HAs^{III}(O)(CH_3)_2 \rightarrow HAs^{I}(CH_3)_2 \rightarrow\!\!\rightarrow \underset{\text{TMAO}}{As^{V}(O)(CH_3)_3}$$

According to this scheme the intermediary metabolites would include methylated arsine and arsine oxide species. Alternatively nonmethylative oxidation of arsine could lead to arsenite and arsenate via hydroxylated arsine species. Other metabolites possibly based on the oxidation of elemental As or arising via the postulated arsine hydroperoxide are also possible.

5. Acute Toxicity of Arsenic and Arsenic Compounds

5.1 Acute Toxicity to Adult Humans

The relative acute toxicity of arsenic compounds decreases as follows: arsine (As^{-III}) > organo-arsine derivatives > arsenites (As^{III}) > arsenoxides ($As^{II}I$) > arsenates (As^{V}) > pentavalent organic compounds (As^{V}) > arsonium metals (As^{I}) > metallic arsenic (As^{0}), where the Roman numeral indicates the oxidation state (HSDB, 1995).

Acute inhalation exposure may result in severe irritation of the mucous membranes of the upper and lower respiratory tract with symptoms of cough, dyspnea, and chest pain (Friberg *et al*., 1986). These may be followed by garlicky breath and gastrointestinal symptoms including vomiting and diarrhea (HSDB, 1995). Signs of acute poisoning are dermatitis, nasal mucosal irritation, laryngitis, mild bronchitis, and conjunctivitis (Friberg *et al*., 1986). The acute toxic symptoms of trivalent arsenic poisoning are due to severe inflammation of the mucous membranes and increased permeability of the capillaries (HSDB, 1995). Ingestion of 2 grams of As_2O_3 was fatal to an adult male (Levin-Scherz *et al*., 1987).

5.2 Acute Toxicity to Infants and Children

Relatively little data are available on acute toxicity of arsenic compounds to children. Childhood poisonings due to arsenic have been reported in the medical literature, often with little dosimetry. Campbell & Oates (1992) surveyed 200 child poisonings and found of the four deaths reported one was due to arsenic-containing weed killer (probably cacodylic acid). Alternatively, the use of arsenic trioxide in cancer chemotherapy seems well tolerated. George *et al*. (2004) reported the treatment of 11 children with acute promyelocytic leukemia with i.v. 0.15 mg As_2O_3/kg-d (8 treatment cycles over a period of 12 months). The toxic effects noted, including leukocytosis and skin hyperpigmentation, were considered minimal. Relapse-free survival was 81%.

5.3 Acute Toxicity to Experimental Animals

The lethal concentration low (LC_{Lo}) for $AsCl_3$ in the cat for a 20-minute inhalation exposure is 100 ppm (740 mg/m³) (Flury, 1921). In the mouse, the LC_{Lo} of $AsCl_3$ for a 10-minute exposure is 338 ppm (2500 mg/m³) (Flury, 1931).

A single intratracheal instillation of 17 mg As_2O_3/kg in rats resulted in multifocal interstitial pneumonia and focal proliferative bronchiolitis and alveolitis observed at necropsy 14 days post-exposure (Webb *et al*., 1986). The authors suggest that As_2O_3 induced an acute fibrogenic response.

Changes in host resistance from inhalation exposure to As_2O_3 aerosol were examined in female CD1 mice using a streptococcus infectivity model and an assay for pulmonary bactericidal activity (Aranyi *et al*., 1981; Aranyi *et al*., 1985). Mice (100-200/group) were exposed to As_2O_3 aerosol (or filtered air) for 3 hours/day, 5 days/week, for 1, 5 or 20 days. Aerosol exposed and control mice were then combined before challenge with

Streptococcus zoopidemicus aerosol (4-8 replicate exposures). Statistically significant increases in mortality ($P < 0.05$) were observed in mice exposed: (1) once to 271, 496, and 940 μg As/m^3; (2) 5 times to 519 μg As/m^3; and (3) 20 times to 505 μg As/m^3. Multiple exposures at a given exposure level did not correlate with increased mortality, suggesting an adaptation mechanism. Single exposures did, however, show a dose-response for increased mortality with increasing level of arsenic exposure. Bactericidal activity was evaluated by measuring the ratio of viable bacteria count to radioactive count in the lung 3 hours after infection with ^{35}S-labeled *Klebsiella pneumoniae*. A single exposure to 271, 496, and 940 μg As/m^3, but not 123 μg As/m^3, resulted in significantly decreased bactericidal activity. Five exposures to 519 μg As/m^3 and twenty exposures to both 245 and 505 μg As/m^3 resulted in decreased bactericidal activity. The studies indicate a NOAEL for immunotoxicity of 123 μg As/m^3. This study provides a partial mode of action of arsenic-induced increase in mortality due to experimental lung infections with the mouse pathogen *S. zooepidemicus*. The second bactericidal assay with radiolabelled *K. pneumoniae* provides a plausible explanation, namely that arsenic exposure above 123 μg/m^3 inhibits normal immune bactericidal response in the lung.

Among the other adverse effects of inorganic arsenic noted in experimental animals, the most interesting and relevant to the 8-hour and chronic RELs are those on the brain and nervous system. These include changes in brain histology and conditioned reflexes, changes in locomotor activity, and decreased acetyl cholinesterase, GAD, and GABA levels in the hypothalamus, brain stem and cerebellum. Arsenic induced alterations of brain structure and function are consistent with the more subtle neuro-developmental effects seen in children exposed to inorganic arsenic at lower environmental levels.

5.4 Developmental and Reproductive Toxicity

Arsenic is listed under California Proposition 65 (Cal/EPA, Safe Drinking Water and Toxic Enforcement Act of 1986) as a developmental toxicant. The oxidation state of arsenic determines the teratogenic potential of its inorganic compounds; trivalent (III) arsenic compounds possess greater teratogenic potential than pentavalent (V) compounds. In hamsters, a single maternal intravenous injection of 20 mg/kg sodium arsenate (V) ($AsHNa_2O_4$) on gestation day 8 was lethal to 44% of all embryos (Willhite and Ferm, 1984). A smaller dose (10 mg/kg) of sodium arsenite (As^{III}) ($AsHNaO_2$) administered in the same manner resulted in 90% embryonic lethality.

Fetal malformations, including exencephaly, resulted from an intravenous injection of $AsH_3Na_2O_4$ (As^V) into pregnant hamsters on gestation day eight (Ferm and Carpenter, 1968). The reproductive NOAEL in this experiment was 5 mg/kg. A significant reduction in fetal body weight, but no malformations were observed following a maternal dose of 5 mg/kg AsH_2NaO_3 (As^{III}) by the same route on gestation day eleven or twelve (Harrison and Hood, 1981).

A significant increase in pre-implantation mortality followed exposure of pregnant rats to aerosolized As_2O_3 at 1 mg/m³ for 5 months; no maternal toxicity was observed (Kamkin, 1982). At the LOAEL, 0.3 mg/m³, slightly elevated pre-implantation lethality was

observed. The validity of this report cannot be evaluated, however, because key experimental details were not reported

A significant decrease in spermatozoa motility was observed in male rats following continuous exposure to As_2O_3 at a concentration of 40 mg/m³ for 48 hours (Kamil'dzhanov, 1982). Intravenous injection of radioactive arsenate (As^V) or arsenite (As^{III}) in several rodent species, including mice and hamsters, resulted in accumulation of arsenic in the lumen of the epididymal duct, which suggests that long term exposure of sperm may occur *in vivo* following acute exposure to As (Danielsson *et al*., 1984).

Nagymajtenyi *et al*., (1985) exposed pregnant CFLP mice (8-11 females/group) to As_2O_3 aerosol for 4 hours/day on gestational days 9-12 at concentrations of 0, 0.26, 2.9, or 28.5 mg As_2O_3/m^3 (~0.2, 2.2, and 21.6 mg As/m^3. The aerosol was generated by spraying an aqueous solution of As_2O_3. On the 18th day of gestation the mice were sacrificed and the fetuses removed. The numbers of live and dead fetuses were recorded, weighed, and examined microscopically. Fifty fetuses were stained with Alizarin red-S for skeletal examination. Chromosome preparations were made from livers of 10 fetuses per exposure group. Twenty mitoses in each fetus (200/group) were scored for chromosomal damage and 10 percent of these were karyotyped. The data were analyzed with either Fisher's exact test or in the case of fetal weights with the Dunnett multiple comparison t-test.

A statistically significant decrease in fetal weight was observed in all of the dose groups ($P < 0.05$), with a 3, 9, and 29% reduction in average fetal weight with increasing dose (Table 6.4.1). Significantly delayed bone maturation (ossification defects) was observed only in the highest dose group (sternum 14/50; limbs 32/50, both $p < 0.05$). However, an apparent positive dose-related trend in the number of fetuses with skeletal malformations was observed (2 [control], 3, 7, 31, respectively). A similar dose-related trend in chromosome aberrations in liver cells was also observed in the number of cells with damage (6[control], 10, 13, 24), chromatid gaps, chromatid breaks, chromosome fragments, and chromosome breaks (5[control], 10, 13, 27). Only the number of damaged cells and chromosome breaks at the high dose were significantly different from the control ($p < 0.05$).

Table 6.4.1 Data from Table 1 of Nagymajtényi et al. (1985).

As_2O_3 (mg/m^3)	Number of litters	Living fetuses per mother	Number of fetuses examined	% dead fetuses	Average fetal weight (grams)
28.5±0.3	11	9.6	100	29	0.981±0.04*
2.9±0.04	8	12.8.	100	13	1.146±0.03*
0.26±0.01	8	12.5	100	12	1.225±0.03*
0	8	12.5	100	8	1.272±0.02

* Significantly different from control ($p<0.05$)

This study demonstrates that inhalation exposure to inorganic arsenic is markedly fetotoxic. Arsenic concentrations of 28.5 mg/m^3 caused a reduction in the number of live fetuses, in fetal weight, and an increase in fetuses with delayed osteogenesis.

Rats exposed to 1 μg As_2O_3/m^3 (0.76 μg As/m^3) for 5 months showed increased preimplantation mortality and delayed ossification in fetuses (Kamkin, 1982). Experimental detail was not presented, thus limiting the usefulness of this study.

A significant decrease in spermatozoa motility was observed in male rats following continuous exposure to 32.4 mg As_2O_3/m^3 for 48 hours (Kamil'dzhanov, 1982). Similarly, motility was decreased after: (1) a 120-hour exposure to 7.95 mg/m^3; (2) a 252-hour exposure to 1.45 mg/m^3; and (3) an 800-hour exposure to 0.36 mg/m^3.

Holson *et al*. (1999) administered arsenic trioxide (As_2O_3) by whole body inhalation to groups of 25 Crl:CD (SD)BR female rats every day for six hours per day, beginning fourteen days prior to mating and continuing throughout mating. The target exposure levels were 0.3, 3.0, and 10.0 mg As_2O_3/m^3 (measured means: 0.24, 2.6, 8.3 mg As/m^3). Maternal toxicity evidenced by the occurrence of rales, a decrease in net body weight gain, and decreased food intake during pre-mating and gestation exposure, was observed only at the high dose. The NOAEL for maternal toxicity was 2.6 mg As/m^3 (3.4 mg As_2O_3/m^3). No treatment-related malformations or developmental variations were observed at any exposure level. The NOAEL for developmental toxicity was 8.3 mg As/m^3 (11 mg As_2O_3/m^3). The median mass aerodynamic diameter of particle sizes generated in the exposure chambers ranged from 1.9 to 2.2 μm for the three doses indicating that the dusts were respirable. However there were no blood or urine arsenic analytical data to assess delivered doses.

Nemec *et al*. (1998) evaluated the developmental toxicity of inorganic arsenic in mice and rabbits. CD-1 mice (25/dose group) and New Zealand White rabbits (20/dose group) were gavaged with aqueous arsenic acid (H_3AsO_4) doses of 0, 7.5, 24, or 48 mg/kg-d on gestation days (GD) six through 15 (mice) or 0, 0.19, 0.75, or 3.0 mg/kg-d on GD six through 18 (rabbits). The animals were examined at necropsy (GD 18, mice; GD 29, rabbits). Treatment related maternal toxicity including mortality (2/25) was observed only in the highest dose administered to mice. Effects on maternal weight gain were noted only on GD 6-9 ($P < 0.01$) and GD 15-18 ($P < 0.05$) of the mid dose and on GD 6-9 ($p < 0.05$) of the low dose. While overall maternal weight gains were statistically significantly reduced only at the top dose there was an apparent negative trend in decreased GD18 body weights with increasing dose (56.2 g control, 54.9 g, 52.7g, 46.7g, respectively). While the authors identified a NOAEL for maternal toxicity of 7.5 mg/kg-d, the apparent negative trend noted above suggests that this may be a LOAEL (4.0 mg As/kg-d).

Statistically significant adverse effects on offspring growth or survival were seen only at the highest dose of 48 mg/kg-d. However, there was an apparent negative trend in the number of live fetuses per litter with increasing dose (12.3 control, 11.6, 11.0, 6.6, respectively). An increased incidence of resorptions per litter was seen in the 48 mg/kg-d dose group ($P \leq 0.01$), (mainly early resorptions). Early and total resorptions showed

an apparent positive trend (6.4% total control, 6.1%, 9.6%, 41.9%, respectively). Mean fetal weight showed an apparent negative trend (1.3 g control, 1.32 g, 1.23 g, 0.99 g, respectively). There were no statistically significant dose-related increases in the overall incidence of fetal malformations; however, the mean percent of litter malformation was about three-fold higher in the 48 mg/kg-d dose group than in the lower doses and control. The NOAEL for developmental toxicity would appear to be 7.5 mg/kg-d (4.0 mg As/kg-d).

Maternal toxicity in rabbits, including mortality, slight body weight loss, and clinical signs (decreased urination and defecation, occasional prostration and ataxia), occurred only at the high arsenic acid dose of 3.0 mg/kg-d. The number of does with decreased urination and defecation appeared to be slightly higher in the mid- and low-dose groups, but these effects may not have been treatment related and no effects on body weight were seen. At sacrifice on GD 29 maternal body weight appeared to be reduced in the high dose group. A significant loss in mean maternal gravid body weight occurred during the first six days of high-dose treatment (GD 6-12) ($p \leq 0.01$). This effect persisted and was significantly different from controls for the entire treatment interval (GD 6-18). There were no statistically significant increases in the incidences of any developmental parameters, including malformations. Fetal survival, mean fetal weight, and sex ratio on GD 29 were not affected by the treatment. The number of live fetuses per litter was reduced and resorptions per litter increased in the high-dose group. The latter findings were mainly due to one doe with a totally resorbed litter. The overall values were the range from laboratory historical controls. The authors identified a NOAEL of 0.75 mg/kg-d (0.4 mg As/kg-d) for both maternal toxicity and developmental toxicity.

Stump *et al*. (1999) administered either sodium arsenate (As^{V}) i.p. or arsenic trioxide (As^{III}) i.p. or by gavage on GD 9 to 25 Crl:CD (SD) BR rats. The doses of sodium arsenate were 0, 5, 10, 20, and 35 mg/kg (0, 1.2, 2.4, 4.8, 8.4 mg As/kg). The doses of arsenic trioxide were: i.p. 0, 1, 5, 10, and 15 mg/kg (0, 0.8, 3.8, 7.6, and 11.4 mg As/kg); and by gavage (p.o.) 0, 5, 10, 20, 30 mg/kg (0, 3.8, 7.6, 15.2, 22.7 mg As/kg). Sodium arsenate (i.p.) caused decreased maternal food consumption (GD 9-20), decreased body weights and body weight gains at the highest dose of 35 mg/kg. Decreased food consumption was also seen in the 20 mg/kg dose group at GD 9-10 and GD 9-20. Arsenic trioxide (i.p.) resulted in excessive mortality in the highest dose-group (19/25) and significant reductions in maternal food consumption, body weight at GD20, body weight change, and net body weight in the next highest dose-group (10 mg/kg). Arsenic trioxide (p.o.) resulted in less mortality in the highest dose-group (7/25). Clinical signs were noted in the 20 and 30 mg/kg dose-groups including changes in fecal consistency and decreased defecation. Food consumption (GD 9-10) was decreased in a dose-dependent manner across As treatment groups. The study identified single dose maternal effects NOAELs of 2.4 mg As/kg for sodium arsenate (i.p.) and 3.8 mg As/kg for arsenic trioxide i.p. A LOAEL of 3.8 mg As/kg was identified for arsenic trioxide p.o.

Intraperitoneal administration of sodium arsenate or arsenic trioxide caused neural tube and ocular defects (exencephaly, microphthalmia/anophthalmia, and other craniofacial defects) in the offspring of treated rats. These effects were statistically significant only

at doses causing maternal toxicity or mortality (35 and 10 mg/kg, respectively). Oral administration of arsenic trioxide caused no treatment-related malformations. The study identified single dose developmental NOAELs of 2.4 mg As/kg for sodium arsenate i.p., 3.8 mg As/kg for arsenic trioxide i.p., and 15.2 mg As/kg for arsenic trioxide p.o.

DeSesso *et al*. (1998), in a comprehensive review of the developmental toxicity of inorganic arsenic, concluded that cranial neural tube defects (NTDs) were induced in rodents only when exposure occurred early in gestation, at high maternally toxic doses, and by parenteral routes of administration. They argued that such NTD effective doses are unlikely to be achieved by the oral, inhalation, or dermal routes in rodents, and that inorganic arsenic does not represent a realistic developmental risk in humans subjected to any environmentally relevant exposure scenarios.

Male and female Charles River CD mice (10/group) were treated with 0 or 5 ppm arsenite in drinking water continuously through three generations (Schroeder and Mitchener, 1971). Endpoints examined included the interval between litters, the age at first litter, the ratio of males to females, the number of runts, stillborn offspring, failures to breed, and congenital abnormalities. The study showed an alteration in the number of small litters in the arsenic exposed group.

Female CD-1 mice (8-15/group) were treated by oral gavage with 0, 20, 40, or 45 mg sodium arsenite/kg on a single day of gestation between days 8 and 15 (Baxley *et al*., 1981). Maternal mortality, fetal malformations, and increased prenatal death were observed among animals treated with 40 and 45 mg sodium arsenite/kg.

Pregnant golden hamsters (>10/group) were treated by oral gavage with a single administration of 0, 20, or 25 mg/kg sodium arsenite on one of gestational days 8-12 (Hood and Harrison, 1982). Prenatal mortality was increased among animals receiving 25 mg/kg on gestational days 8 and 12 and fetal weights were decreased among animals receiving 25 mg/kg on gestational day 12. One dam died following administration of 20 mg/kg.

Intravenous injection of radioactive arsenate (V) or arsenite (III) in several rodent species, including mice and hamsters, resulted in accumulation of arsenic in the lumen of the epididymal duct, which suggested that long term exposure of sperm to arsenic may occur *in vivo* following acute exposure (Danielsson *et al*., 1984).

6. Chronic Toxicity of Arsenic and Arsenic Compounds

6.1 Chronic Toxicity to Adult Humans

Arsenic in drinking water is carcinogenic to humans (Group 1, IARC, 2004). Arsenic compounds show limited to sufficient evidence of carcinogenicity in experimental animals (IARC, 2004). The U.S. Environmental Protection Agency has classified arsenic as Group A; a human carcinogen, based on sufficient evidence from human data including increased lung cancer mortality in multiple human populations exposed primarily through inhalation, increased mortality from multiple internal organ cancers (liver, kidney, lung, bladder), and increased skin cancers observed in populations exposed to arsenic in drinking water (IRIS online file www.epa.gov/iris/subst/0278.htm). Since this document deals with noncancer risks, the carcinogenicity of arsenic is not covered here in any detail (see OEHHA (1999)).

Smelter workers, exposed to concentrations of arsenic up to 7 mg As/m^3, showed an increased incidence in nasal septal perforation, rhinopharyngolaryngitis, tracheobronchitis, and pulmonary insufficiency (Lundgren, 1954).

In a case-control study, copper smelter workers (n = 47) exposed to arsenic for 8-40 years (plus 50 unexposed controls matched for age, medical history, and occupation) were examined by electromyography and for nerve conduction velocity in the arms and legs (Blom *et al*., 1985). The workers were found to have a statistically significant correlation between cumulative exposure to arsenic and reduced nerve conduction velocities in three peripheral nerves (upper and lower extremities). Slightly reduced nerve conduction velocity in 2 or more peripheral nerves was reported as "more common" among arsenic exposed workers. Minor neurological and electromyographic abnormalities were also found among exposed workers. Occupational exposure levels were estimated to be 0.05-0.5 mg As/m^3, with As_2O_3 the predominant chemical form. Except for three arsenic exposed workers who had long-term exposure to lead, exposure to other heavy metals was insignificant.

The smelter workers described by Blom *et al*. (1985) (number of controls reduced to 48) were further examined for prevalence of Raynaud's phenomenon and for vasospastic tendency by measurement of finger systolic pressure at 10°C and/or 15°C relative to that at 30°C (FSP%) (Lagerkvist *et al*., 1986). The FSP% was found to covary with the duration of exposure to arsenic, and the prevalence of Raynaud's phenomenon was significantly increased among exposed workers. Daily arsenic uptake was estimated at less than 300 μg/day and was confirmed with urinary excretion data.

Hyperpigmentation and hyperkeratinization were observed in workers exposed to 0.4 - 1 mg/m^3 inorganic arsenic for two or more years (Perry *et al*., 1948).

Most of the relevant epidemiological data on arsenic adverse effects comes from studies of arsenic exposure via drinking water. These studies are relevant because arsenic exerts similar toxic effects once it enters the body. For example, arsenic causes lung cancer in humans by both oral and inhalation routes. The adverse effects

summarized below include skin lesions(keratosis and altered pigmentation), vascular effects on the heart, brain and peripheral vasculature, peripheral neuropathy, and lung disease.

6.1.2.1 Skin Effects

Mazumder *et al*. (1998) investigated arsenic-associated skin lesions of keratosis and hyperpigmentation in 7683 exposed subjects in West Bengal, India. While water arsenic concentrations ranged up to 3400 μg/L, over 80% of the subjects were consuming water with < 500 μg/L. The age-adjusted prevalence of keratosis was strongly related to water As concentration, rising from zero in the lowest exposure level (< 50 μg/L) to 8.3% for females drinking water containing >800 μg As/L, and from 0.2 to 10.7% in males, respectively. A similar dose-response was observed for hyperpigmentation: 0.3 to 11.5% for females; and 0.4 to 22.7% for males. Overall males had 2-3 times the prevalence of both keratosis and hyperpigmentation than females apparently ingesting the same doses of arsenic per body weight. Subjects that were more than 20% below standard body weight for their age and sex had a 1.6-fold increase in the prevalence of keratoses, suggesting that malnutrition may play a role in increasing susceptibility.

Rahman *et al*. (2006) evaluated arsenic exposure and age- and sex-specific risk for skin lesions in a population-based case-referent study in Bangladesh. The entire population over four years of age of Matlab, Bangladesh (N = 166,934) was screened for skin lesions. Skin lesions were classified as hyperpigmentation (melanosis), hypopigmentation (leukomelanosis), or keratosis. A total of 504 cases with skin lesions were identified. A randomly selected referent group of 1830 subjects was included in the study. Arsenic exposure was assessed by personal history of tube well use since 1970 or year of birth if later. Water samples from all functioning tube wells were measured for arsenic concentration by hydride-generation atomic absorption spectroscopy. A dose-response relationship was observed for increased skin lesions and arsenic exposure for both sexes (P < 0.001). For males using the metric of As μg/L the highest exposure quintile (≥ 300 μg/L) gave an adjusted odds ratio (OR) of 9.56 (95% CI = 4.20-21.8). Females gave a corresponding OR of 6.08 (3.06-15.5). The cumulative As exposure metric (μg/L x years) gave OR's of 10.4 and 9.19, respectively. In an analysis with males and females combined, adjusted for age and socioeconomic status, males had significantly higher risk of As-related skin lesions than females, when females' lowest average exposure quintile was used as the reference. For the highest quintile, the males OR was 10.9 (5.8-20.4) and the females OR was 5.78 (3.10-10.8), P = 0.005.

Dermatitis and irritation of the mucous membranes have been observed in arsenic-exposed workers (Vallee *et al*., 1960). Hepatic fatty infiltration, central necrosis, and cirrhosis were observed in two patients who ingested As_2O_3 (1% in Fowler's solution) for three or more years (Morris *et al*., 1974). Daily consumption of 0.13 mg As/kg in contaminated well water resulted in the chronic poisoning and death of four children; at autopsy, myocardial infarction and arterial thickening were noted (Zaldivar and Guillier, 1977).

6.1.2.2 Vascular Disease

Vascular diseases have long been noted to be associated with chronic arsenic exposures among German vineyard workers (Grobe, 1976) and inhabitants of Antofagasta, Chile (Borgono *et al*., 1977). Peripheral vascular diseases have been reported to be associated with the occurrence of arsenic in well waters in Taiwan (Chen and Wu, 1962; Chi and Blackwell, 1968; Tseng, 1977; Chen *et al*., 1988). Concentrations in one study were characterized as 0.10 – 1.8 ppm (Yu *et al*., 1984). The term arseniasis or arsenosis connotes vascular disease associated with chronic exposure to arsenic, specifically blackfoot disease (BFD). BFD is characterized by progressive narrowing of the peripheral arteries, particularly those of the lower extremities. This can lead to ulceration, gangrene and amputation. The etiology of BFD is unclear but arsenic is thought to be the principal cause. The term arsenicosis refers to arsenic induced skin lesions ranging in severity over four stages, seven grades and 20 sub-grades from diffuse melanosis (skin pigmentation or depigmentation) to aggressive skin and internal malignancy (Saha, 2003).

Wu *et al*. (1989) found significant trends of mortality rates from peripheral vascular diseases and cardiovascular diseases with concentrations of arsenic in well water. However, no significant association was observed for cerebrovascular accidents. Engel and Smith (1994) evaluated arsenic in drinking water and mortality from vascular disease in 30 U.S. counties from 1968 to 1984. Mean As levels in drinking water ranged from 5.4 to 91.5 μg/L. Standardized mortality ratios (SMRs) for diseases of arteries, arterioles, and capillaries (DAAC) for counties exceeding 20 μg/L were 1.9 (90% C.I. = 1.7-2.1) for females and 1.6 (90% C.I. = 1.5-1.8) for males. SMRs for three subgroups of DAAC including arteriosclerosis and aortic aneurysm were also elevated as were congenital abnormalities of the heart and circulatory system.

Tseng *et al*. (1996) studied the dose relationship between peripheral vascular disease (PVD) and ingested inorganic arsenic in blackfoot disease endemic villages in Taiwan. A total of 582 adults (263 men and 319 women) underwent Doppler ultrasound measurement of systolic pressures on bilateral ankle and brachial arteries and estimation of long-term arsenic exposure. The diagnosis of PVD was based on an ankle-brachial index of < 0.9 on either side. Multiple logistic regression analysis was used to assess the association between PVD and As exposure. A dose-response relationship was observed between the prevalence of PVD and long-term As exposure. The odds ratios (95% confidence intervals) after adjustment for age, sex, body mass index, cigarette smoking, serum cholesterol and triglyceride levels, diabetes mellitus and hypertension were 2.77 (0.84-9.14), and 4.28 (1.26-14.54) for those who had cumulative As exposures of 0.1 to 19.9 and ≥ 20 (mg/L) x yr, respectively. A follow up study (Tseng *et al*., 1997) indicated that PVD was correlated with ingested As and not with abnormal lipid profiles. The lipid profiles studied were total cholesterol, triglyceride, high-density lipoprotein cholesterol (HDL-c) and low-density lipoprotein cholesterol (LDL-c), apolipoprotein AI, and apolipoprotein B. Other lipids such as modified LDL, subclasses of LDL and HDL, and other lipoproteins such as lipoprotein (a), which may track as better indicators of atherosclerosis, were not included. Also, the roles of platelet aggregation and coagulation profiles were not studied.

Chen *et al*. (1996) evaluated the dose-response relationship between ischemic heart disease (ISHD) mortality and long-term arsenic exposure. Mortality rates from ISHD among residents in 60 villages in an area of Taiwan with endemic arseniasis from 1973 through 1986 were analyzed for association with As concentrations in drinking water. Based on 1,355,915 person-years and 217 ISHD deaths, the cumulative ISHD mortalities from birth to age 79 yr were 3.4%, 3.5%, 4.7%, and 6.6% for the median As concentrations of < 0.1, 0.1-0.34, 0.35-0.59, and ≥ 0.6 mg/L, respectively. Multivariate-adjusted relative risks (RRs (95% C.I.)) associated with cumulative arsenic exposure from well water were 2.46 (0.53-11.36), 3.97 (1.01-15.59), and 6.47 (1.88-22.24) for 0.1-9.9, 10.0-19.9, and 20+ (mg/L)-yr, respectively, compared with those without As exposure.

Chiou *et al*. (1997b) evaluated the dose-response relationship between prevalence of cerebrovascular disease and ingested arsenic among residents of the Lanyang Basin in northeast Taiwan. A total of 8102 adults from 3901 households were recruited for the study. Arsenic in well water of each household was determined by hydride generation and atomic absorption spectrometry. Logistic regression analysis was used to estimate multivariate-adjusted odds ratios and 95% confidence intervals for various risk factors of cerebrovascular disease. A significant dose-response relationship was observed between As concentration in well water and prevalence of cerebrovascular disease after adjustment for age, sex, hypertension, diabetes mellitus, cigarette smoking, and alcohol consumption. The dose-response relationship was even more prominent for cerebral infarction with multivariate-adjusted odds ratios (95% C.I.) of 1.0, 3.4 (1.6-7.3), 4.5 (2.0-9.9), and 6.9 (3.0-16), respectively, for those who consumed well water with As concentrations of 0, 0.1-50.0, 50.1-299.9, and > 300 μg/L. For cumulative arsenic exposures of <0.1, 0.1-4.9, and ≥ 5.0 (mg/L)-yr, the odds ratios were 1.00, 2.26, and 2.69 for cerebrovascular disease and 1.00, 2.66, and 3.39 for cerebral infarction, respectively. All of the values above for As exposed groups were significantly greater than unexposed at P < 0.05.

Chen *et al*. (1995) also investigated the association between long-term exposure to inorganic arsenic and the prevalence of hypertension. A total of 382 men and 516 women were studied in villages where arseniasis was endemic. Hypertension was defined as a systolic blood pressure of 160 mm Hg or greater, or a history of hypertension treated with antihypertensive drugs. The long-term arsenic exposure was calculated from the history of artesian well water consumption obtained through subject questionnaires and the measured arsenic concentration in well water. Residents in villages where long-term arseniasis was endemic had a 1.5-fold increase in age- and sex-adjusted prevalence of hypertension compared with residents in nonendemic areas. The duration of well water consumption, average As water concentration, and cumulative As exposure were all significantly associated with hypertension. For the cumulative As exposure in (mg/L)-yr, the percent prevalence values were: 0, 5.0%; 0.1-6.3 (mg/L)-yr, 4.9%; 6.4-10.8 (mg/L)-yr, 12.8%; 10.9-14.7 (mg/L)-yr, 22.1%; 14.8-18.5 (mg/L)-yr, 26.5%; > 18.5 (mg/L)-yr, 29.2%.

As part of a study of arsenic exposure via drinking water and mortality outcome in Millard County, Utah, Lewis *et al*. (1999) found a statistically significant association with

mortality from hypertensive heart disease. Median drinking water concentration of arsenic ranged from 14 to 166 μg/L for the 946 subjects in the study. The standard mortality ratios (SMR) without regard to specific exposure levels were SMR = 2.20 (95% C.I., 1.36-3.36) for males and SMR = 1.73 (95% C.I., 1.11-2.58) for females. When analyzed by cumulative exposure groups of low (< 1.0 (mg/L)-yr), medium (1.0-4.9 (mg/L)-yr), and high (≥ 5.0 (mg/L)-yr), there was no apparent dose response relationship. However the cumulative dose estimates in this study were lower than in the Chen *et al*. (1995) discussed above so the results of the two studies are not inconsistent.

Chen *et al*. (2006) conducted a cross-sectional analysis of the association of arsenic exposure from drinking water and blood pressure in 10,910 subjects. Time-weighted well arsenic concentrations (TWA) based on current and past well usage were derived. Odds ratios (OR's) for high pulse pressure (systolic – diastolic pressure ≥ 55 mmHg) by increasing TWA quintiles (≤ 8, 8.1-40.8, 40.9-91.0, 91.1-176.0, 176.1-864.0 μg/L) were: 1.00 (referent); 1.39 (95% C.I. 1.14, 1.71); 1.21 (0.9, 1.49); 1.19 (0.97, 1.45); 1.19 (0.97,1.46). OR's for systolic hypertension (≥ 140 mmHg) suggested a similar but weaker association. Participants with lower than average intake of B vitamins and folate showed somewhat higher OR's. No associations were apparent for TWA and diastolic hypertension.

In a study related to those above, Lai *et al*. (1994) studied inorganic arsenic ingestion and the prevalence of diabetes mellitus. A total of 891 adult residents of villages in southern Taiwan where arseniasis is endemic were included in the study. Diabetes status was determined by an oral glucose tolerance test and a history of diabetes regularly treated with sulfonylurea or insulin. Cumulative arsenic exposure in ppm-yr was determined from the detailed history of drinking artesian well water. There was a dose-response relation between cumulative arsenic exposure and prevalence of diabetes mellitus. The relation remained significant after adjustment for age, sex, body mass index, and activity level at work by a multiple logistic regression analysis giving multivariate-adjusted odds ratios of 6.61 and 10.05, respectively, for exposures of 0.1-15 ppm-yr and > 15.0 ppm-yr versus an unexposed group. In an effort to confirm this association between diabetes mellitus and arsenic observed for drinking water in Taiwan, Rahman and Axelson (1995) reviewed 1978 case-control data from a Swedish copper smelter. Twelve cases of diabetes mellitus (death certificate) were compared with 31 controls without cancer, cardiovascular and cerebrovascular disease. The odds ratios for diabetes mellitus with increasing arsenic exposure categories were 1.0 (reference level), 2.0, 4.2, and 7.0 with the 95% confidence level including unity. The trend was weakly significant, p = 0.03. Albeit with limited numbers, the study provides some support for a role of arsenic exposure in the development of diabetes mellitus.

6.1.2.3 Neurological Disease

Hafeman *et al*. (2005) evaluated the association between arsenic exposure and peripheral neuropathy in a cross-sectional study of 137 adults in Bangladesh. Exposure measures included individual arsenic water concentration, cumulative arsenic index (CAI), and urinary arsenic concentration. Experimental measures were primarily

vibrotactile threshold testing of the index finger (IVT) and toe (TVT) and secondarily tapping speed, grip strength, ankle reflex, and proprioception. The cumulative arsenic index and urinary arsenic were both significantly associated with elevated TVT (P = 0.02 and P = 0.009, respectively) after adjustment for age and gender. While dose-response relations were difficult to define, a linear regression analysis of TVT (vibration units) versus the continuous measures of urinary arsenic and CAI gave slopes of 0.02 and 0.0025 TVT units/50 μg As/mg urinary creatinine, respectively. The association between IVT and arsenic exposure was not statistically significant. No association was found between any measure of arsenic exposure and grip strength, tapping speed, ankle reflex, or proprioception.

6.1.2.4 Lung Disease

Several studies have reported effects of arsenic exposure through drinking water on the lung. Mazumder et al. (2000) reported increasing respiratory symptoms, including cough, shortness of breath, and chest sounds, with increasing arsenic concentrations in the drinking water in people residing in West Bengal, India. The effects seen were marked in individuals who also had arsenic related skin lesions. In a later study also in West Bengal, these investigators also reported a large increase (OR = 10; 95% CI 2.7-37) in bronchiectasis in individuals with skin lesions compared to those without arsenic-related skin lesions (Mazumder et al., 2005).

Von Ehrenstein *et al*. (2005) studied the relation between lung function, respiratory symptoms, and arsenic in drinking water among 287 adults, including 132 with arsenic-induced skin lesions in West Bengal, India. Arsenic levels in drinking water and the number of male subjects with or without skin lesions were: 0-99 μg/L, 9, 36; 100-399 μg/L, 66, 34; ≥400 μg/L, 18, 15, respectively. For respiratory symptoms of "shortness of breath at night" and "morning cough", the odds ratios (ORs) for men with skin lesion versus those without was 2.8 with 95% confidence intervals (C.I.) of (1.1, 7.6) and (1.2, 6.6), respectively. For men with skin lesions, the average forced expiratory volume in one second (FEV_1) was reduced by 256.2 mL (95% C.I.; 113.9, 398.4) P < 0.001. Average forced vital capacity (FVC) was reduced by 287.8 mL (95% C.I.; 134.9, 440.8) P < 0.001. In men a 100 μg/L increase in arsenic level was associated with a 45.0 mL decrease (95% C.I.; 6.2, 83.9) in FEV_1 (P = 0.02) and a 41.4 mL decrease (95% C.I.; -0.7, 83.5) in FVC (P = 0.054). The findings were adjusted for age, height and smoking in both males and females. Women participating in the study (N = 109) had a lower risk of developing skin lesions than men and exhibited few respiratory symptoms.

6.2 Chronic Toxicity to Infants and Children

The adverse effects of inorganic arsenic exposure reported in children include skin lesions, neurodevelopmental effects (IQ and related effects), lung disease expressed in later years, and reproductive effects (decreased birth weight, spontaneous abortion, neonatal death).

As noted above Mazumder *et al*. (1998) observed a dose-response for arsenic-associated skin lesions in a cross-sectional survey of 7683 subjects in West Bengal,

India. The study population was divided by age decades such that the effect on young children (≤ 9 yr) and adolescents (10-19 yr) could be analyzed separately. The prevalence of keratosis in females and males was 0.2 and 0.5 percent in young children and 1.0 and 1.7 percent in adolescents, respectively. The comparable values for hyperpigmentation were 1.7 and 2.0 percent and 2.2 and 3.5 percent, respectively. Overall 1149 young children and 1599 adolescents were surveyed. The low- to mid-dose quantal responses for combined skin lesions in young children using the mid points of the arsenic concentration ranges (μg/L) were: 25, 0/414; 75, 0/95; 125, 4/118; 175, 2/50; 275, 6/161; 425, 11/101. For the adolescents the comparable values were: 1/730; 2/147; 2/107; 7/110; 26/213; 9/58.

The adverse effects of inorganic arsenic on the developing intellectual function of exposed children have been reported in several studies summarized in this section. While some of the studies have deficiencies, as a group they indicate that arsenic exposure, like lead exposure, presents a risk to children. The neurodevelopmental endpoint has been selected by OEHHA as the critical effect for deriving 8-hour and chronic RELs for inorganic arsenic.

Calderon *et al*. (2001) conducted a cross-sectional study to examine the effects of chronic exposure to lead (Pb) and arsenic (As), and also nutrition, on the neuropsychological development of children. Two populations of children aged six to nine years (N = 41, 39) with differing As exposure levels (63 vs. 40 μg/g) but similar Pb exposures (8.9 vs. 9.7 μg Pb/dL blood, respectively) were compared using the Wechsler Intelligence Scale for Children (WISC) Revised Version for Mexico. After controlling for significant potential confounders verbal IQ was observed to decrease with increasing urinary arsenic ($P < 0.01$). Language, verbal comprehension and long-term memory also appeared to be adversely affected by increasing arsenic exposure (concepts and knowledge factors, $P < 0.05$ each). Blood lead was significantly associated with a decrease in attention (sequential factor, $P < 0.05$). However since blood lead is an imprecise measure of lead burden there could be some residual confounding in this study.

The relationship between arsenic exposure via drinking water and neurological development as indicated by intelligence (IQ) was assessed in Thailand (Siripitayakunkit *et al*., 1999) in 529 children aged six to nine years using a cross-sectional design. Arsenic levels in hair were used to assess exposure and the WISC test for children was used to assess IQ. The range of arsenic concentrations in hair was 0.48 to 26.94 μg/g (mean = 3.52, SD = 3.58). The mean IQ of the study was 90.44 (range 54 to 123). Most of the IQs were classified as average (45.7%) or dull normal (31.6%). Approximately 14% and 3% of the children were in the borderline and mental defective groups, respectively. The percentage of children in the average IQ group decreased significantly from 57 percent to 40 percent with increasing arsenic exposure. The percentage in the lower IQ group increased with increasing As (23% to 38%) and in the low IQ group (zero to six percent). In a comparison of IQ between children with As hair levels ≤ two ppm or > two ppm, arsenic was found to explain 14 percent of the variance in IQ after controlling for father's occupation, mother's intelligence score, and

family income. Arsenic levels in hair above 2 ppm were associated with a 0.75-point decrease in IQ below the grand mean and As levels above 5 ppm with a two point decrease. Although the cross-sectional study design does not allow for establishment of the time precedence of exposure to arsenic, the investigators stated that the subjects of the study were born in a period of chronic arsenic poisoning and that this cohort has been continuously exposed since birth due to their non-mobility. The study suffers from small numbers of children exposed to low arsenic (hair arsenic $\leq$ 1 ppm) so this group could not be compared to the high arsenic children. Also the possible exposure to chemical confounders like lead was not discussed.

In a parallel cross-sectional study (Siripitayakunkit *et al*., 2001) the 529 children (above) were subjected to the Motor-Free Visual Perception Test (MVPT) and the Visual-Motor Integration Test (VMI). The visual perception score of each child was compared with the score of children in a control sub-district of the same age. The cutoff point for poor perception was the mean minus one standard deviation (SD) in each age level. Among arsenic-exposed children, 21 percent had poor visual perception and 17.6 percent had poor VMI. The comparable values in the control population were 16.5 percent and 15.8 percent, respectively. Potential confounders were controlled by multiple classification analysis. Only five percent of the variance in visual perception of children was significantly explained by arsenic (P = 0.01). The grand mean perception score was 20.57 and the adjusted values at low, medium and high hair As were 20.92, 20.51, and 20.03, respectively. Alternatively, these authors did not find an effect of arsenic on visual-motor integration.

Like the study of IQ decrements noted above, this study has the advantage of associating an adverse effect in children with a metric of chronic arsenic exposure, hair arsenic concentration. Disadvantages include a limited level of reporting and possible confounding with exposure to other metals.

Tsai *et al*. (2003) performed a cross-sectional study of the effect of arsenic exposure on the development of cognitive function among adolescents. Forty-nine 13-year old students were divided into low and high exposure groups and were compared with 60 13-year old unexposed children. Four neurobehavioral tests were conducted: continuous performance test (CPT); symbol digit (SD); pattern memory (PM); and switching attention (SA). Exposure in terms of As concentration in drinking water averaged 0 (<0.15), 131.2, and 185.0 ppb for control and exposure groups, respectively. Average cumulative arsenic exposures were 0, 252.1, and 768.2 mg (e.g., 184.99 ppb x 1008.6 cm^3/d x 11.28 yr x 365 d/yr x 10^{-3}). Neurobehavioral analysis revealed significant dose-response effects of arsenic exposure on CPT (P = 0.005), PM (P = 0.009) and SA (P = 0.0001), but not on SD (P = 0.23). A multiple linear regression analysis of the dose-response relationship between cumulative arsenic exposure and neurobehavioral endpoints showed a strong arsenic effects for CPT (low exposure group, P = 0.001), PM (high exposure group, P = 0.003) and SA (high and low exposures, P = 0.0001). This study is limited by low numbers but seems in line with other findings of As-induced CNS effects. The authors note that “the central nervous system of child and adolescents might be more vulnerable than adult to neurotoxicant”. Although no dose-response relationship between As exposure and nerve conduction

velocities was observed, the authors could not exclude the possibility of peripheral nerve dysfunction.

Wasserman *et al*. (2004) conducted a cross-sectional study of intellectual function in 201 As-exposed 10-year old children in Bangladesh. Children's intellectual function was assessed with tests drawn from the Wechsler Intelligence Scale for Children version III including Verbal, Performance, and Full-Scale raw scores. Children provided urine for arsenic and creatinine and blood samples for blood lead and hemoglobin measurements. After adjustment for sociodemographic covariates such as maternal education, height and head circumference, and waterborne levels of manganese (Mn), As in drinking water was associated with reduced intellectual function, in a dose-dependent manner. Children exposed to water arsenic of > 50 μg/L had significantly lower Performance and Full-Scale scores than did children with water As levels < 5.5 μg/L. Using the Full-Scale raw score, As water concentrations of 10 and 50 μg/L were associated with decrements of 3.8 and 6.4 points, respectively. The relationships between urinary arsenic concentration (μg As/g creatinine) and child intellectual function were not statistically significant but were in the expected (negative) direction (Full-Scale, P = 0.09; Performance, P = 0.14; Verbal, P = 0.11). Since there was no standard of intelligence for use in Bangladesh these decrements could not be directly equated with U.S. standard IQ points. However, "other simpler predictors of child intellectual function, such as maternal education and child height and head circumference, were significantly related to intellectual raw scores in the expected directions." In this study, as in others of this type exposure is inferred from water concentration.

Smith *et al*. (1998) studied lung and urinary bladder cancer mortality in a region of northern Chile (Region II, Antofagasta) where the residents were exposed to arsenic in their drinking water. Arsenic levels ranged from a population weighted average of 570 μg/L between 1955 and 1969 to 100 μg/L by 1980. Standardized mortality ratios (SMRs) were estimated for Region II as follows. Census data were used to calculate the person-years at risk during 1989-1993 by 10-year age groups, for men and women separately. National mortality data were obtained for 1991, the midpoint of the study period, and age- and sex-specific mortality rates were calculated for each cause of death of interest for the rest of Chile excluding Region II. The expected number of deaths was then calculated for Region II by multiplying the rest of the Chile 1991 age- and sex-specific mortality rates by the person-years at risk for residents in Region II for the period 1989-1993. Standardized mortality ratios were estimated by dividing observed deaths by expected deaths. Statistical tests of significance were based on the Poisson distribution, and 95 percent confidence intervals were calculated using exact methods.

The SMRs (observed/expected deaths) for bladder, kidney, liver, and skin cancers, and all other cancers combined, were not related to age in either sex. However, lung cancer mortality ratios were particularly high in younger men aged 30-39 yr (SMR = 11.7, 95 percent C.I. 6.4-19.6, P < 0.001). The estimated SMRs were not as elevated in all groups. The values for the subsequent 10-year age groups were: 5.9; 4.9; 2.9; 4.0; 2.8; and 3.8 for the total with a 95%CI of 3.5-4.1. Also observed was a decreasing trend in chronic obstructive pulmonary disease deaths (COPD), with higher rates among

younger men, particularly those aged 30-39. Four COPD deaths were reported among men (0.8 expected), and six deaths among women (0.1 expected). These ten individuals who died of COPD would have been young children at the time of peak arsenic water levels in 1955-1970. Smoking was accounted for but not in men and women separately.

In a later study Smith *et al*. (2006) reported increased mortality from lung cancer and bronchiectasis in young adults following arsenic exposures *in utero* and in early childhood. For subjects born just before the high exposure period (1950-1957) and exposed in early childhood the SMR for bronchiectasis was 12.4 (95% C.I., 3.3-31.7; P < 0.001). For those born during the high exposure period (1958-1970) with likely *in utero* and early childhood exposure the SMR for bronchiectasis was 46.2 (C.I., 21.1-87.7; P < 0.001). The authors conclude that "exposure to arsenic in drinking water during early childhood or *in utero* has pronounced pulmonary effects, greatly increasing subsequent mortality in young adults form both malignant and nonmalignant lung disease."

Additional evidence supporting a link between childhood arsenic exposure and subsequent lung disease comes from autopsies of children in the affected area. The results of five autopsies of children, who died in 1968 and 1969 in Antofagasta and showed skin lesions and other evidence of arsenic poisoning, also showed lung abnormalities in four of the children. Two of these cases exhibited interstitial fibrosis (Rosenberg, 1974). Also, a survey of 144 children in Antofagasta with skin pigmentation due to arsenic exposure reported a history of bronchopulmonary disease 2.5-fold more frequent than children with normal skin (15.9 vs. 6.2 percent, respectively) (Borgono *et al*., 1977).

Chronic exposure to arsenic has been associated with decreased birth weight and an increased rate of spontaneous abortion in female smelter workers. However, this association is confounded by the presence of other toxicants in the smelting process, including lead (Nordstrom *et al*., 1979). Anemia and leukopenia have been reported in infants ingesting approximately 3.5 mg As/day in contaminated milk over a period of 33 days (Hammamoto, 1955).

Premature birth and subsequent neonatal death was reported in a single individual following ingestion of arsenic (Lugo *et al*., 1969).

Ihrig *et al*. (1998) conducted a hospital-based case-control study of stillbirths and environmental arsenic exposure using an atmospheric dispersion model linked to a geographical information system. They collected data on 119 cases and 267 controls in a central Texas area including a facility with 60-year history of arsenic-based agricultural product manufacture. Four exposure groups were categorized (0; < 10 ng/m^3; 10-100 ng/m^3; and > 100 ng/m^3). For the period 1983-93 they fit a conditional logistic regression model including maternal age, race/ethnicity, parity, income group, exposure as a categorical variable, and exposure-race/ethnicity interaction. Effects were only seen in the Hispanic group with the medium exposure group having a prevalence odds ratio and 95% confidence interval of 1.9 (0.5-6.6) and the high

exposure group 8.4 (1.4-50.1). The authors postulate a possible influence of a genetic polymorphism affecting folate metabolism in Hispanic populations possibly leading to increased neural tube defects and stillbirths. Small numbers limits this study; for example, there were only seven cases in the high exposure group and five of these were Hispanic.

Von Ehrenstein *et al*. (2006) studied pregnancy outcomes, infant mortality, and arsenic exposure via drinking water in West Bengal, India. The reproductive histories of 202 women were reviewed including measurements of 409 drinking water wells. The total number of pregnancies was 660 and the number of live births plus stillbirths was 558. Odds ratios for spontaneous abortion, stillbirth, neonatal mortality (death in the first month) and infant mortality (death in the first year) were estimated by logistic regression. Exposure to arsenic concentrations $\geq$ 200 μg/L during pregnancy was associated with a six-fold increased risk of stillbirth after adjustment for potential confounders (OR = 6.07; 95% C.I. 1.24-24.0, p = 0.01). The odds ratio for neonatal death was 2.81 (95% C.I. 0.73-10.8). No significant associations were found for arsenic exposure and spontaneous abortion (OR = 1.01; 95% C.I. 0.38-2.70) or overall infant mortality (OR = 1.33; 95% C.I. 0.43-4.04). Arsenic related skin lesions were observed in12 women who had increased risk of stillbirth (OR = 13.1; 95% C.I. 3.17-54.0).

6.3 Subchronic and Chronic Toxicity to Experimental Animals

Female albino rats (20 per group) were exposed to 0, 1.3, 4.9, or 60.7 μg As_2O_3/m^3 as aerosol continuously for 3 months (Rozenshtein, 1970). Decreased whole blood sulfhydryl group content, histological changes in the brain, bronchi, and liver, changes in conditioned reflexes, and changes in chronaxy ratio were observed in both the high- and mid-dose groups. Among animals in the high dose group, eosinophilia, decreased blood cholinesterase activity, decreased serum sulfhydryl content, and increased blood pyruvic acid were observed. No significant changes were observed in the low-dose group.

Male mice (8-10 per group) were exposed to 0, 0.5, 2.0, or 10.0 ppm sodium arsenite in drinking water for 3 weeks followed by a 28-day recovery period (Blakley *et al*., 1980). The primary immune response of the spleen (as indicated by changes in IgM-production assayed by plaque-formation) was suppressed at all dose levels. The secondary immune response was also suppressed at all dose levels as indicated by a decrease in the number of IgG producing cells.

Male Sprague-Dawley rats (7-28 per group) were exposed to 0, 40, 85, or 125 ppm sodium arsenate in drinking water for 6 weeks (Brown *et al*., 1976). Rats from all arsenic exposed groups showed increased relative kidney weights, decreased renal mitochondrial respiration, and ultrastructural changes to the kidney.

Male ddY mice (number not stated) received 0, 3, or 10 mg As_2O_3/kg/day orally for 14 days and were examined for changes in concentrations of monoamine-related substances in various brain regions and for changes in locomotor activity (Itoh *et al*., 1990). Locomotor activity was increased in the low-dose group and decreased in the

high-dose group. Several monoamine-related compounds were altered in both dose groups in the cerebral cortex, hippocampus, hypothalamus, and corpus striatum. The study indicates an effect of arsenite on brain chemistry but is inconclusive with respect to dose response.

Male and female Wistar rats (7-10 per group) were treated from age 2 to 60 days by oral gavage with daily administration of 0 or 5 mg As/kg body weight (as sodium arsenate) (Nagaraja and Desiraju, 1993; 1994). After 160 days, body weights, brain weights, and food consumption were decreased in the arsenic exposed group. Acetylcholinesterase (AChE) and GAD activity and GABA levels were decreased in the hypothalamus, brain stem, and cerebellum during the exposure period; all but AChE activity returned to normal during the post-exposure period. Changes in operant conditioning were also observed among the exposed animals.

Female Holtzman rats (>5 per group) were treated with 0, 100, 500, 1000, 2000, or 5000 ppm As_2O_3 in feed for 15 days (Wagstaff, 1978). Hexibarbitone sleeping time was altered in all arsenic exposed groups. Body weight and feed consumption were decreased among animals in the groups exposed to $\geq$ 500 ppm As_2O_3. Clinical signs of toxicity observed among arsenic exposed animals included roughened hair, diarrhea, and decreased physical activity.

Male Sprague-Dawley rats and C57 black mice (12 per group) were treated with 0, 20, 40, or 85 ppm sodium arsenate in drinking water for up to 6 weeks (Woods and Fowler, 1978). Among arsenic exposed rats, heme synthetase activity was decreased in all exposed groups. Among animals exposed to $\geq$ 40 ppm sodium arsenate, hepatic ALA synthetase activity was decreased and urinary uroporphyrin and coproporphyrin were increased. Among exposed mice, heme synthetase activity was decreased and uroporphyrinogen I synthetase activity was increased in all exposed groups. Among animals exposed to $\geq$ 40 ppm sodium arsenate, urinary uroporphyrin and coproporphyrin were increased.

Administration of 3.7 mg As_2O_3/kg/day to Rhesus monkeys for 12 months did not result in any neurologic change detectable by an EEG (Heywood and Sortwell, 1979). Two of the 7 animals exposed to this concentration died before the conclusion of the 52-week period. Of the surviving animals, two were retained for a 52-week recovery period after which they were sacrificed and necropsied. No significant changes in organ weights or gross appearance were noted.

7. Toxicity of Arsine

7.1 Toxicity to Adult Humans

Numerous case reports of accidental arsine poisoning exist in the literature, but reliable estimates of concentrations during acute human intoxication do not exist. This is due in large part to the insidious nature of arsine toxicity - arsine is a colorless gas, has a mild odor at low concentrations, produces no mucous membrane irritation, and usually results in delayed symptoms of toxicity (Klimecki and Carter, 1995). In mammalian systems, arsine primarily targets the erythrocyte and causes hemolysis and methemoglobinemia with acute exposure (NRC, 1984). Jaundice, hemoglobinuria, anuria, hepatic and renal damage, anoxia, and anemia are secondary effects resulting from hemolysis. Before the advent of dialysis, there were no reports of patients surviving if renal failure developed (Buchanan, 1962). Other acute symptoms reported include headache, weakness, dizziness, dyspnea, nausea, vomiting, diarrhea, and abdominal cramping (Klimecki and Carter, 1995). Central and peripheral nervous systems may be affected by acute arsine exposure, leading to agitation, disorientation, hallucinations, psychopathologic abnormalities, and peripheral nerve degeneration (Frank, 1976; Klimecki and Carter, 1995). The psychopathologic and peripheral abnormalities are thought to be secondary to the conversion of arsine to arsenate or arsenite. The first signs and symptoms of toxicity, hemoglobinuria and/or nausea, are usually delayed 2 to 24 hours following exposure (Kleinfeld, 1980).

A case report documents hemolytic anemia, hematuria, and renal failure following intermittent exposure to arsine gas over 2.5 hours (Parish *et al*., 1979). Symptoms of gastrointestinal distress, headache, and malaise were also reported following this exposure. The concentration of arsine gas sampled 3 days after exposure was 0.1 ppm (0.3 mg/m³), but the concentration at the time of poisoning was unknown. Another typical accidental poisoning resulted when 2 men were exposed to arsine gas in a metal smelting works (Coles *et al*., 1969). Symptoms included nausea, vomiting, red urine, generalized aching, shivering, epigastric pain, and jaundice. However, the more severely affected worker developed symptoms within 1 hour of exposure while the other did not develop symptoms for 24 hours. The more severely affected worker developed acute renal failure that required peritoneal dialysis.

In an occupational study, the highest average concentration of arsine recorded in a battery formation area of a battery manufacturing plant was 20.6 µg/m³ (0.006 ppm) (Landrigan *et al*., 1982). Elevated levels of urinary arsenic were observed in some workers but effects on the hematopoietic system were apparently not examined.

A study by Williams *et al*. (1981) collected personal and area air samples after 2 workers exhibited symptoms of arsine poisoning while restoring a large 19th century painting. Symptoms included headaches, nausea, weakness, vomiting, and red urine. The control-corrected air concentration of arsine ranged from 0.010 to 0.067 mg/m³. While these concentrations are below the OSHA PEL (permissible exposure level) 8-hour TWA (time weighted average) of 0.2 mg/m³, the results may indicate that these workers are sensitive responders or that humans in general may be more sensitive to

the effects of arsine than experimental animals. However, the air samples may not represent the actual concentration of arsine that caused the symptoms of poisoning in the workers since the workplace air was not analyzed for arsine until after symptoms were reported. The study also notes that 'appreciable concentrations' of lead and arsenic were found in the workplace air.

No studies were identified addressing the chronic toxicity of arsine in humans.

7.2 Toxicity to Infants and Children

No studies were identified allowing quantitative assessment of arsine toxicity in infants and children. Arsine's mode of toxic action is not completely understood but appears to involve binding to erythrocyte sulfhydryl groups followed by intracellular ion loss and hemolysis (Rael *et al.*, 2000). Clinical treatment of arsine poisoning usually involves exchange transfusion. It seems plausible that infants and children would be more sensitive to the irreversible hematotoxicity of arsine than adults due to their greater breathing rate per unit body weight.

7.3 Toxicity to Experimental Animals

A number of studies were reviewed to understand the time-concentration relationship of arsine lethality. The most complete and relevant study was the IRDC (1985), which allowed determination of 1% and 5% lethality benchmark doses for exposure durations of 0.5 to 4 hours in rats. The most important acute non-lethal effects noted were hemolysis and reticulocytosis (Peterson and Bhattacharyya, 1985). Longer term effects of arsine also involved significant changes in hematological parameters (hemoglobin and mean corpuscular volume) (Blair, 1990).

LC_{50} values (estimate of concentration resulting in 50 percent mortality of exposed animals) reported by Gates (1946) are as follows: 120-210 ppm (380-670 mg/m³) for 10 minutes in rats, 110 ppm (350 mg/m³) for 30 minutes in dogs (equivalent to 190 ppm (610 mg/m³) for 10 minutes), and 200-300 ppm (640-960 mg/m³) for 10 minutes in rabbits. An LC_{50} in mice was reported as 31 ppm (99 mg/m³) for a 50-minute exposure (Levvy, 1947). The survival time of the fatalities (4 days) was reported to be more or less independent of exposure concentration (2500 mg/m³ to 25 mg/m³) and exposure duration.

The study by Levvy (1947) in mice varied exposure durations for each given concentration of arsine. Because the mortality data were not presented in conventional form by the standard LC_{50} method, the data were normalized to a 1-hour exposure using the modified form of Haber's equation (as described in Section 5.7.1 of the TSD):

$$C^n \times T = K,$$

where C = concentration, T = time, K = a constant determined at a given C, T and the exponent n is a constant determined experimentally. The exponent "n" of 1.8 was determined by varying the term n in a log-normal probit analysis (Crump and Howe,

1983; Crump, 1984) until the lowest chi-square value was achieved. Fifty-four data points were used to estimate the exponent n because these points were of sufficient duration (≥ 5 minutes) and resulted in the best chi-square fit for the line and obvious heterogeneity (Table 7.3.1). This relationship indicates that the toxicity of arsine varies approximately with the product of the square of concentration times time rather that simply concentration times time.

Table 7.3.1 Arsine Mortality in Mice: Results from Levvy (1947) and 1-Hour Adjusted Concentrations Using Haber's Equation (C^n x T = K, where n = 1.8).

Concentration (ppm)	Exposure Duration (min)	Mortality (no. died/total)	1-Hour Adjusted Concentration (ppm)
157*	10	30/30	58
	5	28/30	39
	2.5	17/30	27
	1.7	0/30	22
78.4*	15	21/30	36
	9	10/30	27
31.4	70	30/30	34
	50	15/30	28

** Shaded rows include data used for determination of the ED_{05} and BD_{05}*

Craig and Frye (1988) reported a 4-hour LC_{50} of 42.6 ppm in rats. However, when the rats were separated by sex for statistical purposes, there was slightly greater mortality among females than males (38.9 ppm LC_{50} for females vs. 46.8 ppm LC_{50} for males). No abnormalities were seen at necropsy except red discharge from nose, mouth, and genitalia at the higher concentrations. A concentration-related suppression of body weight gain was observed during the first week of the 14-day post-observation period.

The most comprehensive arsine lethality study was undertaken by IRDC (1985). LC_{50}s of 240, 178, and 45 ppm were determined in rats (10 rats/sex/group) for 30 minute, 1 hour, and 4-hour exposures, respectively. Deaths generally occurred within 3 days following 30-minute exposure to arsine. As in the previous study (Craig and Frye, 1988), there was slightly greater mortality in females than males. Adverse effects noted during exposure included dyspnea, while effects noted post-exposure included a concentration-related increase in hematuria, dark material around the head or the anogenital area, and pallor of ears, eyes, and feet. The higher concentrations resulted in weight loss immediately following exposure, suppressed weight gain during the first week and compensatory weight gains during the second week post-exposure. Necropsy on animals that died showed red, yellow or orange fluid in the bladder, stomach, or intestine, and discoloration of the kidneys, lungs, and liver.

Data in the IRDC (1985) report were used to determine the exponent "n" in the equation C^n x T = K. This was done by varying the term n in a log-normal probit analysis (Crump, 1984; Crump and Howe, 1983) until the lowest chi-square value was achieved. The

value of "n" for extrapolation to 1-hour exposure was dependent on exposure duration. For extrapolation from 30 minutes to 1-hour exposure, n = 2.2; for extrapolation from 4-hours to 1-hour exposure, n = 1.0.

Table 7.3.2 contains the studies which provided adequate raw mortality data from which a maximum likelihood estimate corresponding to 5% lethality (ED_{05}) and benchmark dose at the 95% lower confidence interval of the ED_{05} and ED_{01} (BD_{05} and BD_{01}, respectively) could be determined.

Table 7.3.2 Animal Lethality Benchmark Dose Determinations in ppm for Arsine

Reference	Species	Exposure Time (min)	LC_{50} 60 min[1]	ED_{05} 60 min[1]	BD_{05} 60 min[1]	BD_{01} 60 min[1]
IRDC, 1985	rat	30	175	120	105	86
	rat	60	178	112	88	66
	rat	240	181	118	101	80
Craig and Frye, 1988	rat	240	170	125	102	84
Levvy, 1947	mice	varied[2]	29	20	16	13

[1] Exposure time was extrapolated to 60 minutes, if needed, using a modification of Haber's equation ($C^n * T = K$). For rats, n = 2.2 for extrapolation from 30 minutes to 1-hour, or n = 1.0 for extrapolation from 4 hours to 1-hour; for mice, n = 1.8.

[2] Lethality data for 5 exposure durations were pooled and normalized to a 1-hour exposure using the equation $C^n \times T = K$ (see Table 1).

In other experimental animal studies, a reduction in hematocrit as a function of arsine concentration was observed in mice following a 1-hour exposure (Peterson and Bhattacharyya, 1985). A LOAEL of 9 ppm (29 mg/m³) and a NOAEL of 5 ppm (16 mg/m³) were reported. The demarcation between the NOAEL and LOAEL for this non-lethal effect was well defined, not only among the exposure groups (5 ppm vs. 9 ppm), but also among individual mice in each exposure group (Peterson, 1990). Hematologic recovery of the surviving mice was gradual but nearly complete within 11 days after exposure (Peterson and Bhattacharyya, 1985). The study also reported a NOAEL of 15 ppm (100% survival) and LOAEL of 26 ppm (100% lethality) for lethality.

A continuous benchmark dose analysis of these data was performed. The full data set on hematocrit reduction 24 hours after exposure gave a BMD_{05} of 7.81 ppm and a $BMDL_{05}$ of 5.2 ppm (quadratic continuous model fit P= 0.16). The only other data sets that were adequately fit were the 24 hour increase in reticulocyte count (%) with the 11 and 26 ppm outliers removed (power continuous model, P = 0.50) and the 5 days values with the 9 ppm outlier removed (cubic continuous model, AIC = 61.8). Several response levels were evaluated including 25% relative, 1 and 2 % absolute increases and 1 and 2 standard deviations. The latter SD levels were closest to the minimal significant increase levels and exceeded the control plus one control SD values of 0.88 ppm (24 hr) and 2.0 (5 days). For a 1 SD response level at 24 hours the BMD_{1SD} = 3.29 ppm and the $BMDL_{1SD}$ = 2.17 ppm. The values for 2SD were BMD_{2SD} = 4.69 ppm and $BMDL_{2SD}$ = 3.50 ppm. For the 5 days data set the BMD_{2SD} = 4.32 ppm and the

$BMDL_{2SD}$ = 2.70 ppm. Reticulocytosis may be a more sensitive indicator of adverse hematologic effects of arsine exposure than hematocrit reduction.

A subchronic study in male and female rats and female mice (Fowler *et al*., 1989) supports the sharp increase in dose-response noted by Peterson and Bhattacharyya (1985). All treatment groups exposed to arsine (6 hr/day, 5 days/week) at concentrations of 10 ppm and above showed 100 percent mortality within 4 days while those exposed to 5 ppm or less showed no mortality or overt signs of toxicity. Other effects observed included a dose-related increase in spleen weight and a slight increase in liver weight. Blood samples taken at necropsy showed a slight dose-related decrease in hematocrit and a marked dose-related increase in the activity of red blood cell ALAD (δ-aminolevulinic acid dehydratase).

In a 90-day study, male and female mice were exposed to 0, 0.025, 0.5, and 2.5 ppm arsine gas for 6 hours/day, 5 days/week (Blair *et al*., 1990). After 5, 15, and 90 days, blood was collected for hematologic analysis. Exposure to 2.5 ppm had significant effects on all hematological parameters for nearly the entire exposure period, while 0.5 ppm caused only a few significant changes in hematological parameters at day 90 of exposure (decreased hemoglobin in males and increased MCV in females). Exposure to 0.025 ppm was without effect.

A continuous benchmark dose analysis was performed on the data sets of Blair *et al*. 1990. Adequate fits to the hematocrit data were obtained with the linear and quadratic models with $BMDL_{025}$ (relative risk) values ranging from 0.128 to 0.894 ppm (P values for model fits of 0.11 to 0.96). Absolute reticulocyte count increases gave continuous $BMDL_{10}$'s ranging from 0.22 to 0.68 ppm with linear and quadratic models (P values of 0.31 to 0.99). However, due to the poor dose spacing, essentially a missing dose level between 0.025 and 0.5 ppm, these results are considered inconclusive in determining an alternative NOAEL to 0.025 ppm.

7.4 Developmental and Reproductive Toxicity

In an unpublished study, workers in one semiconductor plant were reported to have a 39% rate of miscarriage, almost twice the national average (Sanger, 1987). Workers were exposed to unidentified levels of arsine gas, but other possible exposures were not identified.

A developmental toxicity study exposed pregnant rats and mice to 0.025, 0.5, or 2.5 ppm (0.079, 1.5, or 7.9 mg/m³) arsine for 6 hours per day on gestation days 6 through 15 (Morrissey *et al*., 1990). The rats exposed to 2.5 ppm exhibited a significant increase in fetal body weight, but no other endpoints of developmental toxicity were observed. The incidence of malformations observed in arsine exposed mice at 0.025 ppm (exencephaly) and at 2.5 ppm (unfused eyelids) was not significantly different from control mice.

8. Derivation of Reference Exposure Levels

8.1 Acute Reference Exposure Level for Inorganic Arsenic

Study	Nagymajtenyi *et al*., 1985
Study population	pregnant mice
Exposure method	maternal inhalation exposure
Exposure continuity	
Exposure duration	4 hours per day on gestation days 9, 10, 11, and 12
Critical effects	decreased fetal weight
LOAEL	0.26 mg/m³ As_2O_3 (0.197 mg As/m³)
NOAEL	not observed
Benchmark concentration	not derived
Time-adjusted exposure	n/a
Human Equivalent Concentration	n/a
LOAEL uncertainty factor (UF_L)	10 (no NOAEL)
Subchronic uncertainty factor (UFs)	n/a
Interspecies Uncertainty Factor	
Toxicokinetic (UF_{A-k})	√10 (animal study)
Toxicodynamic (UF_{A-d})	√10 (animal study)
Intraspecies Uncertainty Factor	
Toxicokinetic (UF_{H-k})	√10 (remaining interindividual variation: study considered effects on fetus or infant)
Toxicodynamic (UF_{H-d})	√10 (interindividual variation)
Cumulative uncertainty factor	1,000
Reference Exposure Level	**0.0002 mg As/m³ (0.20 μg As/m³,)**

Acute Reference Exposure Levels are levels at which intermittent one-hour exposures are not expected to result in adverse health effects (see Section 5 in the Technical Support Document). The most appropriate study for the basis of an acute REL for arsenic is Nagymajtenyi *et al*. (1985). This study was selected since it measured a sensitive toxicological endpoint with a relevant route of exposure, and the experimental design and reporting were considered adequate (as specified in the Non-cancer Risk Assessment technical support document, Section 4.1.1). It involved a significant number of animals exposed by inhalation to three dose levels plus a control. Unfortunately, no NOAEL was obtained. However, a significant dose-related reduction in fetal weight and increased incidences of intrauterine growth retardation, skeletal malformations, and hepatocellular chromosomal aberrations were observed in mice following maternal inhalation exposure to 200 μg As/m^3 (260 μg As_2O_3/m^3) for 4 hours on gestation days 9, 10, 11, and 12 ($p<0.05$). The most sensitive effect, decreased fetal weight, was observed at 200 μg As/m^3, so 200 μg As/m^3 was taken as a LOAEL. Maternal toxicity data were not reported. This study is used as the basis of the acute REL:

0.2 mg/m^3/1000 = 0.0002 mg/m^3 = 0.2 µg As/m^3 (equivalent to 0.065 ppb arsine gas)

No temporal adjustment was made for the critical study since the critical period of exposure for a developmental effect may be very short relative to the study duration (OEHHA, 2007). The study concentration with appropriate uncertainty factors is a "not to exceed" value. An uncertainty factor of 10 (UF_L) was used to account for the lack of a no observed adverse effect level (NOAEL). A second uncertainty factor of 10 was used to account for interspecies differences between the test species and humans. This factor is the product of two components addressing pharmacokinetic (UF_{A-k}) and pharmacodynamic (UF_{A-d}) differences, each assumed to be the √10. A final uncertainty factor of 10 was applied to address human interindividual differences in pharmacokinetics (UF_{H-k}) and pharmacodynamics (UF_{H-d}) also assumed to be √10 each. The overall uncertainty of extrapolating from 4-hour exposures in mice (LOAEL) to no anticipated effects in humans is 1000 as noted in table above and the calculation of the acute REL. The rationale for the choice and value of uncertainty factors used by OEHHA is provided in the Non-cancer Risk Assessment technical support document (Section 4.4.3).

Inorganic arsenic (oxides) are listed as developmental toxicants under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). The studies reviewed in this document support the conclusion that exposure to inorganic arsenic may affect fetal weight, spontaneous abortion, neonatal death and postnatal neurological development.

In humans, the logarithm of infant mortality (death) increases linearly as birth weight decreases from 3500 to 1000 grams (Hogue *et al*., 1987; Rees and Hattis, 1994). This log-linear relationship exists on both sides of the weight (2500 g) conventionally used as a cutoff defining low birth weight. There is no evidence for a threshold. Thus any reduction in fetal weight is a cause for concern since it increases mortality. In the absence of certainty, OEHHA takes the health protective approach that the reduced weight effect in the animal fetuses may be biologically significant, particularly when viewed from a population perspective.

8.2 Inorganic Arsenic 8-Hour Reference Exposure Level

The 8-hour Reference Exposure Level is a concentration at or below which adverse noncancer health effects would not be anticipated for repeated 8-hour exposures which might include daily occupational, in-home or in-school exposures. (see Section 6 in the Technical Support Document).

Due to the possibility of repeated exposure and the relatively slow clearance of arsenic compounds, the 8-hour REL is taken to be equivalent to the chronic REL. The half-life of the initial exponential phase of excretion of arsenic after a single dose is typically between one and two days, but there are also several much slower excretion processes. So a single exposure to arsenic would take several days to be cleared, mainly via urinary metabolites. Repeated exposures can significantly prolong the clearance of arsenic as the internal dose accumulates, so that in terms of internal

dosimetry it would be difficult to distinguish repeated periodic exposure from chronic exposure scenarios. An individual exposed daily via air and/or drinking water might show very similar urinary arsenic excretion to another individual exposed only periodically at work, school etc.

8.3 Inorganic Arsenic Chronic Reference Exposure Level

Study	Wasserman *et al*. (2004); Tsai *et al*. (2003)
Study population	201 children 10 years of age
Exposure method	drinking water
Exposure continuity	continuous
Exposure duration	9.5 to 10.5 years
Critical effects	Decrease in intellectual function, adverse effects on neurobehavioral development
LOAEL	0.23 μg As/m^3 based on est. LOAEL of 2.27 μg/L (Wasserman *et al*., 2004; see Section 8.3.1.1)
NOAEL	not observed
Benchmark concentration	not derived
Time-adjusted exposure	none, exposure considered continuous
Human equivalent concentration	n/a
LOAEL uncertainty factor (UF_L)	3 (LOAEL estimated by quantitative analysis of study data)
Subchronic uncertainty factor (UFs)	1 (default: duration >8% of lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default: human study)
Toxicodynamic (UF_{A-d})	1 (default: human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	√10 (remaining interindividual variation: study considered effects on 10 year-old but not infant)
Toxicodynamic (UF_{H-d})	√10 (default, interindividual variation)
Cumulative uncertainty factor	30
Inhalation Reference Exposure Level	**0.015 μg As/m^3**
Oral Reference Exposure Level	0.0035 μg/kg-d

The chronic Reference Exposure Level is a concentration at which adverse noncancer health effects would not be expected from chronic exposures (see Section 7 in the Technical Support Document).

8.3.1.1 Child Based Values

A number of studies have indicated potentially greater toxicity of arsenic exposure during childhood (see below). Although some PBPK modeling has been applied to inorganic arsenic and its methyl metabolites, the modes of toxic action and relevant internal dosimetry are not sufficiently understood at present to use this modeling directly in REL development. In this section we compare quantitative analyses of dose-

responses and LOAELs in key studies involving arsenic exposures in children. Health protective exposure levels derived from these analyses will be compared with similar analyses from studies in adults in the following section.

The study of Wasserman *et al*. (2004) indicated a dose-response of decreasing Full-Scale intellectual function raw scores with increasing drinking water arsenic exposure in 10-year olds. The values in their Fig.2 give an exact fit to a quadratic model ($Y = Y_0 + aX + bX^2$; Y_0 intercept = 0, a = -0.443, b = 0.0063, R^2 = 1.0) with a low dose slope of – 0.44 points/μg/L. Assuming an adverse effect level of one point loss, then the corresponding arsenic concentration can be calculated as:

-1point/-0.44 point/μg/L = 2.27 μg/L.

This level might be equivalent to a LOAEL. Further, assuming water intake of 1 Liter/day (L/d) and essentially complete intestinal absorption, this can be converted to an intake of 2.3 μg/d. If we assume a drinking water intake based on the 95% upper confidence level (UCL) for U.S. children aged 1 to 10 years of 1564 mL/day the intake would be somewhat higher at 3.6 μg/d (OEHHA, 2000; Table 8.3). Since 10-year old males would inhale about 9.9 m^3/d (OEHHA, 2000), if airborne arsenic were 100% absorbed, this oral effect level would be equivalent to an inhalation level of 2.3 μg/day/9.9 m^3/day = 0.23 μg/m^3. Assuming a more realistic inhalation absorption of 50 % would give a value of 0.46 μg/m^3. Applying a 3-fold UF for an estimated LOAEL based on a quantitative dose response analysis (a higher value would be used without a dose response analysis) and 10-fold for inter-individual variation since only 10-year olds were studied, a health protective air concentration of 0.015 μg/m^3 can be calculated. An oral value based on the average study body weight of 21.9 kg and 100% oral absorption would be 2.3 μg/d/21.9 kg = 0.105 μg/kg-day. Applying the same overall uncertainty factor of 30 the oral health protective value would be 0.105 μg/kg-day/30 = 0.0035 μg/kg-day.

The data of Tsai et al. (2003) for 13 year old children gave dose response relationships for arsenic exposure metrics of ppb As in drinking water and cumulative arsenic intake (mg) vs. the pattern memory (PM) and switching attention (SA) endpoints (ms). A continuous benchmark response analysis for ppb As vs. ms test duration was conducted for PM (BMD05 = 49.75; BMDL05 = 31.2 ppb) and SA (BMD05 = 28.81; BMDL05 = 19.73 ppb) both using a linear model. For cumulative As intake the PM endpoint data were similarly fit by a linear model (BMD05 = 194.1; BMDL05 = 122.7 mg) and the SA data by a polynomial (quadratic) model (BMD05 = 39.1; BMDL05 = 25.4 mg; see Fig. 1). The SA endpoint appears to be the most sensitive. Based on the SA BMDL05 of 19.7 ppb and 1 L/d drinking water intake a minimum effect level of 19.7 μg/d is estimated. If we assume a drinking water intake, based on the 95% UCL for U.S. children aged 11 to 19 years of 2.143 L/d the intake would be 2-fold higher at 42.2 μg/day (OEHHA, 2000; Table 8.3). Using uncertainty factors of 10 for interindividual variation and 3 for extrapolation from a minimum to a no effect level, a health protective intake of 19.7 μg/d/30 = 0.658 μg/d is calculated. Assuming inhalation of 10 m3/d and 50 % absorption (default) this value can be converted to an inhalation value of 0.658

µg/day/(0.50 x 10 m^3/day) = 1.32 µg/m^3. Using the SA cumulative $BMDL_{05}$ of 25.4 mg As and 10 years exposure, an effect level of 25.4 mg/(10 yr x 365days/yr) = 6.96 µg/day is calculated. Using the same assumptions and UFs as above, an inhalation value of 0.044 µg/m^3 can be derived based on As concentration. The cumulative dose metric is a more accurate estimate of arsenic exposure than As water concentration, so the value of 0.046 µg/m^3 or 0.05 µg/m^3 (rounded) is preferred over the concentration based value. An oral value based on an average body weight for a 13-14 year old child (OEHHA, 2000) of 50 kg is 6.96 µg/day/50 kg = 0.139 µg/kg-d. Applying the same overall uncertainty factor of 30 would give 0.139 µg/kg-day/30 = 0.0046 µg/kg-day.

The quantal responses for skin lesions in young children (≤ 9 yr) and adolescents (10-19 yr) from Mazumder *et al*. (1998) were subjected to benchmark dose analysis. For young children, the quantal linear model adequately fit the data (X^2 = 6.1, P = 0.30) with a BMD_{01} = 54.4 µg/L and a $BMDL_{01}$ = 39.3 µg/L. For adolescents, the best fitting model was the log probit (X^2 = 0.77, P = 0.68) with a BMD_{01} = 77.3 µg/L and a $BMDL_{01}$ = 47.4 µg/L. These values are similar to the analysis of all age groups combined (above) and application of a 10-fold UF for intraspecies variation seems adequate for these data. Thus the health protective intake for children for skin effects would be in the range of 3.9 to 4.7 µg/d for one liter/day water intake. For conversion to inhalation equivalent, young children are assumed to inhale 9.9 m^3/day and drink 1 liter/day and adolescents to inhale 14 m^3/day and drink 1.5 liter/day (OEHHA, 2000). It is further assumed that 50 percent of inhaled arsenic is absorbed via the pulmonary and gastro-intestinal routes. The resulting health protective values would be 0.68 to 0.79 µg/m^3.

A study in Thailand (Siripitayakunkit *et al*., 1999) related drinking water arsenic exposure, indicated by hair arsenic, to IQ in 529 six to nine year old children. A continuous benchmark dose response analysis of this data set gave a BMD_{05} = 0.035 µg As/g hair and $BMDL_{05}$ = 0.0155 µg As/g (polynomial model). A slope of –3.2 IQ points/µg/g was derived from the $BMDL_{05}$. Using the conversion factor of 0.01µg As/g hair/µg As/Liter of water (Kurttio *et al*. 1998), a decrease of 1 IQ point would be equivalent to chronic consumption of 30 µg As/L water (OEHHA, 2004). At one liter/day water consumption the 30 µg/d value is over an order of magnitude higher than the analogous estimate indicated by the Wasserman *et al*. (2004) study above. An inhalation value was derived as above: 30 µg/day/(10 m^3/day x 0.50 x 30UF) = 0.20 µg/m^3.

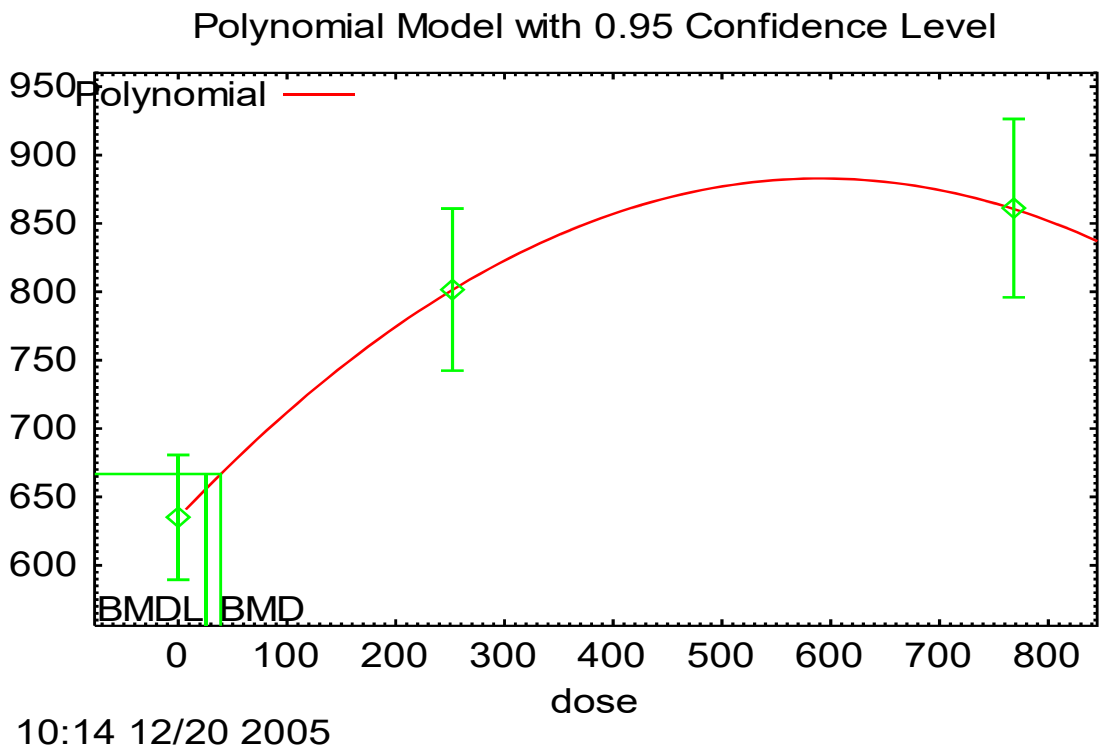
The visual perception data from Siripitayakunkit *et al*. (2001) was subjected to continuous benchmark dose analysis. The $BMDL_{035}$ of 2.40 µg/g hair (polynomial model) was near the low level mean minus one SD score (20.5), presumably an adverse effect level on visual perception as defined by the authors. The linear model gave a higher value (3.69 µg/g) but did not fit the data as well in the low exposure range. Using the conversion factor above, one liter per day water consumption, and a 30-fold cumulative UF results in a presumptive health protective intake of 8 µg/d for this endpoint (2.40 µg/g ÷ 0.01 µg/g/µg/Liter x 1 Liter/day ÷ 30UF = 8.00 µg/d). An inhalation value was derived as above: 8.0 µg/day/(10 m^3/day x 0.50) = 1.6 µg/m^3.

Chronic arsenic exposure appears to have adverse effects on intellectual development and visual perception in children. While the quantitation of these effects and the toxicological significance of the criteria selected are somewhat uncertain, OEHHA thinks they are sufficient to support a chronic reference exposure level (cREL). It is uncertain whether neurological effects are the most sensitive caused by chronic arsenic exposure in children. Additional studies in exposed children are needed to adequately quantify adverse effects. The values above are summarized in Table 8.3.1. The child-based values range from 0.015 to1.6 μg/m^3. The geometric mean of the three cognitive endpoint values (0.015, 0.20, 0.05) is 0.053 μg/m^3.

Table 8.3.1. Inhalation Values Derived from Human Child Studies

Study	Toxic Endpoint	Criterion	Value	Derived cREL, μg/m^3
Wasserman *et al*. (2004)	Intellectual function	One point loss	2.27 μg/d	0.015
Siripitayakunkit *et al*. (1999)	IQ	One point loss	-3.2 IQ/μg/g hair As	0.20
Siripitayakunkit *et al*. (2001)	Visual perception loss	LOAEL	240 μg/d	1.6
Mazumder *et al*. (1998)	Skin Lesions	LED_{01}	39-47 μg/d	0.68-0.79
Tsai *et al*. (2003)	Neurobehavioral effects	LED_{05}	7 μg/d	0.05
Smith *et al*. (2006)	Bronchiectasis mortality	LED_{01}	213 μg/d	1.4

Figure 8.3.1 Switching attention (ms) in 13-year old children versus cumulative arsenic intake in mg (Tsai et al., 2003).



Inorganic arsenic is apparently more potent in its neurotoxic effects in humans than in experimental animals. The values of 2.27 μg/day in Wasserman *et al* (2004) and 7 μg/day in Tsai *et al* (2003) for cognitive effects in 10-13 year-old children are much lower than brain effects seen in animals e.g., 5 mg/kg-day in rats (Nagaraja and Desiraju, 1993; 1994) and 3.7 mg/kg-day in Rhesus monkeys (Heywood and Sortwell, 1979).

The bronchiectasis data from Smith et al. (2006) were subjected to benchmark dose analysis. A control value based on a background incidence rate of 0.04% (1/2500) and exposure of 40 µg As/L x 10 yr were used together with observed incidence values of 4/651 (90 µg As/L x 10 yr) and 9/488 (870 µg As/L x 13 yr). No statistically significant model fits were obtained. The best fitting model was the log probit (X^2 = 4.95, P = 0.026) which gave an LED_{01} ($BMDL_{01}$, 1% response) of 2.77 (mg/L) x yr. This value can be converted to an inhalation value of 1.42 µg/m^3 (2.77mg yr/L x 1000 µg/mg/(13 yr x 10 m^3/d x 30UF x 0.5) = 1.42 µg/m^3). This value has been added to Table 8.3.1 for comparison only due to the poor model fit.

8.3.1.2 Adult Based Values

In this section we review toxicological criteria from studies in adults that may serve as the basis for a chronic REL for inorganic arsenic or otherwise provide supporting information.

Studies in experimental animals show that inhalation exposure to arsenic compounds can produce immunological suppression, developmental defects, and histological or biochemical effects on the nervous system and lung, thus providing supportive evidence of the types of toxicity observed in humans. Among the inhalation studies, the lowest adverse effect level (LOAEL) was quite consistent:

245 μg As/m^3 for decreased bactericidal activity in mice (Aranyi *et al*., 1985);
200 μg As/m^3 for decreased fetal weight in mice (Nagymajtenyi *et al*., 1985); and
270 μg As/m^3 for decreased sperm motility in rats (Kamil'dzhanov, 1982).

Reports of human inhalation exposure to arsenic compounds, primarily epidemiological studies of smelter workers, indicate that adverse health effects occur as a result of chronic exposure. Among the targets of arsenic toxicity are the respiratory system (Lundgren, 1954), the circulatory system (Lagerkvist *et al*., 1986), the skin (Perry *et al*., 1948), the nervous system (Blom *et al*., 1985), and the reproductive system (Nordstrom *et al*., 1979). Occupational exposure levels associated with these effects ranged from 50 to 7000 μg As/m^3. These epidemiological studies suffer, however, from confounding as a result of potential exposure to other compounds, which limits their usefulness in the development of the chronic REL.

A single study showed effects occurring at 4.9 μg As_2O_3/m^3 (Rozenshtein, 1970). However, lack of detail with respect to endpoints and experimental design limits this study's usefulness for developing a Reference Exposure Level.

The cerebrovascular disease (CVD) and cerebrovascular infarct (CI) data of Chiou *et al*. (1997b) were subjected to benchmark dose analysis (BMD). The data were best fit using the quantal linear regression (QL) dose-response equation. Since the responses were of the order of 0.1 to 2 percent, the values calculated were for the 1 percent response (ED_{01}) and its 95% lower confidence limit (LED_{01}), rather than the usual 5 percent response values for the analysis of animal study data.

The values for CI were marginally better fit by the dose-response equation than those for CVD. Also the QL models gave better fits to the unadjusted data sets for both endpoints. The unadjusted ED_{01} and LED_{01} values with goodness of fit P value meeting the acceptable fit criterion of $P \geq 0.1$ were 359 and 189 μg/L for CVD and 268 and 166 μg/L for CI, respectively. Using the cumulative dose metric these values were 5.1, 3.0, 5.9, and 3.5 (mg/L)-yr, respectively. Due to the severity of these and other endpoints analyzed below, the uncertainty in the dose assignments (range mid-points instead of averages), and the fact that the chosen points of departure or LEDs were generally two-fold or more above concurrent control levels, the LED_{01} should be considered equivalent to a LOAEL for the purposes of risk assessment. Due to the severity of the CI endpoint, a 100 UF was used to derive a health protective water concentration of 0.1 to 0.3 μg/L based on the two dose metrics. For CVD with a 30 UF the corresponding values were 0.28 to 1.3 μg/L (for details of analysis see OEHHA, 2004). Assuming 20 m^3/day inhalation, 2 Liters/day water consumption and 50 percent inhalation absorption, the

corresponding inhalation values for these vascular effects would be for CI 0.10 to 0.33 μg/m^3 and for CVD 0.28 to 1.26 μg/m^3.

BMD analysis of the ISHD data from Chen *et al*. (1996) showed that these data were well fit by the QL dose-response equation (ED_{01} = 8.27 (mg/L)-yr, X^2 = 0.26, P = 0.88). The LED_{01} of 5.53 (mg/L)-yr should be considered an effect level for this endpoint. In this analysis the cumulative arsenic dose metric of (mg/L)-yr and resultant benchmark doses were divided by 70 yr to yield comparable lifetime drinking water concentrations of arsenic. Using a cumulative uncertainty factor of 100, a health protective concentration of 0.16 μg/L can be derived (OEHHA, 2004). Assuming 20 m^3/day inhalation, 2 Liters/day water consumption and 50 percent inhalation absorption the corresponding health protective inhalation value for ISHD would be 0.16 μg/m^3.

The Chen *et al*. (1995) data on the association of hypertension (HT) and cumulative arsenic intake via drinking water were subjected to BMD analysis. The QL dose-response equation fit the unadjusted data well but was somewhat less than adequate for the adjusted prevalence values. The acceptable criterion for the X^2 goodness of fit test for the benchmark dose is P $\geq$ 0.10. In the case of arsenic induced hypertension, the 10 percent effect level was chosen due to the higher background and greater dose response range compared to other human studies evaluated where 1% or 5% response levels were used. For HT the LED_{10} is considered an appropriate LOAEL for risk assessment. In the case of the adjusted data set, removal of the highest cumulative dose allows an acceptable fit of the QL equation with an LED_{10} of 7.4 (mg/L)-yr. The data of Rahman *et al*. (1999) were also analyzed. Both crude and adjusted data sets were well fit by the QL model with P values much greater than 0.1. The unadjusted LED_{10} value of 6.3 (mg/L)-yr from Bangladesh is quite similar to comparable value of 7.2 (mg/L)-yr from the Taiwan study (OEHHA, 2004). Health protective drinking water concentrations with a cumulative uncertainty factor of 30 ranged from 0.55 to 0.68 μg/Liter. Assuming 20 m^3/day inhalation, 2 Liters/day water consumption and 50 percent inhalation absorption the corresponding health protective inhalation value for HT would be 0.55 to 0.70 μg/m^3.

The data of Chen *et al*. (2006) indicate a supralinear dose-response. The data were analyzed for benchmark response using metrics of time weighted average (TWA) and cumulative arsenic exposure of TWA times years of exposure or (mg/L)-yr. Systolic hypertension quantal responses of the first four quintiles of the overall population (N = 8726) were fit by the log-logistic model of BMDS (v 1.4.1). The $BMDL_1$ values (1% response) of 71.5 µg/L and 0.66 (mg/L)-yr were obtained (X^2 = 3.8, P = 0.15, d.f. = 2). The pulse hypertension data were similarly fit using the longer-term exposure subpopulation (N = 6319). In this case the 10% response level was used for $BMDL_{10}$'s of 0.49 µg/L and 0.004 (mg/L)-yr (X^2 = 4.45, P = 0.11, d.f = 2). TWA BMDLs for systolic and pulse hypertension in arsenic exposed subpopulations with lower intakes of B vitamins were also evaluated. The $BMDL_{10}$ values for populations with low dietary folate ranged from 62 to 405 µg/L TWA. The results indicate a higher sensitivity of the pulse hypertension effect to low level arsenic than the systolic hypertension effect. The supralinearity of dose-response makes comparison with earlier studies problematic. For

example, projected 10^{-4} extra risk levels for pulse and systolic hypertension from this study are at least an order of magnitude less than values seen earlier with Chen *et al*. (1995) or Rahman *et al*. (1999) although cumulative arsenic exposures were 5-10 times higher in the latter studies (Table 6). A cREL estimated from the 0.49 µg/L value above would be 0.0033 µg/m^3 (0.49 µg/L x 2L/d/(20m^3/d x 0.5 absorption x 30UF).

Similarly, the diabetes mellitus (DM) data of Lai *et al*. (1994) and Rahman *et al*.(1998) were analyzed. In this case, the QL dose-response model adequately fit both unadjusted and multivariate-adjusted prevalences. EDs and LEDs were determined for the 1 and 5 percent response levels. The LED_{05} for the adjusted values appear the best choice for a chronic criterion for arsenic-induced diabetes mellitus, i.e., 8.8 (mg/L)-yr from Lai *et al*. and 0.21 mg/L from Rahman *et al*. The health protective drinking water derived from these values with a cumulative UF of 30 were 0.84 and 1.4 µg/L, respectively (OEHHA, 2004). Assuming 20 m^3/day inhalation, 2 Liters/day water consumption and 50 percent inhalation absorption, the corresponding health protective inhalation values for diabetes mellitus would be 0.85 to 1.4 µg/m^3.

In addition to the values noted above, an estimated LOAEL of 20 (mg/L)-yr for peripheral vascular disease from Tseng *et al*. (1996) was also included in this analysis. Using a cumulative UF of 30, a drinking water value of 1.9 µg/L was derived (OEHHA, 2004). Assuming 20 m^3/day inhalation, 2 Liters/day water consumption and 50 percent inhalation absorption, the corresponding health protective inhalation value for peripheral vascular disease would be 1.9 µg/m^3. The study of Wang *et al*. (2002) on arsenic induced carotid atherosclerosis (subclinical) also gave an estimated LOAEL of 20 (mg/L)-yr and would yield the same health protective values.

The arsenic-induced skin keratosis and hyperpigmentation data of Mazumder *et al*. (1998) were analyzed as above (OEHHA, 2004). For both male and female skin keratosis data sets, adequate fits were obtained by the QL model with lower bound values (LED_{01}) of 49.6 µg/L for males and 124 µg/L for females. Adequate fits could not be obtained for both hyperpigmentation data sets with the models available in the benchmark dose program; however, the dose-response graphs appeared to be linear in the lower exposure groups with respective LED_{01}s of 18.9 and 34.7 µg/L. It appears that a single dose level outlier (125 µg/L) was largely responsible for the failure of the statistical test. Mazumder also included an assessment of skin keratosis and hyperpigmentation prevalence by dose per body weight. Using the dose metric of µg/kg-day, the skin hyperpigmentation data were still unable to be fit by the BMDS models. Therefore only the skin keratosis endpoint appears suitable for the development of a health protective value for arsenic-induced noncancer effects. Using a cumulative UF of 30, a drinking water value of 1.7 µg/L was derived. Assuming 20 m^3/day inhalation, 2 Liters/day water consumption and 50 percent inhalation absorption, the corresponding health protective inhalation value for skin keratosis would be 0.34 µg/m^3.

The skin lesion data of Rahman *et al*. (2006) was analyzed for benchmark response. The unadjusted data reported in Rahman's Table 3 was used with the mid points of the

exposure concentration ranges (e.g., 5, 30, 100, 224, 450 µg/L) and the mean As exposures in Rahman's Table 4 (e.g., 9.8, 59.3, 127, 199, 344 µg/L). For the unadjusted male data, no adequate fit could be obtained. The female data was adequately fit by the quantal linear (P = 0.43) and log-logistic (P = 0.51) models. The latter giving a $BMDL_{10}$ of 6.28 µg/L with mid-point based exposure estimates, and the former giving a $BMDL_{10}$ of 108.2 µg/L with mean As concentrations. Similarly, for the cumulative As dose metric of (mg/L)-yr no adequate fit was obtained with the male data, while the female data were best fit by the log-probit model (P = 0.86) for a $BMDL_{10}$ of 2.80 (mg/L)-yr. Using the age and asset adjusted data with the average As concentrations, an adequate fit to the male data could be obtained with the multistage model if the top dose group was removed, $BMDL_{10}$ = 96.0 µg/L (X^2 = 0.60, P = 0.74). The female adjusted data set gave a lower BMDL of 65.4 µg/L despite the authors' finding that the males were more sensitive. This may simply reflect the difficulty of fitting the male data. In almost all cases, the BMDL values are lower (indicating higher risk) than seen in the earlier study by Mazumder *et al*. (1998) analyzed above.

The Von Ehrenstein et al. (2005) study of decrements in lung function related to arsenic exposure via drinking water reported slopes of -45.0 mL forced expiratory volume in 1 second (FEV_1) and -41.1 mL forced vital capacity (FVC) per 100 µg/L increase in arsenic concentration for exposed men. Assuming low dose linearity these values can be converted to inhalation values of 0.044 µg/m^3 (FEV_1) and 0.048 µg/m^3 (FVC) corresponding to respective 1 mL losses in lung function (e.g., 45/100 = 2.22 µg/L/mL decrement; 2.22 µg/L/mL x 2L water/d /(20m^3/d x 10UF x 0.5) = 0.044 µg/m^3/mL).

The inhalation values derived from oral human exposure studies above are summarized in Table 8.3.2. With the exception of the very low value derived from the pulse hypertension endpoint, the derived health protective inhalation values range over approximately forty fold from 0.044 to 1.7 µg/m^3. These adult values exceed the child-based values (range 0.015 to 1.6 µg/m^3). Therefore the proposed chronic REL value of 0.015 µg/m^3 is derived from the child arsenic exposure studies evaluated above and the adult studies provide supporting information.

In addition to being inhaled, airborne arsenic can settle onto crops and soil and enter the body by ingestion. Thus an oral chronic reference exposure level for arsenic of 0.0035 µg/kg-day is also proposed. (From section 8.3.1.1, 2.3 µg/kg-d/(21.9 kg x 30UF) = 0.0035 µg/kg-d).

Table 8.3.2 Inhalation Values Derived from Adult Human Drinking Water Studies

Study	Toxic Endpoint	Criterion	Value	Derived chronic REL, ($\mu g/m^3$)
Chiou *et al*. (1997b)	Cerebrovascular disease	LED_{01}	378 μg/d	1.26
Chiou *et al*. (1997b)	Cerebrovascular infarct	LED_{01}	332 μg/d	0.33
Chen *et al*. (1996a)	Ischemic Heart Disease Mortality	LED_{01}	5.53 (mg/L)-yr	0.16
Chen *et al*. (1995)	Hypertension	LED_{10}	5.8 (mg/L)-yr	0.55
Chen *et al*. (2006)	Systolic and pulse hypertension	SHT LED_{01} PHT LED_{10}	71.5 µg/L 0.49 µg/L	1.43 0.0033
Lai *et al*. (1994)	Diabetes mellitus	LED_{05}	8.8 (mg/L)-yr	0.85
Rahman *et al*. (1998)	Diabetes mellitus	LED_{05}	0.21 mg/L	1.4
Mazumder *et al*. (1998)	Skin keratosis	LED_{01}	50 μg/L	0.33
Rahman *et al*. (2006)	Skin keratosis or altered pigmentation	LED_{10}	65.4 µg/L	0.44
Tseng *et al*. (1996)	Peripheral vascular disease	est. LOAEL	20 (mg/L)-yr	1.69
Wang *et al*. (2002)	Carotid atherosclerosis	est. LOAEL	20 (mg/L)-yr	1.69
Von Ehrenstein *et al*. (2005)	Lung Function decrements	-1 mL FEV_1 -1 mL FVC	2.22 µg/L 2.42 µg/L	0.044 0.048

9. Arsine Based Calculations

The NAC/NRC (National Advisory Committee on Acute Exposure Guideline Levels for Hazardous Substances/National Research Council Subcommittee on Acute Exposure Guideline Levels) derived an Acute Exposure Guidance Level-2 (AEGL-2, disabling) of 0.17 ppm (500 $\mu g/m^3$) for one-hour exposure to arsine based on the hemolysis mouse data of Peterson and Bhattacharyya (1985) (Thomas and Young, 2001). Due to the steepness of the dose response the derivation of an AEGL-1 (Non-disabling) was considered inappropriate. Also the reliance on animal data was considered more "scientifically valid than AEGLs estimated from limited anecdotal human data". The panel used a total UF of 30 (10 for interspecies differences and 3 for intraspecies differences).

Based on the same study data, OEHHA calculated a continuous $BMDL_{1SD}$ of 2.17 ppm (6.9 mg/m^3) for reticulocytosis. When this value was adjusted with uncertainty factors of 10 for interspecies and 30 for intraspecies differences (including 10 for the intraspecies toxicokinetic sub-factor, as proposed in OEHHA, 2007 draft) the potential acute reference exposure level (aREL) for a one hour exposure was 2.17 ppm/300 = 0.0072 ppm (23 $\mu g/m^3$).

Despite the additional 10-fold margin of safety and more sensitive endpoint incorporated in the OEHHA derivation summarized above, there is still residual uncertainty in this comparison aREL value for arsine. There is particular concern with respect to the lack of adequate human data, given that rodents appear more resistant to the effects of acute exposure to various inorganic forms of arsenic than humans. The analogy between arsine and other inorganic forms of arsenic is supported by the observation that arsine exposure in humans and experimental animals results in similar metabolites excreted in urine as result from other inorganic arsenic exposure (Landrigan *et al*., 1982; Buchet *et al*., 1998). A further source of concern with a REL based on the Peterson and Bhattacharyya (1985) study is that while the margin of exposure for hemolysis is greater than 1000, the margin for total lethality is less than 4000. Although a steep dose-response slope for acute lethality is not unprecedented, it is a problematic feature when combined with the uncertainty in animal-to human extrapolation noted above. Thus, OEHHA staff have low confidence in using the Peterson and Bhattacharyya study as a basis of an aREL value for arsine and instead will rely on the aREL based on arsenic trioxide inhalation in mice (0.2 $\mu g/m^3$ arsenic, equivalent to 0.065 ppb arsine), which is sufficiently protective for all inorganic arsenic species.

A comparison of various possible values for an 8-hour REL for arsine is shown in Table 8.3.3. Adjustment of the one-hour NOAEL from Peterson and Bhattacharyya (1985) to eight hours using the modified Haber equation for mice gives a value of 1.6 ppm (4.98 mg/m^3)/300UF = 0.053 ppm (17 $\mu g/m^3$). This value is much higher than the values observed by Williams *et al*. (1981) in workers exposed to arsine concentrations estimated at 0.01 to 0.07 mg/m^3. The adverse effects noted included headache, nausea, weakness and vomiting. Although based on only a couple of subjects, the Williams *et al*. study would indicate an 8-hour value of about 0.04 mg/m^3/30 UF = 0.001 mg/m^3 or 1$\mu g/m^3$.

Alternatively, the 90-day study of Blair *et al*. (1990) gives a NOAEL for hematologic effects in mice of 0.025 ppm arsine at 6 hours/day, 5 days/week. Applying the same 300 UF as above gives 0.083 ppb or 0.26 μg/m^3. This latter figure seems more in line with the limited human observations and more suitable for potentially repeated 8-hour exposures to arsine. The intraspecies extrapolation includes additional uncertainty factors (PK + PD UF) for exposure of infants and children to arsine.

Table 8.3.3. Development of Health Protective Values for Arsine

Study	Toxic Endpoint	NOAEL/LOAEL/ BMDL	*Derived REL μg/m^3*
Peterson and Bhattacharyya, 1985	Reticulocytosis in mice 1 hour exposure	$BMDL_{1SD}$ 2.17 ppm 6.9 mg/m^3	*Acute 23*
Peterson and Bhattacharyya, 1985	As above with 8-hour adjustment	1.6 ppm 4.98 mg/m^3	*8-hour 17*
Williams *et al*., 1981	Headache, nausea, weakness, and vomiting in exposed workers	0.01 to 0.07 mg/m^3, average 0.04 mg/m^3 LOAEL.	*8-hour 1.0*
Blair et al*., 1990*	*Hematologic effects*	*NOAEL 0.025 ppm 6 hr/day*	*8-hour 0.26*

PBPK modeling of arsenic species in experimental animals and humans is presently considered inadequate to apply directly to the derivation of RELs for repeated arsine exposures.

Arsine exposure at atmospheric concentrations that caused adverse maternal effects did not adversely affect endpoints of developmental toxicity in mice or rats (Morrissey *et al*., 1990). In the absence of neurodevelopmental studies with arsine, it is assumed that such an effect would be comparable to those of other inorganic forms of arsenic. In view of the observed effect levels for hematological effects noted in the animal studies, both 8 hour and chronic effects of arsine are considered to be adequately covered by the respective cREL for inorganic arsenic based on neurodevelopmental effects observed in children (i.e., 0.015 μg/m^3 arsenic, equivalent to 0.005 ppb arsine)). In view of the concern over neurodevelopmental effects for all inorganic forms of arsenic, OEHHA concludes that it is appropriate to apply this value for 8-hour and chronic exposures to arsine.

10. Arsenic as a Toxic Air Contaminant that Disproportionately Impacts Children

In view of the neurodevelopmental toxicity studies discussed above, it is clear that infants and children are more susceptible to the toxicity of arsenic than adults. OEHHA recommends that inorganic arsenic and arsine be identified as a Toxic Air Contaminant the disproportionately impacts children under the California Health and Safety Code Section 39699.5.

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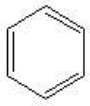
Benzene Reference Exposure Levels

(benzol; benzole; cyclohexatriene)

CAS: 71-43-2



1 Summary

The Office of Environmental Health Hazard Assessment (OEHHA) is required to develop guidelines for conducting health risk assessments under the Air Toxics Hot Spots Program (Health and Safety Code Section 44360(b)(2)). In response to this statutory requirement, OEHHA developed a Technical Support Document (TSD) that describes acute, 8-hour, and chronic Reference Exposure Levels (RELs). The TSD was adopted in December 2008 (OEHHA, 2008) and presents methodology reflecting the latest scientific knowledge and techniques, and in particular explicitly includes consideration of possible differential effects on the health of infants, children, and other sensitive subpopulations, in accordance with the mandate of the Children's Environmental Health Protection Act (Senate Bill 25, Escutia, Chapter 731, Statutes of 1999, Health and Safety Code Sections 39669.5 *et seq.*). These guidelines have been used to develop the RELs for benzene presented in this document; this document will be added to Appendix D of the TSD.

Benzene is a solvent and chemical intermediate. Acute, high inhalation exposure may lead to eye, nose, and throat irritation and central nervous system depression in humans. Prolonged or repeated exposures have been associated with both blood cell proliferation and reduction in blood cell numbers due to bone marrow suppression, including peripheral lymphocytopenia, pancytopenia, and aplastic anemia. The non-cancer adverse health effects of benzene result from the ability of its metabolites to adversely affect rapidly dividing cells, especially in the bone marrow where detoxifying enzymes for its toxic metabolites are present at lower levels than the liver. Children may be more sensitive to benzene because so many of their tissues are undergoing rapid cell division and differentiation for growth and development to stimulate and maintain growth. This review includes relevant material published through December 2013 and is a technical review of those studies specifically applicable to developing non-cancer acute, 8-hour, and chronic inhalation RELs for benzene.

Although benzene is a known human carcinogen (IARC Group 1), this document does not discuss issues related to the cancer potency factor. That was derived previously and is available at www.oehha.ca.gov/air/hot_spots/index.html.

1.1 Benzene Acute REL

Reference Exposure Level	**27 μg/m³ (0.008 ppm; 8 ppb)**
Critical effect(s)	Developmental hematotoxicity in fetal and neonatal mice
Hazard Index target(s)	Developmental; Immune System; Hematologic System

1.2 Benzene 8-Hour REL

Reference Exposure Level	**3 μg/m³ (0.001 ppm; 1 ppb**)
Critical effect(s)	Decreased peripheral blood cells in Chinese workers
Hazard Index target(s)	Hematologic System

1.3 Benzene Chronic REL

Reference Exposure Level	**3 μg/m³ (0.001 ppm; 1 ppb)**
Critical effect(s)	Decreased peripheral blood cells in Chinese workers
Hazard Index target(s)	Hematologic System

2 Physical and Chemical Properties **(HSDB, 2007)**

Description	clear, colorless liquid
Molecular formula	C_6H_6
Molecular weight	78.1 g/mol
Density/Specific gravity	0.8787 @ 15°C/4°C
Boiling point	80.1°C
Melting point	5.5°C
Vapor pressure	94.8 mm Hg @ 25°C (0.125 atm)
Flashpoint	-11°C
Explosive limits	upper = 8.0% by volume in air lower = 1.4% by volume in air
Solubility	miscible with ethanol, chloroform, ether, carbon disulfide, acetone, oils, and glacial acetic acid; slightly soluble in water (1,790 mg/L @ 25°C)
Octanol/water partition coefficient	log Kow = 2.13
Odor threshold	0.875 ppm (2.8 mg/m³) (Haley, 1977) 4.68 ppm (15.3 mg/m^3) (HSDB, 2007)
Odor description	aromatic odor (sweet); gasoline-like odor

Metabolites	hydroquinone, benzoquinone, catechol, phenol
Conversion factor	1 ppm = 3.26 mg/m³

3 Occurrences and Major Uses

Benzene was widely used in the past as a multipurpose organic solvent. The tire industry and shoe factories used benzene extensively. This use was discouraged due to its high toxicity and, at least in the United States, its use as a solvent has decreased. Present uses include benzene as a raw material in the synthesis of styrene, phenol, cyclohexane, aniline, and alkyl benzenes and in the manufacture of various plastics, resins, and detergents. Synthesis of many pesticides and pharmaceuticals also involves benzene as a chemical intermediate. Benzene is a natural constituent of crude oil as well as a product of petroleum refining (e.g., cracking) and is emitted in large quantities from oil refineries and petroleum storage facilities, which are a major source of exposure for the general public nearby. Mobile sources together emit the most benzene into the ambient air. Annual production in the U.S. was estimated to be 12.32 billion pounds (6.16 million tons) in 1993 (HSDB, 2007). In 2010 estimated U.S. production was 1.8 billion gallons (13.3 billion pounds) (Balboa, 2011).

Benzene exposure also arises from cigarette smoking (including passive smoking), home use of solvents or gasoline, and leaking underground storage tanks (Goldstein and Witz, 2009).

Estimates for benzene emissions from the Statewide 2008 California Toxics Inventory (CTI) were 1,284 tons from stationary sources, 117 tons from area-wide sources, 5,024 tons from on-road mobile sources, 4,393 tons from other mobile sources, and 46 tons from natural sources (CARB, 2008). The top 25 benzene-emitting facilities in the Air Toxics Hot Spots program in 2008 emitted between 4,000 and 49,000 pounds per year.

A survey of indoor levels of volatile organic chemicals reported a geometric mean of 0.69 µg/m^3 (0.22 ppb) for benzene (range = 0.29 – 2.11 µg/m^3) in 29 small- and medium-sized commercial buildings in California (Wu et al., 2011).

Indoor benzene levels were measured prior to and after the Ireland Public Health Tobacco Act of 2002 ban on smoking in pubs (McNabola et al., 2006). The average ambient concentration of benzene measured inside two Dublin pubs in March 2004 prior to the ban was 4.83 µg/m^3 (1.5 ppb). The average ambient level outside the pubs was 0.84 µg/m^3 (0.26 ppb). In August 2004 after the ban the average indoor level was 0.54 µg/m^3 (0.2 ppb). The average ambient outside level was 0.13 µg/m^3 (0.04 ppb).

The TEACH (Toxic Exposure Assessment, Columbia/Harvard) study characterized personal exposures to urban air toxics among 41 high school students living in Los Angeles in 2000 (Sax et al., 2006). Exposure was analyzed using 48-hr personal monitoring, outdoor ambient monitoring, and in-home ambient monitoring. The students

were mainly Hispanic (93%), and were required to be non-smokers from non-smoking families. The mean outdoor concentration of benzene was 3.32 µg/m^3 (1 ppb) (maximum = 5.56 µg/m^3 (1.7 ppb)), while the mean in-home concentration was 3.87 µg/m^3 (1.2 ppb) (maximum = 11.4 µg/m^3 (3.5 ppb)). The mean personal concentration was 4.64 µg/m^3 (1.4 ppb) (maximum =11.27 µg/m^3 (3.5 ppb)).

Nazaroff and Singer studied hazardous air pollutants including benzene within US residences. Data analyses indicated that some 16 million US juveniles (2 months to 16 years old) were exposed to benzene from Environmental Tobacco Smoke (ETS) in the home (Nazaroff and Singer, 2004). Assuming that from 14 to 20 cigarettes are smoked per day in each residence, with an average of 430 µg benzene per cigarette, the resulting indoor air level was calculated to be 1.1-2.5 µg/m^3 (0.3-0.8 ppb) and the daily intake of benzene for juveniles was 14 – 31 µg.

In 2002 the estimated statewide ambient concentration of benzene was approximately 0.6 ppb (~2 µg/m^3) (CARB, 2004). Statewide the annual average benzene concentration has decreased from ~2.5 ppb in 1990 to ~0.5 ppb in 2007 (CARB, 2009). The Bay Area Air Quality Management District maintains a 32-station air monitoring network to determine whether the Bay Area is in compliance with California and National Ambient Air Quality Standards. Some of the monitoring sites include toxics sampling equipment. Table 3.1 shows benzene levels in ambient air at various sampling stations in the Bay Area Air Quality Management District in 2008. Benzene levels were determined by a modification of USEPA method TO-15, which uses gas chromatography/mass spectrometry. The minimal detectable level for benzene is 0.014 ppb (0.046 µg/m^3).

Table 3.1. Benzene Levels (ppb) at Monitoring Stations in the Bay Area in 2008

Station	Arithmetic Mean	Maximum	Minimum	Samples
Benicia – VIP	0.106	0.350	0.030	60
Berkeley	0.269	1.00	0.050	122
Bethel Island	0.135	0.510	0.040	62
Concord - Treat Blvd.	0.167	0.450	0.050	62
Crockett - Kendall Ave	0.116	0.250	0.040	62
Fremont-Chapel Way 1	0.195	0.630	0.070	40
Fremont-Chapel Way 2	0.230	0.590	0.100	31
Fort Cronkhite	0.0681	0.200	0	62
Livermore - Rincon Ave.	0.197	0.540	0.060	62
Martinez - Jones St	0.172	0.610	0.030	60
Napa - Jefferson St	0.321	1.05	0.080	62
Oakland	0.234	0.520	0.060	62
Oakland - Filbert St.	0.191	0.610	0.040	60
Redwood City	0.244	0.710	0.090	62
Richmond - 7th St	0.165	0.320	0.020	62
San Francisco - Arkansas 1	0.176	0.410	0	62
San Francisco - Arkansas 2	0.182	0.470	0.060	31
San Jose - Jackson St. 1	0.316	1.11	0.050	120
San Jose - Jackson St. 2	0.296	1.00	0.110	31
San Pablo - Rumrill	0.232	0.440	0.100	62
San Rafael	0.190	0.370	0.050	62
Santa Rosa - 5th St	0.210	0.800	0.030	62
Sunnyvale - Ticonderoga	0.153	0.430	0.050	56
Vallejo - Tuolumne St	0.196	0.660	0.060	62

Source: BAAQMD. Toxic Air Contaminant Air Monitoring Data for 2008. Available at: http://www.baaqmd.gov/Divisions/Engineering/Air-Toxics/Toxic-Air-Contaminant-Control-Program-Annual-Report.aspx. The values are 24-hour integrated samples.

Table 3.2 shows benzene levels in ambient air at ten fixed sampling locations in the South Coast Air Quality Management District between 2004 and 2006 taken as part of the Multiple Air Toxics Exposure Study (MATES) III study. The MATES III study included an air monitoring program, an updated emissions inventory of toxic air contaminants, and a modeling effort to characterize risk, especially the carcinogenic risk from exposure to air toxics. Year 1 was April 2004 through March 2005. Year 2 was April 2005 through March 2006. The analytical method used generally followed the US EPA Method TO-15: determination of volatile organic compounds collected in specially prepared canisters and analyzed by gas chromatography/mass spectrometry.

Table 3.2. Benzene Levels (ppb) at 10 Fixed Sites in South Coast in 2004 - 2006

	Year 1 (4/2004 - 3/2005)				Year 2 (4/2005 – 3/2006)			
Location	Mean	SD	N	Max	Mean	SD	N	Max
Anaheim	0.44	0.28	118	1.44	0.42	0.33	115	2.06
Burbank	0.73	0.42	118	2.16	0.69	0.44	122	1.85
Central LA	0.59	0.30	117	1.83	0.57	0.31	121	1.53
Compton	0.82	0.70	118	3.50	0.78	0.67	118	3.53
Inland Valley	0.49	0.24	115	1.26	0.49	0.24	116	1.24
Huntington Park	0.76	0.46	98	2.20	-	-	-	
North Long Beach	0.56	0.35	119	1.62	0.48	0.34	118	1.70
Pico Rivera	0.57	0.32	121	1.86	-	-	-	
Rubidoux	0.45	0.25	114	1.23	0.43	0.26	120	1.32
West Long Beach	0.57	0.44	114	1.95	0.50	0.38	120	1.77

Source: http://www.aqmd.gov/prdas/matesIII/Final/Appendices/f-MATESIIIAppendixVIFinal92008.pdf. Values are 24 hour integrated samples.

Note that all the levels in Table 3.2 are higher than the highest mean value (0.321 ppb) in the Bay Area (Table 3.1). Table 3.3 shows benzene levels from ten sites in a subproject of MATES III in which mobile monitoring stations (microscale) were intentionally put near a known (fixed) emission source and the results compared to a fixed site nearby over a period of three to ten months.

Table 3.3. Benzene Levels (ppb) at Monitoring Stations in South Coast 2004-2006

Site	Monitor	Mean (ppb)	SD	Max	Samples	Time interval
Commerce	Microscale*	0.69	0.33	1.72	62	11/2004 – 5/2005
Huntington Park	Fixed	0.93	0.52	2.20	46	"
Indio	**Microscale**	**0.21**	**0.1**	**0.37**	**26**	**3/2005 – 5/2005**
Rubidoux	**Fixed**	**0.39**	**0.23**	**0.94**	**26**	**"**
San Bernardino	Microscale	0.73	0.38	1.52	45	10/2004 – 2/2005
Inland Valley(SB)	Fixed	0.51	0.28	1.11	46	"
Sun Valley	**Microscale**	**0.52**	**0.23**	**1.11**	**91**	**6/2005 – 3/2006**
Burbank	**Fixed**	**0.75**	**0.46**	**1.85**	**101**	**"**
Santa Ana	Microscale	1.04	0.6	2.84	47	9/2005 – 1/2006
Anaheim	Fixed	0.61	0.4	2.06	46	"

*A mobile monitoring device was intentionally located near a known but not specifically identified emission source of air toxics.
Sources: http://www.aqmd.gov/prdas/matesIII/Final/Document/e-MATESIIIChapter5Final92008.pdf; Dr. Jean Ospital, South Coast AQMD

The South Coast Air Quality Management District has recently conducted MATES IV. Preliminary results show that benzene levels at the ten monitoring stations have decreased since MATES III.

Benzene exists mostly in the vapor phase. It reacts with photochemically produced hydroxyl radicals with a calculated half-life of 13.4 days. In atmospheres polluted with NOx or SO_2 the half-life can be as short as 4-6 hours (http://www.epa.gov/ogwdw/pdfs/factsheets/voc/tech/benzene.pdf).

4 Metabolism

Inhalation of benzene is the principal route of concern for the general public; approximately half the benzene inhaled by humans is absorbed (Nomiyama and Nomiyama, 1974; Pekari et al., 1992). In men and women exposed to 52-62 ppm benzene for 4 hours, 46.9 percent of the inhaled dose was absorbed. Of this, 30.1 percent was retained and 16.8 percent was excreted unchanged in the expired air (Nomiyama and Nomiyama, 1974).

After absorption, a fraction of benzene is metabolized in the liver, and benzene and its metabolites reach the kidney, the lung, the brain, and the bone marrow. Benzene itself is neurotoxic, but its metabolites have other toxic properties. Important aspects of benzene metabolism are depicted in Figure 4.1.

(1) Benzene is metabolized in the liver and bone marrow to benzene epoxide by the cytochrome P450 system, primarily CYP2E1 (but also to varying extents by CYP1A1, CYP2B1, CYP2F1, and CYP2F2). Benzene epoxide has a half-life of approximately 8 minutes in rat blood (Lindstrom et al., 1997) and thus could travel from the liver to other organs including bone marrow.

(2) Benzene epoxide rearranges nonenzymatically to phenol, initially the major metabolite of benzene. Phenol is oxidized, also by CYP2E1, to hydroquinone. Hydroquinone can be oxidized to the toxic metabolite 1,4-benzoquinone non-enzymatically by reacting with O_2 or enzymatically by myeloperoxidase (MPO) in bone marrow. 1,4-Benzoquinone can be converted back to hydroquinone by NAD(P)H:quinone oxidoreductase (NQO1), a detoxifying reaction (Ross, 2005).

(3) Benzene epoxide is enzymatically transformed by microsomal epoxide hydrolase to benzene dihydrodiol, which is then dehydrogenated to catechol by dihydrodiol dehydrogenase.

Most of the catechol and phenol metabolites are excreted within 24 hours in the urine, while hydroquinone requires 48 hours (Teisinger et al., 1952).

(4) Benzene epoxide is also metabolized to a ring-opened product, trans, trans-muconaldehyde. t,t-Muconaldehyde (or E,E-muconaldehyde using the EZ nomenclature system for geometric isomers) can be metabolized to t,t-muconic acid (E,E-muconic acid) (oxidation) and to 6-hydroxy-t,t-2,4-hexadienal (reduction) (Short et al., 2006).

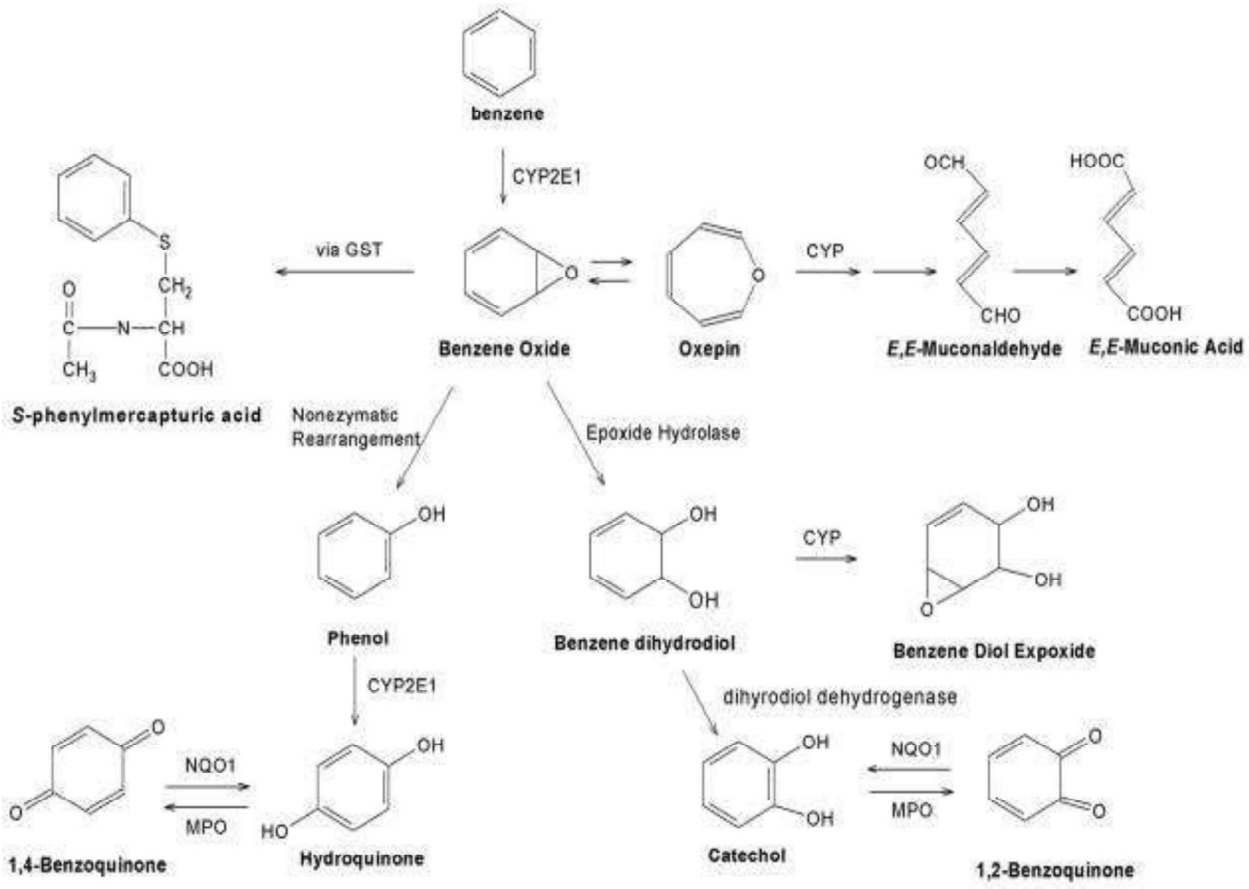
(5) Benzene epoxide can be conjugated with glutathione by glutathione-S-transferases to ultimately form S-phenylmercapturic acid (SPMA).

(6) Benzene epoxide also equilibrates with its oxepin, a seven-atom monocyclic structure, which may be an intermediate in one or more of the previous pathways (Figure 4.1).

(7) The benzene metabolites with hydroxyl groups (phenol, catechol, hydroquinone, and 1,2,4-benzenetriol) can form sulfates and glucuronidates (Nebert et al., 2002), and quinol thioethers after reaction with glutathione (Bratton et al., 1997) as part of phase II metabolism (not shown in Figure 4.1).

(8) Benzene metabolites can form adducts with DNA and proteins, especially albumin.

Figure 4.1. Intermediary metabolism of benzene



Source: (Rappaport et al., 2010)

The metabolites of benzene found in individual experiments depend on the species and the exposure conditions. As an example, Table 4 compares the percentage of water soluble metabolites in 24 hour urine samples from mice and rats exposed to either 5 ppm or 600 ppm benzene for the first 6 of the 24 hours (Sabourin et al., 1989).

Table 4.1. Percentage of water soluble metabolites in 24 hour urines (Sabourin et al., 1989)

Metabolite	5 ppm (3 mice)	600 ppm (3 mice)	5 ppm (2 rats)	600 ppm (3 rats)
Phenyl glucuronide	1	15	1.4	1
Catechol glucuronide	Non-detect	Non-detect	Non-detect	Non-detect
Phenyl sulfate	36	52	56	73
Hydroquinone monoglucuronide	26	9	8.5	0.5
Hydroquinone sulfate	6.6	2.3	2.9	1.5
Pre-phenylmercapturic acid	6	15	9.5	17
Phenylmercapturic acid	1	Non-detect	1.3	1
Muconic acid	23	5	18.5	4
Unknown	Non-detect	Non-detect	1.4	Non-detect
Total	99.6	98.3	99.5	98

4.1 Mechanistic Studies

Benzene causes hematotoxicity through its metabolites, which lead to DNA strand breaks, chromosomal damage, sister chromatid exchange (SCE), inhibition of topoisomerase II, and damage to the mitotic spindle. The hematotoxic (and carcinogenic) effects of benzene are associated with free radical formation either as benzene metabolites, particularly 1,4-benzoquinone, or as lipid peroxidation products (Smith et al., 1989; USEPA, 2002; Rana and Verma, 2005). The effects of intraperitoneal injection of benzene and various of its metabolites on erythropoiesis were studied in mice in vivo (Snyder et al., 1989). The most potent inhibitor of red blood cell (RBC) production was a mixture of hydroquinone (50 mg/kg) and t,t-muconaldehyde (1 mg/kg), which implicates at least two pathways of benzene metabolism in toxicity (Figure 4.1). Several other metabolites also inhibited red cell formation. Most of the studies which investigated the role of genetic polymorphisms in xenobiotic metabolizing enzymes focused on the CYP2E1 and various detoxifying pathways.

Transgenic mice, in which the gene for CYP2E1 has been knocked out ($cyp2e1^{-/-}$), do not show toxicity when exposed to 200 ppm (650 mg/m^3) benzene for 6 hr (Valentine et al., 1996). CYP2E1 protein and its associated enzymatic activity were not detected in early fetal human liver samples (Vieira et al., 1996).

Transgenic male mice, in which the gene for microsomal epoxide hydrolase was knocked out, did not show benzene toxicity (e.g., decreased white blood cell (WBC)

counts) when exposed to 50 ppm (160 mg/m^3) benzene for two weeks, while control male mice did (Bauer et al., 2003). In humans, susceptibility to chronic benzene poisoning has been related to the epoxide hydrolase genotype (Sun et al., 2008). Specifically the risk of benzene poisoning increased in the subjects with microsomal epoxide hydrolase (EPHX1) GGAC/GAGT diplotype (P = 0.00057) or AGAC/GAGT diplotype (P = 0.00086). Surprisingly, neither diplotype altered the level of microsomal epoxide hydrolase enzyme activity. Thus the mechanism involved is not obvious. The authors also reported that less prevalent combinations of four single nucleotide polymorphisms (SNPs) could either increase or decrease the odds of chronic benzene poisoning relative to the more prevalent combinations (Table 8.5). This exemplifies the potentially broad distribution in metabolism and thus toxicity in humans.

Yoon and co-workers investigated the involvement of the aryl hydrocarbon receptor (AhR) in benzene hematotoxicity using wild-type ($AhR^{+/+}$), heterozygous ($AhR^{+/-}$), and homozygous null ($AhR^{-/-}$) male mice (Yoon et al., 2002). No hematotoxicity and no changes in peripheral blood and bone marrow cells were induced in $AhR^{-/-}$ mice by a 2-week inhalation exposure to 300 ppm (978 mg/m^3) benzene. The lack of hematotoxicity was associated with the lack of p21 over-expression, regularly seen in wild-type mice following benzene inhalation. (p21, also known as Cdkn1a in mice and CDKN1A in humans, **is a** cyclin-dependent kinase inhibitor important in the braking of the cell division cycle.) Combined treatment of $AhR^{-/-}$ mice with two benzene metabolites (phenol and hydroquinone) induced hematopoietic toxicity. The aryl hydrocarbon receptor may have a role in the regulation of hematopoiesis and in benzene-induced hematotoxicity (Gasiewicz et al., 2010).

In Wistar rats of both sexes with a large body fat content, benzene was eliminated more slowly and remained in the body for a longer time than in rats with a small body fat content. Accordingly, the decrease in WBC during chronic benzene exposure was seen only in rats with large volumes of fat tissue. In humans, the elimination of benzene was slower in women than in men (slope of the benzene concentration in blood curve starting 3 hrs post-exposure was -0.00198/minute in women vs. -0.0033/minute in men). The authors suggest that the slower elimination in women is due primarily to the higher percentage and distribution of body fat tissue. The authors concluded that women may be inherently more susceptible to benzene, which has a high affinity for fat tissue (Sato et al., 1975). Based on this observation, obese adults and children may also be more susceptible to benzene toxicity than non-obese adults and children.

4.2 Toxicokinetic studies:

The pharmacokinetics of benzene follows a two-compartment model in the rat. The rapid phase for benzene elimination in expired air has a half-life ($t_{1/2}$) of 0.7 hours, and the $t_{1/2}$ for the longer phase is 13.1 hours (Rickert et al., 1979). The benzene metabolites catechol, quinone, and hydroquinone were found to be preferentially retained in the bone marrow (Greenlee et al., 1981). These reactive metabolites are not readily excreted, and are cytotoxic to the stem cells in the bone marrow.

Based partly on an early PBPK model for styrene (Ramsey and Andersen, 1984), Medinsky and coworkers developed a model to describe the uptake and metabolism of benzene in F344/N rats and B6C3F1 mice and to determine if the observed differences in toxic effects between mice and rats could be explained by differences in metabolic pathways or by differences in uptake (Medinsky et al., 1989a). For inhalation concentrations up to 1,000 ppm (3,260 mg/m^3) for six hours, mice metabolized at least two to three times as much total benzene (per kg body weight) as rats. In regard to metabolites, rats primarily formed phenyl sulfate, a detoxification product (see Table 4.1). In addition to phenyl sulfate, mice formed hydroquinone glucuronide and muconic acid which are part of toxicity pathways. The formation of hydroquinone showed the greatest difference between mice and rats. Metabolic rate parameters (Vmax and Km) were very different for hydroquinone conjugation and muconic acid formation compared to formation of phenyl conjugates and phenyl mercapturic acids. Assumed toxication pathways had high affinity, low capacity kinetics; detoxification pathways were low affinity, high capacity. Model simulations suggested that hydroquinone and muconic acid comprised a larger fraction of the total benzene metabolized at lower benzene levels for both rats and mice than at higher levels (where detoxification metabolites predominated). (See also Table 4.1).

The animal model of Medinsky et al. (1989a) was extended to predict benzene metabolism in people exposed near occupational exposure limits in effect at the time of the paper's publication (Medinsky et al., 1989b). For 8 hr inhalation exposures less than 10 ppm (32.6 mg/m^3), metabolites of hydroquinone, the precursor of the toxic 1,4-benzoquinone, were predicted to predominate in people. Lower levels of muconic acid, a metabolite of muconaldehyde, were predicted below 10 ppm. Above 10 ppm, detoxification metabolites, including phenyl conjugates, predominated (Medinsky et al., 1989a).

A PBPK model, based on that of Medinsky above, was developed to describe the disposition of benzene in 3 and 18 month-old C57BL/6N mice and to examine the key parameters affecting changes in benzene disposition with age (McMahon et al., 1994). The model included a rate constant for urinary elimination of metabolites as an age-related increase in Km for production of hydroquinone conjugates from benzene. The study indicated that age-related changes in physiology, including decreased elimination of hydroquinone conjugates at 18 months, were responsible for altered disposition of benzene in aged mice.

Travis and colleagues developed three PBPK models to describe the pharmacokinetics of benzene in mice, rats, and humans, respectively, using five anatomical compartments: liver, fat, bone marrow, muscle (poorly perfused), and other richly perfused organs (e.g., brain, heart, kidney, and viscera), all interconnected by the arterial and venous blood flow (Travis et al., 1990). Benzene metabolism showed Michaelis-Menten kinetics and occurred primarily in the liver (human Vmax = 29.04 mg/h) and secondarily in the bone marrow (human Vmax = 1.16 mg/h). Graphical comparisons of model results with empirical data in the three species from previously

published reports were quite favorable for exposure by inhalation and gavage, and from intraperitoneal and subcutaneous injection.

Cole and coworkers developed a PBPK model in mice to relate inhaled benzene levels to tissue doses of benzene, benzene oxide, phenol, and hydroquinone (Cole et al., 2001). Parameter values in the literature were used. Additional parameters, estimated by fitting the model to published data, were first-order rate constants (k_i) for pathways lacking in vitro data and the concentrations of microsomal and cytosolic protein. The model was constrained by using the in vitro metabolic parameters (Vmax, first-order rate constants (k_i), and saturation parameters), rather than in vivo values. Even though data from multiple laboratories and experiments were used, model simulations matched the data reasonably well in most cases. No extrapolation to humans was attempted.

A three-compartment model was fit to human data on benzene disposition and bone-marrow metabolism (Watanabe et al., 1994). The general relationship between cumulative quantity of metabolites produced and inhalation concentration, was S-shaped, inflecting upward at low concentrations, and saturating at high concentrations.

Kim, Rappaport and associates studied the relationships between levels of five benzene metabolites (E,E-muconic acid, S-phenylmethylmercapturic acid, phenol, hydroquinone, and catechol) and benzene exposure among 250 exposed and 136 control Chinese workers (Kim et al., 2006a; Kim et al., 2006b). Benzene metabolism was nonlinear with increasing benzene levels above 0.03 ppm. They then statistically tested whether human metabolism of benzene is better fit by a kinetic model having two pathways rather than only one (i.e., CYP2E1) (Rappaport et al., 2009). Michaelis-Menten-like models were fit to individual urinary benzene metabolites and the corresponding air concentrations of benzene (range: < 0.001 ppm - 299 ppm (0 - 975 mg/m^3)) for 263 nonsmoking Chinese females. The different values of Akaike's information criterion (AIC) obtained with the two models gave strong statistical evidence favoring two metabolic pathways. The low-affinity pathway (likely due to CYP2E1) had an affinity ("Km") of 301 ppm (981 mg/m^3) for benzene in air; the value for the high-affinity pathway (unknown but possibly due to CYP2F1 (Sheets et al., 2004) or CYP2A13) was 0.594 ppm, a 500-fold difference. The exposure-specific metabolite level predicted by the two-pathway model at non-saturating benzene concentrations was 184 µM/ppm of benzene, which is close to an independent estimate of 194 µM/ppm for a nonsmoking Chinese female (Weisel et al., 2003). Rappaport estimated that a nonsmoking woman would metabolize about three times more benzene from the ambient environment under the two-pathway model (184 µM/ppm) than under the one-pathway model (68.6 µM/ppm). A follow-up study examined the individual urinary metabolites of benzene in each woman (Rappaport et al., 2010). The data indicated that the predicted high-affinity enzyme pathway is predominant at less than 1 ppm and metabolism favors the ring-opening pathway to t,t-muconaldehyde in this exposure scenario (see Figure 4.1).

The concept of increased dose specific benzene metabolism at levels below 3 ppm has important implications for low level environmental exposures. The degree of increased efficiency has been debated (Price et al., 2012; 2013) and defended by the original authors (Rappaport et al., 2013)

Kim and coworkers also studied the effect of various reference single nucleotide polymorphisms (SNPs) affecting metabolic enzymes on the metabolism of benzene and the relative amounts of different metabolites produced (Kim et al., 2007). They found that polymorphisms in GSTT1 (glutathione-S-transferase), NQO1, CYP2E1, and EPHX1 (rs1051740 or rs2234922) all affect the production of metabolites changing the relative formation of S-phenyl mercapturic acid, phenol, catechol, and hydroquinone by the liver. Interactions with smoking were also observed.

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Bois and colleagues modeled the distribution and metabolism of benzene in humans using population pharmacokinetics, Bayesian statistical inference, and PBPK modeling (Bois et al., 1996). Based on existing experimental data on three subjects from Pekari et al. (1992), they used Markov chain Monte Carlo methods to derive distributions of variability and uncertainty for model parameters. The model adequately fit both prior physiological information and the experimental data. For benzene exposures up to 10 ppm (32.6 mg/m^3), the median population fraction metabolized in the bone marrow was 52 percent (90% CI = 47-67%), and was linear in the three subjects studied. Inter-individual variation for metabolic parameters showed geometric standard deviations (GSD) of between 1.2 and 1.4. However, the posterior distribution of estimates of the quantity of benzene metabolized in the bone marrow was very broad. At 1 ppm (3.26 mg/m^3) continuous exposure (the occupational inhalation exposure threshold in the U.S), this estimate ranged from 2 to 40 mg/day. The authors pointed out that this large (20-fold) spread reflects a substantial element of uncertainty since the extent of metabolism in the bone marrow is not a measured parameter, but is inferred from the model inputs and assumptions which are themselves subject to uncertainty.

Yokley and associates developed a human PBPK model that quantified tissue levels of benzene, benzene oxide, phenol, and hydroquinone after inhalation and oral benzene exposures (Yokley et al., 2006). The model was integrated into a statistical framework that acknowledges sources of variation due to inherent intra- and inter-individual variation, measurement error, and other data collection issues. They estimated the population distributions of key PBPK model parameters. They hypothesized that observed interindividual variability in the dosimetry of benzene and its metabolites resulted primarily from known or estimated variability in key metabolic parameters and that a statistical PBPK model that explicitly included variability in only those metabolic parameters would sufficiently describe the observed variability. They identified parameter distributions for the PBPK model to characterize observed variability through the use of Markov chain Monte Carlo analysis applied to two data sets. The identified parameter distributions described most of the observed variability, but variability in physiological parameters such as organ weights may also be helpful to predict the observed human-population variability in benzene dosimetry.

Various benzene exposure scenarios were simulated for adult men and women using PBPK modeling (Brown et al., 1998). Women had a higher blood/air partition coefficient (8.20 vs. 7.80) and maximum velocity of metabolism (19.47 vs. 13.89 mg/hr) for benzene than men. Women generally had a higher body fat percentage than men (30% vs. 20%). Physicochemical gender differences resulted in women metabolizing 23-26 percent more benzene than men in the same scenario, although benzene blood levels are generally higher in men. These authors also stated that women may be at higher risk for certain effects of benzene exposure.

Knutsen and coworkers adapted a PBPK model of benzene inhalation based on a mouse model (Cole et al., 2001; Yokley et al., 2006) to include bone marrow and bladder compartments (Knutsen et al., 2013). They used data on human liver microsomal protein levels and linked CYP2E1 activities (Lipscomb et al., 2003a; Lipscomb et al., 2003b) and estimated metabolite-specific conversion rate parameters by fitting model equations to biomonitoring data (Waidyanatha et al., 2004) and adjusting for background levels of urinary metabolites (Qu et al., 2000). Human studies of benzene levels in blood and breath, and of phenol levels in urine (Pekari et al., 1992) were used to validate the rate of conversion of benzene to benzene oxide. Urinary benzene metabolites in Chinese workers (Kim et al., 2006a) provided model validation for rates of human conversion of benzene to muconic acid and phenylmercapturic acid, phenol, catechol, hydroquinone, and 1,2,4-benzenetriol. The model predicts that (1) liver microsomal protein and CYP2E1 activities are lower on average in humans than in mice, (2) mice show far lower rates of benzene conversion to muconic acid and phenylmercapturic acid, and (3) mice show far higher conversion of benzene to hydroquinone and 1,2,4-benzenetriol. Several metabolic rate parameters used in the model differ from other human models.

In summary benzene metabolism has been studied in animals and humans and has been the subject of several pharmacokinetic models, some of which adequately fit the observed data. The most important finding from the models for humans is that benzene is efficiently metabolized at low doses. The studies of the kinetics of benzene metabolism in humans have not only identified some quantitative differences from the results seen in animals, but have also allowed the exploration of dose level effects and the impact of various gene polymorphisms in the enzymes involved. This is of particular interest in the case of the studies by Kim, Rappaport and colleagues which were of a substantial number of individuals from the population in the epidemiological studies of benzene toxicity by Lan et al. (2004) (see below).

4.3 Metabolic Interaction with Other Chemicals

In the environment exposure to multiple chemicals occurs, both voluntarily and involuntarily. Benzene is only one of hundreds of chemicals emitted from refineries and vehicles and of thousands of chemicals in cigarette smoke. Humans vary widely in their intake of xenobiotics including alcohol. Some xenobiotics interact with benzene. For example, toluene is a competitive inhibitor of benzene oxidation by CYP2E1, and co-

exposure may decrease benzene toxicity. Ethanol exposure may also change susceptibility to benzene toxicity.

CYP2E1 (also known as Microsomal Ethanol Oxidizing System (MEOS)) has been reported to activate/metabolize more than 80 chemicals (Lieber, 1997) including benzene (Figure 4.1) and ethanol. Ethanol induces CYP2E1. For example, a 4-fold increase in CYP2E1 has been observed in human alcoholics (Lieber, 1997), while moderate drinking increased CYP2E1 25% (Snawder and Lipscomb, 2000).

Daiker and coworkers investigated the interactive effects of ethanol consumption and benzene inhalation in animals (Daiker et al., 2000). They used a liquid diet containing 4.1% ethanol to induce liver CYP2E1 activity 4-fold in female CD-1 mice. Groups of six ethanol-exposed or pair-fed control mice were exposed to benzene or air for 7 hours/day, 5 days/week for 6 or 11 weeks. One experiment using this protocol studied immunotoxicity endpoints. No statistically significant alterations were found in spleen lymphocyte cellularity, subtype (e.g., CD4+, CD8+) profile, mitogen-induced proliferation, cytokine production (IL2, IFNγ), or natural killer cell lytic activity after 6 weeks of ethanol diet, 0.44 ppm (1.4 mg/m^3) benzene exposure, or both. Subsequent experiments exposed animals to 4.4 ppm (14.3 mg/m^3) benzene. Bone marrow and spleen cells were evaluated for DNA-protein cross-links, and spleen lymphocytes were monitored for hypoxanthine guanine phosphoribosyl transferase (hprt)-mutant frequency. No changes in either endpoint were found in mice exposed to 4.4 ppm (14.3 mg/m^3) benzene for 11 weeks with or without co-exposure to 4.1% ethanol. Benzene and ethanol did not have interactive adverse effects under these specific conditions at 0.44 to 4.4 ppm benzene exposure. In an older study, 5% and 15% ethanol ingestion potentiated the effect of 300 ppm (980 mg/m^3) benzene on decreasing bone marrow and spleen cell levels in C57Bl/6J male mice (Baarson et al., 1982).

5 Acute Toxicity of Benzene

5.1 Acute Toxicity to Adult Humans

Deaths from acute exposure to benzene are often related to physical exertion and release of epinephrine with subsequent respiratory depression. Frequently, the person trying to rescue a collapsed victim will die during the effort of lifting the unconscious person (HSDB, 2007). Anesthesia may develop at concentrations above 3,000 ppm (9,600 mg/m³). At exposures greater than 1,000 ppm (3,200 mg/m³) (duration unspecified), CNS symptoms include giddiness, euphoria, nausea, and headaches; heightened cardiac sensitivity to epinephrine-induced arrhythmias may develop (Snyder, 1987). These effects may be accompanied by symptoms of mild irritation to the eyes and mucous membranes. Acute hemorrhagic pneumonitis is highly likely if benzene is aspirated into the lung (HSDB, 2007). Respiratory tract inflammation, pulmonary hemorrhages, renal congestion, and cerebral edema have been observed at autopsy in persons with acute benzene poisoning by inhalation. In these cases, blood levels of 2 mg percent (2 mg/100 ml) benzene were not associated with hematological changes (Winek and Collom, 1971).

A case report described three deaths due to acute benzene poisoning from a shipboard accident (Avis and Hutton, 1993). Exposure levels were not estimated. Autopsies showed skin, respiratory, and cerebral injury. Benzene levels in body fluids and tissues were consistent with the lipophilicity of benzene. In a single fatal acute case of benzene intoxication aboard a chemical cargo ship (Barbera et al., 1998), the authors found blood clots inside the heart and main vessels, multi-organ congestion, and pulmonary edema. They also measured benzene (rounded to whole numbers) in several organs: liver (379 µg/g tissue), heart (183 µg/g tissue), brain (179 µg/g tissue), kidneys (75 µg/g tissue), lungs (22 µg/g tissue), blood (32 µg/mL), and urine (2 µg/mL).

Systemic poisoning by benzene can occasionally result in neuroretinal edema and in retinal and conjunctival hemorrhage (Grant, 1986). Additionally, petechial hemorrhages of the brain, pleura, pericardium, urinary tract, mucous membranes, and skin may occur in cases of fatal, acute benzene poisoning (Haley, 1977).

Major concerns of systemic benzene toxicity include pancytopenia and acute myelogenous leukemia (IARC, 1982). Both are typically seen in chronic and subchronic exposures. Cells of the myeloid pathway, erythroid in particular, are specific targets of benzene toxicity.

Fifteen degassers were acutely exposed over several days to > 60 ppm benzene during removal of residual fuel from fuel tanks on ships (Midzenski et al., 1992). The maximal level was approximately 653 ppm (2,129 mg/m^3). Volatilization of benzene from the residual fuel was the suspected source of benzene. Twelve workers reported mucous membrane irritation. Eleven reported neurotoxic symptoms. Workers with more than 2 days (8 hours/day) of acute exposure were significantly more likely to report dizziness and nausea than those with 2 or fewer days. Blood cell analyses over a 4-month period

after exposure found at least one hematologic abnormality consistent with benzene exposure in 9 degassers. For example, white blood cell counts were below normal in 4 workers. At one year, 6 workers had persistent abnormalities; an additional worker, with normal hematologic parameters initially, later developed an abnormality consistent with benzene exposure. Many large granular lymphocytes were found in the peripheral blood smears of six of the workers. There were no significant associations between the presence of hematologic abnormalities and either the number of hours of acute benzene exposure or the duration of employment as a degasser in this study.

Two studies may indicate an acute NOAEL for adult humans. Japanese students between the age of 18 and 25 breathed one of seven organic solvents for 2.7 to 4 hours in a 60 m^3 chamber. No adverse effects were reported in three males and three females exposed to 52-62 ppm benzene for the full 4 hours (Nomiyama and Nomiyama, 1974). In a study of the absorption and elimination of inhaled benzene (Srbova et al., 1950), the authors mentioned that no adverse effects were seen in 23 adult volunteers exposed to 47 to 110 ppm benzene for 2 to 3 hours. Thus 110 ppm (359 mg/m^3) is a possible 3-hour NOAEL for acute effects of benzene in humans (National Academy of Sciences, 2009) .

5.2 Acute Toxicity to Infants and Children

Children were among those exposed to benzene and other chemicals following an extended (40 day) flaring incident at a petroleum refinery in Texas City, Texas in 2010 (D'Andrea and Reddy, 2013). The total release of chemicals was more than 500,000 pounds of which more than 17,000 pounds (3.4%) were benzene. Some of the other chemicals released were toluene, hydrogen sulfide, nitrogen oxides, and carbon monoxide. A total of 157 subjects < 17 years (mean age = 15.4 years) were exposed and compared to 155 (mean age = 11.8 years) unexposed children. Somatic symptoms included neurological problems (e.g., unsteady gait, memory loss, headaches) in 80% of the exposed and upper respiratory symptoms in 48%. Blood samples were taken 143 days (median time; range = 117 to 290 days) after the incident. WBC counts (x $10^3/\mu L$) were statistically significantly decreased in exposed children compared with unexposed (6.8 ± 2.1 vs. 7.3 ± 1.7, p = 0.022), and platelet counts (x $10^3/\mu L$) were significantly increased in the exposed group compared with unexposed (278.4 ± 59.9 vs. 261.6 ± 51.7, p = 0.005). Exposed children also had significantly higher levels of alkaline phosphatase (183.7 ± 95.6 vs. 165 ± 70.3 IU/L, p =0 .04), aspartate aminotransferase (23.6 ± 15.3 vs. 20.5 ± 5.5 IU/L, p = 0.015), and alanine amino-transferase (19.2 ± 7.8 vs. 16.9 ± 6.9 IU/L, p = 0.005) compared with the unexposed indicating an adverse effect on the liver. Unfortunately no reports of benzene levels in the air during the incident are publically available.

5.3 Acute Toxicity to Experimental Animals

The oral LD_{50} in rats was calculated to be 3.4 g/kg in young rats and 4.9 g/kg in older rats (Kimura et al., 1971). Death was observed in 2 out of 10 rats exposed to 33,000 mg/m³ (10,300 ppm) for 12.5-30 minutes daily for either 1 or 12 days ((IARC, 1982)). A 4-hour LC_{50} of 13,700 ppm (43,800 mg/m³) was reported in female rats (Drew and Fouts, 1974; IARC, 1982). An LC_{Lo} of 45,000 ppm (144,000 mg/m³) is reported in rabbits (NIOSH, 1994). In mice, an LC_{50} of 9,800 ppm (31,400 mg/m³) is reported (NIOSH, 1994). Leukopenia has been demonstrated to occur in rabbits exposed to 240 ppm (767 mg/m³) for 10 hours/day for 2 weeks (IARC, 1982).

Brief inhalation of air saturated with benzene vapor (concentration unknown) resulted in ventricular extrasystole in cats and primates, with periods of ventricular tachycardia that occasionally terminated in ventricular fibrillation (Sandmeyer, 1981b).

The RD_{50} is a chemical concentration that depresses the respiratory rate in mice by 50 percent due to sensory irritation of the upper respiratory tract. An attempt to determine the inhalation RD_{50} for benzene was not successful (Nielsen and Alarie, 1982). The investigators showed that inhalation of 5,800 ppm (18,800 mg/m³) benzene in mice caused an increase in respiratory rate beginning at 5 minutes following onset of exposure. They speculated that the stimulation of respiratory rate resulted from the action of benzene on the central nervous system. In this study, the authors reported that benzene was not irritating to the upper airways of the animals up to 8,500 ppm (27,710 mg/m^3).

Repeated subcutaneous dosing of mice with benzene for 6 to 20 days resulted in a dose-related decrease in red blood cell production as measured by the incorporation of ^{59}Fe into developing erythrocytes. The DBA mouse strain was more sensitive than the CD-1 and C57BL6 strains. Research using multiple species indicated that mice are more sensitive to adverse effects on erythropoiesis from benzene than are rabbits which are more sensitive than rats (Longacre et al., 1980; Longacre et al., 1981a; IARC, 1982).

Acute exposure to benzene may disrupt erythropoiesis and result in genotoxicity. Subcutaneous injection of 5, 13, 33, and 80 mmol/kg (390, 915, 2,577, and 6,248 mg/kg) benzene in 8- to 10-week-old, male, Swiss-Webster mice inhibited erythropoiesis in a dose-dependent manner, as measured by uptake of radiolabeled iron in the bone-marrow 48 hours after benzene injection (Bolcsak and Nerland, 1983). Three metabolites of benzene (phenol, hydroquinone, and catechol) also inhibited iron uptake.

Results from subacute exposures further illustrate the hematotoxic effects of benzene and the potential for immunotoxicity. Inhalation of 103 ppm (334 mg/m³) benzene for 6 hours/day for 7 days by mice caused decreased spleen and marrow cellularity and decreased spleen weights (Green et al., 1981). Benzene inhalation at 0, 10, 30, 100, and 300 ppm (0, 32.6, 97.3, 326, and 973 mg/m³) for 6 hours/day for 5 days resulted in

a decreased host-resistance to bacterial infection by *Listeria monocytogenes* (Rosenthal and Snyder, 1985). The numbers of *L. monocytogenes* isolated from the spleen were increased in a dose-dependent manner on day 4 of infection. The total numbers of T- and B-lymphocytes in the spleen and the proliferative ability of the splenic lymphocytes were decreased in a dose-dependent manner by benzene exposures of 30 ppm (97.3 mg/m³) or greater. No decrement in host resistance or immune response was observed at 10 ppm (32.6 mg/m³) benzene. Later studies in mice have also shown that exposure to 10 ppm for a subacute duration does not significantly alter hematological parameters in blood, spleen, thymus, or bone marrow.

Inhalation of 0, 10, 31, 100, or 301 ppm (0, 32.6, 100.4, 326, or 978 mg/m^3) benzene for 6 hours/day for 6 days resulted in a dose-dependent reduction in peripheral lymphocytes, and a reduced proliferative response of B- and T-lymphocytes to mitogenic agents in mice (Rozen et al., 1984). Total peripheral lymphocyte numbers and B-lymphocyte proliferation in response to lipopolysaccharide (LPS) were significantly reduced at 10 ppm (32.6 mg/m^3). The proliferation of T-lymphocytes was significantly reduced at 31 ppm (100.4 mg/m^3).

Farris et al. (1997) reported the hematological consequences of benzene inhalation in 12-week-old male B6C3F1/CrlBR mice exposed to 1, 5, 10, 100, and 200 ppm (3.26, 16.3, 32.6, 326, and 652 mg/m^3) benzene for 6 hr/day, 5 days/week for 1, 2, 4, or 8 weeks (Farris et al., 1997). The study also evaluated hematology in small recovery subset groups at each concentration (4 weeks exposure to benzene, then up to 25 days in air). There were no significant effects on hematopoietic parameters from exposure to 10 ppm benzene or less. Thus 10 ppm (32.6 mg/m^3) was a NOAEL for up to 8 weeks of exposure in this study. Exposure to 100 and 200 ppm benzene reduced the number of total bone marrow cells, progenitor cells, differentiating hematopoietic cells, and most blood parameters. Replication of primitive progenitor cells in the bone marrow was increased during the exposure period as a compensation for the cytotoxicity. At 200 ppm, the primitive progenitor cells maintained an increased percentage of cells in S-phase through 25 days of recovery compared with controls.

Evans and coworkers used CD1 and C57BL/6J mice in a time-sampling protocol to quantify seven categories of behavior (stereotypic, sleeping, resting, eating, grooming, locomotion, and fighting). Animals were exposed 6 hours per day for 5 days to 0, 300, or 900 ppm (0, 960 or 2,930 mg/m³) benzene followed by two weeks of no benzene exposure. The authors designed the inhalation exposures to "reflect" occupational exposure at that time. An increase in active behavior in the form of eating and grooming was observed in both strains of mice following exposure to 300 ppm and 900 ppm benzene for 6 hours/day for 5 days (Evans et al., 1981).

Exposure of BALB/c male mice to 50 ppm (162 mg/m^3) benzene on 14 consecutive days resulted in a significantly reduced blood leukocyte count (Aoyama, 1986).

6 Chronic Toxicity of Benzene

6.1 Chronic Toxicity to Adult Humans

The primary toxicological effects of chronic benzene exposure are on the hematopoietic system. Neurological effects are also of concern at slightly higher concentrations. Impairment of immune function and/or various types of anemia may result from the hematotoxicity. Developmental and Reproductive toxicity are covered in Section 7.0 below.

Tissues often react to injury by dysplasia, including hypoplasia or hyperplasia, which may progress to more serious conditions such as aplastic anemia, fibrosis, or neoplasia. Myeloproliferative disorders are a group of diseases in which the bone marrow produces excess red blood cells, white blood cells, or platelets. In myelodysplastic syndrome (MDS), the bone marrow produces low numbers of blood cells or defective blood cells. In 10-30% of cases MDS may progress to acute myeloid leukemia (Schnatter et al., 2012). In 1999 the World Health Organization classified both myeloproliferative disorders and MDS as myeloid neoplasms (Harris et al., 1999). An update of three nested case control studies of petroleum distribution workers in Australia, Canada, and the United Kingdom indicated a monotonic dose-response relationship of MDS with cumulative benzene exposure (Schnatter et al., 2012). OEHHA currently considers both myeloproliferative disorders and MDS to be cancer endpoints.

The hematologic lesions in the bone marrow can lead to peripheral lymphocytopenia or pancytopenia following chronic exposure. Repeated benzene exposures can also lead to life-threatening aplastic anemia. These lesions may lead to the development of leukemia years later, after apparent recovery from the hematologic damage (Degowin, 1963).

Investigators observed 28 cases of pancytopenia among 32 patients in Turkey, who were chronically exposed to benzene vapors from adhesives ranging from 150 to 650 ppm (489 to 2,119 mg/m^3) for 4 months to 15 years (Aksoy et al., 1972). Bone marrow samples revealed variable hematopoietic lesions, ranging from acellularity to hypercellularity. Central nervous system (CNS) abnormalities were reported in four of six individuals with pancytopenia following chronic occupational exposure to unknown concentrations of benzene for an average of 6 years (Baslo and Aksoy, 1982). The abnormalities included reduced sensory and motor nerve conduction velocities.

A retrospective longitudinal study correlated average benzene exposure with total white blood cell counts in a cohort of 459 Pliofilm rubber workers in Ohio (Kipen et al., 1988). The authors found a significant ($p < 0.016$) negative correlation between average workplace benzene concentrations and white blood cell counts for the years 1940-1948. A reanalysis of these data (Cody et al., 1993) showed significant decreases in red (RBC) and white (WBC) blood cell counts among a group of 161 workers during the 1946-1949 period compared with their pre-exposure blood cell counts. The decline in

blood counts was measured over the course of 12 months following start of exposure. During the course of employment, workers with low monthly blood cell counts were transferred to other areas with lower benzene exposures; this potentially created a bias towards non-significance by removing sensitive subjects from the study population. Since there was a reported 75 percent rate of job change within the first year of employment, this bias could be very strong. In addition, there was some indication that blood transfusions were used to treat some "anemic" workers, which would cause serious problems in interpreting the RBC data, since RBCs have a long lifespan (120 days) in the bloodstream. Two of Cody's co-authors performed the exposure analysis and determined a range of monthly median exposures of 30-54 ppm throughout the 12-month segment examined (Crump and Allen, 1984). Despite the above-mentioned potential biases, workers exposed above the median concentrations displayed significantly decreased WBC and RBC counts compared with workers exposed to the lower concentrations using a repeated measures analysis of variance (ANOVA).

In a separate analysis of the workers studied by Kipen et al., staff at NIOSH studied the relationship of benzene exposure to WBC and RBC counts collected from 1940 through 1975 for 657 employees (Ward et al., 1996). The study estimated benzene exposures with a job exposure matrix developed earlier (Rinsky et al., 1987). The maximum daily benzene exposure estimate was 34 ppm (111 mg/m^3). The authors used conditional logistic regression to analyze the effects of (1) benzene exposure in the 30, 90, and 180 days before blood testing and (2) cumulative exposure up until the blood test date. For WBCs all exposure metrics showed a statistically significant relationship ($p < 0.05$) with low cell counts. For RBCs there was a weak positive exposure-response, which was significant ($p = 0.03$) for one of the exposure metrics (in total cumulative dose in ppm-yr prior to testing). The authors found no evidence for a threshold for the hematologic effects of benzene.

The mortality from all cancers and leukemia, in addition to hematologic parameters, was investigated in male workers exposed to benzene for 1-21 years between 1952 and 1978 at a Gulf Oil refinery in Texas (Tsai et al., 1983). The cohort of 454 included maintenance workers and utility men and laborers assigned to benzene units on a "regular basis". Exposures to benzene were determined using personal monitors. The median air concentration was 0.53 ppm (1.7 mg/m^3) in the work areas of greatest exposure to benzene and the average length of employment was 7.4 years. The analysis of overall mortality revealed no significant excesses. Mortality from all causes (SMR = 0.58, $p \leq 0.01$) and from diseases of the circulatory system (SMR = 0.54, $p \leq 0.05$) was significantly below expected values based on comparable groups of U.S. males. The authors concluded that a healthy worker effect was present. An internal comparison group of 823 people, including 10 percent of the workers who were employed in the same plant in operations not related to benzene, showed relative risks (RR) of 0.90 and 1.31 for all causes and cancer at all sites, respectively ($p < 0.28$ and 0.23). A subset of 303 workers was followed for medical surveillance. Up to four hematological tests per year were conducted. Total and differential WBC counts, hemoglobin, hematocrit, RBC, platelets, and clotting times were found to be within normal (between 5th and 95th percentile) limits in this group. (OEHHA considered 0.53

ppm (1.7 mg/m^3) to be a NOAEL. This study was the basis of OEHHA's previous chronic REL of 60 µg/m^3.)

Complete blood count (CBC) data from employees who had ever participated in the Shell Benzene Medical Surveillance Program were compared to employees who had not participated (Tsai et al., 2004). The study included 1,200 employees in the surveillance program (mean eight hour TWA benzene exposure of 0.60 ± 5.60 ppm (median = 0.1 ppm) (2 ± 18 mg/m^3) from 1977 to 1988 and of 0.14 ± 0.82 ppm (median = 0.1 ppm) (0.5 ± 2.7 mg/m^3) since 1988) and 3,227 comparison employees. The study evaluated abnormality of six blood count parameters (WBC, lymphocytes, RBC, hemoglobin, mean corpuscular volume (MCV), and platelets) and the adjusted mean values of these parameters in the exposed group. No increased abnormality of the six parameters was found among exposed employees, however a significant decrease ($p = 0.02$) in the MCV was seen in the exposed workers. The mean values of the exposed employees, adjusted for age, gender, race, amount of time between first and last exam, and current smoking, were similar to those in the comparison group. No adverse hematological effects were found. However, the "exposed" group had a very wide range of benzene exposure levels as evidenced by the reported mean, standard deviation, and median values. The coefficient of variation (SD/mean) was greater than 100 percent. The median exposure value of 0.1 ppm (0.326 mg/m^3) means that half the workers were exposed below that level.

Routine data collected from 1980 to 1993 for Monsanto's medical/industrial hygiene system were used to study 387 workers with daily 8-hour time-weighted average exposures (TWA) of 0.55 ppm benzene (1.8 mg/m^3) (range = 0.01 – 87.69 ppm; based on 4213 personal monitoring samples; less than 5 percent exceeded 2 ppm) (Collins et al., 1997). Controls were 553 unexposed workers. There was no increase in the prevalence of lymphopenia, an early, sensitive indicator of benzene toxicity, among exposed workers (odds ratio = 0.6; 95% confidence interval (CI) = 0.2 to 1.8), taking into account smoking, age, and sex. There also was no increase in risk among 266 workers exposed for 5 or more years (odds ratio = 0.6; 95% CI = 0.2 to 1.9). There were no differences between exposed and unexposed workers for other measures of hematotoxicity, including mean corpuscular volume and counts of total white blood cells, red blood cells, hemoglobin, and platelets.

Between 1967 and 1994 a cohort of 105 workers exposed to low levels of benzene (as measured by personal monitors) was studied at a small petroleum company in Texas (Khuder et al., 1999). The exposure ranged from 0.14 ppm to 2.08 ppm (0.46 to 6.78 mg/m^3) (8-hour TWA) (mean ± 1 SD = 0.81 ± 0.72 ppm). The mean complete blood counts (CBC) were within the normal range, as were the WBC. Other CBC values (RBC, hemoglobin level, MCV, and platelet count) were significantly reduced during the follow-up period. Duration of employment was significantly related to the changes in MCV and platelet counts. The reductions in MCV were statistically significant only among workers employed for more than 10 years. The study suggests that low levels of benzene may affect some CBC values.

A collaboration among the National Cancer Institute, the Shanghai Hygiene and Anti-Epidemic Center, the University of California Berkeley, and other institutions has produced an impressive amount of data on levels of benzene exposure and their effects on nearly 75,000 Chinese workers in 672 factories in 12 cities (Dosemeci et al., 1994; Yin et al., 1994; Hayes et al., 1996; Rothman et al., 1996b; Qu et al., 2002; Lan et al., 2004). The initial studies were on exposure between 1949 and 1987 (Dosemeci et al., 1994), but subsequent reports include later years. Chronic benzene poisoning, defined by a WBC level less than 4000 cells per microliter over several months duration, is a compensable adverse health effect for workers in China and a precursor of chronic disease.

In a cross-sectional study, hematologic outcomes were assessed in 44 (23 male and 21 female) workers heavily exposed to benzene (median = 31 ppm (101 mg/m^3) as an 8-hr TWA) for six months to 16 years (mean = 6.3 years) at three workplaces, each manufacturing a different product in Shanghai (Rothman et al., 1996a). Controls were 44 age and gender-matched unexposed workers at two other workplaces. Hematologic parameters (total WBC, absolute lymphocyte count, platelets, RBC, and hematocrit) were decreased among exposed workers compared to controls (Table 6.1); an exception was the red blood cell mean corpuscular volume (MCV), which was higher among exposed subjects. In a subgroup of 11 workers with a median 8 hr TWA of 7.6 ppm (24.8 mg/m^3) (range = 1-20 ppm) and not exposed to more than 31 ppm (101 mg/m^3) on any of 5 sampling days, only the absolute lymphocyte count was significantly different between exposed workers and controls (p = 0.03). Among exposed subjects, a dose response relationship with various measures of current benzene exposure (i.e., personal air monitoring, benzene metabolites in urine) was present only for the total WBC count, the absolute lymphocyte count, and the MCV. The results support the use of the absolute lymphocyte count as the most sensitive indicator of benzene-induced hematotoxicity.

Table 6.1. Selected peripheral blood cell count data from Rothman *et al*. (1996)

	Controls (N=44)	≤ 31 ppm benzene Median (8 h TWA) = 13.6 ppm (N=22)	> 31 ppm benzene Median (8 h TWA) = 91.9 ppm (N=22)
WBC (mean (SD)/µL)	6800 (1700)	6400 (1800)	5600 (1900)[a]
Absolute lymphocyte count (mean (SD)/µL)	1900 (400)	1600 (300)[a]	1300 (300)[c]
RBC(mean x10^3 (SD)/µL)	4700 (600)	4600 (460)[b]	4200 (600)[c]
Platelets (mean (SD)/µL)	166 (59)	132 (45)[b]	121 (43)[a]
MCV (µm^3)(mean(SD))	88.9 (4.9)	89.8 (3.9)	92.9 (3.4)[c]

[a] $p < 0.01$; [b] $p < 0.05$; [c] $p < 0.001$

Subsequently, the research group examined genetic influences related to metabolism of benzene on chronic benzene poisoning. They reported that, in a case-control study (50 cases, 50 controls) within the Shanghai worker cohort, benzene poisoning was two to

three times more likely if a person had either rapid chlorzoxazone metabolism (ascribed by the authors to CYP2E1, although chlorzoxazone is metabolized by both CYP2E1 and CYP1A2 (Neafsey et al., 2009)), or no NAD(P)H:quinone oxidoreductase (NQO1) activity (NQO1*2/*2 null genotype), and seven to eight times more likely with both rapid chlorzoxazone metabolism and no NQO1 activity (Table 6.2) (Rothman et al., 1997). Although several polymorphisms of CYP2E1 have been identified (Neafsey et al., 2009), Rothman and colleagues examined only one (the c2 allele) and found no effect on the risk of chronic benzene poisoning.

Table 6.2. Joint effects of chlorzoxazone metabolism activity and NQOl genotype on benzene poisoning from Rothman et al. (1997)

Chlorzoxazone metabolism	NQO1 genotype	Odds ratio	95% CI	No. cases
Slow	+/+ and +/-	1	-	8
Slow	-/-	2.4	0.6-9.7	6
Rapid	+/+ and +/-	2.9	1.0-8.2	21
Rapid	-/-	7.6	1.8-31.2	13

The incidence of the NQO1*2/*2 null activity genotype varies approximately 8-fold among tested ethnic groups (Table 6.3). The percentage of Chinese with the null activity NQO1*2/*2 genotype is five times that of non-Hispanic whites (22.4 % vs 4.4 %) (Kelsey et al., 1997; Ross, 2005) (Table 6.3). Investigators found an even higher incidence of 34% of the null phenotype among 198 Hmong refugees from Cambodia now living in Minnesota (Kiffmeyer et al., 2004). All the ethnic groups in Table 6.3 are found in California. The data on increased susceptibility to benzene due to null activity of NQO support the role of benzoquinone as a key metabolite in benzene-induced toxicity.

Table 6.3 Percent of NQO1*2/*2 individuals in different populations (Ross, 2005)

Population	NQO1*2/*2 (%)	# of Persons genotyped
Hmong	34.0	198
Chinese	22.4	49
Korean	18.8	69
Native American	17.9	56
Mexican Hispanic	15.5	61
Japanese	12.2	156
African American	5.2	136
Non-hispanic white	4.4	114

GST metabolic enzymes are involved in the detoxification of benzene by conjugating benzene oxide with glutathione to S-phenylmercapturic acid, and by conjugating other hydroxyl –containing metabolites with glutathione. GST null activity variants are very common in the human population (Table 6.4). People who are GST null (no activity of the particular transferase) are less able to detoxify benzene. The GSTM1 null activity is slightly more prevalent in the Chinese population than among Caucasians (58% vs

53%), while the GSTT1 null activity is nearly three times higher in Chinese than Causasians (57% vs 20%). [Conjugation with glutathione is usually a detoxification step, although in some instances the glutathione conjugate can show toxicity (Ginsberg et al., 2009).]

Table 6.4 GSTM1 and GSTT1 genotypes in populations (Ginsberg et al., 2009)

	% GSTM1 genotype			% GSTT1 genotype		
Population	+/+	+/-	-/- (null)	+/+	+/-	-/- (null)
Chinese	6	36	58	6	37	57
Caucasian	7.3	39	53	34	46	20
Japanese	11	44	45	11	45	44
Mexican-American	13	46	41	45	44	11
African-American	29	50	21	28	50	22
Korean	-	-	-	7	40	53

In a study that partially confirmed and extended the study of Rothman and colleagues, Chen and coworkers studied single nucleotide polymorphisms (SNPs) in CYP2E1, NQO1, MPO, GSTM1 and GSTT1 in 100 benzene-exposed workers diagnosed with chronic benzene poisoning and 90 benzene-exposed matched controls (Chen et al., 2007). The SNPs can lend different degrees of functionality to the protein product, in this case metabolic enzymes. Benzene poisoning was defined according to the criteria from the Ministry of Health in China. The criteria include: (1) total white cell count < 4000 per μl or white cell count between 4000 and 4500 per μl and platelet count < 80,000 per μl, and (2) evidence of chronic benzene exposure. There was a 2.82-fold (95% CI = 1.42-5.58) increased risk of benzene poisoning in the workers with the NQO1 609C > T mutation genotype (T/T) compared with the heterozygote and the wild-type (C/C) (Table 6.5)(Chen et al., 2007). Workers with the GSTT1 null genotype had a 1.91-fold (95% CI = 1.05-3.45) increased risk of poisoning compared with those with GSTT1 non-null genotype. A three genes' interaction revealed a 20.41-fold (95% CI = 3.79-111.11) increased risk of poisoning in subjects with the NQO1 609C > T T/T genotype and with the GSTT1 null genotype and the GSTM1 null genotype compared with those carrying the NQO1 609C > T C/T and C/C genotype, GSTT1 non-null genotype, and GSTM1 non-null genotype (Table 6.5). Multiplying the null genotype frequencies in Tables 6.3 and 6.4 results in an estimation that 7.4% of the Chinese population has this combination. The confidence intervals are large both for the adjusted OR value of 20.41 and the unadjusted OR of 16.13 due to only 2 controls in the denominator. These authors found no association of CYP2E1 (using wild type and two SNPs) and MPO (wild type and one SNP) genotype with chronic benzene poisoning in these 190 benzene-exposed Chinese workers.

Table 6.5 Interaction of three genes in benzene poisoning

NQO1	GSTT1	GSTM1	Cases	Controls	OR (95% CI)	ORadj (95% CI)
T/T	null	null	17	2	16.13 (3.2–83)**	20.41(3.9–111)**
T/T	+	null	9	3	5.7 (1.3–25.6)*	5.3 (1.26–23.8)*
T/T	null	+	3	6	0.95 (0.20–4.57)	0.96 (0.19–4.78)
T/T	+	+	9	5	3.4 (0.92–12.8)	3.8 (0.99–14.3)
C/C&C/T	null	+	14	11	2.43 (0.83–7.14)	2.59 (0.87–7.75)
C/C&C/T	null	null	21	18	2.23 (0.85–5.85)	2.69 (0.99–7.25)
C/C&C/T	+	null	16	24	1.27 (0.48–3.34)	1.37 (0.51–3.73)
C/C&C/T	+	+	11	21	1.0	1.0

**p<0.01, *p<0.05.

Personal benzene exposure and blood cell counts were measured in 130 exposed workers (62 men and 68 women) in three factories in Tianjin, China (near Bejing) and in 51 age- and gender-matched unexposed subjects (Qu et al., 2002). Benzene air levels on the day of blood sampling ranged from 0.06 to 122 ppm (0.2 to 398 mg/m^3). The 4-week average exposure levels were 0.08 to 54.5 ppm (0.26 to 178 mg/m^3). Significant decreases of RBC, WBC, and neutrophils were observed (Table 6.6). The decreases correlated with both personal benzene exposures and levels of biomarkers: the urinary metabolites S-phenylmercapturic acid and trans,trans-muconic acid, and the albumin adducts of benzene oxide and 1,4-benzoquinone. The depressions in RBC, WBC, and neutrophils were exposure dependent and were also significantly different in the lowest exposed group (≤ 0.25 ppm) compared with unexposed subjects. The results suggested to the authors that lymphocytes may not be more sensitive than neutrophils to chronic benzene exposure. Some of the workers were likely co-exposed to toluene. Since toluene protects against the adverse effects of benzene (Snyder et al., 1989), the presence of this co-exposure in this study could have masked some of the possible effects that benzene may have in other benzene-exposed workers. The statement that some cell counts were significantly depressed at ≤ 0.25 ppm benzene is potentially important, but it was difficult to ascertain from the presentation of the data how many workers were exposed at that level.

Table 6.6. Selected peripheral blood cell count data from Qu *et al*. (2002)

Workers (N)	51	54	36	29	11
Mean (SD) cumulative exposure (ppm-yr)	0	32 (21)	74 (51)	123 (65)	237 (188)
Current exposure (ppm) (last four weeks)	0.004 (0.003)	3.07 (2.9)	5.89 (4.8)	17.4 (15.5)	50.6 (55.4)
RBC ($x10^4/\mu L$)*	463 (52)	403 (62) #	396 (57)	404 (51)	391 (39)
WBC (per µL)*	6671 (1502)	6383 (1330)	6089 (1455)	6103 (1560)	4727 (548)
Neutrophils (per µL)*	4006 (1108)	3377 (868) #	3491 (1121)	3501 (1314)	2480 (451)

*$p < 0.001$, test for exposure-response trend

#$p < 0.01$ vs. control by t test for difference between the means (only lowest benzene tested)

A cross-sectional survey studied 250 (86 male and 164 female) Chinese workers exposed in two shoe manufacturing facilities near Tianjin to glues containing 0.6 to 34 percent benzene for 6.1 ± 2.1 years (Lan et al., 2004). For each worker, individual benzene (and toluene) exposure was monitored repeatedly (up to 16 months) before blood samples were drawn. WBC and platelet counts were significantly lower than in the 140 control garment workers, even for exposure below 1 ppm benzene in air (mean = 0.57 ± 0.24 ppm) (1.86 ± 0.78 mg/m^3) (Table 6.7). Total lymphocytes and the specific subtypes B cells and $CD4^+$-T cells (the last also a target of the Human Immunodeficiency Virus (HIV) (Wigzell, 1988)) were also lower than controls. Progenitor cell colony formation declined significantly with increasing benzene exposure and was more sensitive to the effects of benzene than was the number of mature blood cells. Genetic variants in myeloperoxidase (MPO) and NQO1 influenced susceptibility to benzene hematotoxicity. Increased myeloperoxidase activity and decreased NQO1 activity were associated with increased hematotoxicity. The authors concluded that hematotoxicity from benzene exposure may be evident among genetically susceptible subpopulations. A confounder is the co-exposure of the workers to toluene, a competitive inhibitor of benzene metabolism.

Table 6.7. Selected peripheral blood cell count data from Table 1 of Lan *et al*. (2004)

	Controls (< 0.04 ppm) (n = 140)	Low exposure 0.57 ppm (n = 109)	Medium 2.85 ppm (n = 110)	High 28.73 ppm (n = 31)	p for 0.57 ppm vs. controls
WBC	6480 (1710)*	5540 (1220)	5660 (1500)	4770 (892)	< 0.0001
Granulocytes	4110 (1410)	3360 (948)	3480 (1170)	2790 (750)	< 0.0001
Lymphocytes	2130 (577)	1960 (541)	1960 (533)	1800 (392)	0.018
$CD4^+$ T cells	742 (262)	635 (187)	623 (177)	576 (188)	0.003
B cells	**218 (94)**	**186 (95)**	**170 (75)**	**140 (101)**	0.003
Monocytes	241 (92)	217 (97)	224 (93)	179 (74)	0.018
Platelets	230 (60) x 10^3	214 (49) x 10^3	200 (53) x 10^3	172 (45) x 10^3	0.023

* Unadjusted mean cell number (± 1 SD) per microliter of blood

When trend analysis was used to examine only the 219 workers exposed to <10 ppm benzene, inverse associations of cell count decrease with benzene increase were each statistically significant ($p < 0.05$) for total WBCs, granulocytes, lymphocytes, B cells, and platelets. In 60 workers exposed to mean benzene <1 ppm over the most recent year, and in a subset of 50 who also had <40-ppm-years lifetime cumulative benzene exposure, all five cell types were decreased compared to controls ($p < 0.05$). A group of 30 workers exposed to <1 ppm benzene, with negligible exposure to other solvents including toluene, had decreased levels of WBCs, granulocytes, lymphocytes, and B cells compared to controls ($p < 0.05$) but not of platelets (Lan et al., 2004). These findings confirm hematotoxicity in Chinese workers exposed to ≤ 1 ppm benzene.

In response to criticism by (Lamm and Grunwald, 2006) of the adequacy of their dose-response data, the authors (Lan et al., 2006) confirmed the monotonicity of their data by spline regression analysis of benzene exposure and WBC counts. They found no apparent threshold in their exposure range of 0.2 to 75 ppm (0.65 to 245 mg/m^3) benzene.

To assess possible toxicity in progenitor cells, peripheral blood from 29 benzene-exposed workers and 24 controls were examined by Lan et al. (2004) for effects of benzene on progenitor cell colony formation including colony forming units-granulocyte-macrophage (CFU-GM), blast forming units-erythroid (BFU-E), and colony forming units-granulocyte, erythroid, macrophage, megakaryocyte (CFU-GEMM). Exposed workers were split into < 10 ppm and > 10 ppm benzene groups. Statistically significant ($p < 0.01$), dose-dependent decreases were observed in colony formation in all three classes of progenitor cells.

In contrast, investigators in Israel compared growth of BFU-E and CFU-GM colonies in 17 male petroleum workers exposed to 0.28–0.41 ppm benzene with 20 healthy control subjects (Quitt et al., 2004). Benzene-exposed workers had significantly increased growth of autonomous BFU-E and unstimulated CFU-GM when compared with controls. Surprisingly, unexposed smokers had increased colony growth without the addition of

cytokines (erythropoietin and granulocyte colony stimulating factor) compared to unexposed nonsmokers. Colony growth was not significantly different between the groups after the addition of cytokines.

In order to identify specific genes involved in the cell count changes above, the authors used a commercial assay (Golden Gate assay by Illumina) to analyze 1,395 single nucleotide polymorphisms (SNPs) in 411 genes in the 250 benzene-exposed workers and the 140 unexposed controls (Lan et al., 2009). Statistically significant findings clustered in five genes (BLM, TP53, RAD51, WDR79, and WRN) that have important roles in DNA repair and genomic maintenance. TP53 (tumor protein p53), the "guardian of the genome," is a tumor suppressor gene and is mutated in up to 50 percent of human cancers. WDR79 is located next to TP53 on chromosome 17 and is also known as TCAB1 and WRAP43 (for WD40-encoding RNA antisense to p53). BLM (for Bloom syndrome) codes for a member of the RecQ helicase family which is involved in DNA replication fork repair processes. WRN (Werner's syndrome) codes for an enzyme(s) with helicase, exonuclease, and ATPase properties. RAD is a homologue of RecA involved in homologous recombination and repair. One or more SNPs in each gene were associated with statistically significant reductions of 10-20 percent in the WBC count among benzene-exposed workers ($p = 0.0011$ to 0.0002) but not among controls.

A further study of this cohort involved 1,023 tag SNPs in 121 gene regions important for benzene effects (Hosgood et al., 2009). Linear regression was used to investigate possible relationships between genetic polymorphisms and total white blood cell (WBC) count and its subtypes. The minp (minimal p value) test assessed the association on the gene region level. The false discovery rate (FDR) method was used to control for multiple comparisons.[1] Vascular endothelial growth factor (VEGF) (minp = 0.0030) and ERCC3 (a gene involved in nucleotide excision repair of DNA) (minp = 0.0042) were the gene regions most significantly associated with altered WBC counts among benzene-exposed workers, after accounting for multiple comparisons. Statistically significant changes were also found for WBC subtype counts, including granulocytes, CD4+ T cells, and lymphocytes for VEGF, and granulocytes and NK cells for ERCC3. Further, in workers exposed to <1 ppm benzene, a SNP in VEGF was associated with changes in WBC and granulocyte counts, and SNPs in ERCC3 were associated with changes in WBC, NK cell, and granulocyte counts.

A cross-sectional study of the same workers evaluated the association between SNPs in genes involved in innate immunity and benzene hematotoxicity. A total of 1,236 tag SNPs in 149 gene regions of six pathways were analyzed (Shen et al., 2011). Six regions were significant for their association with WBC counts based on gene-region ($p < 0.05$) and SNP analyses (False Discovery Rate < 0.05): MBP (myelin basic protein), VCAM1 (vascular cell adhesion molecule 1), ALOX5 (arachidonate 5-lipoxygenase),

[1] The False Discovery Rate (FDR) of a set of predictions is the expected percent of false predictions in the set. If the algorithm returns 100 genes with an FDR of 0.3, expect 30 of them to be false and 70 to be correct.

MPO (myeloperoxidase), RAC2 (a member of a group of small GTPases), and CRP (C reactive protein). Specific SNPs for VCAM1, ALOX5, and MPO were the three most significant SNPs and showed similar effects on WBC subtypes: granulocytes, lymphytes, and monocytes. A 3-SNP block in ALOXE3 showed a global association (omnibus P = 0.0008) with WBCs, but the SNPs were not individually significant.

In a different population of Chinese workers, investigators from ExxonMobil, Fudan University, and the University of Colorado studied peripheral blood counts in 855 workers using benzene glues in five factories (including one shoe factory "B") in and around Shanghai, China (Schnatter et al., 2010). A group of 73 controls was used. The workers were exposed to weekly benzene levels of 0.07 to 872 mg/m^3 (median = 7.4 mg/m^3 or 2.3 ppm). Lifestyle and demographic information was obtained by questionnaire. Possible genetic influences were assessed with five single nucleotide polymorphisms (SNPs) in the NQO1(2 SNPs), MPO, CYP2E1, and GSTT1 genes. Effects on peripheral blood were seen for red cell indices, including anemia and macrocytosis, for benzene exposures above 10 ppm (32.6 mg/m^3). The most sensitive parameters to benzene exposure based on change point regression analysis in this study were decreases in neutrophil counts and an increase in the mean platelet volume (MPV) at and above 7.77 and 8.24 ppm (25.1 and 26.9 mg/m^3), respectively. These "change points" appear to be LOAELs for benzene effects in this study. In addition, there was a statistically significant decrease in red cells in workers exposed to less than 1 ppm benzene and in those exposed to greater than 10 ppm benzene (based on the confidence intervals of the odds ratios, which did not include 1), but not in those workers between 1 and 10 ppm (Table 6.8). Note, however, that the confidence intervals were very wide. The report tells when the factories opened but does not indicate the years of employment of the workers. However, since factories D and E opened in 1999 and 1998, respectively, and the sampling was done in 2003 and 2007, those workers would have been exposed for 4 to 9 years.

Table 6.8. Odds ratios for blood parameters at different benzene exposure levels

Parameter	< 1 ppm (95% CI)	1-10 ppm (95% CI)	> 10 ppm (95% CI)
WBC	2.49 (0.31 - 20.0)	1.92 (0.23 - 15.7)	4.07 (0.51 – 32.4)
RBC	10.8 (1.41 – 82.5)	5.13 (0.66 – 39.9)	16.0 (2.11 – 121)
MCV*	5.65 (0.63 – 51.1)	5.91 (0.75 – 46.5)	17.7 (2.35 – 134.1)
Platelets	2.18 (0.24 – 19.8)	1.76 (0.20 – 15.2)	4.54 (0.56 – 36.7)

Data are from Table 5 of (Schnatter et al., 2010). Benzene exposure was based on the average weekly readings of individual workers. Workers were sampled 1-14 times (average = 4) between 2003 and 2007.
*MCV = mean corpuscular volume of RBCs

Other recent studies have not found effects of benzene on blood cells at low levels. Swaen and colleagues studied hematological effects at low benzene air levels among Dow Chemical Company employees in the Netherlands (Swaen et al., 2010). They compared 8,532 blood samples from 701 male workers with low benzene exposure to 12,173 samples from 1,059 male workers with no occupational benzene exposure for the years 1981-2007. A Job Exposure Matrix was constructed using 21,584 benzene

air measurements for the exposed employees. The Matrix was used to estimate benzene exposure in the year in which each blood sample was collected. The average lymphocyte counts for the unexposed and exposed group were similar: 2,090.29 and 2,097.02 cells per microliter, respectively. The lymphocyte levels are similar to controls in other populations. Adjustments for smoking, age, and month of blood sample did not change the results. No adverse effect on any blood parameters was seen. Stratification into three exposure subgroups (<0.5 ppm (1.63 mg/m^3), 0.5-1 ppm, and >1 ppm (3.26 mg/m^3)) showed no significant differences for any of the blood parameters among the exposure categories including the non-exposed.

In 1981, South Korea banned use of glues or solvents containing more than 1 percent benzene from the workplace, except where benzene is used in a completely sealed process. After the ban (in 2000), the number of workers possibly exposed to benzene was estimated to be 196,182 workers in 6,219 factories. Benzene exposure in different industries was assessed by reviewing the claimed cases for workmen's compensation due to hematopoietic diseases related to benzene which were investigated by Korea OSHA between 1992 and 2000 (Kang et al., 2005). Six factories were evaluated for benzene exposure. Personal air monitoring was performed in 61 workers; urine samples were collected from 57 to measure trans,trans-muconic acid (t,t-MA); and hematologic examination was performed. The geometric mean of benzene in air was 0.094 ppm (range = 0.005-5.311 ppm) (0.3 mg/m^3; range = 0.02-17 mg/m^3). Seven samples were higher than 1 ppm but less than 10 ppm, the occupational exposure limit in Korea. The geometric mean of t,t-MA in urine was 0.966 mg/g creatinine (range = 0.24-2.74). The benzene exposure level was low except in a factory where benzene was used to polymerize other chemicals. Ambient benzene from 0.1 to 1 ppm (0.326 to 3.26 mg/m^3) was significantly correlated with urinary t,t-MA concentration ($r=0.733$, $p<0.01$). Hematologic parameters did not show any significant differences among groups based on the level of exposure. Korean workers were not highly exposed to benzene and the level of exposure was mostly less than 1 ppm.

In summary, some recent studies have reported reduced peripheral blood cell counts at workplace benzene levels at and below 1 ppm, especially among Chinese workers. Lymphocytes and lymphocyte subtypes are the most sensitive to benzene, but some studies find other cell types, such as red blood cells, most sensitive to benzene. Many genes involved in benzene metabolism, in DNA repair, in genome maintenance, and in other cellular functions influence the peripheral blood cell count in exposed workers. (Genes, and the enzymes they code for, involved in the formation of muconaldehyde and muconic acid (Figure 4.1), have not been reported to affect cell count, perhaps because of the large number of enzymes catalyzing alcohol dehydrogenation (Edenberg, 2000) and aldehyde dehydrogenation, oxidation, and reduction (Marchitti et al., 2008)).

6.2 Chronic Toxicity to Infants and Children

Several epidemiological and ecological studies have been published, which examine the association between benzene exposure and health outcomes in children, notably leukemia (Brosselin et al., 2009). However, most of these studies use proximity to gasoline stations or roads with high traffic volumes as proxies for benzene exposure. Since the resulting exposures are to complex mixtures of VOCs and/or vehicular exhaust of which benzene is one component among many, the role of benzene in the reported health effects is not clear. Nonetheless, we briefly describe some below.

In France, Brosselin and colleagues studied the association between acute childhood leukemia and residing next to gas stations and automotive repair shops for 2003-2004 (the ESCALE study (SFCE))(Brosselin et al., 2009). A total of 765 cases of acute leukemia and 1,681 controls under 15 years of age was studied. Acute leukemia was significantly associated with residence next to either gas stations or automotive-repair garages (odds ratio (OR) = 1.6 [95% CI = 1.2-2.2]) and next to a gas station only (OR = 1.9 [95% CI = 1.2-3.0]). The OR did not show a tendency to increase with exposure duration. The results were not modified by adjustment for potential confounders including urban/rural status and type of housing (Brosselin et al., 2009). In a further study of this population, acute leukemia was significantly associated with higher estimates of traffic NO_2 levels at the home (> 27.7 µg/m^3) compared with lower NO_2 levels (< 21.9 µg/m^3) [OR = 1.2; 95% CI = 1.0-1.5] and with the presence of a heavily-trafficked road within 500 meters (m) of the home compared with the absence of such a road in the same area (OR=2.0; 95% CI = 1.0-3.6). There was a significant association between acute leukemia and a high density of heavy-traffic roads within 500 m compared with the reference category with no heavy-traffic road within 500 m (OR = 2.2; 95% CI= 1.1-4.2), and a significant positive linear trend of the association of acute leukemia with the total length of heavy-traffic road within 500 m (Amigou et al., 2011).

An earlier case-control study in France for the years 1995-1999 involved 280 leukemia cases and 285 controls. There was no association between the mothers' work exposure to hydrocarbons during pregnancy and leukemia, or between residential traffic density and leukemia. There was a statistically significant association between residences near a gas station or an automotive repair shop during childhood and the risk of childhood leukemia (OR = 4.0, 95% CI = 1.5-10.3), with a positive duration trend. The association was strong for acute non-lymphocytic leukemia (OR = 7.7, 95% CI = 1.7-34.3) and was not altered by adjustment for potential confounders (Steffen et al., 2004).

An individual analysis with an ecologic measure of exposure studied 977 cases of childhood lymphohematopoietic cancer diagnosed from 1995-2004 in Texas (Whitworth et al., 2008). Exposure values were the U.S. Environmental Protection Agency's 1999 modeled estimates of benzene and 1,3-butadiene for 886 census tracts surrounding Houston. Census tracts with the highest benzene levels had elevated rates of all leukemia [rate ratio (RR) = 1.37; 95% CI = 1.05-1.78]. The association was higher for acute myeloid leukemia (RR = 2.02; 95% CI, 1.03-3.96) than for acute lymphocytic

leukemia (RR = 1.24; 95% CI, 0.92-1.66). Among census tracts with the highest 1,3-butadiene levels, the authors observed RRs of 1.40 (95% CI, 1.07-1.81), 1.68 (95% CI, 0.84-3.35), and 1.32 (95% CI, 0.98-1.77) for all leukemia, acute myeloid leukemia, and acute lymphocytic leukemia, respectively.

In a case–control study of California children under the age of six, 69 cases of acute lymphoblastic leukemia (ALL) and 46 cases of acute myeloid leukemia (AML) were identified in the California Cancer Registry, and 19,209 controls were culled from California birth records for 1990 through 2007 (Heck et al., 2013). The children resided within 2 km (for ALL) or 6 km (for AML) of an air toxics monitoring station. The authors used logistic regression to estimate the risk of leukemia associated with one interquartile range increase in air toxics exposure. Risk of ALL was elevated with 3rd trimester exposure to benzene (OR = 1.50, 95% CI = 1.08-2.09), and to five other air toxics related to fuel combustion. Risk of AML was increased with 3rd trimester exposure to benzene (OR = 1.75, 95% CI = 1.04-2.93), as well as to chloroform and two other traffic-related toxics. During the child's first year, exposure to benzene did not increase the risk to either leukemia, while exposure to butadiene, ortho-xylene, and toluene increased risk for AML and exposure to selenium increased risk for ALL.

6.3 Chronic Toxicity to Experimental Animals

A number of animal studies have demonstrated that benzene exposure can induce bone marrow damage, changes in circulating blood cells, developmental and reproductive effects, alterations of the immune response, and cancer. With respect to chronic toxicity, hematological changes appear to be the most sensitive indicator (Table 6.9).

Wolf and coworkers conducted repeat benzene exposures (7-8 h/day, 5 days/week) in several species. Rabbits were exposed to 80 ppm (261 mg/m^3) for 175 total exposures; rats were exposed to 88 ppm (287 mg/m^3) for 136 total exposures; and guinea pigs were exposed to 88 ppm (287 mg/m^3) for 193 total exposures (Wolf et al., 1956). The observed effects included leukopenia, increased spleen weight, and histological changes to the bone marrow.

Hematologic effects, including leukopenia, were observed in rats exposed to mean concentrations of 44 ppm (143 mg/m^3) or greater for 5 to 8 weeks. Exposure to 31 ppm (100 mg/m^3) benzene or less did not result in leukopenia after 3 to 4 months of exposure (Deichmann et al., 1963).

Among Sprague-Dawley rats and AKR/J mice exposed to 300 ppm (972 mg/m^3) benzene, 6 hours/day, 5 days/week for life, Snyder and coworkers found lymphocytopenia, anemia, and decreased survival time (Snyder et al., 1978).

Male mice exposed to 400 ppm (1,304 mg/m^3) benzene, 6 hours/day, 5 days/week for 9.5 weeks showed depressed bone marrow cellularity, decreased stem cell count, and altered morphology in spleen colony-forming cells (Cronkite et al., 1982)

Mice are more sensitive than rats or rabbits to the hematologic and leukemic effects of benzene (IARC, 1982; Sabourin et al., 1989). Metabolism of benzene to hydroquinone, muconic acid, and hydroquinone glucuronide is much greater in mice than rats, whereas the detoxification pathways are approximately equivalent between the two species (Sabourin et al., 1988).

A study on the chronic hematological effects of benzene exposure in C57 Bl/6 male mice (5 or 6 per group) showed that peripheral lymphocytes, red blood cells and colony-forming units (CFUs) in the bone marrow and spleen were significantly decreased in number after treatment with 10 ppm (32.4 mg/m^3) benzene for 6 hours/day, 5 days/week for 178 days compared to unexposed controls (Baarson et al., 1984). Ten ppm, the only concentration studied, was the workplace exposure standard at the time.

Male and female mice (9 or 10 per group) were exposed to 10, 25, 100, 300 and 400 ppm benzene for 6 hours/day, 5 days/week for 2 to 16 weeks (Cronkite et al., 1985). After 2 weeks at 100 ppm (326 mg/m^3) benzene and higher, mice showed both decreased bone marrow cellularity and a reduction of pluripotent stem cells in the bone marrow. The decrease in marrow cellularity continued for up to 25 weeks following a 16-week exposure to 300 ppm (972 mg/m^3) benzene. Peripheral blood lymphocytes (PBLs) were dose-dependently decreased with benzene exposures of greater than 25 ppm (81 mg/m^3) for 16 weeks, but recovered to normal levels following a 16-week recovery period.

Fifty Sprague-Dawley rats and 150 CD-1 mice of both sexes were exposed to 0, 1, 10, 30, or 300 ppm (0, 3.26, 32.6, 97.2, or 972 mg/m^3) benzene, 6 hours/day, 5 days/week for 13 weeks (Ward et al., 1985). Serial necropsies were conducted at 7, 14, 28, 56, and 91 days (20 percent of each group of rodents at each time point). No hematological changes were found for mice and rats at 1, 10, or 30 ppm. In male and female mice significant increases in mean cell volume and mean cell hemoglobin values and decreases in hematocrit, hemoglobin, lymphocyte percentages, and decreases in red cell, leukocyte and platelet counts were observed at 300 ppm (978 mg/m^3) . The changes were first observed after 14 days of exposure. Histological changes in mice included myeloid hypoplasia of the bone marrow, lymphoid depletion in the mesenteric lymph node, increased extramedullary hematopoiesis in the spleen, and periarteriolar lymphoid sheath depletion. Effects were less severe in the rats. In this subchronic study 30 ppm (97.2 mg/m^3) was a NOAEL.

The National Toxicology Program (NTP, 1986) conducted a chronic (2 year) toxicity “bioassay” in F344 rats and B6C3F1 mice of benzene by gavage in corn oil. Doses were 0, 25, 50, and 100 mg/kg-day for females and 0, 50, 100, and 200 mg/kg-day for males. Dose-related lymphocytopenia and leukocytopenia were observed in both species in all dosed groups. Mice exhibited lymphoid depletion of the thymus and spleen and hyperplasia of the bone marrow.

Investigators at Brookhaven National Laboratory exposed CBA/Ca mice to 10, 25, 100, 300, 400 and 3,000 ppm (32.6, 82, 326, 972, 1,304 and 9,720 mg/m^3) benzene 6 hours/day, 5 days/week for up to 16 weeks (Cronkite et al., 1989). No effects were observed at 10 ppm. Lymphopenia was observed in the 25 ppm (82 mg/m^3) exposure group. Higher concentrations of benzene produced dose-dependent decreases in blood lymphocytes, bone marrow cellularity, spleen colony-forming units (CFU-S), and an increased percentage of CFU-S in S-phase synthesis.

Farris et al. exposed B6C3F$_1$ mice to 1, 5, 10, 100, and 200 ppm (3.26, 16.3, 32.6, 326, and 652 mg/m^3) benzene for 6 hr/day, 5 days/week, for 1, 2, 4, or 8 weeks (Farris et al., 1997). In addition some animals were allowed to recover from the exposure for up to 25 days. There were no significant effects on hematopoietic parameters from exposure to 10 ppm benzene or less. Exposure to higher levels reduced the number of total bone marrow cells, progenitor cells, differentiating hematopoietic cells, and most blood parameters. The replication of primitive progenitor cells was increased. The authors suggested that this last effect, in concert with the genotoxicity of benzene, could play a role in the carcinogenicity of benzene.

Table 6.9. Important non-acute animal inhalation studies of benzene

Study	Animal	Exposure	Duration	Effect	NOAEL	LOAEL
(Farris et al., 1997)	Mice	6 h/d, 5 d/wk	1, 2, 4, or 8 wk	hemato-poiesis	10 ppm	100 ppm
(Cronkite et al., 1989)	Mice	6 h/d, 5 d/wk	Up to 16 wk	hemato-poiesis	10 ppm	25 ppm
(Aoyama, 1986)	Mice	6 h/d	14 days	hemato-poiesis	not found	50 ppm
(Ward et al., 1985)	Mice & rats	6 h/d, 5 d/wk	13 weeks	hemato-poiesis	30 ppm	300 ppm
(Cronkite et al., 1985)	Mice	6 h/d, 5 d/wk	2-16 wk	hemato-poiesis	25 ppm	100 pm
(Baarson et al., 1984)	Mice	6 h/d, 5 d/wk	178 d	hemato-poiesis	not found	10 ppm
(Deichmann et al., 1963)	Rats	5 h/d, 4 d/wk	5 wk-4 mo	hemato-poiesis	31 ppm	44 ppm
(Wolf et al., 1956)	Rabbits, rats, guinea pigs	7 h/d	136-193 exposures	hemato-poiesis	not found	80-88 ppm

7 Developmental and Reproductive Toxicity

7.1 Human Studies

Based on blood samples taken at birth from mother and infant, benzene can cross the human placenta and be in the umbilical cord at a level equal to or greater than in maternal blood (Dowty et al., 1976). The database of benzene effects on human

reproductive and developmental toxicity is limited to a few reports which usually have small samples, unmeasured exposure to benzene, and exposure to other chemicals. CYP2E1, which is a key enzyme in the pathway from benzene to its toxic metabolites, was not detected in human livers in the early fetal period (Vieira et al., 1996) but was detectable at low levels in some fetuses beginning in the second trimester (Johnsrud et al., 2003). In the third trimester CYP2E1 is present in most fetuses at 10-20 percent of adult levels (Table 7.1). However, many phase II enzymes which detoxify benzene metabolites are also low in the fetal period (McCarver and Hines, 2002). For example, for seven of eight substrates of UDP-glucuronyltransferase in human liver, the level during the fetal period ranged from less than 1 to 30 percent of adult levels and the level at the end of the fetal period ranged from 6 to 31 percent of adult levels. For only one substrate (5-hydroxytryptamine) were adult levels of UDP-glucuronyltransferase present in the fetal period (Leakey et al., 1987).

Table 7.1. Changes of CYP2E1 content in human liver with age

Age	N	pmol CYP2E1/mg protein
1st trimester fetus: 8-13.4 weeks	14	- (not detectable)
2nd trimester fetus: 13.6-25 weeks	45	0.3 ± 0.6 (mean ± SD)
3rd trimester fetus: 27-40 weeks	14	5.8 ± 4.6
Neonate: 0-29 days	42	13.4 ± 16.0
Infant: 1.1-11.3 months	64	36.2 ± 20.3
Prepubertal: 1.1-10.0 years	41	43.1 ± 20.6
Adolescent: 11.0-17.7 years	20	~68 (median)
Adult (Snawder and Lipscomb, 2000)	40[a]	52.2 ± 24.2
Adult (Shimada et al., 1994)	60[b]	22 ± 20

Values are from (Hines, 2007) except as noted

[a] black, caucasian, and hispanic subjects

[b] of the 60 subjects, 30 were Japanese and 30 caucasian

The EDEN Mother-Child Cohort Study Group assessed the relation between personal exposure to airborne benzene in non-smoking pregnant French women and fetal growth (Slama et al., 2009). A group of 271 mothers recruited from the University Hospitals of Nancy and Poitiers from September 2003 through June 2006 carried a diffusive air sampler during week 27 of gestation to assess benzene exposure. The authors estimated head circumference of the offspring by ultrasound measurements during the second and third trimesters of pregnancy and at birth. Median benzene exposure was 1.8 µg/m^3 (0.5 ppb) (5 and 95th percentiles, 0.5 and 7.5 µg/m^3). An increase of 1 in log-transformed benzene exposure was associated with a gestational age-adjusted decrease of 68 g in mean birth weight (95% CI, -135 to -1 g; p = 0.05) and of 1.9 mm in mean head circumference at birth (95% CI, -3.8 to 0.0 mm; p = 0.06). Similarly, this differential in exposure was also associated with an adjusted decrease of 1.9 mm in head circumference during the third trimester (95% CI, -4.0 to 0.3 mm; p = 0.09) and of 1.5 mm in head circumference at the end of the second trimester (95% CI, -3.1 to 0 mm; p = 0.05). The association cannot necessarily be attributed solely to benzene, particularly since the benzene exposure may reflect exposure to a mixture of associated

traffic-related air pollutants. Traffic-related air pollutants have been associated in a number of studies with adverse birth outcomes including low birth weight.

Lindbohm and colleagues reported a statistically significant increase in spontaneous abortions in women whose husbands worked at petroleum refineries or with petroleum derived solvents including benzene (16 spontaneous abortions among 93 pregnancies; odds ratio = 2.2; 95% CI = 1.3-3.8) (Lindbohm et al., 1991).

The Texas Birth Defects Registry contained data on neural tube defects (533 cases of spina bifida and 303 cases of anencephaly) in babies delivered between 1999 and 2004 (Lupo et al., 2011). Census tract-level estimates of annual benzene, toluene, ethylbenzene, and xylene (BTEX) levels were obtained from the U.S. EPA's 1999 Assessment System for Population Exposure Nationwide. Mothers living in census tracts with the highest benzene levels were more than twice as likely to have offspring with spina bifida than were women living in census tracts with the lowest levels (odds ratio = 2.30; 95% CI = 1.22-4.33). No other significant associations were observed for benzene and no associations were found for toluene, ethlybenzene, and xylene. A variety of confounders such as race/ethnicity, maternal age, and socioeconomic status were taken into account.

Ghosh and colleagues investigated the effect of ambient air pollution in Los Angeles County on birth weight among 8,181 term (≥ 37 wk gestation), low birth weight (LBW; <2,500 g) children and 370,922 term normal birth weight children born from 1995 through 2006; all mothers lived within 5 miles of at least one of four stationary toxic air contaminant monitors (Ghosh et al., 2012). The influence of local variation in traffic pollution was assessed by land-use-based, regression-modeled estimates of oxides of nitrogen. Adjustments were made for maternal age, race/ethnicity, education, and parity, and for infant gestational age (and gestational age squared). Logistic regression indicated that the odds of term LBW increased 2–5 percent (range of 95% CI = 0%-9%) per interquartile-range increase in modeled traffic pollution estimates and in monitoring-based air toxics exposure estimates for (1) the entire pregnancy, (2) the third trimester, and (3) the last month of pregnancy. Models stratified by monitoring station (to investigate air toxics associations based solely on temporal variations) resulted in 2-5 percent increased odds per interquartile-range increase in third-trimester exposures to benzene, toluene, ethyl benzene, and xylene (BTEX); some confidence intervals indicated statistically significant effects. However, benzene was not a better predictor of LBW than toluene, ethyl benzene, xylene, or PAHs (Polycyclic Aromatic Hydrocarbons excluding naphthalene).

In the latter 1990s, the level of benzene in gasoline sold in the United States decreased as the result of regulation. Zahran and coworkers investigated the relationship between maternal exposure to benzene and birth weight outcomes among US residents in 1996 and 1999. A total of 3.1 million singleton births registered with the U.S. National Center for Health Statistics were included (Zahran et al., 2012). Maternal benzene concentrations were estimated at the county level using data from the US EPA's National Air Toxics Assessment. Regression analysis estimated that a 1 $\mu g/m^3$ (0.3 ppb) increase in maternal exposure to benzene (1) reduced birth weight by 16.5 g (95%

CI, 17.6-15.4), (2) increased the odds of a low birth weight (LBW) child by 7 percent, and (3) increased the odds of a very LBW child by a multiplicative factor of 1.23 (95% CI, 1.19-1.28). In counties where benzene levels decreased 25 percent from 1996 to 1999, birth weight increased by 13.7 g (95% CI, 10.7-16.8) and the risk of low birth weight (LBW) decreased by a factor of 0.95 (95% CI, 0.93-0.98). The authors admit that concentrating on benzene is a limitation since PM also affects birth weight.

As noted above, in a California case-control study evaluating risk of childhood leukemia from ambient exposure to benzene and other air toxics, Heck et al (2013) observed elevated risk of ALL with 3rd trimester exposure to benzene (OR = 1.50, 95% CI = 1.08-2.09), and to five other air toxics related to fuel combustion. Risk of AML was increased with 3rd trimester exposure to benzene (OR = 1.75, 95% CI = 1.04-2.93), as well as to chloroform and two other traffic-related toxics.

Xing and coworkers used multicolor fluorescence in situ hybridization (FISH) to measure the incidence of sperm with numerical abnormalities of chromosomes X, Y, and 21 among 33 benzene-exposed men and 33 unexposed men from Chinese factories (Xing et al., 2010). Passive air monitors were used to measure benzene as well as toluene and xylene. Benzene levels for the exposed ranged from zero (i.e., limit of detection) to 24 ppm (78 mg/m^3); nine had levels ≤ 1 ppm (≤ 3.26 mg/m^3). Exposed men were grouped into low and high exposure based on levels of urinary t,t-muconic acid. Compared to controls, sperm aneuploidy increased across low- and high-exposed groups for disomy X [incidence rate ratio (IRR) for low = 2.0; 95% CI = 1.1-3.4; and IRR for high = 2.8; 95% CI = 1.5-4.9], and for overall hyperhaploidy for X, Y and 21 chromosomes (IRR for low = 1.6; 95% CI, 1.0-2.4; and IRR for high = 2.3; 95% CI, 1.5-3.6, respectively). Even for the nine exposed to ≤ 1 ppm, the authors found statistically significantly elevated disomy X (IRR = 1.8; 95% CI = 1.1-3.00) and hyperhaploidy (IRR = 2.0; 95% CI= 1.1-3.9) compared with the 33 unexposed men. In this study benzene increased the frequencies of aneuploid sperm for chromosomes associated with chromosomal abnormality syndromes in human offspring at surprisingly low levels. Further studies with this cohort using chromosome 1 and low, moderate and high exposure groups yielded IRRs and 95% CIs for all structural aberrations combined of 1.42 (95% CI= 1.10-1.83), 1.44 (CI = 1.12-1.85), and 1.75 (CI = 1.36-2.24) and for deletion of 1p36.3 alone of 4.31 (CI = 1.18-15.78), 6.02 (CI = 1.69-21.39), and 7.88 (CI = 2.21-28.05) for men with low, moderate, and high exposure, respectively, compared with unexposed men (Marchetti et al., 2012).

7.2 Animal Studies

Inhalation of ^{14}C-benzene by pregnant mice resulted in labeled material in the fetuses (Ghantous and Danielsson, 1986).

Groups of 40 female Sprague-Dawley rats were exposed to 0, 1, 10, 40, and 100 ppm (0, 3.26, 32.6, 129.6, or 326 mg/m³) benzene for 6 hours/day during days 6-15 of gestation (Coate et al., 1984). At least 80 percent of the 40 females in each group littered (mean litter size = 13 fetuses). The viscera and skeletons of the fetuses were evaluated for variants and the fetal body weight and length were measured. No increase in variants was noted. A significant decrease was noted in the body weights of fetuses from dams exposed to 100 ppm (326 mg/m³) benzene (Table 7.2). No effects were observed at 40 ppm (130 mg/m³), the NOAEL for this experiment.

Table 7.2. Fetal body weights from Table 5 of Coate *et al*. (1984)

Group	Litters	benzene ppm	Fetal male bw (g, mean ± SD)	Fetal female bw (g)	Live† fetuses per litter (mean±SD)
1	32/40	0	4.02 ± 0.349	3.78 ± 0.303	13.0 ± 3.10
2	33/40	0	4.06 ± 0.430	3.85 ± 0.477	12.5 ± 2.98
3	37/40	1	3.86 ± 0.381	3.69 ± 0.350	13.8 ± 2.47
4	37/40	10	3.88 ± 0.303	3.70 ± 0.385	13.3 ± 2.56
5	37/40	40	3.91 ± 0.492	3.64 ± 0.382	12.9 ± 2.90
6	35/40	100	3.77 ± 0.226*	3.56 ± 0.274*	13.8 ± 2.43

* significantly lower than 0 ppm groups; $p < 0.05$
† There were no dead fetuses.

Exposure of pregnant Swiss Webster mice to concentrations as low as 5 ppm (16 mg/m³) benzene on days 6-15 of gestation (6 hr/day) resulted in bone-marrow hematopoietic changes in the offspring that persisted into adulthood (Keller and Snyder, 1986). However, the hematopoietic effects (e.g., bimodal changes in erythroid colony-forming cells (CFU-E)) were of uncertain clinical significance.
In a subsequent, similar study, the authors (Keller and Snyder, 1988) found that exposure of mice in utero for 6 h/day to 5, 10 and 20 ppm (16.3, 32.6, and 65.2 mg/m^3) benzene on days 6-15 of gestation resulted in suppression of erythropoietic precursor cells and persistent, enhanced granulopoiesis in peripheral blood cells of 2-day neonates (Table 7.3) and increased granulocytes in the livers of 2-day neonates and the spleens of adults at 6 weeks (data not shown). There was a dose-dependent decrease in early nucleated red cells (basophilic normoblasts) (Table 7.3). The authors considered these effects to be significant bone-marrow toxicity. OEHHA staff previously used this study to develop a Maximum Allowable Daily Level (MADL) for Proposition 65 (OEHHA, 2001). The benzene MADL is 49 µg/day for an inhalation exposure and 24 µg/day for an oral exposure.

Table 7.3. Differential peripheral blood cell counts in fetuses of benzene-exposed pregnant mice.[#]

Exposure	Blasts	Dividing Granulo-cytes	Nondividing granulocytes	Early[&] nucleated red cells	Late[&] nucleated red cells	Primitive nucleated red cells	Lympho-cytes
16-day fetuses							
Air	0.00±0.00	0.50±0.16	1.60±0.50	5.10±1.34	0.40±0.22	92.4±1.95	
5 ppm	0.00±0.00	2.10±0.67	3.60±1.57	5.80±1.88	0.80±0.25	87.4±4.11	
10 ppm	0.10±0.00	0.90±0.28	1.30±0.33	4.00±0.60	1.20±0.39	92.4±1.20	
20 ppm	0.10±0.00	1.50±0.50	2.20±0.63	3.90±0.79	1.50±0.34	90.7±1.48	
2-day neonates							
Air	0.00±0.00	3.80±0.66	67.60±2.44	**7.30±1.36**	6.20±1.79		14.0±3.1
5 ppm	0.20±0.14	3.10±0.57	72.30±3.09	**1.70±0.62***	3.60±0.88		17.9±2.4
10 ppm	0.10±0.10	5.90±1.04	67.90±2.88	**0.50±0.22***	7.30±0.83		16.9±2.0
20 ppm	0.10±0.10	2.10±0.62	80.40±2.67*	**0.00±0.00***	1.60±0.45*		14.2±2.5
6-week adults							
Air	0.00±0.00	2.20±0.47	19.3±2.28	0.00±0.00	0.20±0.14		75.0±3.0
5 ppm	0.00±0.00	1.20±0.47	22.0±2.47	0.10±0.10	0.20±0.13		72.3±3.1
10 ppm	0.00±0.00	0.60±0.22	24.2±2.59	0.00±0.00	0.10±0.10		75.1±2.9
20 ppm	0.10±0.10	2.20±0.63	16.7±2.27	0.10±0.10	0.20±0.13		77.6±2.4

[#] 100 cells were counted from 1 male and 1 female from each of 5 litters per treatment (n=10)

* $p < 0.05$ vs corresponding control by Dunnett's test. Values are mean±SE.

[&] Late nucleated red cells contain hemoglobin; early nucleated red cells do not.

An exposure of 500 ppm (1,600 mg/m³) benzene for 7 hours per day through days 6-15 of gestation was teratogenic in the fetal brain of Sprague-Dawley rats, while 50 ppm (160 mg/m³) and 500 ppm resulted in reduced fetal weights on day 20 of gestation (Table 7.4) (Kuna and Kapp, 1981). The higher exposure levels also had significantly more fetuses with skeletal variants. No fetal effects were noted at an exposure of 10 ppm (32.6 mg/m^3), which is the NOAEL for this study.

Table 7.4. Fetal body weight and length (Kuna and Kapp, 1981)

Benzene	0 ppm	10 ppm	50 ppm	500 ppm
Inseminated rat dams (n)	17	18	20	19
Live fetuses/implants (n)	107/119	188/197	127/131	151/165
Mean body weight of live fetuses (g)	4.4 ± 0.6	4.4 ± 0.5	3.8 ± 0.7*	3.6 ± 0.8*
Mean crown-rump length (cm) in live fetuses	4.1 ± 0.2	4.1 ± 0.2	3.9 ± 0.3	3.8 ± 0.4*
Fetuses (litters) with skeletal or visceral variants (n)	3 (3)	2 (1)	23** (6)	30** (6)
Fetuses with brain anomalies or variants	0/35	0/56	5/35	7/44***

* statistically significant difference from control ($p < 0.05$); values are mean ± 1 SD.
** significantly different by chi-square test
*** statistically different from control ($p<0.05$) by Fisher Exact Test (2-tailed)

Inhalation of 500 ppm benzene (the only concentration tested) for 7 hours/day on gestational days 6 to 15 in CF-1 mice and days 6 to 18 in white New Zealand rabbits induced minor skeletal variations that the authors did not consider to be teratogenic (Murray et al., 1979).

Exposure of CFY rats to continuous benzene inhalation (24 h/day) at 150, 450, 1500, or 3000 mg/m^3 (50, 150, 500, or 1000 ppm) from days 7-14 of gestation led to decreased fetal body weights, elevated liver weights, and signs of skeletal retardation at 150 mg/m³ (50 ppm) benzene, the lowest concentration tested (Tatrai et al., 1980).

Female CFLP mice and NZ rabbits were exposed by inhalation to 0, 500, or 1,000 mg/m^3 (0, 153, or 307 ppm) benzene for 24 h/day from day 6 to day 15 of pregnancy (Ungvary and Tatrai, 1985). Maternal toxic effects were moderate and dose dependent. Benzene induced skeletal variations and weight retardation in fetuses of rabbits at 1,000 mg/m^3 and in fetuses of mice at 500 and 1,000 mg/m^3. Benzene increased the post-implantation loss (percent fetuses dead or resorbed) in rabbits at 1,000 mg/m^3. Benzene induced spontaneous abortion in rabbits at 1,000 mg/m^3.

In order to determine if prenatal exposure to benzene induces neurobehavioral changes in offspring, 0.1 mg/kg benzene was injected subcutaneously on gestation day 15 into four pregnant female Sprague-Dawley rats (Lo Pumo et al., 2006). There were no changes in total number of neonates, body weight, and eye opening time between progeny of benzene-exposed dams and controls, and no malformations. At birth, neonatal reflexes (cliff aversion, forelimb, placing, bar holding, forelimb grasping, startle) were scored in benzene-exposed pups. More benzene-exposed pups exhibited reflexes each day compared to controls. Also, the completion (maximum appearance, i.e. 100 percent of the litter exhibited each reflex) of neonatal reflexes in benzene-exposed animals preceded that of controls. Beginning at 2 months after birth, cognitive and motor performance was assessed in males of the prenatally benzene-exposed progeny. Motor activity in the open-field test showed reduced ambulation in benzene-

exposed rats compared to controls. Acquisition of active avoidance responses in the shuttle-box test was impaired in benzene-exposed rats vs. controls. Prenatal benzene exposure was associated with reduced retention latency in a step-through passive avoidance task. The authors concluded that acute exposure to benzene during gestational organogenesis may cause long-lasting changes in motor behavior and cognitive processes. It is problematic to extrapolate this acute subcutaneously administered dose to an equivalent inhalation exposure.

Exposure of rabbits to 80 ppm (261 mg/m^3) and of guinea pigs to 88 ppm (277 mg/m^3) benzene 7 hours/day, 5 days a week for 8 months caused testicular degeneration (Wolf et al., 1956).

In a one-generation reproduction study, groups of 26 female Sprague-Dawley rats were exposed for 6 hours per day by inhalation to 1, 10, 30, and 300 ppm benzene during a 10-week premating period and during mating (to proven fertile males), gestation, and lactation (Kuna et al., 1992). There was no effect on female reproductive performance at any benzene level. Performance measures included number of litters (range = 19-24), mean gestation length (21.6-21.9 days), mean pup number per litter (11.7-12.6), and viability index (96.9-99.5%). At 30 and 300 ppm there was a trend for 21-day-old pups toward reduced body and organ weight but differences were statistically significant ($p < 0.05$) only for female pups at 300 ppm (978 mg/m^3) (32.59 ± 5.05 g vs. 36.3 ± 5.20 g in controls).

Studies *in vitro* indicate that immature hematopoetic cells are more sensitive to hydroquinone than adult cells. Zhu and coworkers compared the effects of hydroquinone on mouse embryonic yolk sac hematopoietic stem cells (YS-HSCs) and adult mouse bone marrow hematopoietic stem cells (BM-HSCs) (Zhu et al., 2013). HSCs were isolated, enriched ~4-fold, and exposed to 1.25, 2.5, 5, or 10 µM hydroquinone. Hydroquinone decreased proliferation, differentiation and colony formation, but increased the apoptosis of both types of HSCs. The cytotoxic and apoptotic effects of hydroquinone were more apparent and the reduction in colony formation was more severe in YS-HSCs than in BM-HSCs; most differences were less than 3-fold.

7.3 Genotoxicity

A review of the data from more than 1,400 genotoxicity tests for benzene and its metabolites (Whysner et al., 2004) led to the conclusion that benzene and its metabolites do not produce reverse mutations in *Salmonella typhimurium* but are clastogenic and aneugenic, producing micronuclei (MN), chromosomal aberrations (CA), sister chromatid exchanges (SCE), and DNA strand breaks.

The International Agency for Research on Cancer (IARC) recently summarized the genotoxicity of benzene (IARC, 2012): “There is strong evidence that benzene metabolites, acting alone or in concert, produce multiple genotoxic effects at the level of

the pluripotent haematopoietic stem cell resulting in chromosomal changes in humans consistent with those seen in haematopoietic cancer. In multiple studies in different occupational populations in many countries over more than three decades a variety of genotoxic changes, including chromosomal abnormalities, have been found in the lymphocytes of workers exposed to benzene."

In the most sensitive inhalation study of genotoxicity in animals, inhalation of 3, 10, and 30 ppm (9.7, 32.6, and 97.8 mg/m^3) benzene for 6 hours by adult male Sprague-Dawley rats resulted in a significant increase over controls in the frequency of sister chromatid exchanges (SCE) in peripheral blood lymphocytes (Erexson et al., 1986). One ppm (3.26 mg/m^3) was a tentative NOAEL for the effect. Male DBA/2 mouse peripheral blood lymphocytes showed a significant concentration-related increase in SCE frequency over controls at 10, 100, and 1,000 ppm (32.6, 326, and 3,260 mg/m^3) benzene, the three concentrations tested. Mouse femoral bone marrow also showed a significant concentration-dependent increase in micronuclei at 10, 100, and 1,000 ppm over controls (Erexson et al., 1986).

7.4 Toxicogenomics

In order to study hematotoxicity at the level of altered multigene expression, cDNA microarray analyses were performed on mouse bone marrow tissue extracts during and after a 2-week exposure to 300 ppm (978 mg/m^3) benzene (Yoon et al., 2003). Expression of fifteen genes was at least doubled by benzene exposure compared to controls. Two of these were increased nearly five-fold (a polycomb binding protein and Metallothionein 1). CYP2E1 expression was increased 2.13 fold. Conversely this high-level benzene exposure decreased expression of a G-protein coupled receptor to 1 percent of its normal output.

One of the cohorts of Chinese workers described above (Lan et al., 2004) was analyzed by microarray analysis for global gene expression in the peripheral blood mononuclear cells (WBC) of 83 workers exposed to benzene levels ranging from < 1 ppm (3.26 mg/m^3) to > 10 ppm (32.6 mg/m^3). The workers were divided into 4 exposure groups and compared to a group of 42 controls (Table 7.5) (McHale et al., 2011). Changes in many metabolic pathways and extensive increases (and probably decreases, which are not discussed) of the expression of specific genes were found at all benzene exposure levels (McHale et al., 2011). The AML (acute myeloid leukemia) pathway was among the pathways most significantly associated with benzene exposure. Alterations in immune response pathways (e.g., toll-like receptor signaling pathway, T-cell receptor signaling pathway) were associated with most exposure levels. A 16-gene increased expression signature (relative to no exposure) was associated with all levels of benzene exposure. The three genes with the highest increased expression were a serpin peptidase inhibitor, a tumor necrosis factor, and interleukin 1 alpha.

The above summaries of acute and chronic toxicity of benzene are intended to give an overview of the data and to analyze reports most relevant to developing Reference Exposure Levels (RELs) for benzene, i.e., inhalation studies. More comprehensive

reviews of benzene toxicity are available (Sandmeyer, 1981a; World Health Organization, 1993; USEPA, 2002; ATSDR, 2007; Wilbur et al., 2008; Goldstein and Witz, 2009; IARC, 2012; Wang et al., 2012).

8 Derivation of Reference Exposure Levels

8.1 Acute Reference Exposure Level for Benzene

Key study	Keller and Snyder, 1988
Study population	pregnant female mice
Exposure method	inhalation of 0, 5, 10, or 20 ppm benzene
Exposure continuity	6 hours per day
Exposure duration	10 days (days 6-15 of gestation)
Critical effects	decreased early nucleated red cell counts (Table 7.3)
LOAEL	5 ppm (16 mg/m^3)
NOAEL	not found
$BMCL_{0.5SD}$	not used due to poor fit (Table 8.1)
Human equivalent concentration	*5* ppm (RGDR* = 1)(systemic effect)
Time adjustment factor	Not done (see below)
LOAEL uncertainty factor (UF_L)	√10 (see below)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	2 (default) (OEHHA, 2008)
Toxicodynamic (UF_{A-d})	√10 (default)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	10 (default)
Toxicodynamic (UF_{H-d})	√10 (default)
Database uncertainty factor	1 (developmental studies are available)
Cumulative uncertainty factor	600
Acute Reference Exposure Level	**8 ppb (27 μg/m³)**

*The Regional Gas Dose Ratio (RGDR) is the ratio of the regional gas dose calculated for the respiratory region affected by the inhaled toxicant in the animal species to the regional gas dose in the corresponding region in humans. For a toxicant with a systemic effect, the default value is 1.

Reference Exposure Levels are based on the most sensitive, relevant health effect reported in the medical and toxicological literature. Acute Reference Exposure Levels are levels at which infrequent one-hour exposures are not expected to result in adverse health effects (see Section 5 of the Technical Support Document (OEHHA, 2008)). Studies of developmental toxicity usually use repeat exposures in utero, either throughout gestation or during organogenesis. The acute REL for benzene is based on a developmental study (Keller and Snyder, 1988) in which pregnant mice were exposed 6 hours per day during days 6 through 15 of gestation. However, developmental toxicity may occur in response to just one exposure during a specific window of susceptibility. A literature search found 133 single-day exposure developmental toxicity

studies involving 58 chemicals (Davis et al., 2009). The same endpoints observed in repeat dose studies are often observed with single exposures, an acute effect. The acute REL derived above is a level not to be exceeded in any one hour period, which is the default application for acute RELs based on developmental studies (OEHHA, 2008)

In the key study, which OEHHA earlier used to develop a Proposition 65 MADL for benzene (OEHHA, 2001), a monotonic dose response was seen for early nucleated red cells in 2 day neonates. The LOAEL was 5 ppm. A NOAEL was not detected. The several continuous models in BMDS version 2.2 were fit to the data. The Hill Model calculated a $BMCL_{0.5SD}$ of 0.0112 ppm, which was much smaller than the model's $BMC_{0.5SD}$ of 0.92 ppm, while other models had poor fits ($p < 0.1$) (data not shown). The poor results were in part due to the high adverse response (> 75 percent decrease in differential cell count) at 5 ppm, the lowest dose, and hitting a bound of 0 at 20 ppm, the highest dose. The data from the highest dose were omitted and the BMDS linear model was fit to the data. The value for fit was also below 0.1 (Table 8.1). The BMDS results were not used as the point of departure for the REL. However, despite the relatively poor fit to the data, the proximity of the $BMCL_{0.5SD}$ of 1.51 ppm to the LOAEL of 5 ppm provides some support for the use of √10 for the LOAEL to NOAEL UF.

Table 8.1. Benzene 2d neonate data (drop 20 ppm) in BMDS 2.2 Linear Model

Variance	Deviation	BMC(ppm)	BMCL(ppm)	p for fit	AIC* (fitted)
Constant	1 SD	4.14	3.01	0.0364	98.0831
Constant	**0.5 SD**	**2.07**	**1.51**	**0.0364**	**98.0831**
Constant	0.05 Relative	0.48	0.40	0.0364	98.0831
Not	1 SD	8.11	5.18	0.015	76.4167
Not	0.5 SD	4.06	2.59	0.015	76.4167
Not	0.05 Relative	0.548	0.512	0.015	76.4167

*Akaike Information Criterion

The default interspecies UF_{A-k} of 2 for residual pharmacokinetic differences was used. As indicated above PBPK models for benzene are available in mice, rats, and humans. The hematological effects in the key study have a plausible mechanism involving the toxic metabolites of benzene.

A discussion of evidence for the extent of inter-individual variability appears in Section 8.3 describing derivation of the chronic REL. A number of toxicokinetic studies (described in Section 4) and studies of the association of genetic polymorphisms in metabolizing enzymes and chronic benzene poisoning suggest that the toxicokinetic variation in adults can be accommodated by the default factor of 10. However, one study (Chen et al., 2007) of variability in susceptibility to chronic benzene poisoning suggests a larger than 10 fold variability in response to benzene based on genetic polymorphisms affecting metabolism. These results are based on evaluation of chronically exposed workers. Thus, their application to the acute REL, meant for assessing the hazard of infrequent one hour exposures, does not appear warranted. Further, in the case of the acute REL, the critical effect is based on developmental toxicity following pre-natal exposure, and it is therefore reasonable to assume that systematic differences associated with early lifestage (including effects *in utero*) are

accommodated in the toxicity data. The default intraspecies UF_{H-k} of 10 coupled with a UF_{H-d} of $\sqrt{10}$ for a total UF for intraspecies variability of 30, was therefore considered to be sufficient for the acute benzene REL derivation.

CYP2E1, a principal enzyme in the pathway of benzene metabolism which produces toxic metabolites, has not been detected early in human fetal liver (Vieira et al., 1996) and rises to only 10-20 percent of the adult level by the third trimester (Johnsrud et al., 2003)(Table 7.1). However, since many detoxifying enzymes are also low during this period (McCarver and Hines, 2002), bone marrow toxicity from benzene metabolites might occur in the fetus. The variation in CYP2E1 levels between the third trimester fetus and the adult (Table 7.1) is also compatible with the default value of 10 for toxicokinetic variability among humans.

Additional inter-individual variability issues are addressed by the UF_{H-d} as discussed below.

The default intraspecies UF_{H-d} (toxicodynamics) of $\sqrt{10}$ was used to account for pharmacodynamic variability among pregnant women and their fetuses, the most sensitive group for the acute REL, and among infants, children, and adults (OEHHA, 2008). During embryonic and fetal development, hematopoiesis occurs first (mesoblastic period) in the extraembryonic yolk sac beginning in the 2nd week and ceasing by the eighth week of gestation, then in the liver (hepatic period) and to a lesser extent in thymus and spleen beginning at the 5th-6th week of gestation, and finally in the bone marrow (myeloid period) beginning at the 16th-18th week of gestation or even earlier (Charbord et al., 1996; Peault, 1996; Brugnara and Platt, 2003). The bone marrow volume increases linearly with body weight between 29-33 weeks of gestation and term (Hudson, 1965).

Blood cell type and rates of formation change with age (e.g., Table 7.3) and hematopoiesis would be expected to be more dynamic during developmental (growth) stages than in the adult. The erythroblast count, a marker of the contribution of the liver to erythropoiesis, decreases exponentially from 83 erythroblasts/100 leukocytes at 17 weeks gestation to 4/100 at term (Nicolaides et al., 1989). The third trimester fetus is said to produce red cells at three to five times the rate in adults at steady-state (Palis and Segel, 1998). The estimate is based on (1) the linear decline in reticulocytes per 100 red blood cells from ~10 percent at 17-24 weeks of gestation to ~4 percent at term (Matoth et al., 1971; Zaizov and Matoth, 1976; Nicolaides et al., 1989), (2) a comparison of reticulocytes/1000 red cells in newborns (mean = 51.9) versus adults (mean = 15.7) (Seip, 1955), and (3) a computerized simulation analysis of total red cell volume and life span at different life stages (Bratteby et al., 1968).

In a study of infants born prematurely, the body weight steadily increased (tripled) with gestational age, the percent reticulocytes declined overall, and the red blood cells (RBC) per volume was fairly constant (Table 8.2) (Zaizov and Matoth, 1976). Since both the bone marrow volume (Hudson, 1965) and the red blood cell volume (Bratteby,

1968) increase with gestational age and body weight, the net formation of RBCs must be substantial.

At birth a large drop in red cell production results in a transient physiological anemia of clinical concern (Palis and Segel, 1998). which reaches a low point in total red cells and hematocrit at 6-9 weeks of life after which red cell counts increase again (Matoth et al., 1971).

Table 8.2. Red cell values on first postnatal day in infants born prematurely (Zaizov and Matoth, 1976)

Gestation (wk)	N (infants)	Body wt (g)[a]	% retics.	RBC x 10^4
24-25	7	725 ± 185	6.0 ± 0.5	4.65 ± 0.43
26-27	11	993 ± 194	9.6 ± 3.2	4.73 ± 0.45
28-29	7	1174 ± 128	7.5 ± 2.5	4.62 ± 0.75
30-31	25	1450 ± 232	5.8 ± 2.0	4.79 ± 0.74
32-33	23	1816 ± 192	5.0 ± 1.9	5.00 ± 0.76
34-35	23	1957 ± 291	3.9 ± 1.6	5.09 ± 0.50
36-37	20	2245 ± 213	4.2 ± 1.8	5.27 ± 0.68
term[b]	19		3.2 ± 1.4	5.14 ± 0.70

[a] mean ± standard deviation

[b] term data based on (Matoth et al., 1971)

Although hematopoiesis is dynamic during development, we were unable to find pertinent quantitative data justifying a $UF_{H\text{-}d}$ factor greater than the default factor of $\sqrt{10}$.

In the study (Coate et al., 1984) that was the basis of OEHHA's previous acute REL for benzene (OEHHA, 1999), statistically significant decreased fetal body weight was seen only at 100 ppm, the highest dose tested (Table 7.2). A mechanism for the fetal effect of decreased body weight in the study is not obvious. The effects on fetal body weight may be due to the parent compound, which can cross the placental wall, and/or to one of more benzene metabolites. The Keller and Snyder (1988) study is a much more sensitive study than the Coate et al. study showing effects on the hematopoietic system in neonates at much lower gestational exposure levels than Coate et al. found affecting fetal body weight.

8.2 8 hour Reference Exposure Level for Benzene

The 8-hour Reference Exposure Level is a concentration at or below which adverse noncancer health effects would not be anticipated for repeated 8-hour exposures (see Section 6 of the Technical Support Document (OEHHA, 2008)).

For a health protective approach, OEHHA determined that the 8 hour REL should be the same as the chronic REL: 1 ppb (0.001 ppm; 3 $\mu g/m^3$). It is unclear whether the adverse effects of repeated benzene exposure are reversed by overnight or over-the-weekend periods of non-exposure and they are likely to continue to worsen with additional exposure.

8.3 Chronic Reference Exposure Level for Benzene

Study	Lan et al. (2004)
Study population	250 male and female Chinese shoe workers aged 29.9 ± 8.4 years (vs. 140 controls)
Exposure method	Discontinuous occupational exposure
Exposure continuity	8 hr/day (10 m^3 per 20 m^3 day), 6 days/week
Exposure duration	6.1 ± 2.1 years
Critical effects	Decreased peripheral blood cell counts (7 categories; see Table 6.4)
LOAEL	0.57 ± 0.24 ppm (1.86 ± 0.78 mg/m^3)
NOAEL	Not found
$BMCL_{0.5SD}$	0.476 ppm (Hill Model version 2.15)(Table 8.3)
Average continuous exposure	0.204 ppm (0.476 ppm x 10/20 x 6/7)
Human equivalent concentration	0.204 ppm (0.665 mg/m^3)
LOAEL uncertainty factor (UF_L)	Not applicable with BMC
Subchronic uncertainty factor (UF_S)	√10 (8-≤12% expected lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default, human study)
Toxicodynamic (UF_{A-d})	1 (default, human study)
Intraspecies uncertainty factor	60 (see explanation below)
Toxicokinetic (UF_{H-k})	
Toxicodynamic(UF_{H-d})	
Database uncertainty factor	1 (developmental studies are available)
Cumulative uncertainty factor	200
Chronic Reference Exposure Level	**1 ppb (0.001 ppm: 3 µg/m^3)**

The chronic Reference Exposure Level is a concentration at which adverse noncancer health effects would not be expected from continuous chronic exposures (see Section 7 in the Technical Support Document (OEHHA, 2008)).

In the 219 workers exposed to <10 ppm benzene, inverse associations of cell count with benzene exposure were statistically significant ($p < 0.05$) for total WBCs, granulocytes, lymphocytes, B cells, and platelets. This allowed exploration of which cell might be the most sensitive indicator. The point of departure for the REL was derived using the changes in B cell levels (Lan et al., 2004), which were considered the most sensitive endpoint, as a function of benzene concentration (Table 6.1.4) and the continuous models in the BMDS software. The Hill model (version 2.15) in the BMDS software gave acceptable values for fit and the lowest AIC. We specified a risk of 0.5 estimated standard deviation from the control mean as the benchmark and obtained a BMC of 1.62 ppm and a BMCL of 0.476 ppm (p value for fit = 0.303) (Table 8.4). The U.S. Environmental Protection Agency (USEPA) has suggested use of 1 standard deviation from the control mean as a benchmark but a $BMCL_{1SD}$ could not be obtained with the B cell data using the Hill model (Table 8.4).

Table 8.4. Benzene B cell data in BMDS 2.2 (Hill Model Version: 2.12; 02/20/2007)

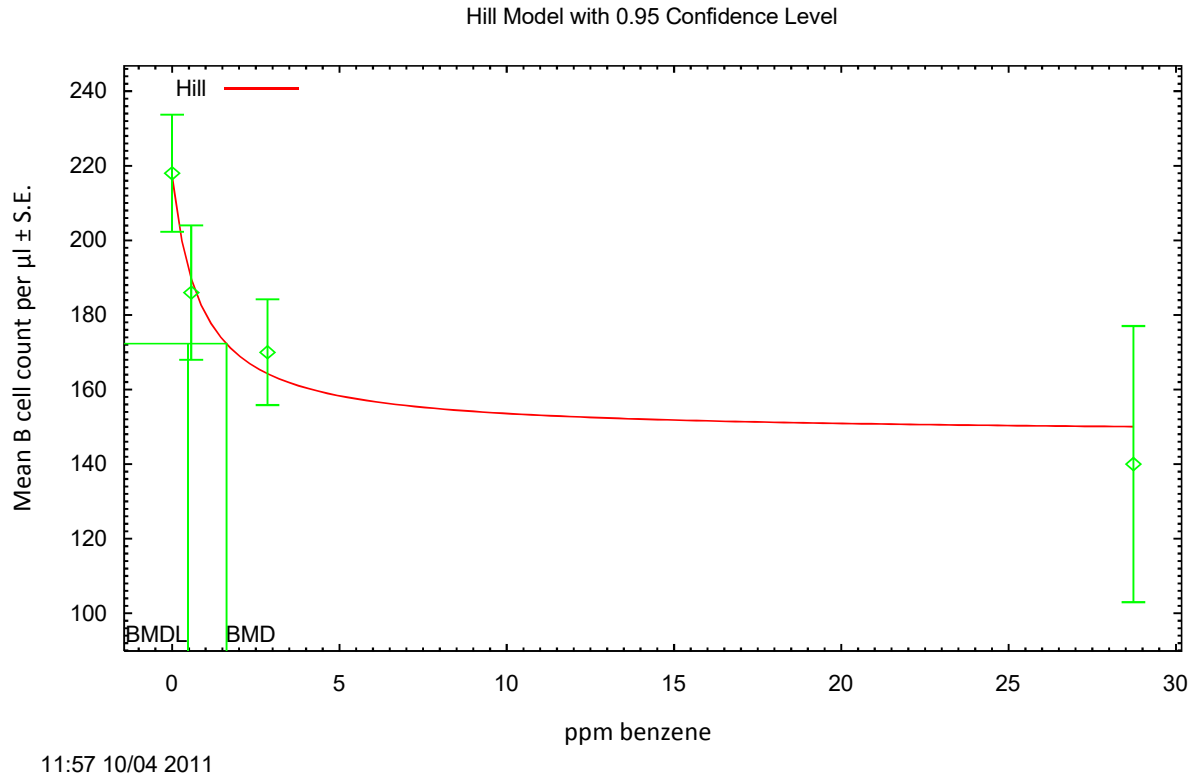
Model	BMC (ppm)	BMCL (ppm)	BMC/BMCL	p (test 4)	AIC (fitted)
Constant variance (rho = 0)					
Polynomial 0.5 SD	3.04	2.05	1.5	0.04099	3907.44
Exponential 0.5 SD (Models 4 and 5)	1.22	0.44	2.8	0.1105	3905.811
Power 0.5 SD	20.35	14.03	1.7	0.0006241	3916.02
Linear 0.5 SD	20.35	14.03	1.7	0.0006241	3916.02
Hill 0.1 SD	0.131	0.0299	4.4	0.303	3904.325
Hill 0.25 SD	0.422	0.1039	4.1	0.303	3904.325
Hill 0.5 SD	**1.624**	**0.4764**	**3.4**	**0.303**	**3904.325**
Hill 0.05 Relative Dev	0.164	0.038	4.3	0.303	3904.325
Hill 1.0 SD	Failed (BMR not in range of mean function)				
Variance not constant (rho ≠ 0)					
Hill 0.1 SD	0.129	Failed	-	0.663	3904.575
Hill 0.25 SD	0.427	Failed	-	0.663	3904.575
Hill 0.5 SD	1.813	Failed	-	0.663	3904.575
Hill 1.0 SD	Failed (BMR not in range of mean function)				

The Lan *et al*. (2004) study is more sensitive than both the Tsai *et al*. (1983) study, used previously by OEHHA for its chronic REL (OEHHA, 2000), and the Rothman *et al*. (1996) study used by USEPA for its Reference Concentration (RfC). Effects on the hematologic system are seen at a level where Tsai *et al*. did not find significant changes. However, as indicated above, at least half (≥ 50%) of the exposures in Tsai *et al*. were less than 0.1 ppm, the median concentration. In Lan *et al*., 0.09 ppm is two standard deviations below the mean of 0.57 ppm indicating that in Lan *et al*. only 2.5 percent of the exposures were below 0.09 ppm. The findings of significant depression in some blood cell counts at ≤ 0.25 ppm by Qu *et al*. (2002) and at 0.79 ppm by Khudar *et al*. (1999) are compatible with the results of Lan *et al*. (2004). Schnatter et al. (2010) found decreases in total WBC, but the study did not differentiate cell types using cell markers. Differences in benzene effects on WBC sub-types could not be seen by the

methods used in Scnhatter et al (2010). Thus, it was not as detailed or specific about which cells were affected by benzene exposure as the Lan et al (2004) study. Using the available information from the study on total WBC counts, OEHHA derived a comparison REL from Schnatter et al (2010) using a NOAEL approach (see below) that was higher than that derived from Lan et al (2004)

Figure 8.3 shows the graph of the Hill model fit to the data of benzene level in ppm on the X axis and mean B cell counts on the Y axis.

Figure 8.3. The continuous Hill model fit to the B cell data of Lan et al. (2004).



Human Inter-individual Variability and the Intraspecies Uncertainty Factor for Chronic Exposure (UF_H)

A combined intraspecies uncertainty factor (UF_H) of 60 was used instead of separate toxicokinetic and toxicodynamic factors since there were reasons for and against higher and lower values for each subfactor.

As described in Section 4 above, PBPK models for benzene are available in mice, rats, and humans. The hematological effects in the key study (Lan et al., 2004) have a plausible mode of action involving toxic metabolites of benzene, although the details of this mechanism are not completely characterized. A number of the human studies described in Sections 4 through 6 examined the extent of inter-individual variability in

the human population on benzene metabolism and toxicity, including the impacts of various genetic polymorphisms in enzymes believed to be involved in benzene metabolism. These have included enzymes believed to have a role in either activation or detoxification of reactive metabolites.

By default, OEHHA uses an intraspecies toxicokinetic uncertainty factor (UF_{H-k}) of 10 (OEHHA, 2008), which is generally thought to make allowance for the expected variability in kinetic factors including differences between infants and children and adults. However, for benzene there are sufficient compound-specific data in humans to address the question of whether this default is adequate in this case. Most benzene-specific reports of toxicokinetic influences on chronic benzene poisoning in adult workers are consistent with the default value of 10 (Table 8.5).

TABLE 8.5 INTER-INDIVIDUAL VARIABILITY IN BENZENE METABOLISM AND TOXICITY

Reference	Ratio	Comment
Variability in observed odds of chronic benzene poisoning due to occupational exposure		
(Rothman et al., 1997)	OR*=7.6 (95%CI 1.8-31.2)	Increased chlorzoxazone metabolism and null NQO1 (see Table 6.2)
(Chen et al., 2007)	OR=20.41 (95%CI 3.9-111)	3 genes interaction – NQO1,GSTT,GSTM; 95%CI very large due to only 2 controls in top denominator (see Table 6.4)
(Sun et al., 2008)	OR (see comment)	Epoxide hydrolase alleles very variable; GAGT haplotype increases (OR=7.8; 95%CI 2.73-18.38) and GGGT haplotype decreases (OR=0.19; 95%CI 0.06-0.57) odds of benzene poisoning
Variability in measured enzyme activity or content		
(Ross, 2005)	Ratio = 5	**NQO1** null activity is 5 times greater in Chinese population than white (see Table 6.3)
(Hines, 2007)	Up to 10 fold	Liver content of **CYP2E1** 3rd trimester fetus vs adults (see Table 7.1) pmol CYP2E1/mg protein about 10 fold less than adult liver
	2 fold	Ratio of pmol CYP2E1/mg protein in liver (Mean + 2SD)/Mean ~2 among pre-adolescents; similar in adults
	2.4 fold	Ratio of pmol CYP2E1/mg protein in liver (Mean + 3SD)/Mean ~2.4 among pre-adolescents; similar in adults
(Hines, 2008)	See comment	**GSTM** increases steadily during gestation; readily detectable at 30 weeks. No difference in GSTM content of infant (>2 weeks to 67 weeks) and adult liver GSTM content
(Hines, 2008)	See comment	**EPHX1** present in gestational liver samples; activity ranged from 41 to 306 pmol/min/mg protein in 8 to 22 week gestation samples; adult samples 424 ± 236 pmol/min/mg protein.
Population variability in benzene metabolism		
(Rappaport et al., 2013)	3.5	Ratio (90th percentile /median) for hydroquinone metabolite of benzene in Chinese workers (see Table 8.6 below)

*Odds ratio of benzene poisoning in adults

Chinese workers with high rates of chlorzoxazone metabolism (due to CYP2E1 and CYP1A2 (Neafsey et al., 2009)) and no NQO1 had an odds ratio (OR) of 7.6 for benzene poisoning compared to those with low chlorzoxazone metabolism and normal NQO1 activity (Table 6.2) (Rothman et al., 1997). The prevalence of no NQO1 activity is five times greater (22.4% vs. 4.4%) in the Chinese population compared to non-

Hispanic whites (Ross, 2005) (Table 6.3). A three genes' interaction revealed a 20.41-fold increased risk of poisoning in subjects with the NQO1 T/T genotype and with the GSTT1 null genotype and the GSTM1 null genotype compared with those carrying the NQO1 C/T and C/C genotype, GSTT1 non-null genotype, and GSTM1 non-null genotype (Chen et al., 2007). However, the 95% confidence interval for the OR of 20.41 was quite large (3.9-111) (Table 6.5), which indicates substantial uncertainty in the estimate of the OR.

GSTM1 null activity is slightly more prevalent in the adult Chinese population than among Caucasians (58% vs 53%), while GSTT1 null activity is nearly three times higher among Chinese than Causasians (57% vs 20%)(Table 6.4).

Some portion of these variations in genotype and enzyme levels, which make a person more sensitive to benzene, is present in the population of Chinese workers studied in Lan et al. (2004), which was used as the basis of the 8-hour and chronic RELs. Although the production of toxic metabolites and rates of detoxification are both involved in toxicity, the observation that CYP2E1 levels are up to 10-fold lower in the third trimester fetus relative to the adult liver (Table 7.1) provides some support for a 10-fold variability in toxicokinetic uncertainty among humans.

These variations in genotype and enzyme levels, which make a person more or less sensitive to benzene, were further studied by Kim, Rappaport and others. Rappaport presented supplemental material (Rappaport et al., 2013) in which they showed results of a reanalysis of the original studies (Kim et al., 2006b) correcting for sampling variability in the calibration model. Variation in the amounts of different metabolites of benzene was calculated at various exposure levels; those in the low dose range are the most relevant for consideration of REL development. Percentiles of these modeled values for a 30 ppb (98 $\mu g/m^3$) benzene exposure are shown in Table 8.6. The results of this model indicate about a 5 fold variation in production of total metabolites at a 30 ppb exposure in humans from the 10th to the 90th percentile. The ratio of the 90th percentile of the toxic hydroquinone metabolite to the median is around 3.5. These results are consistent with a toxicokinetic variability factor of roughly 10.

Table 8.6 Percentiles of the predicted metabolite levels at 30 ppb benzene using a bootstrap procedure that accounts for sampling variability in the calibration model (Rappaport et al., 2013).

Benzene (ppb)	Metabolite	p10	p25	p50	p75	p90
30	Muconic acid	10.9**	16.2	22.4	28.6	34.7
30	SPMA*	0.0	0.0	0.1	0.1	0.1
30	Phenol	110.1	264.7	412.4	574	724.2
30	Catechol	0.0	0.0	50.2	98.3	132.8
30	Hydroquinone	0.0	0.0	13.3	29.0	47.1
30	Sum*	172.7	337.9	510.1	705.1	848.7

* SPMA, S-phenylmercapturic acid; sum, sum of predictions from the 5 models of individual metabolites

** µmol/L in urine

In a modeling study (Bois et al., 1996) based on three research workers in Finland Pekari et al., 1992), interindividual variation in toxicokinetic parameters was decribed by population-based distributions with geometric standard deviations between 1.2 and 1.4. On the other hand, the PBPK model-estimated quantity of benzene metabolized in human bone marrow at 1 ppm benzene continuous exposure ranged from 2 to 40 mg/day, a 20-fold variation (based on ± three standard deviations from the mean). The authors pointed out that this range is mainly reflective of the large model uncertainty because of the limited information on metabolism in human bone marrow, rather than indicating such considerable inter-individual variation in the actual values. The confidence in this result is limited by the small number of subjects and large model uncertainty.

These studies provide some indications of the range of variation in metabolism of benzene, and the relationship between some polymorphisms and odds of chronic benzene poisoning. The overall objective of applying an intraspecies uncertainty factor in risk assessment is to protect subpopulations which are recognized as present to a significant degree in the general population. It has been argued that a suitable value for a variability factor, such as the human toxicokinetic subfactor for intraindividual variability (UF_{H-k}), is the ratio of the (median + 3 SD), approximately the 99th percentile, to the median (Meek et al., 2002). This is distinct from the overall range (from some stated upper to lower confidence interval). On the other hand these distribution-based approaches to defining the uncertainty factor (UF) are hard to apply to situations where there are many factors contributing to human variability in toxicokinetics and toxicity, as is likely for benzene toxicity. Further, due to the complex network of interrelated metabolic pathways, a percentage variation in a particular enzyme level does not automatically translate into a similar difference in the overall level of toxic metabolites.

The studies for which these ranges of variation are reported are in healthy adults (workers or volunteers), so they do not necessarily reflect the variation expected for infants and children. We noted earlier that CYP2E1 levels are up to 10-fold lower in the third trimester fetus relative to an adult (Table 7.1, based on Hines, 2007). Since the levels early in fetal development are essentially zero, the range of variation is very large if the whole gestational period is included, although maternal metabolism is probably the dominant factor in the early part of this period. The detoxifying enzymes also vary; GSTM for example is low early in gestation increasing steadily through the second and third trimesters and postnatally. Such variation in expression of CYP2E1, GSTM and other enzymes involved in benzene metabolism between young and adult lifestages is in addition to that observed as interindividual variability among adults.

Obesity changes the kinetics of benzene metabolism since benzene is fat soluble (Sato et al., 1975). As noted in Section 4.1, there is evidence that clearance of benzene is slower in women than men likely due to a higher body fat content and thus larger volume of distribution. Interestingly, obesity also increases the level of CYP2E1. In overfed, obese male Sprague-Dawley rats (978 ± 233 g), the total P450 content of liver was elevated 88% over non-obese controls (583 ± 83.7 g). Microsomal ethanol oxidation, which is a function of CYP2E1, was 19% per gram of liver and 87% per total

liver higher in obese rats relative to controls (Salazar et al., 1988). Investigators in Tennessee compared nine obese women (119 ± 16 kg) with nine age-matched control women (72 ± 11 kg) and reported a significantly increased clearance of orally-administered chlorzoxazone in the obese women (6.23 ± 1.72 vs. 4.15 ± 0.81 ml/min-kg, normalized by body weight). The absolute mean difference between control and obese was 2.47 fold (O'Shea et al., 1994). Since increased chlorzoxazone metabolism is due in part to CYP2E1 and is associated with increased risk of benzene poisoning (Rothman et al., 1997), obesity may be another risk factor for adverse effects of benzene, and another consideration in the value of the intraspecies uncertainty factor.

The above discussion reflects only consideration of the toxicokinetic variation in the human population. Toxicodynamic variability is addressed below. However, that source of variability is partially included in the overall extent of variation noted in studies (e.g., Chen et al. 2007, shown in Table 8.5) where benzene poisoning was measured as a function of metabolic enzyme genotype.

Most of the available studies suggest that the default value of 10 for UF_{H-k} covers the expected variability in metabolic capabilities. Although compared to the California population there is incomplete representation of ethnic groups, it is important to note that the population examined in the critical study (Lan et al., 2004) does include representation of the genetic polymorphisms most clearly recognized at this point as affecting metabolic capabilities, and was in fact the basis for one of the studies of diversity in metabolic capability. Therefore the response data reflect at least some, although not all, of the variability in toxicokinetics in the target population for REL derivation. There are still concerns for lack of information about toxicokinetic effects in young humans. Further, the study by Chen et al (2007) suggests a larger than 10 fold variability based on genetic polymorphisms for metabolic enzymes involved in the activation and detoxification of benzene.

The intraspecies UF_{H-d} (toxicodynamics) is used to account for pharmacodynamic variability among pregnant women and their fetuses and among infants, children, and adults (OEHHA, 2008). During embryonic and fetal development hematopoiesis first occurs in the extraembryonic yolk sac, then in the liver and thymus, and finally in the bone marrow during the second and third trimesters (Peault, 1996). Blood cell type and rates of formation change with age (e.g., Table 7.3) and would be expected to be more dynamic during pre- and post-natal developmental stages than in adults. Further discussion of this subfactor can be found in the acute REL derivation above. However, unlike the acute REL where a sensitive developmental stage was the critical effect, the key study for the chronic REL involved only exposures and effects in adult workers.

In view of the remaining uncertainties with regard to toxicokinetics in infants and children, and the larger variation in response observed by Chen et al. (2007) based on specified metabolic enzyme gene polymorphism interactions, we consider it prudent to assign an overall uncertainty factor for human inter-individual variability of 60, which is twice the default. This UF_H is not further subdivided into UF_{H-k} and UF_{H-d} since this assignment is uncertain.

As a comparison chronic REL, OEHHA used the study by Schnatter and colleagues of a different group of Chinese workers exposed to benzene (Schnatter et al., 2010).

Study	Schnatter et al. (2010)
Study population	855 male and female exposed Chinese workers (vs. 73 controls)
Exposure method	Discontinuous occupational exposure
Exposure continuity	8 hr/day (10 m^3 per 20 m^3/day), 6 days/week
Exposure duration	Not specifically stated in text but only 4-9 years for factories D and E
Critical effects	Decreased neutrophils and decreased platelet volume
LOAEL	7.77 ppm (25 mg/m^3)("change point")
NOAEL	Not identifiable
BMCL	Data not available to calculate
Average continuous exposure	3.3 ppm (7.77 ppm x 10 m^3/20 m^3 x 6d/7d)
Human equivalent concentration	*3.3 ppm (10.8 mg/m^3)*
LOAEL uncertainty factor (UF_L)	√10 (change point near threshold)
Subchronic uncertainty factor (UF_S)	√10 (8-≤12% expected lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default, human study)
Toxicodynamic (UF_{A-d})	1 (default, human study)
Intraspecies uncertainty factor	60 (see above for key study)
Toxicokinetic (UF_{H-k})	
Toxicodynamic(UF_{H-d})	
Database uncertainty factor	1 (developmental studies are available)
Cumulative uncertainty factor	600
Chronic Reference Exposure Level	**6 ppb (18 µg/m^3)**

The comparison REL is higher than that derived using the key study. OEHHA staff did not consider the study superior to the key study (Lan et al., 2004). Among its specific limitations (1) it used a relatively small number of controls (1 control per ~11 exposed) which decreased its power, (2) length of employment of the workers was not given, and (3) the study did not examine the lymphocyte subtypes, whereas the Lan study did.

The federal Agency for Toxic Substances and Disease Registry (ATSDR) developed a draft Minimal Risk Level (MRL) for chronic (365 days or more) exposure to benzene of 0.003 ppm (10 µg/m^3) based on the Lan *et al*. (2004) study (ATSDR, 2005; Wohlers et al., 2006; Wilbur et al., 2008). ATSDR also used the data on B cells (see Table 3 above) in the continuous Hill model. However, they defined the BMR as 0.25 standard deviation from the mean, and got a BMC of 0.42 ppm and a BMCL of 0.10 ppm.

In 2003, USEPA derived a Reference Concentration (RfC) for benzene of 10 ppb (30 μg/m^3) using the decreased lymphocyte counts in the Rothman *et al*. (1996) study (see Table 6.1), a benchmark dose approach, and their judgment of appropriate uncertainty factors (a factor of 10 for use of a LOAEL due to lack of an appropriate NOAEL, a factor of 10 for intraspecies variability, a factor of 3 for subchronic-to-chronic extrapolation, and a factor of 3 for database deficiencies, especially the lack of two-generation reproductive and developmental toxicity studies for benzene) (IRIS, 2007). This RfC was derived prior to the publication of Lan et al. (2004).

8.4 Data Strengths and Limitations for Development of the RELs

Both the animal and human databases for benzene are extensive compared to many other chemicals in commerce. However, a major data gap is the absence of health effects data in infants and children and in young animals. The hematopoietic system of a growing child must not only keep up with blood cell turnover but must also supply extra cells for a growing body. Rapidly dividing cells are more prone to mutation and other cellular changes resulting from chemical exposure. Thus infants and children may be more sensitive to benzene and its metabolites.

A data gap of a specific test is that of a two-generation reproductive study (Chapin and Sloane, 1997). USEPA considered that this gap warranted an additional "database" uncertainty factor in its benzene RfC derivation. Due to the otherwise extensive animal and human data available for benzene, including developmental studies in animals, we did not apply such a factor. OEHHA's acute REL is based on a developmental study in mice.

8.5 Benzene as a Toxic Air Contaminant Especially Affecting Infants and Children

Under Health and Safety code Section 39669.5, OEHHA establishes and maintains a list of Toxic Air Contaminants (TACs) that may disproportionately impact infants and children. OEHHA evaluates TACs for addition to this list as we develop Reference Exposure Levels for TACs. In view of the wide-spread exposure to benzene, the documented toxicokinetic variability in benzene metabolism, the transplacental genotoxicity and developmental toxicity of benzene, the documented increased sensitivity of early in life exposure to benzene carcinogenicity in animals, as well as the dynamic hematopoiesis that occurs during human development, there is valid concern that benzene exposure may disproportionately impact infants and children.

In addition to the concern regarding increased early-in-life exposure resulting in noncancer effects described in this document, increased sensitivity of the young to the carcinogenic effects of benzene is also a major concern and is described in this section as well. Benzene causes leukemia in exposed workers, including acute myeloid

leukemia(AML) and acute non-lymphocytic leukemia. A positive association has also been found between benzene exposure in workers and acute lymphocytic leukemia, chronic lymphocytic leukemia, multiple myeloma, and non-Hodgkin lymphoma. A recent report on petroleum workers found that cumulative benzene exposure showed a monotonic dose-response relationship with myelodysplastic syndrome, considered a type of cancer by IARC (Schnatter et al., 2012).

Acute lymphoblastic leukemia is the most common childhood cancer (~80%); other types of leukemia including AML also occur in children (IARC, 2012). Some epidemiological studies have reported statistically significant associations of increases in childhood leukemia, especially acute non-lymphocytic leukemia, with maternal exposures during pregnancy or paternal exposures prior to conception to benzene or benzene-containing mixtures (Shu et al., 1988; Buckley et al., 1989; McKinney et al., 1991). These findings are consistent with evidence in animals that exposure to benzene (1) induced transplacental genotoxicity (Ning et al., 1991), (2) altered hematopoiesis transplacentally (Keller and Snyder, 1988), (3) increased the frequency of micronuclei and DNA recombination events in haematopoietic tissue of fetal and post-natal mice (Lau et al., 2009), and (4) induced transplacental carcinogenicity (Badham et al., 2010), and with evidence that (5) Chinese workers incur chromosomal damage in their sperm at exposures < 1 ppm benzene (Xing et al., 2010; Marchetti et al., 2012). However, other epidemiological studies did not find an association between occupational paternal exposure to benzene and childhood leukemias.

In animals, exposures to benzene early in life and through adulthood resulted in a 2-fold higher increase in the incidences of cancer compared to exposures only as adults (Maltoni et al., 1989).

In an in vitro cell-based assay, the cytotoxic and apoptotic effects of hydroquinone were more apparent and the reduction in colony formation was more severe in embryonic hematopoietic stem cells (HSC) than in adult HSCs (Zhu et al., 2013).

Several studies, summarized in Section 7, suggest an association of exposure to benzene and adverse developmental outcomes in humans (Slama et al., 2009; Lupo et al., 2011; Zahran et al., 2012). Benzene is listed under California's Proposition 65 as a chemical known to the state to cause male developmental toxicity.

OEHHA recommends that benzene be identified as a toxic air contaminant which may disproportionately impact children pursuant to Health and Safety Code, Section 39669.5(c).

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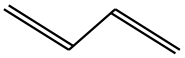
1,3-Butadiene Reference Exposure Levels

(butadiene; buta-1,3-diene; biethylene; bivinyl; divinyl; vinylethylene)

CAS 106-99-0



1 Summary

The Office of Environmental Health Hazard Assessment (OEHHA) is required to develop guidelines for conducting health risk assessments under the Air Toxics Hot Spots Program (Health and Safety Code Section 44360 (b) (2)). In response to this statutory requirement OEHHA developed a Technical Support Document (TSD), adopted in December 2008,that describes acute, 8-hour and chronic RELs. The TSD presents methodology that explicitly includes consideration of possible differential effects on the health of infants, children and other sensitive subpopulations, in accordance with the mandate of the Children's Environmental Health Protection Act (Senate Bill 25, Escutia, chapter 731, statutes of 1999, Health and Safety Code Sections 39669.5 et seq.). These guidelines have been used to develop the following RELs for butadiene; this document will be added to Appendix D of the TSD.

Butadiene is a major commodity product of the petrochemical industry. Workers acutely exposed to butadiene during rubber manufacturing experienced irritation of the eyes, nasal passages, throat, and lung. Some workers also experienced coughing, fatigue, and drowsiness. Inhalation of butadiene is mildly narcotic at low concentrations. Exposure to very high concentrations can result in narcosis, respiratory paralysis, and even death. Repeated exposure can damage human sperm cells and increase ovarian atrophy in mice. The studies reviewed for this document include those published through August 2012.

Although butadiene is a carcinogen (IARC Group 1, IARC, 2012), this document does not discuss issues related to the cancer potency factor. That has been previously derived and is available at www.oehha.ca.gov/air/hot_spots/index.html.

1.1 Butadiene Acute REL

Inhalation reference exposure level	**660 µg/m^3 (297 ppb)**
Critical effect(s)	Lowered male fetal weight
Hazard Index target(s)	Development

1.2 Butadiene 8-Hour REL

Inhalation reference exposure level	**9 µg/m^3 (4 ppb)**
Critical effect(s)	Increased incidence of ovarian atrophy in mice
Hazard Index target	Female reproductive system

1.3 Butadiene Chronic REL

Inhalation reference exposure level	**2 µg/m^3 (1 ppb)**
Critical effect	Increased incidence of ovarian atrophy in mice
Hazard Index target	Female reproductive system

2 Physical & Chemical Properties

Description	Colorless gas
Molecular formula	C_4H_6
Molecular weight	54.09 g/mol
Density	0.6211 g/ml at 20 ºC
Boiling point	-4.4 ºC
Melting point	-108.9 ºC
Vapor pressure	2100 mm Hg at 25 ºC
Flashpoint	- 76 ºC
Flammability limits	Extremely flammable
Solubility	Very slightly soluble in water ; soluble in ethanol, ether, acetone, benzene and organic solvents
Odor threshold	0.0014 mg/l; mildly aromatic with slight petroleum odor
Octanol-water partition coefficient	Log Kow = 1.99
Henry's Law constant	0.074 atm m^3/mole (HSDB, 2011)
Conversion factor	1 ppm = 2.21 mg/m^3 at 20 ºC, 1 bar 1 mg/m^3 = 0.445 ppm at 20 ºC, 1 bar

3 Occurrence and Exposure

1,3-Butadiene (butadiene, BD) is a major commodity product of the petrochemical industry. The largest quantities are used in the production of styrene-butadiene rubber copolymers for car and truck tire manufacturing. Butadiene polymers are also used in a variety of other industrial applications, including the production and synthesis of certain latex products, resins, and nitrile rubbers. Most environmental releases of butadiene (78.8%) are associated with non-point or mobile sources such as motor vehicles. About 1.6% of butadiene releases are fugitive or accidental emissions during manufacture,

use, transport, storage, or disposal. The remainder comes from other sources including direct volatilization from gasoline, stack emissions from incinerators, cigarette smoke, and the burning of plastics (U.S. EPA, 2002; HSDB, 2004). Butadiene is a component of gasoline (Kane and Newton, 2010) as well as a product of the combustion of minor gasoline components, olefins and cyclohexane (Zhang et al., 2008). Approximately 26 percent of butadiene emissions in California can be attributed to on-road motor vehicles, with an additional 27 percent attributed to other mobile sources, such as recreational boats, off-road recreational vehicles, and aircraft. Area-wide combustion sources contribute approximately 21 percent and include agricultural waste burning, open burning associated with forest management, and woodstoves and fireplaces. Stationary sources contribute less than one percent of the statewide 1,3-butadiene emissions. The primary stationary sources with reported 1,3-butadiene emissions are petroleum refining, manufacturing of man-made materials, and oil and gas extraction. The primary natural sources of 1,3-butadiene emissions are wildfires. The total statewide emission inventory for butadiene was estimated at 3,754 tons for 2008 (CARB, 2009).

Butadiene is subject to rapid destruction by reactions in the atmosphere in the presence of O_3, OH radical, and NO_x from which a number of reactive electrophiles are formed, including acrolein, formaldehyde, epoxybutene, and other aldehydes (Tuazon et al., 1999; Baker et al., 2005; Doyle et al., 2007). Baker et al. (2005) investigated the formation of butadiene and hydroxyl radical-initiated reaction products using atmospheric pressure ionization mass spectrometry (API-MS) and solid phase extraction followed by gas chromatography. The products from butadiene were identified as 4-hydroxy-2-butenal ($HOCH_2CH=CHCHO$) and its nitro derivative ($HOCH_2CH=CHCH_2ONO_2$) and isomers. The rate constant for the reaction of OH radicals (OH) with 1,3-butadiene was 6.66×10^{-11} $cm^3molecule^{-1}s^{-1}$ and with 4-hydroxy-2-butenal was $(5.7\pm1.4) \times 10^{-11}$ $cm^3molecule^{-1}s^{-1}$ both at 298±2K. The formation yields of acrolein and 4-hydroxy-2-butenal were 58±10% and 25+15-10%, respectively. Hydroxynitrates from the reaction of hydroxyperoxy radicals with NO account for an additional 7-10% of products from butadiene. Acrolein also reacts with OH radicals to form glycolaldehyde ($HOCH_2CHO$) with yields of 25 to 32 percent. For 1,3-butadiene the reaction with OH radicals is the dominant chemical loss process during daytime, with butadiene lifetimes of 1-2 hr at OH concentrations of 2×10^6 molecules/cm^3.

Sexton et al. (2007) investigated the photochemistry of 1,3-butadiene in an outdoor smog chamber. The butadiene atmospheric lifetime and transformation rates were dependent on concentrations of NO, NOx, other organic compounds, sunlight, temperature, and humidity. The results were compared with computer-based simulations of butadiene transformations (Morphecule Mechanism model). The major observed products with daytime BD/NOx were acrolein, formaldehyde, furan, 1,3-butadiene monoxide and an organic nitrate probably peroxyacylnitrate . Other carbonyls found were glyoxal, glycolaldehyde, glycidaldehyde, 3-hydroxy propanaldehyde, hydroxyl acetone, butenedial, and malonaldehyde. The model simulations were representative of the observed results.

Doyle et al. (2004) studied the photochemical degradation of 200 ppb 1,3-butadiene in presence of 50 ppb NO. The initial and major photochemical products were acrolein, acetaldehyde and formaldehyde. They observed that the photoproducts were more

toxic to A549 human lung cells in vitro than butadiene. In a similar study Doyle et al. (2007) showed that BD + NOx + 5 hours light was more toxic to A549 cells than a synthetic mixture of acrolein, formaldehyde and ozone photoproducts or ozone alone. The photoproducts of butadiene were primarily acrolein, acetaldehyde, formaldehyde, furan and ozone. Toxicity was assessed by increased lactate dehydrogenase (LDH) release and increased interleukin-8 (IL-8) and interleukin-6 (IL-6) protein release.

3.1 Ambient Exposures

Despite its rapid removal, butadiene is almost always present at very low concentrations in US cities and large suburban areas.. Elevated concentrations have been measured in the vicinity of heavily trafficked areas, refineries, chemical manufacturing plants, and plastic and rubber factories (ATSDR 1992). Statewide levels throughout California have consistently dropped from an annual average high of 0.41 ppb in 1990 to approximately 0.1 ppb in 2007. Sampling of 18 communities in the San Francisco Bay area showed a maximum butadiene concentration of 0.26 ppb (San Jose). The majority of all samples were below the minimum detection limit (MDL) of 0.05 parts per billion by volume (ppbv) (BAAQMD, 2008). Similar sampling of 10 communities in the Los Angeles air basin showed a maximum butadiene concentration of 0.78 ppb (Compton). The majority of all samples were below the MDL of 0.2 ppbv (SCAQMD, 2008). In general, mean values in southern California are about twice those in the San Francisco Bay area e.g., San Jose, 0.069 ppb vs. Compton, 0.14 ppb.

One recent study measured butadiene concentrations prior to and after the Ireland Public Health Tobacco Act of 2002 ban on smoking in pubs (McNabola et al., 2006). The average concentration of butadiene measured inside pubs prior to the ban was 4.15 $\mu g/m^3$ (± 1.61 $\mu g/m^3$). This is compared to average ambient outside measurement of 0.12 $\mu g/m^3$ (0.05 ppm) and an average indoor measurement of 0.22 $\mu g/m^3$ (0.1 ppm) following the smoking ban. Similar results were obtained in a survey of 10 Finnish restaurants with 4.3 ± 3.2 SD $\mu g/m^3$ (1.9 ppm) butadiene (geometric mean = 2.7, range = 0.26-10.1, N = 20 measurements) in smoking areas compared with 1.1 ± 1.3 SD (0.5 ppm) butadiene (geometric mean = 0.52, range = 0.11-3.9, N =20) in non-smoking areas (Vainiotalo et al., 2008).

The TEACH (Toxic Exposure Assessment, Columbia/Harvard) study characterized personal exposures to urban air toxics among high school students living in inner city neighborhoods of New York City (Kinney et al., 2002). Exposure to air toxics was analyzed in 46 high school students using 48-hr personal monitoring, outdoor ambient monitoring, and in-home ambient monitoring. The students were mainly African American and Hispanic, and were required to be non-smokers from non-smoking families. The subjects ranged in age from 12.5 to 19.6 years old, with 42% male and 58% female. Investigators measured levels of particulates and concentrations of 17 volatile organic compounds (VOCs). Butadiene levels tended to be higher in the home and from personal exposures than what was measured in ambient outdoor air. The mean outdoor concentrations of butadiene were 0.13 $\mu g/m^3$ (winter) and 0.14 $\mu g/m^3$ (summer), versus in-home ambient concentrations of 1.18 $\mu g/m^3$ in winter and 1.01

µg/m^3 in summer. Mean concentrations obtained from personal air monitors were 0.87 µg/m^3 (0.39 ppm) in winter and 1.16 µg/m^3 (0.52 ppm) in summer (Kinney et al., 2002).

Marshall et al. (2006) estimated the intake of butadiene from ambient air pollution in California's South Coast Air Basin. Butadiene concentrations were based on air dispersion modeling for the period April, 1998 to March, 1999. Surveys from 25,064 respondents were used in the study. The 28,746 person-days in the data set are from 11,749 households. Travel survey data were collected for 15-24 week periods in 2000-2002. The method used four main inputs: temporal information about people's position (latitude and longitude); microenvironment, and activity level; temporally and spatially explicit model estimates of ambient butadiene concentrations; and stochastically determined microenvironmental adjustment factors relating the exposure concentration to the ambient concentration, age-, gender-, and activity-specific breathing rates. The calculated average breathing rate (m^3/day-person) for the study was 13.1. The mean intake rate for 1,3-butadiene was 7.3 µg/day ±7.6 SD. This corresponds to an average concentration of 0.56 µg/m^3 (0.24 ppb)(7.3/13.1) or approximately 8% of the chronic REL for butadiene derived in this document.

A qualitatively similar difference between personal/indoor air and outdoor air concentrations was observed in metropolitan Mexico City (Serrano-Trespalacios et al., 2004). Personal exposures to 34 VOCs were measured for adolescents and their families living close to one of five central monitoring stations over the period of one year. Simultaneous 24-hr indoor, outdoor and central site measurements were also taken. Indoor butadiene concentrations (mean = 2.5 µg/m^3, 1.1 ppb) were 2 to 6 times higher than outdoors measurements (mean 0.9 µg/m^3, 0.40 ppb). Personal exposures for all participants including adolescents (mean = 2.9 µg/m^3, 1.3 ppb) were also significantly higher than ambient outdoor concentrations (Serrano-Trespalacios et al., 2004). Logue et al. (2011) identified 1,3-butadiene as one of nine indoor air pollutants categorized as priority hazards based on available acute and chronic health criteria. Two hundred and sixty-seven chemicals were evaluated with health criteria for 97. Butadiene was categorized based on its cancer risk, however the upper bound estimate of exposure (their Fig.2) is close to the U.S. EPA RfC of 0.9 ppb and the chronic REL derived in this document (1.0 ppb).

Gustafson et al. (2007) measured personal exposures and indoor air concentrations of butadiene, benzene, formaldehyde, and acetaldehyde due to wood burning in a small Swedish town. Ambient air concentrations of butadiene for 1 day sampling (N = 9) had a mean of 0.12µg/m^3(0.05 ppb) (95%CI, 0.04-0.16). Indoor personal monitoring in the wood burning group (N = 14) gave mean butadiene concentrations of 0.31 to 0.38 µg/m^3 (0.14 to 0.17 ppb) for 1 to 7 days sampling. The referent group (N=10) had mean values of 0.11 to 0.14 µg/m^3 (0.049 to 0.06 ppb) (P < 0.015-0.03). The authors concluded that domestic wood burning increased personal exposure to ambient butadiene as well as indoor exposures to butadiene.

Additional exposure analyses were conducted by Nazaroff and Singer (2004), who studied hazardous air pollutants including butadiene within US residences. The authors found that the population inhalation intake of butadiene was dominated by residential

environmental tobacco smoke (ETS). Mean individual intake of butadiene was also dominated by residential ETS. Data analyses indicated that some 16 million U.S. juveniles (2 months to 16 years old) are exposed to ETS in the home. Assuming between 14-20 cigarettes smoked per day in each residence, with an average of 515 µg butadiene/cigarette, the resulting daily intake of butadiene for juveniles was 16 – 37 µg. The total mean individual inhalation intake for juveniles was estimated to be approximately 10 mg butadiene/year from residential ETS, far exceeding the exposure to butadiene from ambient sources, estimated at approximately 0.3 mg/year (Nazaroff and Singer 2004).

3.2 Worker Exposures

Investigators in the US, Europe, and China report similar average exposures to butadiene in the workplace. However, approaches to exposure assessment vary. Because butadiene monomer production and extraction are generally operated currently as closed processes, exposures tend to be low. With certain tasks, or with accidents and engineering failures, there can be transiently high exposures that are brief and intense. Air measurement may not accurately reflect these peaks. Historical levels of butadiene exposure in the workplace are thought to have been much higher than present values (Lynch 2001). Few data are available for butadiene concentrations prior to the 1970s. Exposure modeling suggests that levels in the 1940s – 1950s were considerably higher, and estimated to be approximately 20 ppm (Lynch et al., 2001). There has been an annual trend of an approximate 6% drop in butadiene concentrations over time, with large decreases in the late 1950s and the early 1980s (Lynch 2001). More current measurements of butadiene in the workplace were provided by Chan et al. (2006), who measured worker exposure to air toxics in an 11-plant petrochemical complex in Taiwan. For the years 1997-1999, only 15.2% of the measurements were above the limit of detection (LOD), with a mean low concentration of 7.7 ppb, a mean high concentration of 10.5 ppb, and a maximum concentration of 3080 ppb butadiene. Specific LODs were not given for the 39 chemicals studied but the mean low concentrations were calculated using 0 for values below the LOD and the mean high concentrations were estimated using LOD/$\sqrt{2}$ for values below the LOD.

Sapkota and colleagues evaluated butadiene exposure of tollbooth workers in the Baltimore Harbor Tunnel during the summer of 2001. Mean ambient butadiene concentrations outside the tollbooths varied by shift, with the morning levels (19.8 µg/m^3) exceeding afternoon levels (14.9 µg/m^3). The lowest concentrations were measured at night, and averaged 4.9 µg/m^3. Considerable protection was offered by the tollbooth itself, within which ambient concentrations even in the height of traffic only measured 6.7 µg/m^3 (3 ppb) butadiene (Sapkota et al., 2005).

Ammenheuser et al. (2002) evaluated BD exposure in 49 workers in a styrene-butadiene rubber plant. The concentration of the butadiene metabolite 1,2-dihydroxy-4-(N-acetylcysteinyl-S)-butane (M1) in urine was used as a biomarker of butadiene exposure and the frequency of hypoxanthine-guanine phosphoribosyl transferase (*HPRT)* mutations in peripheral blood lymphocytes was used as a biomarker of effect. The workers were divided into high and low exposure groups according to job

description and work area. The average butadiene exposure concentrations (by personal organic vapor badge dosimeters) for the two groups were high, 1.48 ppm and low, 0.15 ppm ($P < 0.002$). Both mean M1 and *HPRT* mutant frequencies were more than three-fold higher in the high group than in the low group ($P < 0.0005$). For the high exposure group (N = 19-22) urine M1 mean was 2,046 ± 348 SE ng/mg creatinine and the *HPRT* frequency was 6.8±1.2 SE x 10^{-6}. The values for the low exposure group (N = 20-24) were 585±98 ng/mg creatinine and 1.8±0.2 x 10^{-6}, respectively. The study demonstrated correlation between the three measures of butadiene exposure. All workers, even those not exposed to butadiene, excreted some M1 suggesting other exogenous and/or endogenous sources. It is uncertain whether the observed increase in mutant frequency represents an adverse effect.

4 Metabolism

Common routes of exposure to butadiene include inhalation and dermal exposure.The inhalation absorption of butadiene is dependent on its partition coefficient (log Kow = 1.99) and Henry's Law constant (0.074 atm m^3/mole). Butadiene is absorbed very quickly into the lungs and blood. Physiological modeling uses blood/air partition coefficients of about 1 for butadiene (e.g., lung/air = 0.65 in humans, Pery & Bois, 2009; blood/air = 1.22 in humans, Brochot et al., 2007). The dosimetry of butadiene in rodents has been assessed by measuring steady-state concentrations of butadiene epoxides in blood and deposition in tissues following butadiene exposure. The steady-state in vivo concentrations of epoxybutene in the blood of mice exposed to 62.5, 625, and 1250 ppm butadiene for 4 to 6 hours was 4-8 times higher than those measured in rats at these BD concentrations and exposure periods, i.e. 0.4 to 8.6 µM in mice vs. 0.01 to 2.5µM in rats (Bond and Medinsky, 2001). Average tissue epoxides in mice for exposures of 625 ppm or 1250 ppm butadiene for 6 hours ranged from 2 to 3.5 mmol/g for lung epoxybutene, 0.5 to 0.75 mmol/g for liver epoxybutene, and 0.6 to 1.5 mmol/g for lung diepoxybutane, respectively. In rats at exposures of 625, 1250, or 8000 ppm butadiene, lung epoxybutene ranged from 0.2 to 1.1 mmol/g and liver epoxybutene ranged from 0.1 to 1.2 mmol/g (Bond et al., 1996).

Butadiene metabolites play a role in the toxicity of butadiene. It is not always clear which metabolites are responsible for various observed toxicities (e.g., cardiovascular). In some cases, strong evidence implicates specific toxicological endpoints are associated with particular metabolites.

In general, studies using human tissues showed that humans metabolized butadiene more like rats than mice, with lower rates of diepoxybutane formation (Bond et al., 1996). Perez et al. (1997) report the formation of N-(2,3,4-trihydroxybutyl)valine hemoglobin adducts (THBV) from the butadiene metabolite epoxybutanediol in rats and occupationally exposed humans. The adduct levels in rats exposed to 50, 200, or 500 ppm butadiene were 13.4, 5.9, and 1.15 pmol THBV/g globin/ppm butadiene, respectively. In humans exposed to 1 ppm butadiene, hemoglobin adducts were 8.2 and 10.7 pmol THBV/g globin/ppm. The results indicate that butadiene is absorbed into human blood at relatively low concentrations and forms hemoglobin adducts at levels comparable to those seen in rats.

Once in the body, butadiene is activated, creating the toxic metabolite(s) associated with adverse effects. Activation of butadiene typically occurs in liver microsomes via P450-mediated oxidative metabolism in mammals (Bond and Medinsky, 2001). Epoxybutene is the major oxidative metabolite, which is further oxidized to diepoxybutane and hydrolyzed to epoxybutane diol by microsomal epoxide hydrolase (Bond and Medinsky, 2001; Elfarra et al., 2001) (Figure 1).

Available data indicate that metabolism is qualitatively similar among all species studied, although the rates of metabolite formation differ. Mice form the initial oxidative metabolite, epoxybutene, approximately 6 to 8 times faster than rats or humans (Csanady et al., 1992) and produce a greater proportion of active epoxide metabolites than rats (Bond et al., 1986; Himmelstein et al., 1994; Thornton-Manning et al., 1995; Csanady et al., 2011).

This greater formation of epoxy metabolites may be related to differences in the amino acid composition of the binding pocket of CYP2E1 in rodents that facilitate hydrogen bonding and increase the probability of a second epoxidation. Compared to the rat, mouse CYP2E1 has an additional methylene group in the active site that binds epoxybutene more tightly, thus further enhancing formation of the second epoxide (Lewis et al., 1997). This observed difference in the quantity of epoxides formed correlates with the observed sensitivity and higher overall toxic response in mice versus rats. In vitro data from adult liver samples indicate that humans form epoxides of butadiene at rates (Vmax/Km, where Vmax = maximum reaction rate e.g. µmoles/hr and Km = reactant or substrate concentration (S) in µmol/L giving half the Vmax, where the overall reaction rate is more precisely defined by the Michaelis-Menten relation v = Vmax x S/(Km + S)) similar to mice but less than rats (Duescher and Elfarra 1994; Krause and Elfarra 1997), although it is unclear how this relates to in vivo toxicity in humans. Other authors, notably Csanady et al. (1992), reported that the Vmax/Km ratio obtained with mouse liver microsomes was 5.6- and 8.2-fold higher than the ratios obtained with human or rat liver microsomes, respectively. The observed differences in human butadiene oxidation rates between the studies may be attributed to variability in the expression of P450 2E1, 2A6 or other P450 enzymes in the human liver samples (Duescher and Elfarra, 1994). Detoxification of butadiene epoxides also varies across species, with human tissues preferentially detoxifying the derived epoxides through microsomal epoxide hydrolase to form butane diol followed by conjugation with GSH, whereas detoxification in mice occurs through glutathione-*S*-transferase (Boogaard and Bond 1996; Kemper et al., 2001). As a result, mice predominantly excrete 1-hydroxy-2-(N-acetylcysteinyl)-3-butene (MII), while adult humans excrete mainly 1,2-dihydroxy-4-(N-acetylcysteinyl-S)-butane (MI) (Figure 1). Boogard et al. (2001) reported urinary metabolites resulting from 8 hours occupational exposure to 1 ppm butadiene: MI, 2213 µg/L and MII, 39 µg/L.

The reactive metabolites of butadiene, including 1,2-epoxy-3-butene (EB), 3,4-epoxy-1,2-butane diol (EB diol), diepoxybutane (DEB), and hydroxymethylvinyl ketone (HMVK) have been shown to covalently bind to biological macromolecules, including DNA in the testes, lung, and liver, and certain proteins, including hemoglobin (Koivisto et al., 1998; Hayes et al., 2000; Begemann et al., 2001; Boogaard et al., 2004). In vivo experiments

have demonstrated species differences in adduct formation. For example, following a nose-only 6 hr inhalation exposure of 200 ppm ^{14}C-1,3-butadiene, measured uptake in mice was almost twice that for rats; the formation of specific DNA adducts was nearly 10 times higher in mice than rats (Boogaard et al., 2004). Quantitatively similar profiles of adducts were observed in an inhalation study using 20 ppm, although the overall level of DNA adducts formed in rats and mice was very low (Booth et al., 2004).

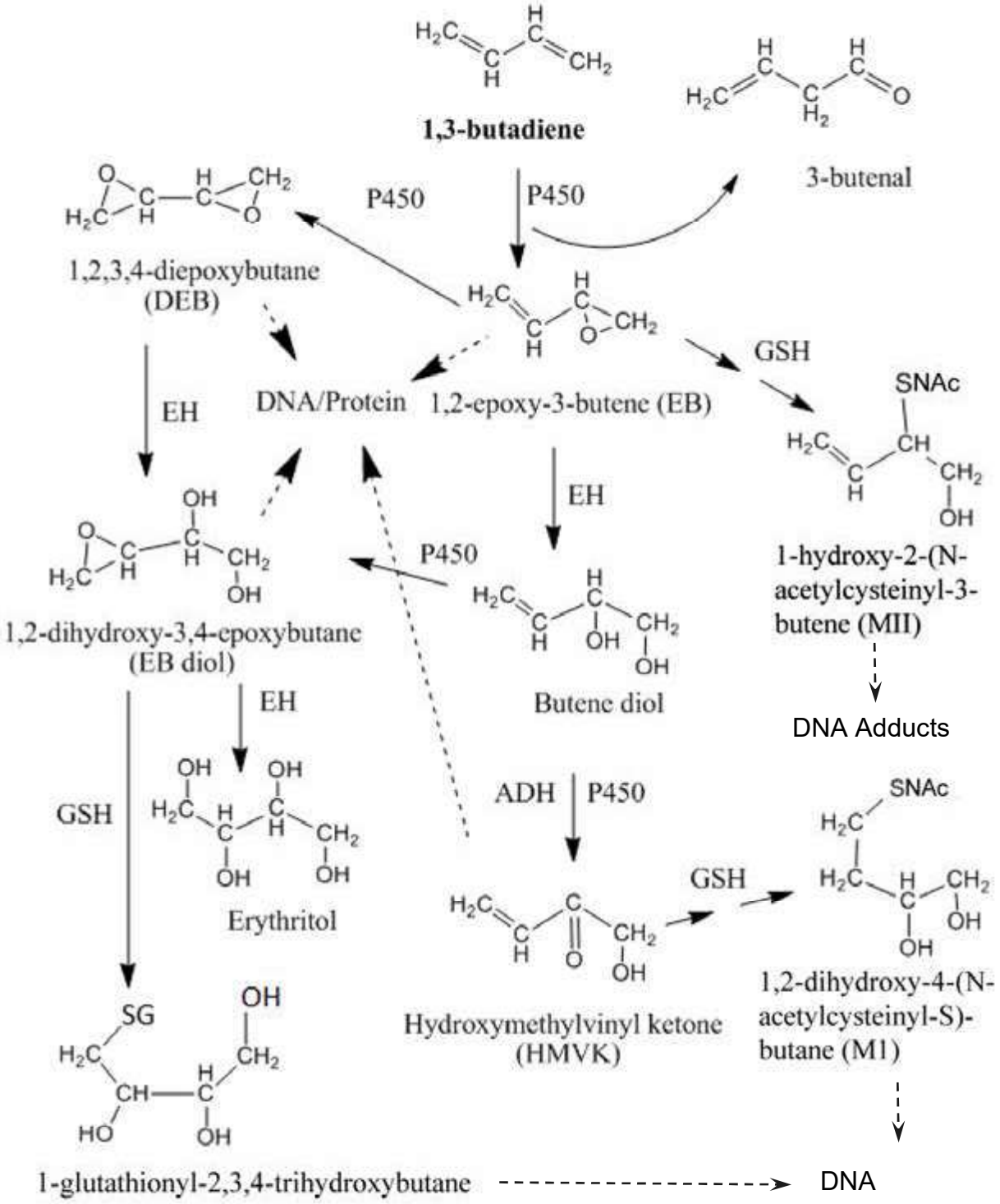


FIGURE 3 METABOLIC SCHEME FOR 1,3-BUTADIENE

This scheme presents the major identified reactive metabolites. Dashed arrows emanate from butadiene metabolites reported to form adducts with DNA or proteins. Abbreviations: EH, epoxy hydrolase; GSH, glutathione; ADH, alcohol dehydrogenase; P450, Cytochrome P450; NAc, N acetylcysteinyl; G, glutathionyl.

Cho and Guengerich (2012b) reported the mutagenicity in the *Escherichia* coli *rpoB* gene of the DEB-GSH conjugate *S*-(2-hydroxy-3,4-epoxybutyl)glutathione. Three DNA adducts were identified in the *E.coli* DEB/GST/GSH system: *S*-[4-(N(7)-guanyl)-2,3-dihydroxybutyl]GSH; *S*-[4-(N(3)-adenyl)-2,3-dihydroxybutyl]GSH; and *S*-[4-(N(6)-deoxyadenosinyl)-2,3-dihydroxybutyl]GSH.

Butadiene reactive metabolites also appear to form stable hemoglobin adducts in humans and experimental animals. In one study, Begemann et al. (2001) found that workers in a butadiene monomer production plant exposed to a median concentration of 440 $\mu g/m^3$ (0.2 ppm) had significantly increased levels of epoxybutene hemoglobin adducts versus unexposed controls. Results from another study indicated that levels of hemoglobin adducts of epoxybutane diol were substantially higher than those of epoxybutene in both inhalation-exposed rats and occupationally exposed humans (Perez et al., 1997). Forty-one butadiene polymer production workers in China were exposed to median butadiene concentrations of 2 ppm (6 hr time-weighted average) and had greater levels of hemoglobin adducts when compared with unexposed controls ($p < 0.0001$) (Hayes et al., 2000). These adduct levels were significantly correlated with butadiene concentrations ($p < 0.03$). The exposed workers did not differ from unexposed workers with respect to frequency of diepoxybutane-induced sister chromatid exchanges or aneuploidy, leading the authors to suggest that there were no correlations of biomarkers of butadiene exposure with these specific genotoxic effects (Hayes et al., 2000).

Sangaraju et al. (2012) used a more sensitive liquid chromatography-electrospray ionization tandem mass spectrometry method of measuring DEB-specific adducts in mouse liver DNA (bis-N7G-BD) following 2 weeks exposure (6hr/d, 5d/week) to various concentrations of 1,3-butadiene from 0.5 to 625 ppm. At low concentrations of 0.5, 1.0 and 1.5 ppm butadiene they found bis-N7G-BD (1,4-bis-(guan-7-yl)-2,3-butanediol) adducts at 0.17, 0.14, and $0.14/10^7$ nucleotides/ppm BD, respectively. At higher concentrations of 6.25, 62.5, 200 and 625 ppm BD the adduct levels were significantly lower at 0.051, 0.013, 0.009, and $0.006/10^7$ nucleotides/ppm BD, respectively. A similar pattern of higher efficiency of adduct formation at lower exposures was also seen with DEB-specific hemoglobin adducts by Georgieva et al. (2010). At the same low concentration butadiene exposures (0.5, 1.0 and 1.5 ppm), pyr-Val (N,N-(2,3-dihydroxy-1,4-butadiyl)valine) Hb adducts were formed at 21.0, 20.0 and 26.0 pmol pyr-Val-Hb/g globin/ppm BD. At 6.25, 62.5, 200 and 625 ppm butadiene concentrations, adduct formation was 12.0, 6.7, 3.7, and 2.5 pmol pyr-Val Hb/g globin/ppm BD, respectively.

Overall the results indicate that the efficiency of DEB reaction with cellular macromolecules is higher at lower exposure levels in mice. It is unknown whether a similar increased efficiency at low exposure levels occurs in humans. Boysen et al. (2012) have observed low but clearly detectable levels of pyr-Val-Hb in workers with 8-hr time weighted average butadiene exposures of 0.01 ppm (N = 23, controls), 0.24 ppm (N = 24, monomer workers), or 0.81 ppm (N = 34, polymerization workers). The levels of pyr-Val-Hb adducts found were 0.13, 0.16, and 0.29 ($P<0.05$ vs controls and monomer workers) pmol/g globin, respectively. The authors concluded that humans were less efficient in the formation of DEB than mice or rats at similar butadiene

exposures. HB-Val, indicative of epoxybutene concentrations, was found at 0.22, 0.47, and 2.23 pmol/g globin and THB-Val, indicative of epoxybutane diol concentrations, was found at 95, 179, and 716 pmol/g globin, respectively. The formation of DEB relative to other epoxides was significantly different in the highest exposed workers compared to controls and lower exposures. The pyr-Val concentrations in individual workers were significantly correlated with their HB-Val concentrations when analyzed combined or separately ($P < 0.01$, $P < 0.05$, respectively). In contrast the pyr-Val concentrations were significantly correlated with the THB-Val concentrations when analyzed combined or separately only for the high exposure group ($P < 0.01$).

5 Acute Toxicity of 1,3-Butadiene

5.1 Acute Toxicity to Adult Humans

There is a paucity of data on acute human exposure to butadiene. For eyes and skin, direct contact with liquid butadiene can cause burns similar to frostbite, while vapors or fumes may be irritating to the eyes. Some early occupational health studies indicated that workers exposed to butadiene during rubber manufacturing experienced irritation of the eyes, nasal passages, throat, and lung (Wilson 1944). Some workers also experienced coughing, fatigue and drowsiness, although the symptoms diminished after the exposure ceased. Inhalation of butadiene is mildly narcotic at low concentrations, and may result in a feeling of lethargy and drowsiness (Sandmeyer, 1981). Exposure to very high concentrations of butadiene can result in narcosis, respiratory paralysis, and even death. The first signs of acute exposure to high concentrations are blurred vision, nausea, paresthesia, and dryness of the mouth, throat, and nose. This may be followed by fatigue, headache, vertigo, hypotension, slowed pulse rate, and unconsciousness (ATSDR, 1992).

In more recent occupational health studies, while there were significant differences in short-term inhaled concentrations of butadiene between exposed workers (mean 1.5 $\mu g/m^3$, range 0.2 – 69.0 $\mu g/m^3$) and unexposed workers (mean 0.4 $\mu g/m^3$, range < 0.1 – 3.8 $\mu g/m^3$), biomarkers of effect, such as sister chromatid exchanges, were not different between groups of workers (Lovreglio et al., 2005). A study of 437 full-shift and 14 short-term samples indicated that exposure to butadiene in the polymer industry ranged from < 0.005 – 43.2 ppm for 8 hr samples, and 0.088 – 210 ppm for acute (15 – 120 min) exposures (Fajen et al., 1990). Data on potential adverse effects from acute exposure were not reported. Since the workers in many of these studies were exposed to mixtures of chemicals, the relationship of acute butadiene exposure and adverse effects remains unclear.

In an acute study of human physiological factors, 133 adult subjects (both male and female) were exposed to 2 ppm (4.42 mg/m^3) butadiene for 20 minutes (Lin et al., 2001) followed by purified air for 40 minutes. Five exhaled breath samples collected during exposure were used to measure the respiratory uptake of butadiene. The absorbed dose was defined as µg butadiene uptake/kg body weight. Although the subjects were given identical administered doses, there was a wide range of uptakes, 0.6-4.9 µg/kg..

The total butadiene concentration inhaled was significantly higher in males than in females; however there was no significant difference in the respiratory uptake fraction of the total concentration inhaled, which ranged from 18-74% for all participants. Females had larger body burdens per kilogram of body weight than males. Additionally, both age and smoking were negatively associated with butadiene uptake. The authors suggested that the wide range of butadiene uptake values indicates that administered dose is a poor estimator of absorbed dose or body burden (Lin et al., 2001).

Khalil et al. (2007) evaluated neurological parameters for a random cohort of 310 subjects who had been exposed to 1,3-butadiene due to accidental leakage and release of BD in an industrial area and 50 matched unexposed controls. A set of clinical neurological tests was utilized including electroencephalograms (EEGs), somatosensory evoked potentials (SSEPs), brainstem auditory evoked potentials (BAEPs), visual evoked potentials (VEPs), and electromyography/nerve conduction tests (EMG/NCT). Exposed individuals were divided into mild (N = 212) and severe (N = 98) subgroups based on preliminary testing. Among the mild subgroup the most common finding was encephalopathy characterized by headaches and light headedness that resolved within hours to six months. The electroneurodiagnostic tests were normal except for abnormal BAEPs in 21/212 (9.91%) subjects. In the severe subgroup encephalopathy was characterized by confusion, irritability, impaired judgment, altered levels of consciousness, disequilibrium, numbness, paresthesia, ataxia, weakness, nausea, vomiting, and memory deficits. The EEGs were mildly abnormal (12/98, 12%) and BAEPs and VEPs strongly so (63/98, 49/98, respectively). Within the 50 controls, one had an abnormal EEG on heavy medication and 2 (4%) had polyneuropathy with diabetes and alcohol abuse, and two had abnormal BAEPs due to deafness or hearing abnormalities. All controls had normal VEPs. The authors concluded that butadiene met the definition of a neurotoxicant. The butadiene-induced neurotoxic effects of most of the subjects were reversible except for 18 (6%) subjects that demonstrated irreversible neurotoxic effects.

5.2 Acute Toxicity to Infants and Children

The exposures most infants and children have to butadiene tend to be chronic and low level. However, by correlating changes in health effects with short-term changes in ongoing measurements of butadiene and other VOC's, it may be possible to discern the potential toxicity associated with acute exposures. This is the approach taken below to determine the effects of air pollutants on asthma exacerbation in children.

Delfino and colleagues studied the relationship between asthma symptoms in children and concentrations of ambient VOCs and criteria air pollutants, including butadiene (Delfino et al., 2003). To be eligible to participate, children were required to have a minimum 1-year history of physician diagnosed asthma and at least two symptomatic days per week that required use of a β-agonist inhaler. Twenty-two Hispanic children, aged 10 – 16, who were living within the Los Angeles air basin and who were nonsmokers from nonsmoking households, were enrolled in the study. The children kept daily symptom diaries from November 1999 through January 2000 and the severity of their symptoms was analyzed for association with ambient concentrations of

particulates, ozone, and VOCs. Regression analysis examined air pollution concentrations on the same day or up to 4 days prior to the reported asthma symptoms, thereby allowing the analysis of the lag between the measured concentrations and the onset of health effects.

Adjusted odds ratios (OR's) for more severe asthma symptoms were as follows: for 1.4 ppb NO_2, 1.27 (95% CI, 1.05-1.54); 1.00 ppb benzene, 1.23 (95% CI, 1.02-1.48); 3.16 ppb formaldehyde, 1.37 (95% CI, 1.04-1.80); 37 µg/m^3 PM_{10}, 1.45 (95% CI, 1.11-1.90); 2.91 µg/m^3 elemental carbon, 1.85 (95% CI, 1.11-3.08); and 4.64 µg/m^3 organic carbon, 1.88 (95% CI, 1.12-3.17).

Butadiene was detected in 74 daily air pollution measurements with a mean concentration of 0.51 ppb (range 0.05 – 1.50 ppb). This study presented an OR of 1.32 (95% CI = 0.97-1.80) for the association between asthma symptoms and ambient butadiene concentrations on the previous day, and an OR of 1.16 (95% CI = 0.90-1.49) for the association between asthma symptoms and same-day butadiene levels. While these estimates are elevated, the confidence intervals included no effect. Thus, the authors interpreted these results as suggestive of an increased risk of asthma symptoms in children with butadiene exposure. However, the study was limited by small numbers, as only seven subjects reported symptom scores >2 and only 16 with scores >1. Also, associations for scores >2 were strongly influenced by one subject with moderate persistent asthma (Delfino et al., 2003). Since many of these pollutant chemicals occur together it will always be difficult to tease out effects due to specific pollutants. However, such studies may be of use in comparison with studies of accidental releases of butadiene where the problem of concurrent exposures is much less.

5.3 Acute Toxicity to Experimental Animals and In Vitro Toxicity

Few studies have reported the acute or short-term effects of butadiene. The lethal concentration resulting in 50% mortality in a population (LC_{50}) was measured in an acute inhalation study using 2 hr exposures for mice and 4 hr exposures for rats (Shugaev 1969). The mouse LC_{50} was determined to be 122,000 ppm, and the rat LC_{50} was 129,000 ppm; no other effects were reported. In a National Toxicology Program study, male and female B6C3F1 mice were exposed to 0, 625, 1,250, 2,500, 5,000, or 8000 ppm butadiene in air for 15 days (NTP, 1984). Survival rates were unaffected by dosing, and no respiratory effects, cardiovascular lesions, or hepatic/gastrointestinal histopathology were noted even at the highest concentration. There was, however, a non-significant decrease in mean body weight at 8000 ppm butadiene when compared with controls (NTP 1984). No severe immunological changes were noted in humoral or cell-mediated immunity in mice exposed to 1250 ppm butadiene for 6 weeks (Thurmond et al., 1986).

The effects of butadiene inhalation (12.5 and 1250 ppm) on birth outcomes following a single acute 6-hr exposure of male mice were reported by Anderson et al. (1996). The mean number of implants per female was reduced at both concentrations compared to controls, but statistically significant only at the higher level ($p < 0.05$). A dominant lethal

effect (see Section 7.2) was not evident with the acute exposure, and there was no significant increase in post-implantation losses or fetal abnormalities.

In contrast to the results of the studies of the parent compound cited above, short-term studies of butadiene metabolites have shown acute effects, some of which were severe. Henderson and colleagues investigated the acute and sub-acute toxicity of the oxidative metabolite butadiene diepoxide in female B6C3F1 mice and in Sprague Dawley rats. Examination of the organs, including the liver, kidney, marrow, heart, and ovaries revealed that a single 6 hr inhalation exposure to 18 ppm butadiene diepoxide (3 to 4/group) induced no clinical signs of toxicity. However, the mice showed a slight increase in the number of alveolar macrophages and focal necrosis of the olfactory epithelium that started to reverse 7 days after exposure (Henderson et al., 1999). In the sub-acute portion of the study, mice (15/group) were exposed to either 2.5 or 5 ppm butadiene diepoxide for 6 hr/day for 5 days. The animals showed no body weight changes and no histopathology of the nose, larynx, or lung. However, in an earlier part of the study there was significant toxicity when mice and rats (56/group) were exposed to either 10 or 20 ppm butadiene diepoxide for 6 hr/day for 7 days. Both mice and rats experienced significant weight loss, corneal opacity, labored breathing, ruffled coats and hunched posture, as well as nasal mucosa degeneration, necrosis, inflammation, and ulceration. Additionally there were individual instances of focal hepatic necrosis and bone marrow atrophy in the mice. All but one of 56 mice from the high dose group were dead by the end of 12 days (98.2 %); by comparison, mortality in the low dose group was only 29% at 10 days of the 21 day study duration.

In a study of the butadiene metabolite 3-butene-1,2-diol, male B6C3F1 mice (4 to 5/group) were given a one-time intraperitoneal (i.p.) dose of 250 mg/kg and male Sprague Dawley rats (4 to 5/group) were given either 125, 200, or 250 mg/kg 3-butene-1,2-diol i.p. (Sprague et al., 2004). Two of the four rats dosed with 250 mg/kg died within 24 hours. Prior to death, the rats were lethargic and experienced seizures. At necropsy, it was evident that rats dosed at the highest level experienced severe hepatic necrosis and hemorrhage. The rats dosed with 200 mg/kg also showed indications of hepatic necrosis, inflammation, and hemorrhage. No other rat organ examined showed consistent dose-related lesions, although dosed rats exhibited significant hematological differences and significantly lower hepatic levels of glutathione when compared with controls (Sprague et al., 2004). Mice necropsied 4 hrs after treatment with 250 mg/kg 3-butene-1,2-diol did not exhibit any lesions, or any significant hematological changes. However, the mice did have significantly lower levels of hepatic glutathione 1 hr after treatment when compared to controls (Sprague et al., 2004). Half-lives for 3-butene-1,2-diol were calculated to be 2.12 hr in the rat and 0.44 hr in the mouse, which may partially account for the observed differences in acute toxicity between the two species (Sprague et al., 2004).

Results from a human embryonic lung fibroblast study suggest that in vitro exposure to the butadiene metabolite 1,2:3,4-diepoxybutane (100 μM for 1 hr) is associated with substantial inhibition of cell proliferation and cell cycle arrest at G_1 (Schmiederer et al., 2005). The authors suggested that cell proliferation was inhibited by a diepoxybutane-mediated alteration to cell division (Schmiederer et al., 2005). Another in vitro study

found that products from the incomplete combustion of butadiene were differentially taken up and retained by human bronchial epithelial cells (Penn et al., 2005). Investigators found that the combustion-generated “ultrafine” particles (defined by the authors as <2.5 µm aerodynamic diameter) migrated from culture medium to the cell membrane, but not into the cell interior. The organic chemicals bound to the particles, however, were found to migrate from the particle surface, through the cell membrane into the cytosol, and into cellular vesicles. The authors suggested that toxicants, including butadiene, may transfer into cells directly without the cellular uptake of the carrier particles i.e., direct uptake from the vapor phase (Penn et al., 2005).

6 Developmental and Reproductive Toxicity

6.1 Developmental Effects

Many investigators have studied the potential for butadiene and its metabolites to cause reproductive or developmental toxicity. Earlier studies focused on overall reproductive fitness following short-term exposures, while more recent studies have focused on specific effects and mechanisms of toxicity.

Some of the first studies on the reproductive and developmental toxicity of butadiene were nested within chronic studies (Owen et al., 1987; Melnick et al., 1990). The National Toxicology Program developed the first series of short-term studies to evaluate developmental and reproductive toxicity of inhaled butadiene in mice and rats (Morrissey et al. 1990). In a three-part study, Sprague Dawley rats (24-28/group), and B6C3F1 and Swiss (CD-1) mice (18-22/group) were exposed to 0, 40, 200, or 1000 ppm butadiene on gestation days 6-15 for 6 hr/day and examined for teratological effects. A separate set of male mice was exposed to 0, 200, 1000, or 5000 ppm for 6 hr/day for 5 days for a sperm morphology study. Pregnant rats exhibited toxicity at 1000 ppm in the form of reduced extragestational weight gain and, during the first week of treatment, decreased body weight gain; there were no other differences in fertility or developmental parameters between exposed and control groups. In mice, however, there were increased numbers of fetal variations (supernumerary ribs, reduced ossification) in litters from dams exposed to 200 and 1000 ppm butadiene. These teratogenic effects occurred in the presence of maternal toxicity and fetal weight gain reductions. Male mice treated with 1000 or 5000 ppm butadiene showed significant increases in abnormal sperm 5 wks after exposure, consistent with an effect of butadiene on mature spermatozoa and spermatids (Morrissey et al., 1990).

Teratological effects at maternal butadiene exposures of 200 ppm and higher were also observed by Hackett et al. (1987a), along with signs of maternal toxicity. However, in their study of reproductive performance, and maternal and fetal toxicity, Hackett et al. included a lower dose of 40 ppm. For this study, 78 pregnant female CD-1 mice received whole-body exposure to 0, 40, 200, or 1000 ppm butadiene for 6 hr/day on gestation days (gd) 6-15, with necropsy on gd 18. Mice were weighed prior to mating and repeatedly during gestation. They were observed for signs of toxicity during exposure and examined for gross tissue abnormalities at necropsy. Reproductive parameters included numbers of implantations sites, resorptions, and live and dead

fetuses. Live fetuses were examined for signs of morphological anomalies and growth retardation. The incidences of fetal variations (supernumerary ribs and reduced ossification of the sternebrae) were significantly elevated in litters from mice exposed to 200 and 1000 ppm ($P < 0.05$). At these exposure levels, there was also evidence of maternal toxicity as shown by significantly lower maternal weight gain ($P \leq 0.05$). There was a significant dose-dependent reduction of fetal body and placental weights at the two higher doses for female fetuses, and at all doses in males ($P \leq 0.05$) (Table 1). The observation that males fetuses appeared to be susceptible to butadiene at levels that were not maternally toxic is the basis of the acute REL.

Green (2003) reanalyzed the data of Hackett et al. (1987) and found inconsistencies associated with the presentation and calculation of mean values for maternal and fetal body weights, sex ratio, and reproductive data. When the data were analyzed in the context of analysis of covariance (ANCOVA) with sex ratio and litter size as covariates, no statistically significant difference was found between fetal weights at the 40 ppm exposure level and the controls. The results of the Green (2003) re-analysis are shown in Table 2B. In addition to the covariance adjusted pairwise tests of means in Table 2, Green also evaluated the ratios of treatment means to control means and calculated a 95% confidence interval (CI) for this ratio using the variance-covariance matrix from the ANCOVA. For male fetal weights the ratios (and 95% CI) were: control, 100 (referent); 40 ppm, 95.7(100.1); 200 ppm, 82.6(87.2); and 1000 ppm, 77.0(81.5). Since the upper 95% CI for the 40 ppm exposure level includes 100 there is no statistically significant difference from the control at this level. The other data sets for combined sexes and female fetal weights gave similar results.

In a companion study, Hackett et al. (1987b) exposed female Sprague-Dawley rats to whole body inhalation of 1,3-butadiene for 6 hr/day at 0, 40, 200, or 1000 ppm. The female rats (24 to 28/dose group) that had been mated to unexposed males were exposed on gestation days 6 thru 15 and sacrificed on gd 20. There were no significant differences among treatment groups in maternal body weights or extragestational weights at 40 or 200 ppm, but at 1000 ppm depressed body weight gains were observed during the first 5 days of exposure and extragestational weight gains were lower than control values. Placental weights, fetal body weights and sex ratios were unaffected by butadiene treatment. There were no significant differences among groups for incidences of fetal malformations.

The dose-response analyses of the Hackett et al. (1987) and the Green (2003) re-analysis data sets are described and discussed in Section 8.1. Those analyses employ the benchmark dose software (BMDS v. 2.3.1) and do not depend on a specific no observed adverse effect level (NOAEL) or lowest observed adverse effect level (LOAEL). Rather, the benchmark model uses the entire dose-response data set. The key value for a non-cancer dose response is usually the benchmark concentration level $BMCL_{05}$, or the 95% lower confidence limit on the concentration causing a 5% response. Considerable experience has shown that the $BMCL_{05}$ is a better choice for a point of departure than a single dose NOAEL.

TABLE 1. BODY WEIGHT AND FETAL AND PLACENTAL MEASURES AFTER 1,3-BUTADIENE EXPOSURE (HACKETT ET AL., 1987A)

Observation	1,3-Butadiene Concentration (ppm)			
	0	40	200	1000
Number examined				
Mothers	18	19	21	20
Litters	18	19	21	20
Fetuses	211	237	259	244
Maternal weight gain (g)[a] (11-16 gd)	13.3 ± 0.6[b]	12.7 ± 0.4[b,c]	11.4 ± 0.5[c,d]	10.6 ± 0.4[d]
Pup body weight (g)[a]				
Females	1.30 ± 0.02[b]	1.25 ± 0.01[b]	1.10 ± 0.02[c]	1.02 ± 0.03[d]
Males	1.38 ± 0.03[b]	1.31 ± 0.02[c]	1.13 ± 0.02[d]	1.06 ± 0.02[e]
Sex ratio (% male)	51.6 ± 3.91	49.8 ± 3.06	51.5 ± 3.68	51.8 ± 3.29
Placental weight (mg)[a]				
Females	83.1 ± 3.03[b]	80.9 ± 2.46[b]	74.7 ± 3.52[b,c]	70.1 ± 2.33[c]
Males	89.3 ± 3.05[b]	89.5 ± 2.27[b]	80.1 ± 2.35[c]	74.5 ± 1.81[c]

[a]Mean ± standard error; [b-e] Values that do not share a common superscript letter are significantly different ($p \leq 0.05$) from one another.

TABLE 2. BODY WEIGHT AND FETAL AND PLACENTAL MEASURES AFTER 1,3-BUTADIENE EXPOSURE (GREEN, 2003 REANALYSIS OF HACKETT ET AL., 1987A DATA)

Observation	1,3-Butadiene Concentration (ppm)			
	0	40	200	1000
Number examined				
Mothers	18	19	21	20
Litters	18	19	21	20
Fetuses	211	237	259	244
Pup body weight (g)	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Combined	1.350 ± 0.028	1.283 ± 0.013	1.126 ± 0.021*	1.038 ± 0.025*
Females	1.309 ± 0.021	1.253 ± 0.012	1.100 ± 0.022*	1.015 ± 0.026*
Males	1.382 ± 0.033	1.307 ± 0.016	1.132 ± 0.016*	1.060 ± 0.024*
Sex ratio (% male)	51.55 ± 3.866	49.66 ± 2.947	51.44 ± 3.677	51.80 ± 3.310
Placental weight (mg)				
Combined	86.99 ± 2.960	85.30 ± 2.283	78.65 ± 3.243	73.06 ± 1.826*
Females	83.15 ± 3.023	80.89 ± 2.474	74.33 ± 3.540	70.84 ± 2.284*
Males	89.58 ± 2.995	89.71 ± 2.263	80.27 ± 2.324	74.64 ± 1.785*

Note: * significantly different from controls ($P < 0.05$).

6.2 Dominant Lethal Effects

The primary purpose of the dominant lethal assay is to identify toxicants that have the ability to enter the gonad and cause a genetic lesion in the gamete, which results in cytogenetic damage in the fertilized zygote without recognized changes in fertilizability. Generally, male animals are either given 1 – 5 doses of the test agent, or are dosed over the entire cycle of spermatogenesis, then mated at weekly intervals with untreated females. The females are necropsied prior to giving birth and examined for uterine contents. The total number of implanted embryos is compared over dose groups and with controls. Dominant lethal assays use conceptus failure as an endpoint for potential male-mediated developmental toxicity.

Nested within the larger National Toxicology Program study discussed above, dominant lethality was studied in litters sired from male mice exposed to 70, 200, 1000, or 5000 ppm butadiene for 6 hr/day for 5 days (Morrissey et al., 1990). There was no mortality noted in the male mice even at the highest butadiene concentrations, and body weights were unaffected. One week following exposure to 1000 ppm, investigators observed a statistically significant increase in dead implants as a percentage of total implants ($p \leq 0.05$). There were smaller non-statistically significant increases in dead implants at 200 and 5000 ppm (p values not given). During the second week following exposure, there were significant increases in dead implants in both the 200 and 1000 ppm groups ($p \leq 0.05$). The investigators noted that the dose-dependency of the effects weakens at higher dose levels, but the effect in week 1 and 2 is consistent with an effect of butadiene on mature spermatids and spermatozoa. The authors suggested that because of the effects noted in sperm morphology and dominant lethality, butadiene might act as a germ cell mutagen in mice (Morrisey et al., 1990).

In 1993, Anderson and colleagues considered dominant lethality in a more focused study of male-mediated reproductive toxicity following acute and short-term butadiene exposure. In the acute study, male CD-1 mice were exposed to 0 (n = 25), 1250 (n = 25), or 6250 (n = 50) ppm butadiene one time for 6 hr, then mated with untreated females. In the short-term study, male CD-1 mice were also exposed to 0, 12.5, or 1250 ppm butadiene for 6 hr/day 5 days/wk for 10 weeks prior to mating, then mated with untreated females. The necropsied dams were examined for the number of live fetuses, the number of early and late post-implantation deaths, and the number and type of fetal gross malformations. A single 6 hr exposure did not elicit a dominant lethal effect, although there was a non-significant reduction in the mean number of implants in the 1250 and 6250 ppm dose groups. Such findings may indicate germ cell toxicity or pre-implantation losses, which are generally not associated with heritable changes (Anderson et al., 1993). Subchronic exposures to 12.5 ppm butadiene were associated with increased congenital malformations and late fetal deaths. In addition, there was a significant incidence of dominant lethality at 1250 ppm butadiene. The authors concluded that butadiene is mutagenic and teratogenic following subchronic exposures (Anderson et al., 1993).

To further elucidate the dominant lethality of butadiene, Adler and Anderson (1994) exposed CD-1 male mice to 1250 ppm for 6 hr/day, 5 day/week for 10 weeks prior to

mating, and then mated the exposed males with unexposed females for 4 successive weeks. There was a total (summed) incidence of 23.1% dominant lethality over 3 weeks of mating. The highest weekly incidence of dominant lethality was 12.4% after week 2 of mating. No other fertility differences were noted between exposed and control animals. From the timing of the dominant lethal effect, the authors suggested that spermatozoa and late spermatids were the most sensitive germ cell types to butadiene inhalation (Adler and Anderson, 1994). Most of these results were duplicated in another report by Anderson and colleagues (Anderson et al., 1996) and are consistent with dominant lethal findings by Morrisey et al. (1990).

In 1994, Adler and colleagues designed a cross-bred (102/E1 x C3H/E1) mouse study to consider not only dominant lethality but teratogenicity in pregnancies allowed to come to term. Male mice (20 per group) were exposed to 0 or 1300 ppm butadiene for 6 hr/day for 5 days, and then mated with unexposed females for 4 consecutive weeks. Groups of pregnant dams were sacrificed at gestation day 14 following successive weeks of mating. The percentage of dead implants and dominant lethals was elevated in litters that were sired during weeks 1, 2, and 3 following butadiene exposure in the males. The effect, however, was highly significant ($p \leq 0.01$) in week 2. All other fertility parameters were similar to controls (Adler et al., 1994). From the timing of effects, the authors concluded that dominant lethal mutations were induced in spermatozoa and late spermatids, suggesting that butadiene may induce heritable translocations in these germ cell stages (Adler et al., 1994), consistent with their previous work in CD-1 mice (Adler and Anderson 1994).

Two other studies have demonstrated a positive association between inhalation of low concentrations of butadiene and dominant lethality, with mice being more susceptible than rats (Anderson et al., 1998; Brinkworth et al., 1998). Brinkworth and colleagues exposed male CD-1 mice to 0, 12.5 or 125 ppm butadiene for 6 hrs/day for 5 days a week for 10 weeks followed by mating with untreated females. A significant increase in dominant lethality was noted, but only in the 125 ppm group. Anderson and colleagues exposed male CD-1 mice to 0, 12.5, 65, or 130 ppm butadiene for 6 hr/day, 5 days/week for four weeks and groups of male Sprague Dawley rats to 0, 65, 400, or 1250 ppm butadiene for 6 hr/day, 5 days/week for 10 weeks. There was a significant increase in dominant lethality in mice in the 65 and 130 ppm dose groups, although the effect was not dose-related. Male-specific effects in the rats were not observed at any exposure level (Anderson et al., 1998). Additionally, one study showed that the butadiene metabolite diepoxybutane is also associated with dominant lethality. Male mice were given either 0 or 54 mg/kg diepoxybutane (DEB), and mated for up to 16 days after treatment with untreated females. A single dose of 54 mg/kg DEB was toxic to mature spermatozoa; therefore, there was a low number of total implants in the first 8 days after treatment. However, there was an increase in dominant lethals throughout all mating intervals. The authors suggested that diepoxybutane is likely a late spermatid mutagen (Adler et al., 1995).

Accumulated data appear to suggest that inhalation exposure of butadiene is associated with an increase in dominant lethal effects even at concentrations below the threshold for acute toxicity. There is evidence of species and strain differences in

susceptibility, with mice being more susceptible than rats, and outbred CD-1 mice appearing to show dominant lethality at lower butadiene concentrations than other strains of mice. Regardless of the length of pre-mating dosing (i.e., a single 6 hr, 5 day, or 4-10 week exposures), dominant lethal effects were associated with butadiene effects in the more mature male germ cells, specifically mature sperm and late spermatids.

6.3 Germ Cell Mutagenicity

Results from dominant lethal experiments suggest that butadiene exposure may be associated with germ cell mutagenicity. As such, several researchers investigated the potential for butadiene to induce heritable mutations. In one study, C3H/E1 male mice were exposed to 1300 ppm butadiene for 6 hr/day for 5 days and mated with untreated females. Half the offspring were examined for dominant lethality while the other half were allowed to mature in order to study heritable effects in subsequent generations (Adler et al., 1995). There was a non-significant increase in dominant lethal mutations in F_1 litters sired from butadiene-exposed males. However, when the F_1 males were allowed to mature and mate, the resulting F_2 litters were approximately half as large as litters sired by control F_1 mice. Additionally, there was a 2.7% translocation frequency in F_2 pups following F_0 paternal butadiene exposure compared with a 0.05% translocation frequency from historical controls (Adler et al., 1995).

In a follow-up study, mice exposed to 0, 130, or 500 ppm butadiene for 6 hr/day for 5 days were mated for 4 consecutive weeks with untreated females. A positive dominant lethal effect was observed for 130 and 500 ppm during week one of mating (a sperm effect) and for 500 ppm during week two of mating (a late spermatid effect). Among 434 F_1 offspring from butadiene-exposed F_0 sires, there was a 1.15% incidence of translocation when compared with 0.05% translocation in historical controls ($p < 0.001$) (Adler et al., 1998). The heritable mutation was identified as a reciprocal translocation with insertion of the central portion of chromosome 9 into chromosome 19 (Adler et al., 1998). The genetic risk from butadiene exposure was calculated using data from these two studies with a linear dose-response model [$Y = 0.05 + 6.9 \times 10^{-5} X$] where Y is the percentage of offspring with heritable translocations and X is butadiene exposure in ppm hr. Results from the calculations suggest that butadiene has the potential to cause heritable mutations in mouse sperm that can be transmitted to subsequent generations with a doubling dose of 725 ppm-h butadiene (Adler et al., 1998).

Pacchierotti et al. (1998) investigated the paternal transmission of butadiene-induced chromosomal aberrations to one cell embryos. Male mice (102/E1 x C3H/E1) were exposed to 0, 130, 500, or 1300 ppm butadiene for 6 hr/day for 5 days then mated 1:2 with untreated B6C3F1 females. The resulting zygotes were arrested at first cleavage and analyzed for chromosomal aberrations in each of the first three weeks of mating following paternal exposure. Zygotes conceived in weeks one and two of mating were produced from oocytes from untreated females fertilized with either mature sperm or late spermatids. Zygotes conceived in week three of mating were the product of oocyte-early spermatid or oocyte-late prophase spermatocyte unions. Investigators found a dose-dependent increase in structural chromosomal aberrations in first-cleavage

embryos conceived in week one of mating, with significance ($p < 0.005$) achieved at 500 ppm butadiene. Embryos conceived during week two also showed dose-dependent increases in chromosomal aberrations, with significance achieved at 1300 ppm butadiene ($p < 0.025$). The authors concluded that the male germ cells associated with the observed embryo mutations were likely the same types as those associated with male-mediated dominant lethality in other studies, and that sperm in the final stages of maturation were most susceptible to the mutagenic effects of butadiene.

Anderson et al. (1997) evaluated the effects of 1,2-epoxybutene (BMO) and three other chemicals (β-estradiol, daidzein, dibromochloropropane) on human sperm using the alkaline Comet assay for DNA damage in vitro. Fresh and frozen samples from two fertile donors each and frozen samples from two infertile donors were analyzed. All the chemicals induced significant effects in all exposed samples ($P < 0.01$). For BMO exposures of 0, 80, 160, and 320 µM, significant dose-response model fits were obtained only with frozen samples. Using the continuous Hill and polynomial models, $BMCL_{05}$ values ranged from 0.6 to 24.2 µM with an arithmetic mean of 12.3 µM and a geometric mean of 4.64 µM. The effects seen with BMO were comparable to those seen with dibromochloropropane, a known male reproductive toxicant, at 20 to 200 µM. Internal exposure estimates obtained with human PBPK models based on Kohn and Melnick (2001) indicate that BMO blood concentrations in the range of $BMCL_{05}$'s might be achieved by acute occupational exposures to butadiene (e.g., 200 ppm butadiene x 2 hr = 6.8 to 15.6 µM BMO Cmax in venous blood). Alternatively, the human PBPK model of Brochot et al. (2007) predicts lower blood and tissue concentrations of BMO for the same exposure scenario (i.e., 0.1 to 0.7 µM).

The majority of acute reproductive toxicity studies of butadiene have focused on male animals. No similar studies were found for female animals. However, one study by Tiveron and colleagues (1997) considered the acute female reproductive toxicity of the butadiene metabolite diepoxybutane. Female B6C3F1 mice received a single intraperitoneal injection of 26, 34, 43, or 52 mg/kg diepoxybutane, and then mated with unexposed males. The embryos were arrested at first-cleavage metaphase and examined for chromosomal aberrations. There were no consistent diepoxybutane-associated effects on mating, fertilization, or cell-cycle progression of the fertilized oocytes, although there was a decrease in the average number of zygotes harvested from each female. There was, however, a significant increase in frequency and number of chromosomal aberrations in exposed zygotes when compared with controls in all dose groups ($p < 0.05$-0.001).

When comparing the sensitivity of male and female gametes to pre-conception exposures, it appears that zygotes produced from exposed sperm-nonexposed oocytes are many times more likely to contain chromosomal aberrations (Adler et al., 1995) than zygotes conceived with exposed oocytes (Tiveron et al., 1997). While chromosomal damage may be transmitted via female germ cells (Adler et al., 1995), sperm appear to be at much higher risk of the mutagenic effects of butadiene and butadiene metabolites.

6.4 Ovarian Atrophy

Reproductive organs appear to be critical targets of chronic butadiene exposure, and ovotoxicity is the basis of the chronic and 8-hour RELs. Effects in the female reproductive tract were identified in an NTP chronic study, where B6C3F1 mice were exposed to 0, 625, or 1250 ppm butadiene for 6 hr/day, 5 days/wk for a planned period up to 103 weeks (NTP, 1984). Significant ovarian atrophy was observed in female mice in both dose groups (40 of 45 females at 625 ppm; 40 of 48 females at 1250 ppm). NTP investigators identified a chronic LOAEL of 625 ppm, based on the observed gonadal effects (NTP, 1984). In an effort to further elucidate the reproductive toxicity, NTP investigators conducted a study in B6C3F1 mice with lower butadiene concentrations (Melnick et al., 1990; NTP 1993). The animals were exposed to 0, 6.25, 20, 62.5, 200, or 625 ppm for 6 hr/day, 5 days/wk for up to 65 weeks. While there was significant mortality, a concentration-related increase in ovarian atrophy was also observed. At 40 weeks, ovarian atrophy was present in females exposed to 200 and 625 ppm butadiene. At 65 weeks, ovarian atrophy was present in all groups exposed to ≥ 20 ppm butadiene, and female mice exposed to the lowest concentrations of butadiene (6.25 ppm) exhibited atrophy at the end of the study at 105 weeks (Melnick et al., 1990; NTP, 1993). Based on these results, NTP investigators identified a chronic LOAEL of 6.25 ppm for reproductive toxicity (NTP, 1993). The 9-, 15- and 24-month ovarian atrophy data from NTP (1993) were subjected to benchmark dose analysis as summarized in Table 3. Only the 9-month interim sacrifice data were adequately fit by the multistage model (X^2 = 2.47, P = 0.78, $BMCL_{05}$ = 19.2 ppm). The 24-month data were adequately fit by the log probit model if the top dose was excluded. If the dose response used the average mixed venous concentration of diepoxybutane (DEB) from the mouse PBPK model an excellent fit to all the 24 months data was obtained (X^2 = 0.1, P = 0.99, $BMCL_{05}$ = 0.58μM DEB equivalent to 0.71 ppm BD). If the data were included in a time-adjusted model, all of the data could be fit (N = 435). Using the log probit model, a $BMCL_{05}$ of 1.01 ppm butadiene was obtained with a X^2 of 1.7, P = 0.64 (BMDS v 2.2). This study forms the basis of the derivation of 8-hour and chronic RELs described in sections 8.2 and 8.3, respectively.

While atrophy may be associated with normal reproductive senescence in rodents, it is noteworthy that butadiene-associated ovarian atrophy was observed in female mice as early as 9 months of age in association with butadiene exposure (NTP 1984). Depletion of ovarian follicles and ovotoxicity were also observed following intraperitoneal administration of butadiene monoepoxide or diepoxide (Doerr et al., 1996). Doerr et al. (1996) administered butadiene monoepoxide (BMO; 0.005-1.43 mmol/kg b.w.) or the diepoxide (DEB; 0.002-0.29 mmol/kg b.w.) to female $B6C3F_1$ mice (n = 10/dose) intraperitoneally daily for 30 days. The investigators analyzed the data on ovarian and uterine weight depression in mice (% body weight ± SD) using a PBPK model to simulate i.p. administrations and extrapolate internal dose metrics to external butadiene inhalation equivalents.

TABLE 3A. OVARIAN ATROPHY IN FEMALE MICE IN 2-YEAR INHALATION STUDY OF 1, 3-BUTADIENE (NTP, 1993).

Exposure Period	Model	X^2	P	BMC_{05} ppm	$BMCL_{05}$ ppm	$BMCL_{05}$ continuous, ppm	Comments
9 months	Multistage	2.47	0.78*	35.0	19.25	3.44	Full data set, N = 58
15 months	Log probit	10.74	0.030	11.2	3.66	0.654	Full data set, N = 52
	Log probit	10.64	0.014	11.1	3.45	0.616	Without top dose, N = 50
24 months	Log probit	6.47	0.091	0.056	0.0034	0.00054	Full data set, N = 325
	Log probit	2.80	0.42*	0.254	0.031	0.0055	Without top dose, N = 246
24 months#	Log logistic PBPK mean blood DEB concn	0.1	0.99	1.21 µM	0.56 µM, 0.71 ppm BD equivalent	0.51 ppm BD equivalent	Full data set, N = 325
9-24 mo time adjusted**	Log probit	1.7	0.64*	2.04	1.01	0.18	Full data, N = 435
9-24 mo time adjusted**	Log logistic	1.13	0.89*	2.03	1.58	0.28	Full data, N = 435

Note: * indicates adequate model fit to data, P ≥ 0.1; ** time adjustment by fitting % atrophy data to the hyperbola y (%) = a – b/(1 + c x dose)^d where a, b, c, and d are parameters, the dose was ppm butadiene (6hr/day, 5days/week), and the % atrophy response was weighted for time (PSI-Plot Hyperbola c, www.polysoftware.com). The fitted values were reconverted to quantal equivalents and analyzed by BMDS 2.2 with log probit, log logistic and multistage models (see Tables A8-A11 in appendix for additional details). # PBPK model simulation was for 24 hr and the 24 hr DEB AUC was divided by 24 to give average daily concentration so continuous adjustment is only 5/7 for 5 days/week exposure.

The values from Figure 2 of Doerr et al. (1996) were estimated as shown in Table 4. Internal dose metrics were then analyzed by benchmark dose methods using BMDS (versions 1.4.1c and 2.1.2). The benchmark dose BMD_{05} was the 0.05 relative deviation of a given dose metric typically using the Hill or Polynomial continuous dose response model and the $BMDL_{05}$ was the 95% lower confidence limit on that dose. The 5% response level is typically chosen by OEHHA for noncancer toxicity endpoints. The PBPK model was based on Kohn and Melnick (2001). The formation of hemoglobin adducts in the model was based in part on Csanady et al. (2003) with additional ACSL model code obtained from Prof. J.G. Filser (personal communication).

TABLE 4. MEAN OVARIAN AND UTERINE WEIGHTS (% BODY WEIGHT) IN MICE ESTIMATED FROM FIGURE 2 OF DOERR ET AL. (1996).

Compound	Dose i.p., mmol/kg-d	Ovary	SD*	Uterus	SD*
BMO	0.005	0.0425	0.007	0.27	0.126
	0.02	0.0425	0.007	0.30	0.126
	0.09	0.038	0.007	0.28	0.126
	0.36	0.034	0.007	0.27	0.126
	1.43	0.020	0.007	0.10	0.126
DEB	0.002	0.0375	0.007	0.34	0.126
	0.009	0.034	0.007	0.33	0.126
	0.036	0.035	0.007	0.22	0.126
	0.14	0.020	0.007	0.11	0.126
	0.29	0.015	0.007	0.03	0.126

*SD values assumed equal for BMD analysis since they appear similar for low doses and decrease for the high doses.

Following the 30 days of exposure, ovaries and uteri were weighed, fixed, stained, and the follicular populations were assessed microscopically. In mice receiving 1.43 mmol BMO /kg, body weights were slightly decreased (10%) while ovarian and uterine weights were significantly decreased ($p < 0.05$). Administration of DEB caused significant decreases in both ovarian and uterine weights at 0.14 and 0.29 mmol/kg b.w. ($p < 0.05$), along with a 15% decrease in body weights at the higher dose. A dose-dependent decrease in ovarian follicle numbers was observed with both epoxides. To facilitate comparison, the dose required to reduce follicle numbers by 50% relative to controls (ED_{50}) was estimated. For small and growing follicles, the ED_{50} values for BMO were 0.29 and 0.40 mmol/kg, respectively. DEB showed greater potency with ED_{50} values for these same follicle populations of 0.10 and 0.14 mmol/kg, respectively. These authors suggested that butadiene ovotoxicity may be associated with metabolism of the parent compound to reactive diepoxides in situ.

Perez et al. (1997) measured N-(2,3,4-trihydroxybutyl)valine (THBV) adducts of hemoglobin in rats exposed to 1,3-butadiene or butadiene epoxides. Sprague-Dawley rats (2 to 3/group) were treated with single i.p. doses of either epoxybutene (78.3 mg/kg), epoxybutanediol (30 mg/kg), or diepoxybutane (16,7, 33.4, 60 mg/kg). The animals were sacrificed and blood was collected after 48 hr. Rats (3/group) were exposed to 1,3-butadiene by inhalation for 6 hr/d for 5 days at concentrations of 0, 50, 200 or 500 ppm. Two humans occupationally exposed to 1 ppm butadiene were also analyzed. The HBI (hemoglobin binding index, pmol THBV adduct/g/µmol/kg for epoxides, or /ppm-hr for butadiene exposures) for rats was 0.07 for epoxybutene, 3.4 for epoxybutanediol, and 4.0 to 9.3 for diepoxybutane. For butadiene exposures in rats, THBV adducts ranged from 0.04 to 0.5 pmol/g/ppm-hr. For the exposed human subjects, the THBV adduct levels were 0.15 and 0.20 pmol/g. The results indicate that

epoxybutanediol is comparable to DEB in it adduct forming ability and considerably more active than BMO.

In the Hazelton Laboratories study, Sprague Dawley rats were exposed to 0, 1000, or 8000 ppm butadiene for 6 hr/day, 5 day/week, for 105 weeks. Although investigators reported tumors in certain reproductive organs, there was no clear statement on the presence or absence of ovarian atrophy, or any other reproductive effect in females (Owen et al., 1987).

Male reproductive effects have also been observed in relation to chronic butadiene exposure, although generally at concentrations greater than those that elicited effects in female animals. In the NTP study, investigators observed a significant concentration-related decrease in testis weight at weeks 40 and 65 for males exposed to ≥ 62.5 ppm butadiene (Melnick et al., 1990). In addition, testicular atrophy (measured at weeks 40 and 60) was observed in males exposed to 625 ppm butadiene (Melnick et al., 1990). In the later NTP study (1993), investigators once again observed testicular atrophy at 625 ppm, and reduced testicular weights in the 200 ppm and 625 ppm exposure groups at the end of the study. However, no effect was seen at the lower butadiene concentrations, as noted in female mice (NTP 1993). In the Hazelton Laboratories study, there was no clear statement of the presence or absence of testicular atrophy in male rats exposed to up to 8000 ppm butadiene. However Leydig cell tumors were observed in 3 males in the 1000 ppm group and 8 males in the 8000 ppm group (Owen et al., 1987).

Kirman and Grant (2012) conducted a meta-analysis with dose-response data from rats and mice that were normalized using an internal dose estimate of diepoxybutane (DEB) in blood that is causally related to ovarian toxicity. A time-to-response (multistage-Weibull) model was used to fit the pooled data sets with exposures from 13 to 105 weeks. Reference concentration (RfC) values were derived for scenarios with average, low and high follicle counts at birth with differing durations of susceptibility to toxic action of DEB. The $BMCL_{01}$ points of departure for these scenarios in ppm continuous butadiene exposure were 17, 1.5, and 240 ppm, respectively. The authors applied a 10-fold uncertainty factor to these values to derive a range of presumably health protective values for human exposures.

7 Chronic Toxicity of 1,3-Butadiene

7.1 Chronic Toxicity to Adult Humans

Studies on the chronic effects of butadiene have been centered in the styrene-butadiene rubber manufacturing industry and the butadiene monomer industry. The Occupational Health Studies Group at the University of North Carolina, Chapel Hill, organized one of the earliest retrospective epidemiological studies conducted in the rubber industry. Investigators observed rubber workers during the period of 1964 – 1972 and reported an increase in overall mortality, emphysema, and cardiovascular diseases (chronic rheumatic and atherosclerotic heart disease) among the subjects (McMichael et al., 1976).

Penn and Snyder (2007) reviewed the evidence supporting an association between butadiene exposure and cardiovascular disease. Two independent longitudinal epidemiological studies have indicated an association. Matanoski et al. (1990) found that butadiene exposure in a styrene-butadiene manufacturing facility was associated with a significant increase in the standardized mortality ratio (SMR: the ratio for mortality in the workers compared to the general population) for arteriosclerotic heart disease in exposed black workers (SMR = 1.48 (95%CI, 1.23-1.76)). The SMRs were adjusted for age, calendar time, and race. Circulatory system disease was also significantly elevated in 214 of 1195 exposed black workers (SMR = 1.18 (95%CI, 1.03-1.35)). Significant differences in these diseases were not seen in 10,915 exposed white workers. In both cases the referent population was U.S. males. Devine (1990) and Devine and Hartman (1996) studied a cohort of nearly 2800 male workers employed at least 6 months at a 1,3-butadiene manufacturing facility. They found significantly elevated SMRs for all causes of death including arteriosclerotic heart disease in nonwhite workers (SMR = 1.28 (95%CI, 1.06-1.53)). For arteriosclerotic heart disease the SMR was 1.42 (95%CI, 0.95-2.04). The referent population was the U.S. nonwhite male mortality rates. Butadiene exposure was also associated with atherogenesis in an avian model (see 7.3 below).

Additional arguments have been made in regard to polymorphisms for xenobiotic metabolizing genes including GSTM1, GSTT1, CYP2E1, and microsomal epoxide hydrolase (EH) and susceptibility to atherosclerosis. Salama et al.(2002) studied 120 atherosclerotic subjects and 90 matched controls for associations between polymorphisms in metabolizing genes and atherosclerotic susceptibility. They found increased atherosclerotic susceptibility associated with the GSTT1 null allele and the fast allele of EH. Also individuals with one of three combined phenotypes (GSTM1 null/CYP2E1 5B, GSTM1 null/mEH YY and GSTT1 null/mEH) exhibited significantly increased atherosclerotic susceptibility (ORs = 3.4-15.42). The importance of EH as a potential cardiovascular disease susceptibility gene in population subgroups and as a key player in butadiene metabolism may influence the AR potential of butadiene in individuals exposed to ETS.

Johns Hopkins University and the National Institute for Occupational Safety and Health initiated two large cohort studies of North American synthetic rubber industry workers (Meinhardt et al., 1982; Matanoski et al., 1990). Investigators studied male workers at eight synthetic rubber plants and two plant complexes in Texas, Louisiana, Kentucky, and Ontario, and included men who began their employment as far back as 1943. Results from these studies were the first to report increased risk of hematologic neoplasms from workplace exposure to butadiene. The University of Alabama designed a series of follow-up epidemiological studies, and has since reported an excess of leukemia among hourly workers with long duration of employment and high butadiene exposure (Delzell et al., 1996), as well as a positive association between cumulative exposure to butadiene and leukemia risk (Macaluso et al., 1996). More recently, University of Alabama investigators evaluated all-cause mortality for the same synthetic rubber industry workers from 1944 – 1998 (Sathiakumar et al., 2005). The subjects had an overall mortality rate 14% lower than expected, including lower rates of cardiovascular, digestive, and genitourinary deaths than the general population.

However, the total group of 17,924 subjects had 16% more leukemia deaths than expected. While this increase was not limited to a single form of leukemia, it was concentrated in long-term hourly workers particularly those in polymerization, coagulation, and maintenance positions (Sathiakumar et al., 2005).

Results from studies of the genotoxic outcomes in workers exposed to butadiene have not been consistent. Begemann et al. (2001) analyzed blood samples from 17 workers in butadiene monomer production and 19 controls from a heat plant in the Czech Republic. Butadiene exposure was assessed by personal monitoring, with a median exposure concentration of 440 µg/m^3 for exposed workers and < 6 µg/m^3 for control subjects. The hemoglobin adduct HBVal, which is formed by a reaction of the *N*-terminal valine with the carbon-1 of epoxybutene, was measured with a limit of detection of 0.2 pmol/g globin. Results showed that the median butadiene-hemoglobin adduct level in monomer production workers was significantly higher than that of controls, with no consistent correlation with any other parameter except smoking (Begemann et al., 2001).

Hayes et al. (2000) also measured a spectrum of genotoxic outcomes, including aneuploidy and sister chromatid exchange, in 41 butadiene polymer production workers and 38 non-exposed controls in China. Full-shift personal exposure varied widely, and short-term breathing zone grab samples showed even greater extremes (median 6.5 ppm, range 0 – 1078 ppm). Hemoglobin adducts were significantly more common in butadiene exposed workers than controls ($p < 0.0001$). In addition, butadiene exposed workers had greater lymphocyte and platelet counts than controls. However, the frequency of total aneuploidy (chromosomes 1, 7, 8, 12) did not differ significantly between exposed and non-exposed workers, nor did structural or numerical chromosomal abnormalities. The authors found no correlation between hemoglobin adducts and any genotoxic markers, nor did they find a positive correlation between butadiene concentrations in air and sister chromatid exchanges (Hayes et al., 2000).

Lovreglio and colleagues (2005) conducted personal monitoring throughout an 8 hr work shift at a petrochemical plant where butadiene was produced and polymerized. Personal monitoring was conducted 3 to 4 times over a 6-week period, with the last session followed by blood sampling of the subjects. Twenty-seven healthy petroleum plant workers were matched with 26 controls not occupationally exposed. Results indicated significantly higher airborne butadiene levels for exposed workers when compared with controls, ranging from 0.2 to 69 µg/m^3. Blood samples were analyzed for sister chromatid exchange and percent chromosomal aberrations in peripheral blood lymphocytes. After correcting for cigarette smoking, the investigators found no genetic marker differences between butadiene exposed and control workers. In their conclusion, the authors stated that there was a lack of genotoxicity in workers exposed to very low concentrations of butadiene similar to ambient levels currently characterized in the general population (Lovreglio et al., 2005).

The Health Effects Institute reported on a genetic epidemiology study of Czech workers exposed to butadiene (Albertini et al., 2003). The study was designed to determine whether biomarkers of exposure could be correlated with in situ levels of butadiene and

personal workplace exposure. Blood and urine samples were collected from males, working in either a butadiene monomer production plant or in a butadiene-styrene polymerization facility. Samples were also collected from male administrative workers who had very limited occupational exposure to butadiene, and served as controls. In addition, full-shift personal monitoring was conducted on each of 10 days over a 60-day period for both groups of workers, including the days on which biological samples were collected. The mean concentrations ranged from 0.026 mg/m^3 for controls to 1.76 mg/m^3 for polymer workers, with maximum concentrations of 0.125 mg/m^3 and 39 mg/m^3, respectively (Albertini et al., 2003). Cytogenetic assays included chromosomal aberrations, breaks, translocations, and sister chromatid exchanges. No significant relations could be identified between group mean chromosomal aberrations, determined by the conventional method or by fluorescent in situ hybridization, and butadiene exposure levels after adjusting for age and smoking. Since tobacco smoke contains butadiene it is possible that this latter adjustment affected the results. In addition, there was no relationship found between butadiene exposure and aberrations associated with glutathione-S-transferase genotypes. Regression analyses showed no significant effects of butadiene exposure on sister chromatid exchanges, although the effect of smoking on sister chromatid exchanges was significant after adjusting for age and occupational butadiene exposure. Hemoglobin adducts of butadiene (to the valine residue) were analyzed as biomarkers for butadiene exposure. There was a significant correlation between the individual subject's exposure levels and two types of hemoglobin adducts. However, the authors cautioned that one adduct, trihydroxybutyl valine (THBVal), also appeared to be formed by an endogenous material other than butadiene and its metabolites, indicating relatively high natural background levels. Overall conclusions from the authors indicate that the cytogenetic endpoints did not prove to be sensitive indicators of butadiene exposure at the levels encountered in these facilities (Albertini et al., 2003).

Since butadiene exposures rarely occur in the absence of other air toxic contaminants it is usually difficult to isolate the effects due to butadiene from those due to other chemicals or combinations. It is OEHHA policy to use human data in preference to animal data when they are of suitable quality. However, in the case of butadiene there are no human dose-response data that can be used to derive a chronic REL with confidence.

7.2 Chronic Toxicity to Infants and Children

Infants and children are rarely exposed to butadiene alone but rather experience long-term exposure to butadiene as one of the combustion products in vehicle exhaust, environmental tobacco smoke (ETS), and other combustion processes. As can be expected with many toxic air contaminants, it is difficult to elucidate the effects of one particular pollutant when it exists in the presence of multiple co-pollutants. Studies of the chronic effects of butadiene in children primarily focus on carcinogenesis as the endpoint. Butadiene has been associated with asthma exacerbation and increased respiratory tract infections, but only in the presence of other pollutants. While some recent studies have aimed to quantify children's exposure to butadiene, ascribing

chronic respiratory effects to butadiene alone remains problematic (see discussion of TEACH study in section 3 above).

7.3 Chronic Toxicity to Experimental Animals

Butadiene is considered a multi-site carcinogen in all identified long-term studies in mice and rats, although there appear to be strain and species differences in sensitivity and severity of effect (NTP 1984; Owen et al., 1987; Melnick et al., 1990; NTP 1993). Instances of tumors include malignant lymphomas, histiocytic sarcomas, cardiac hemangiosarcomas, as well as neoplasms of the liver, lung, mammary gland, ovary, and forestomach (NTP, 1993).

Far fewer data are available for the non-cancerous effects of long-term exposure to butadiene. However, based on these limited data, sensitivity to non-neoplastic events appears to be consistent with species variations in metabolism of butadiene and quantitative differences in the formation of butadiene metabolites (Hughes et al., 2001). For mice, National Toxicology Program (NTP) investigators exposed B6C3F1 males and females to 0, 625, or 1250 ppm butadiene for 6 hrs/day, 5 days/week, for up to 61 weeks (NTP 1984). Liver necrosis was observed in male mice at both doses and in female mice at 1250 ppm. At the highest dose, adverse changes were observed in the nasal cavity, including non-neoplastic lesions, chronic inflammation, fibrosis, cartilaginous metaplasia, osseous metaplasia, and atrophy of the sensory epithelium. In a later study, investigators studied the effects of lower concentrations of butadiene in mice exposed for 6 hrs/day, 5 days/week, for up to 2 years (Melnick et al., 1990; NTP 1993). Two-year survival was significantly decreased in mice exposed to ≥ 20 ppm, which the investigators attributed to butadiene-induced malignant neoplasms. Beyond the neoplastic changes, there were increased incidences of angiectasis, alveolar epithelial hyperplasia, forestomach epithelial hyperplasia, and cardiac endothelial hyperplasia.

Chronic effects in rats were studied by Hazelton Laboratories and reported later by Owen and colleagues (1987; 1990). Groups of 110 male and female Sprague Dawley rats were exposed to 0, 1000, or 8000 ppm butadiene for 6 hrs/day, 5 days/week, for up to 2 years. After the first 52 weeks, investigators euthanized multiple female rats in both dose groups because of the high incidence of large subcutaneous masses. Increased mortality in males was observed in the highest dose group and associated with increased nephropathy. Body weight decreases were observed in the first twelve weeks in the high dose males and females, along with liver and kidney organ weight changes. Although there were minor clinical effects, including slight ataxia, no major changes in neuromuscular function could be definitively associated with butadiene exposure (Owen et al., 1987). Further reporting on this 2-year chronic investigation indicated that there were decreased survival rates at 105 weeks for females and 111 weeks for males (Owen and Glaister 1990). There were no effects on hematology, blood chemistry, and urinalysis, although changes in body and organs weights continued until study termination. Although somewhat equivocal, the rats displayed both common and uncommon tumor types, leading the investigators to suggest that butadiene might be a rat oncogen (Owen and Glaister 1990).

Other studies have identified hematological effects following chronic exposure to butadiene at concentrations at or below those that were associated with systemic toxicity (Irons et al., 1986a; Irons et al., 1986b; NTP 1993). Such hematotoxicity may be associated with the observed changes in organ weights (NTP, 1993). Butadiene exposure has also been associated with bone marrow changes, including bone marrow atrophy, bone marrow toxicity (regenerative anemia), and decreased cellularity as observed in mice exposed to ≥ 62.5 ppm (Melnick et al., 1990; NTP, 1993). Owen and colleagues (1987), however, found no hematological effects in rats exposed to as much as 8000 ppm butadiene in a 2-yr bioassay.

Penn and Snyder (2007) have identified vapor phase butadiene as the principal component in environmental tobacco smoke (ETS) promoting plaque development in an avian model of accelerated atherosclerosis (20 ppm butadiene x 16 weeks). The total butadiene doses that produced atherogenic effects were only 1/80th and 1/1000th the minimal doses causing cancer in mice and rats, respectively. The authors note that side-stream smoke, which represents about 90 % of ETS, contains butadiene at 205 to 400 µg/cigarette versus 16 to 77 µg/cigarette in main-stream tobacco smoke. Furthermore, Penn and Snyder (1996, 2007) found that the atherogenic effect of butadiene exposure was apparently not associated with either of the two principal epoxy metabolites of BD; 1,3-epoxybutene and 1,2:3,4-diepoxybutane. Neither of these metabolites was increased by butadiene exposure in avian liver in contrast to mouse liver.

7.4 Mode of Action

There is currently no accepted mode of action for the acute or chronic effects of butadiene exposure noted in this document. The metabolism of butadiene in all species studied produces epoxide, diepoxide and epoxydiol metabolites in addition to glutathione conjugates and 1,2-butene-3,4-diol. The epoxides all exhibit mutagenic activity in various test systems and react with DNA and proteins to form adducts. Butene diol has exhibited the ability to cause single strand breaks in DNA (Zhang et al., 2012). Adduct forming activity has also been observed for the glutathione conjugate of the butadiene metabolite DEB (Cho and Guengerich, 2012a). One of the DEB-conjugates (*S*-(2-Hydroxy-3,4-epoxybutyl)glutathione) was observed to be more mutagenic than DEB or other BD-epoxides in *Salmonella typhimurium* TA1535 (Cho and Guengerich, 2012b). The ability of DEB-GSH conjugates to form DNA adducts and cause mutations indicate a level of reactivity that may extend to protein binding. While mutagenicity of epoxide metabolites and other genetic toxicity is usually associated with oncogenic effects of butadiene and related chemicals, these genotoxic effects may also be associated with non-cancer effects such as cardiovascular disease, neurodegenerative disease, diabetes mellitus, rheumatoid arthritis, and aging (Burnet, 1974, Cooke et al., 2006). Recent reports indicate a specific mutation (*TREM2*) associated with increased risk of Alzheimer's disease in humans (Guerreiro et al., Jonsson et al., 2012).

In addition to the formation of pyr-Val-Hb and related hemoglobin adducts and their use as biomarkers of internal exposure to specific butadiene epoxy metabolites in

butadiene exposed human subjects, such adducts are also indicative of more general reaction of these metabolites with cellular proteins. The generalized organ and body adverse effects induced by butadiene in mice: fetal body weight decreases, relative organ weight decreases (lung, liver and kidney), and tissue atrophy (ovary, testes, nasal olfactory epithelium) are indicative of, or at least could be plausibly associated with, epoxy adduct formation of key cellular proteins and/or nucleic acids. Such adducts may lead to impaired cellular function and observed organ/tissue effects. The observed neurotoxic effects of butadiene exposure may also be due to reactive epoxide metabolites binding to key proteins and nucleic acids of the central nervous system.

Oxidative stress induced by BD metabolism may also play an important role in the observed tissue/organ toxicity and possible chronic effects in humans exposed to butadiene (Primavera et al., 2008; Yadavilli et al., 2007). Products of butadiene combustion have been observed to inhibit catalase activity and induce oxidative DNA damage repair enzymes in human bronchial epithelial cells in vitro (Kennedy et al., 2009). While the atherogenic effect of butadiene seen in an avian model does not have a clear link to the principal epoxide metabolites of butadiene, it may be related to ETS-induced oxidative stress as seen in mouse heart tissue (Yang et al., 2004). Alternatively, previously unidentified metabolites like the GSH-conjugates of Cho and Guengerich (2012a,b) may be involved in atherogenesis.

8 Derivation of Reference Exposure Levels

8.1 1,3-Butadiene Acute Reference Exposure Level (aREL)

Study	Hackett et al. (1987)
Study population	78 Pregnant CD-1 mice and offspring
Exposure method	Whole body inhalation of 0, 40, 200 or 1000 ppm on GD 6 through 15
Critical effects	Lowered male fetal weight at GD 18
LOAEL	200 ppm
NOAEL	40 ppm (based on Green re-analysis)
$BMCL_{05}$	17.7 ppm (Hill Model)
Exposure duration	6 hr
Time-adjusted exposure	n/a
Human Equivalent Concentration	29.7 ppm (17.7 ppm * 1.68 DAF)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1
Toxicodynamic (UF_{A-d})	√10
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	10
Toxicodynamic (UF_{H-d})	√10
Cumulative uncertainty factor	100
Inhalation reference exposure level	297 ppb (660 μg/m^3)

Acute Reference Exposure Levels are levels at which intermittent one-hour exposures are not expected to result in noncancer adverse health effects (see Section 5 of the Technical Support Document).

The study by Hackett et al. (1987) was selected as it addressed the most sensitive noncancer endpoint associated with butadiene inhalation: developmental effects. A continuous benchmark dose analysis of the male mouse fetal weight data from Table 2 was conducted and the results are presented in Table 5. Both applied and PBPK doses were used but the latter showed little improvement in model fit or values derived. The best value based on the applied dose and the Hill model using the values from the Green (2003) re-analysis of the Hackett data was 17.7 ppm for the mouse and 29.7 ppm for the human equivalent concentration. This analysis in BMDS (v 2.3.1) was based on the male pup data and the homogenous variance assumption, due to the exact model fit and little evidence of differing variance in the exposed groups. We analyzed all the data (male and female) as well as the males only and the males consistently gave better model fits and lower $BMCL_{05}$ values (Table 12A). The nonhomogeneous variance assumption based BMC/BMCL values were about 50% lower than the homogeneous variance values and the model fit, while acceptable, was not exact (see Table A12). In the end we chose the lowest BMCL value giving the best model fit (male pups, Green, 17.7 ppm).

A second mouse PBPK model based on rat and human pregnancy (Gentry et al., 2002; Poet et al. 2010) allowed estimates of fetal exposure to BMO (mean fetal AUC GD 9-18). This metric also gave an exact fit to the fetal body weight data (Table 5). In the summary acute REL calculation above, we employed the standard intraspecies toxicokinetic uncertainty subfactor (UF_{H-k}) of 10: this is specifically justified to account for observed human variability due to polymorphisms in the microsomal epoxide hydrolase (mEH) gene reported by Abdel-Rahman, Wickliffe, Ward and co-workers (Abdel-Rahman et al., 2003, 2005; Wickliffe et al. 2003). When the interaction between BD exposure and inheritance of a variant ATT allele for mEH was evaluated in 49 exposed workers, the increase in HPRT variant mutant frequency was increased to $10.89 \pm 2.16 \times 10^{-6}$ (95% C.I. = 6.56-15.20 ($\times 10^{-6}$), p = 0.0027) over the background rate of $4.02 \pm 1.32 \times 10^{-6}$ (Abdel-Rahman et al. 2005). In this case, the background is not an unexposed general population but rather that portion of the worker study population (N= 33) with exposures < 150 (18.4 ± 5.5) ppb BD. Since mEH is a key enzyme in the detoxification of butadiene epoxide metabolites, low activities in this gene/enzyme translate to increased internal concentrations of these metabolites and risk of related toxic effects. The dosimetric adjustment factor (DAF) is related to the ratio of human and animal blood/air partition coefficients for butadiene and was estimated using mouse and human PBPK models. For example, the butadiene blood/air partition coefficient for rodents used by Kohn and Melnick (2001) was 1.95 and the butadiene blood/air partition coefficient for humans used by Brochot et al. (2007) was 1.22 ± 0.30. This would indicate a DAF based on these values of 1.60. OEHHA's estimates using rodent and human PBPK models was 1.68. That is:

DAF = PBPK predicted human blood concentration/PBPK predicted animal blood concentration and;

Human equivalent concentration (HEC) = Animal experimental concentration x DAF.

TABLE 5. BENCHMARK DOSE ANALYSIS OF MALE MOUSE FETAL WEIGHT DATA OF HACKETT ET AL. (1987).

Dose Metric	N, male fetuses	Model	BMC_{05}	$BMCL_{05}$	$BMCL_{05}$ ppm BD equivalent	Human ppm equivalent 1.68 DAF
Applied BD ppm 6 hr/d						
0	109	Hill (Green reanalysis)	37.2**	17.7**	17.7**	29.7
40	118	Hill (Hackett et al. original values)	28.5**	13.4**	13.4**	22.5
200	133	Polynomial	48.8	41.1	41.1	69.0
1000	126	Power	261 n.s.	225 n.s	225 n.s.	378 n.s.
PBPK AUC Maternal BMO µMhr/d						
0	109	Hill	134**	70.1**	16.5**	27.8
166.4	118	Polynomial	100	69.2	14.9	25.0
371.9	133	Power	106	90.7	19.8	33.2
493.8	126					
PBPK AUC Fetal BMO µMhr/d[a]						
0	109	Hill	10.9**	5.1**	13.4**	22.5
15.2	118					
74.3	133					
356.7	126					

Note ** indicates exact model fit by graph and tabular output, P values were not applicable for exact fits of the Hill model to the continuous data sets or given as P <0.0001 for the other models despite obvious high degrees of fit visually and by tabular output of observed and predicted values; n.s. indicates insignificant model fit (P < 0.1)

[a] based on average fetal BMO AUC during gestation days 9-18.

8.2 1,3-Butadiene 8-Hour Reference Exposure Level

Study	NTP (1993) supported by Doerr et al. (1996)
Study population	B6C3F1 mice
Exposure method	Daily inhalation
Exposure continuity	6 hr/d, 5d/wk
Exposure duration	9-24 months
Critical effects	Increased incidence of ovarian atrophy
$BMCL_{05}$	1.01 ppm
Time-adjusted exposure	758 ppb (1.01 ppm x 6/8 hr/d)
Human Equivalent Concentration	1.27 ppm (0.758 ppm x1.68 DAF)
Subchronic uncertainty factor (UFs)	1
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1
Toxicodynamic (UF_{A-d})	10
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	10
Toxicodynamic (UF_{H-d})	$\sqrt{10}$
Cumulative uncertainty factor	300
Reference Exposure Level	4.2 ppb (9 $\mu g/m^3$)

The 8-hour Reference Exposure Level is a concentration at or below which adverse non-cancer health effects would not be anticipated for repeated 8-hour exposures (see Section 6 in the TSD). The study of NTP (1993) and the endpoint of ovarian atrophy was selected as the basis of both the 8 hr and chronic RELs. The benchmark concentration analysis of this study is summarized in Table 3 above. We selected the value of 1.01 ppm for the $BMCL_{05}$ based on the full data sets of 9, 15 and 24 months exposures as the best basis for the derivations. This study is supported by that of Doerr et al. (1996). The Doerr study involves PBPK modeling (Table 6) to estimate internal dose metrics for ovarian effects resulting from i.p. doses of mono- or diepoxide metabolites of BD. Dose-response modeling (BMDS v.2.1.2) was used to estimate $BMDL_{05}$'s for the various dose metrics evaluated.

The selected best point of departure, 1.27 ppm, is the $BMCL_{05}$ adjusted for time and human equivalent exposure. The interspecies uncertainty subfactor for toxicokinetics (UF_{A-k}) was reduced from $\sqrt{10}$ to 1 because we think that the mouse is more active in metabolizing butadiene to reactive epoxide metabolites than either the rat or human, thus reducing the uncertainty in the interspecies toxicokinetic extrapolation.

The other departure from defaults which we have made in this derivation is that we have increased the toxicodynamic subfactor (UF_{A-d}) from the default value of $\sqrt{10}$ to 10, based on the uncertainty arising from potentially greater human response to the ovotoxic effects of butadiene epoxide metabolites, particularly diepoxybutane (DEB), as compared to the mouse model from which the primary data for risk calculations were derived. Humans differ substantially from mice in lifespan and in the time available for

chronic exposure to effect ovotoxicity which is far longer in humans, and the generally greater robustness of the mouse reproductive system relative to the human (e.g., see He et al., 2007). Chemicals structurally similar to butadiene, specifically the butadiene dimer 4-vinylcyclohexene (VCH) and its diepoxide (VCD) are established rodent ovotoxicants. These related chemical species produce selective destruction of primordial and primary follicles, premature ovarian failure and increased risk of ovarian tumors (Smith et al., 1990; Ito et al., 2009; Mark-Kappeler et al., 2011). Mechanistic studies of the ovotoxic effects of VCD indicate that activation of proapoptotic signaling events in the Bcl-2 and mitogen-activated protein kinases play a role (Hu et al., 2001a, b, 2002). VCD causes a physiological form of ovotoxicity in which follicle loss is "silent" and mimics normal follicular atresia. Thus the damage caused by VCD, were this to be paralleled in humans, could go unnoticed in exposed and affected individuals leading one investigator to surmise that "As a result, because VCD only targets ovarian preantral follicles, chronic exposure in women to low levels of this chemical may represent a risk for early menopause without prior evidence of disrupted menstrual cycles" (Mark-Kappeler et al., 2011) (also see Hoyer and Sipes, 2007).

TABLE 6. MODELED BUTADIENE INHALATION RESULTING IN OVARIAN AND UTERINE ATROPHY FOLLOWING I.P. BUTADIENE MONO- AND DIEPOXIDE EXPOSURES

Data Set	Metric	Model	P for fit	BMD_{05}	$BMDL_{05}$	6 hr ppm mouse equivalent
Ovary						
BMO i.p.	AUC BMO blood µMhr/d	Power	0.76	2688	1765	N.A.
	AUC DEB blood µMhr/d	Poly	0.92	57.4	20.5	1.80
BMO i.p.	Hb adducts nmol/g/d	Poly	0.92	34.8	15.6	N.A.
DEB i.p.	Hb adducts nmol/g/d	Hill	0.43	183.3	85.1	N.A.
Uterus						
BMO i.p.	AUC BMO blood µMhr/d	Power	0.36	2688	1765	N.A.
	AUC DEB blood µMhr/d	Poly	0.84	103.1	37.9	3.47
BMO i.p.	Hb adducts nmol/g/d	Poly	0.85	799	117	N.A.
DEB i.p.	Hb adducts nmol/g/d	Poly	0.85	799	116.8	N.A.

Notes: BMO = butadiene mono epoxide; DEB = diepoxybutane; EBD = epoxybutenediol; AUC = area under the blood concentration x time curve; Hb = hemoglobin,
table BMD/L values are the average of 30 consecutive daily i.p. administrations,
ppm equivalent is inhalation exposure of butadiene (BD) giving the same internal BMDL dose,
N.A. indicates values unachievable by BD inhalation,
Poly is the polynomial model for continuous dose response in BMDS software,
BMD_{05} indicates 5% relative risk and BMDL the 95% lower confidence limit on the BMD value.

VCH is an industrial chemical released during the manufacture of rubber tires, plasticisers and pesticides, and human exposures to that chemical are likely to be limited to occupational settings. The similarity of the ovotoxcity of VCD, as a model system, however, indicates that of DEB may pose risk derived from mechanistic similarities. Should such mechanistic similarities exist, human females exposed chronically to DEB via butadiene may be at risk of silent ovotoxic effects that would not be manifest for many years. Because of these reproductive uncertainties, OEHHA believes it is adviseable to reject the lower and less conservative default value in favor of a larger UF_{A-d} until further relevant information is available.

The PBPK modeling used two related models. PBPK Model 1 simulates butadiene plus three metabolites BMO, DEB, and butadiene diol (BDD) and estimates EBD as a metabolized dose (AMET). PBPK Model 2 added EBD as a circulating metabolite and erythritol as a metabolized dose (AMET). Both models use parameters and model structure from Kohn & Melnick, 2001. The ovary and uterus data sets (% of body weight vs. i.p. dose) are from Doerr et al. (1996) Fig 2. The general metabolic scheme is: BD →BMO→DEB→EBD→Erythritol and BMO→BDD→EBD→Erythritol. All metabolic steps have Michaelis-Menten kinetics for P450 oxidation, epoxide hydrolases (EH) or the ordered bi bi rate law for glutathione sulfotransferases (GST). Further details of the GST kinetics can be found in Kohn and Melnick (2000). Essentially, the GST reaction rate (moles/hr) is the product of the Vmax, substrate (Ci) and glutathione concentrations (CGSH) divided by the sum of the cross products of the Km's (Kmi, Kmgsh) and tissue concentrations of the substrate and glutathione:

$$V = Vmax*Ci*CGSH/(Kmi*Kmgsh + Kmi*CGSH + Kmgsh*Ci + Ci*CGSH)$$

All model simulations were conducted with Berkeley Madonna software. Additional details on the PBPK modeling including parameters, graphical and tabular model output, benchmark dose analysis, and sample model code are given in the Appendix.

8.3 1,3-Butadiene Chronic Reference Exposure Level (cREL)

Study	NTP (1993) supported by Doerr et al. (1996),
Study population	B6C3F1 mice
Exposure method	Daily inhalation
Exposure continuity	6 hr/d, 5d/wk
Exposure duration	9-24 months
Critical effects	Increased incidence of ovarian atrophy
$BMCL_{05}$	1.01 ppm
Time-adjusted exposure	180 ppb (1.01 ppm x 6/24h x 5/7d)
Human Equivalent Concentration	302 ppb (180 ppb x 1.68 DAF)
Subchronic uncertainty factor (UFs)	1
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1
Toxicodynamic (UF_{A-d})	10
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	10
Toxicodynamic (UF_{H-d})	$\sqrt{10}$
Cumulative uncertainty factor	300
Reference Exposure Level	1.0 ppb (2.2 $\mu g/m^3$)

The chronic Reference Exposure Level is a concentration at which adverse noncancer health effects would not be expected from continuous chronic exposures (see Section 8 in the Technical Support Document). In the derivation of the chronic REL above, the $BMCL_{05}$ is the same as the 8-hour REL but the time adjustment is for potentially continuous exposure rather than 8 hours/day. The uncertainty factors applied are the same in both cases (i.e., 8-hour and chronic) and the proposed RELs are similar to those derived from the supporting study of Doerr et al. (1996), namely 23 ppb and 8 ppb for 8-hour and chronic RELs , respectively. This latter study uses the same toxicity endpoint but with parenteral administration of the butadiene epoxide metabolites BMO and DEB.

Butadiene causes non-cancer effects following chronic exposure, the most important of which appears to be reproductive toxicity. Inhalation exposure to relatively low concentrations of butadiene over a lifetime is associated with adverse effects in the reproductive organs of female and male mice (NTP, 1984; Melnick et al., 1990; NTP, 1993; Doerr et al., 1996). A PBPK model was developed to model the disposition of butadiene and its metabolites based on a rodent model described by Kohn and Melnick (2001), and data on the ovarian toxicity of 1,3-butadiene epoxide in rats and mice (Doerr et al.,1996).

As reported earlier, ovarian atrophy was observed at all concentrations in the NTP chronic bioassays (NTP, 1984; Melnick et al., 1990; NTP, 1993), and showed a dose-dependent effect associated with increased inhalation exposure. In all exposure groups, ovarian atrophy was associated with what might be considered premature reproductive senescence. It is noteworthy that such senescence was observed as early

as nine months in female mice exposed to 200 or 625 ppm, and after 15 months in female mice exposed to ≥20 ppm butadiene (NTP, 1984; NTP, 1993). It is currently unknown how ovarian atrophy in rodents relates to human reproductive senescence. Reproductive senescence is a general term referring to the loss of reproductive function with age. In the female, this involves a loss of normal ovarian, and hypothalamic or pituitary function (Valdez and Petroff, 2004). The correlation between the loss of oocytes and declining fertility with age is well characterized, and it is generally accepted that depletion of follicles results in the final loss of fertility. The actual end of ovarian activity is preceded by a period of irregular reproductive cycles and subfertility in both women and rodents (Valdez and Petroff, 2004). Age-related changes in the rodent hypothalamus and pituitary appear to bring about the final cessation of ovarian cyclicity before follicular depletion occurs (Wise et al., 2002). However, exhaustion of ovarian follicular reserves appears to drive menopause in women (vom Saal et al., 1994). Despite these apparent differences in final reproductive senescence, the biological mechanisms leading to prolonged cycles and aberrant endocrinology appear similar in primates and rodents (Wise et al., 2002; Bellino and Wise 2003).

Currently, there are few data detailing the potential role of butadiene on the etiology of ovotoxicity and late-stage infertility (Hughes et al., 2001). Potential mechanisms might involve the in situ formation of butadiene reactive intermediates, which may have a direct effect on ovarian function (Doerr et al., 1995; Hughes et al., 2001), or a more general role on the hypothalamic-pituitary-gonadal axis. Available data seem to suggest that humans potentially form qualitatively similar metabolites to experimental rodent species, although the rates of formation and the quantities of specific metabolites differ (Bond et al., 1986;Csanady, 1992). Mice appear to produce a greater proportion of active epoxide metabolites than rats (Bond et al., 1986; Himmelstein et al., 1994; Thornton-Manning et al., 1995). However there are conflicting in vitro data that suggest humans may form epoxides of butadiene at comparable rates to mice or at rates several fold less than mice (Csanady et al., 1992; Duescher and Elfarra 1994; Krause and Elfarra 1997). Dahl et al. (1991) reported that following equivalent inhalation exposures, the concentrations of total butadiene metabolites in blood were 5-50 times lower in monkeys than in mice, and 4-14 times lower than in rats. Humans may more closely resemble the monkey than the mouse or the rat in their formation of epoxides from butadiene, and several models adjust for species differences in butadiene pharmacokinetics (Sweeney et al., 1997). In view of the fact that we have used a pharmacokinetic model to assess relevant dosimetry and the weight of published evidence that mice are more active butadiene metabolizers than other species studied, we used a UF of 1 to account for interspecies kinetic differences. However, an interspecies toxicodynamic adjustment for ovarian atrophy endpoint with butadiene is still needed to reflect the expected substantial toxicodynamic differences between mice and women (see the discussion in the derivation of the 8-hour REL). Therefore OEHHA used an interspecies toxicodynamic uncertainty factor of 10. We applied an intraspecies uncertainty factor of 30, 10 for toxicokinetics and $\sqrt{10}$ for toxicodynamics. The overall uncertainty factor was 300, and the cREL is 1.0 ppb.

For comparison, the U.S. EPA's RfC is 0.9 ppb. This value is based on a benchmark concentration (BMC) and a Weibull time-to response model for the ovarian atrophy

endpoint in mice in the NTP 2-year inhalation study (NTP, 1993; U.S.EPA, 2002). U.S.EPA (2002) calculated a BMC_{10} of 1.05 ppm and a $BMCL_{10}$ of 0.88 ppm (continuous) without the top dose. They applied an overall uncertainty factor (UF) of 1000 to derive a final value of 0.88 ppb or 0.9 ppb rounded. The composite UFs included √10 for interspecies, 10 for effect level, 10 for intraspecies, and √10 for data deficiencies.

The Texas Commission on Environmental Quality (TCEQ) used a similar analysis employing the top dose in the same data set to calculate a $BMCL_{05}$ of 462 ppb. Their chronic reference value of 15 ppb employs an overall UF of 30, which includes 10 for intraspecies differences and √10 for data deficiencies (Grant et al., 2010).

Kirman and Grant (2012) conducted a meta-analysis of pooled rodent data on ovarian atrophy resulting from butadiene exposure. They used data in mice from NTP (1993), NTP (1984) and Bevan et al. (1996) together with negative data in rats from Owen et al. (1987) and Bevan et al. (1996). Instead of using a PBPK model to estimate internal dosimetry they used an empirical equation relating average blood concentration of diepoxybutane (DEB) to DEB-specific pyr-Val hemoglobin adducts with separate rate constants and erythrocyte lifespans for mice and rats (4.7×10^{-5}, 40.3; 5.5×10^{-5}, 64.4, L/g hr., days, respectively). This resulted in estimated DEB blood concentrations in mice of 11 to 823 nM for butadiene exposures of 6.25 to 1250 ppm. For rats, estimated blood concentrations of 2.9 to 8.1 nM DEB were obtained for exposure concentrations of 1000 and 8000 ppm butadiene, respectively. Dose response analysis was conducted using the Multistage-Weibull (MSW) time and dose model for incidental effects (ovarian atrophy, extra risk, non-fatal analysis). Analyses were conducted for the mouse data at 823, 686, 471, 186, 73, 29, and 11 nM DEB, for rat data at 2.9 nM DEB, and for pooled mouse and rat data at 0 nM DEB (controls).

The advantage of this approach was the prediction of effects at specific exposure durations that could be compared with human ovarian reserves at times prior to menopause. Three human scenarios for duration of susceptibility to ovarian effects were defined by human menopause at 60 yr (low susceptibility), 49.6 yr. (average susceptibility) and 38.7 yr. (high susceptibility). For these scenarios points of departure (PODs) were determined at the 10% and 1% effect levels with 95% confidence limits i.e., $BMCL_{10}$, $BMCL_{01}$. The $BMCL_{01}$ PODs for high, average and low susceptibility were 1.3, 0.88, and 0.67 nM DEB in blood, respectively. The human equivalent concentrations of butadiene (continuous exposure) $BMCL_{01}$s were 10, 17, and 39 ppm butadiene, respectively. Comparable rodent durations for the human scenario durations were 53.7, 68.8, and 83.2 weeks, respectively. The MSW predicted dose response curve for low follicle count at birth (high susceptibility scenario) was shifted by factors of 3 and 8.5 (25.5 total) to the left to reflect a sensitive individual due to variation in toxicokinetics and toxicodynamics. Similarly, the curve for high follicle count at birth (low susceptibility) was shifted to the right by the same factors. The dose-response curve was not shifted for the average scenario. For the POD $BMCL_{01}$s of 17 ppm BD (average), 1.5 ppm BD (high, 25.5 TK+TD shift UF) , and 240 ppm BD (low,1/25.5 TK+TD shift UF) the derived reference values including an additional net uncertainty factor of 10 were 2, 0.2, and 20 ppm butadiene rounded, respectively. The lowest value

of 0.2 ppm or 200 ppb butadiene is over an order of magnitude higher than that proposed by Grant et al. (2010) for the Texas chronic reference value of 15 ppb butadiene and 67 times higher than the cREL proposed in this document.

This is a novel approach to butadiene non-cancer risk assessment. It rests on a number of assumptions which may not be justified. First of all, it assumes that the effects of butadiene in humans will be exactly as seen in mice, i.e. ovarian atrophy. Ovarian atrophy was the most sensitive non-neoplastic effect noted among several organ effects in mice (decreased lung, liver, and kidney weights) and uterine, testicular and nasal olfactory epithelial atrophies. Next it assumes that all the ovarian effects are due to DEB and that DEB acts the same in rats as in mice. An examination of their Table 3 shows some problems with this latter assumption since at a comparable estimated blood DEB concentration of 11 nM in mice 19/49 showed atrophy, whereas at 8.1 nM in rats no effect was seen (0/110). It appears that mice are much more sensitive to blood DEB than rats. There is also a concern that the effect of including the negative rat data (350 animals) may have reduced the overall response. The choice of a 1% response rate may also be problematic. Usually for non-cancer data the lower bound on the 5% response rate is chosen as the POD i.e., $BMCL_{05}$. While the authors note that several hundred animals were included in the analysis it is questionable if the analysis had the power to detect a 1% increase ($BMCL_{01}$) since the largest denominator for any specific dose level causing an effect was 79 mice. The $BMCL_{01}$ is an extrapolated response well beyond the bulk of observed values. There appears to be a discrepancy in Table 8 which lists a POD of 240 ppm and a reference level of 20 ppm (rounded) where the text gives a value of 255 ppm (10 x 25.5) which would give 26 ppm rounded.

In order to compare their method with ours we used the same TWA DEB internal dose estimates of Kirman & Grant (2012) and conducted a Multistage Weibull non-fatal time to effect analysis (MSW) using U.S.EPA software (U.S.EPA, 2010a) to estimate the benchmark concentration level time adjusted $BMCLt_{05}$ values for the largest and most important data set in their meta-analysis and our cREL derivation, namely the NTP (1993) 24 months data (N= 325). Using individual animal data (dose, time, incident, censored, number) we obtained a value of $BMCLt_{05}$ = 0.502 ppm butadiene equivalent (Table 7). This value is half the 1.01 ppm value based on our time-weighted analysis of 9, 15 and 24 months quantal data (dose, time, number with ovarian atrophy/total number exposed) and the $BMCL_{05}$ for a log probit model (N = 435). While there is no chi-square goodness of fit statistic for the $BMCLt_{05}$, graphical comparisons of the MSW parametric and nonparametric models in probability-time (pr), dose-response (dr), quantile-quantile (qq), and probability-probability (pp) plots indicate excellent fit of the MSW model to the 24 months ovarian atrophy data (Appendix B, U.S.EPA, 2010b). Since the $BMCLt_{05}$ is similar to the $BMCL_{05}$, but is based on fewer animals and conducted with new software with which we have limited experience, the MSW analysis is considered a supporting analysis for the cREL.

Table 7. Multistage Weibull Analysis of Ovarian Atrophy in Female Mice in 2-Year Inhalation Study of 1, 3-Butadiene (NTP, 1993).

Exposure Period	Model	AIC	$BMCt_{05}$ nM DEB	$BMCLt_{05}$ nM DEB	$BMCLt_{05}$ ppm BD equiv.	$BMCLt_{05}$ continuous ppm BD HEC	Comment
24 months	Multi-stage Weibull[1]	300.781[2]	1.56	1.28[3]	0.502[4]	0.151[5]	N = 325; good fit by pr, dr, qq, & pp plots[6]

Note: (1) P(response) = 1-exp{-(t-t0)^c * (beta_0 + beta_1*Dose^1 + beta_2*Dose^2 + beta_3*Dose^3)} run as nonfatal analysis, t0 = 0; (2) Akaike's Information Criterion; (3) $BMCLt_{05}$ 95% lower bound on the 5% response level by MSW with internal DEB dose metric of Kirman and Grant (2012); (4) external equivalent of 0.50 nM DEB in 6hr/d BD; (5) continuous human equivalent concentration of BD (6/24h x 5/7d x 1.68 dosimetric adjustment factor; (6) goodness of fit graphical tests: probability v. time (pr), probability v. dose (dr), time v time (qq), probability v. probability (pp) for parametric and nonparametric msw models (U.S.EPA, 2010b).

It is important to note that in deriving the cREL for butadiene, OEHHA makes no assumption concerning target site concordance in experimental animals and humans. We assume only that the most sensitive site and species with appropriate uncertainty factors will protect against any adverse effect in exposed humans including children.

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Appendix A

This appendix includes information on genotoxicity of butadiene, except discussion of dominant lethal mutations and germ cell mutagenicity, which are covered in the developmental and reproductive toxicity section of the main document. An overview of the genotoxicity of butadiene and its metabolites is presented in Table A1. Also included are data on PBPK modeling of butadiene employed in the derivation of the $BMCL_{05}$ and the 8-hr and chronic RELs. Table A2 gives a historical overview of the PBPK and related models that were more or less available for use.

While genetic toxicology generally provides key supporting documentation for cancer risk assessment rather than the present noncancer assessment, we believe that mutagenicity and other genetox effects, particularly oxidative DNA damage, may contribute to chronic diseases such as heart disease, neurodegenerative diseases, diabetes mellitus, rheumatoid arthritis, and aging, irrespective of their role in initiation and promotion of tumors (F.M.Burnet,1974; Cooke et al., 2006).

A.1 Genetic Toxicity: Introduction

This section includes information on genetic toxicity. Albertini et al. (2010) have provided a comprehensive review of 1, 3-butadiene genotoxicity. As noted above, the metabolism of butadiene produces the major electrophilic metabolites EB, EBD, and DEB. These epoxide metabolites are responsible both for the mutagenicity and carcinogenicity of 1, 3-butadiene. They are DNA reactive forming a variety of adducts, and all are genotoxic in vitro and in vivo. Also butadiene epoxide metabolites form adducts with proteins notably hemoglobin and may exert or influence noncancer endpoints. In general genotoxicity, specifically oxidative DNA damage, may influence a number of chronic diseases and aging in addition to cancer (Cooke et al., 2006; Evans & Cooke, 2006).

A.2 Microbial test systems

Butadiene has induced mutagenic responses in all microbial systems that were provided with exogenous microsomal activation (S-9) that allowed the formation of oxidative metabolites. The purified metabolites epoxybutene (EB) and diepoxybutane (DEB) have also been shown to be mutagenic in all microbial systems without exogenous activation (Albertini, 1999). Carmical et al. (2000) found evidence of stereospecific mutagenicity of diolepoxide derived adducts in an *E.coli* system. The BDE R,R isomer induced a mutantion frequency of 0.14% (A→G mutations exclusively), whereas the S,S isomer induced 0.25% (A→C mutations exclusively). The mutation frequencies induced by BMO isomers were not significantly different from controls (<0.05%). Curiously, a recent report by Cho et al. (2010) demonstrated the mutagenicity in *S. typhimurium* TA1535 of the glutathione conjugate of DEB, *S*-(2-hydroxy-3,4-epoxybutyl)GSH. In general GSH conjugates are regarded as detoxification products but in this case the conjugate was reported to have higher mutagenic potency than DEB.

A.3 Higher organism test systems

Butadiene and its diepoxide have been tested in the fruit fly *Drosophila melanogaster*. BD was negative in sex-linked recessive lethal mutations and the spot wing test whereas DEB was positive in these tests. Studies in mammalian cell systems parallel those in microbial systems with BD, EB, DEB and epoxybutane diol (EBD) showing positive results in systems provided with exogenous activation. In these systems the rank order of mutagenic potency was generally DEB> EB (BMO)>EBD>BD. DEB was generally 40 to 100-fold more potent than EDB. DEB is more likely to cause deletions, whereas all the epoxides induce base substitutions with a preference for A:T base pairs (Albertini, 1999). Both EB and DEB occur in different stereochemical configurations, which have been evaluated in the TK6 human lymphoblastoid cell line for increases in hypoxanthine-guanine phosphoribosyltransferase (HPRT) and thymidine kinase (TK) mutant frequencies. Meng et al. (2007) found no differences in cytotoxicity or mutagenicity among three isomers of DEB or the two isomers of EB. Thus, stereochemistry seems likely to play little role in the mutagenicity of BD. These findings were consistent with in vivo results, which showed little difference in the mutagenic efficiencies of racemic-DEB or meso-DEB in rodents. However, the results seem somewhat at odds with those of Carmical et al. (2000) above, where *S*,*S*-EBD derived adducts preferentially induced mutagenicity in *E.coli*.

Mutagenic studies in whole mammals have generally given positive responses when the animals (mice or rats) were exposed to butadiene by inhalation (Albertini et al., 2010). The tests included the mouse spot test, which involves in utero exposure of a developing embryo, which results in mutations in hair coloring in the offspring. Most of the assays were for mutations in the *hprt* locus in lymphocytes of exposed rodents.

A.4 Genotoxicity in humans

Genotoxicity in humans is usually assessed by the molecular epidemiology of exposed populations via the monitoring of genetic endpoints, including mutations. Several specific biomarkers of BD exposure are available which allow measurement of internal dosimetry of different BD metabolites. Two BD urinary metabolites: M1 (1, 2-dihydroxy-4-[*N*-acetylcysteinyl]-butane) and M2 (an isomeric mixture of 1-hydroxy-2-[*N*-acetylcisteinyl]-3-butene and 2-hydroxy-1-[*N*-acetylcisteinyl]-3-butene have frequently been used as measures of BD exposure (Albertini et al., 2010). N-terminal valine adducts of hemoglobin have also been used as in vivo BD dosimeters (Perez et al., 1997; Boogaard et al., 2001).

There have been several small studies involving one or more biomarkers of exposure and nine populations that have been subjected to comprehensive studies with biomarkers of BD exposure and specific genotoxicity endpoints including somatic gene mutations and chromosome aberrations (Albertini et.al., 2010). Overall the results of these investigations have been mixed. With respect to mutational endpoints, only studies of BD-exposed workers in Texas have reported significantly increased frequencies of *hprt* gene mutations in peripheral blood lymphocytes determined by autoradiography (Albertini et al., 2010; Wickliffe et al., 2009).

Albertini et al. (2007) conducted a molecular epidemiological study of 53 BD-exposed Czech workers and 51 controls. The mean 8-hr time weighted average (TWA) concentrations of BD were 0.008 mg/m^3 (3.5 ppb) and 0.397 mg/m^3 (180 ppb) for female controls and exposed, respectively, with individual 8-hr TWA values up to 9.8 mg/m^3 (4.45 ppm). For male workers, mean TWA values for control and exposed workers were 3.2 and 370 ppb, respectively with single individual values up to 5.72 ppm. For both sexes, the urinary BD metabolites M1 and M2 were elevated in exposed vs. control subjects, reaching statistical significance in males. *HPRT* mutations, via cloning assays, and multiple measures of chromosome level changes (SCEs) were not associated with BD exposures.

Wickliffe et al. (2009) evaluated the frequencies of HPRT mutant lymphocytes in BD polymer workers in a Southeast Texas facility. Thirty workers were exposed to BD concentrations of 93.5 ppb (mean and 2.5 ppb (median) with only one individual's exposure estimate (1684 ppb) exceeding the OSHA PEL of 1.0 ppm. The minimum detection level was 2.5 ppb and 50% of exposures were below this level. *HPRT* mutant frequencies by autoradiographic lymphocyte assay were not significantly associated with current exposures or age (N = 29). However *HPRT* mutant frequencies were significantly associated with occupational longevity (≥ 30 yr, N = 29, R^2 = 0.107, $P < 0.046$). The authors speculate that chronic or past high-level BD exposures may have produced retention of mutant long-term memory T-cells.

TABLE A1. GENOTOXICITY OF 1, 3-BUTADIENE AND METABOLITES
(ADAPTED FROM ALBERTINI 1999 AND ALBERTINI ET AL., 2010).

Compound	Test System	Results	Comments
Microbial, Procaryotic			
BD	*Salmonella typhimurium* TA 1530, TA1535	+	Rat and human S-9, multiple tests
BD	*Salmonella typhimurium* TA 1530, TA1535	-	Without S-9, usually negative, positive results attributed to volatile metabolites
EB (BMO)	*Salmonella typhimurium* TA 1530, TA1535,TA100	+	Without S-9, LEC = 2431 µM
EB (BMO)	*Escherichia coli*	+	Without S-9
EB N^6 adenine adducts	*E.coli* transfected with adducted oligonucleotides	-	Neither isomer adduct was significantly mutagenic, Carmical et a. 2000
EB (BMO)	*Klebsiella pneumoniae*	+	Without S-9
DEB	*Salmonella typhimurium*	+	Without S-9, more potent than EB, LEC = 302µM
DEB	*E.coli*	+	Without S-9
DEB	*Bacillus megaterium*	+	Without S-9
DEB	*Pseudomonas pyocyanea*	+	Without S-9
DEB	*K. pneumonia*	+	Without S-9
DEB-GSH	*Salmonella typhimurium* TA1535	+	*S*-(2-hydroxy-3,4-epoxybutyl)GSH reported more mutagenic than DEB (Cho et al., 2010)
EBD	*Salmonella typhimurium*	+	With or without S-9, LEC = 980 µM
EBD N^6 adenine adducts	*E.coli* transfected with adducted oligonucleotides	+	S,S- stereoisomer of EBD gave higher mutagic frequency than the R,R isomer, Carmical et al., 2000

TABLE A1. GENOTOXICITY OF 1, 3-BUTADIENE AND METABOLITES
(ADAPTED FROM ALBERTINI 1999 AND ALBERTINI ET AL., 2010).

Compound	Test System	Results	Comments
Microbial, Eucaryotic			
DEB	*Neurospora crassa*	+	Without S-9
DEB	*Schizosaccharomyces pombe*	+	Without S-9
DEB	*Saccharomyces cerevisiae*	+	Without S-9
DEB	*Aspergillus nidulans mitotic crossive over and recombinant selection, gene mutations*	+	20μM, 1 min; LEC = 50 mM, 13 min
DEB	*Penicillium multicolor*	+	Both stereoisomers
Insect			
BD	*Drosophila melanogaster*	-	Sex-linked recessive lethal mutations, spot wing test somatic mutations
ED (BMO)	*Drosophila melanogaster* adult males exposed to EB by inhalation for 24 hr. Gene mutations scored	+	Sex-linked recessive lethal mutations induced highest exposure level on 3800 ppm EB (91,200 ppm-hr) w/ DNA repair or at 2000 ppm (24,000 ppm-hr) w/o DNA repair.
DEB	*Drosophila melanogaster,* gene mutations, deletions, CAs	+	Sex-linked recessive lethal mutations, semi lethal and visible mutations, LEDs 100-800 μg/kg by injection.
DEB	*Drosophila melanogaster,* heritable gene deletions, point mutations	+	500 μM (single dose), high frequency of deletions vs. point mutations. Males fed DEB progeny phenotypes scored, or adults from treated larvae.

TABLE A1. GENOTOXICITY OF 1, 3-BUTADIENE AND METABOLITES
(ADAPTED FROM ALBERTINI 1999 AND ALBERTINI ET AL., 2010).

Compound	Test System	Results	Comments
Mammalian cells in vitro			
BD	Mouse Lymphoma	+	S-9
DEB	Human TK6 (*hprt* and *tk* loci)	+	Mutations induced preferentially at A:T base pairs, 40-100x more potent than BDE, LECs = 3.5, 2.3 µM, respectively.
EB (BMO)	Human TK6 (*hprt* and *tk* loci)	+	Mutations induced preferentially at A:T base pairs, 3.5x more potent than BDE, LECs = 122, 243 µM, respectively.
BDE	Human TK6 (*hprt* and *tk* loci)	+	Mutations induced preferentially at A:T base pairs, LECs = 200, 300 µM, respectively.
DEB	Human TK6 (*hprt* locus)	+	Mutations induced preferentially at A:T base pairs
EB (BMO)	Human TK6 (*hprt* locus)	+	Mutations induced preferentially at A:T base pairs
Mammalian, whole animal			
BD inhalation	Mouse melanocyte mutations, mouse spot test	+	500 ppm, 6hr/d on gestation days 8-12, offspring inspected for color spots at 2-3 weeks of age.
BD inhalation	Mouse B6C3F1 *hprt* splenic lymphocytes	+	Mutagenic potency mouse/rat = 5
BD inhalation	Mouse B6C3F1 *hprt* thymic lymphocytes	+	
BD inhalation	Rat Fischer 344 *hprt* splenic lymphocytes	+	
BD inhalation	Rat Fischer 344 *hprt* thymic lymphocytes	+	
BD inhalation	Mouse 102XC3h *hprt* splenic lymphocytes	+	
BD inhalation	Mouse CD1 *hprt* splenic lymphocytes	-	
BD inhalation	Mouse MM *lac I*	+, -	Lung positive, bone marrow and liver negative
BD inhalation	Mouse BB *lac I*	+	

TABLE A1. GENOTOXICITY OF 1, 3-BUTADIENE AND METABOLITES
(ADAPTED FROM ALBERTINI 1999 AND ALBERTINI ET AL., 2010).

Compound	Test System	Results	Comments
BD inhalation	Mouse 2-year Bioassay K-ras mutation	+	Lung and liver tumors, lymphoma
BD inhalation	Mouse 2-year Bioassay H-ras mutation	+	Liver tumors
BD inhalation	Mouse 2-year Bioassay p53, Rb, Chr.4 gene, allele loss	+	Lung and mammary tumors
EB (BMO)	Mouse B6C3F1 *hprt* splenic lymphocytes	+	
EB (BMO)	Mouse 102XC3h *hprt* splenic lymphocytes	±	
EB (BMO)	Rat Fischer 344 *hprt* splenic lymphocytes	±	
EB (BMO)	Rat Lewis *hprt* splenic lymphocytes	-	
DEB	Mouse B6C3F1 *hprt* splenic lymphocytes	+	
DEB	Mouse 102XC3h *hprt* splenic lymphocytes	-	
DEB	Mouse C57B1 *hprt* splenic lymphocytes	-	
DEB	Rat Fischer 344 *hprt* splenic lymphocytes	+	
DEB	Rat Lewis *hprt* splenic lymphocytes	-	
Mammalian cytogenetics in vitro			
BD	Chinese hamster ovary cells, sister chromatid exchanges (SCEs)	+	S-9
BD	Human lymphocytes, SCEs	±	± S-9, S-9 not necessary
EB (BMO)	Mouse, rat and human lymphocytes, Cas	-	EB negative for all species tested

TABLE A1. GENOTOXICITY OF 1, 3-BUTADIENE AND METABOLITES
(ADAPTED FROM ALBERTINI 1999 AND ALBERTINI ET AL., 2010).

Compound	Test System	Results	Comments
EB (BMO)	Mouse and rat splenocytes, Cas	-	EB negative in both species, HIC = 931 µM EB
EB (BMO)	Human peripheral blood lymphocytes, MN induction	+	LEC = 1.0 µM
EB (BMO)	Rat spermatids, MN. Treatment of late pachytene-diakinetic spermatocytes for 4 days, score MN in meiosis.	-	Negative at 1000 µM
DEB	Rat spermatids, MN. Treatment of late pachytene-diakinetic spermatocytes for 4 days, score MN in meiosis.	+	LEC = 5 µM
DEB	Human peripheral blood lymphocytes, MN induction	+	LEC = 0.5 µM
DEB	Mouse and rat splenocytes, Cas	+	DEB positive in both species, 0.47 and 0.36 aberrant metaphases/100 metaphases/µM, respectively. LEC mouse = 40µM, LEC rat = 80µM.
DEB	Mouse, rat and human lymphocytes, Cas	+	DEB positive for all species tested, aberrant metaphases = 0.36/100/µM DEB for mice and rats.
DEB	Rat embryo fibroblasts, chromosome aberrations	+	Induction of Cas and high degree of tetraploidy, LEC = 93 µM
DEB	Rat liver cells, cytological scoring	+	Concentration not stated.
DEB	Human skin fibroblasts	+	Cas positive in Fanconi's anemia heterozygotes, LEC = 0.1 µM.

TABLE A1. GENOTOXICITY OF 1, 3-BUTADIENE AND METABOLITES
(ADAPTED FROM ALBERTINI 1999 AND ALBERTINI ET AL., 2010).

Compound	Test System	Results	Comments
EBD	Rat spermatid, MN induction. Treatment of late pachytene-diakinetic spermatocytes for 4 days, score MN in meiosis.	-	HIC = 100 µM
Mammalian cytogenetics in vivo			
BD inhalation	Mouse Chromosome aberrations (Cas)	+	Lymphocytes and bone marrow multiple tests
BD inhalation	Mouse induced micronuclei (MN)	+	Lymphocytes and bone marrow multiple tests
BD inhalation	Mouse, induced MN in lung fibroblasts, 500 ppm (males) and 1300 ppm, 6hr/d x 5d	+	Significant increase in kinetochore (+) MN in males at 500 ppm, and kinetochore (+) and (-) MN in females at 1300 ppm.
BD inhalation	Mouse SCEs	+	Lymphocytes and bone marrow multiple tests
BD inhalation	Rat Cas	-	
BD inhalation	Rat MN	-	
BD inhalation	Rat SCEs	±	
EB (BMO), i.p. injection	Mouse, Cas in bone marrow cells	+	Positive dose response 25-150 mg/kg
EB (BMO), i.p. injection	Mouse and Rat, MN in splenic lymphocytes	+	Positive in both species, LED mice = 40 mg/kg, LED rats = 80 mg/kg
DEB, s.c. injection	Rat, peripheral blood lymphocytes Cas	+	Stickiness and clumping of chromosomes at 1 mg/kg, chromosome fragmentation at 3 mg/kg
DEB, i.p. injection	Mouse and Rat, MN in splenic lymphocytes by cytokinesis-block method; characterization of induced MN by FISH.	+	Positive in both species, LED mice = 15 mg/kg, LED rats = 30 mg/kg
DEB, i.p. injection	Mouse, Cas in spermatogenic cells	+	Significant increase in chromosome breaks.

TABLE A1. GENOTOXICITY OF 1, 3-BUTADIENE AND METABOLITES
(ADAPTED FROM ALBERTINI 1999 AND ALBERTINI ET AL., 2010).

Compound	Test System	Results	Comments
EBD, i.p. injection	Rat, MN in bone marrow cells at 30 and 60 mg.kg	±	Weak positive at 30 mg/kg only.
EBD, i.p. injection	Rat, MN in spermatids at 30 amd 60 mg/kg	+	Significant induction of MN on days 2 and 3 post-exposure (diploteme and late pachyteme)
Mammalian germ cell genotoxicity in vivo			
BD inhalation	Mouse dominant lethals	+	Multiple tests
BD inhalation	Mouse heritable translocation	+	2 studies
BD inhalation	Mouse sperm head abnormalities	+	Increases at 200 ppm, statistically significant at 1,000 and 5,000 ppm, 6hr/d x 5 d
BD inhalation	Mouse spermatid micronuclei	+	
BD inhalation	Mouse testicular cells Comet Assay	+	DNA fragmentation
BD inhalation	Rat dominant lethal	-	
EB (BMO), i.p. injection	Mouse splenic lymphocytes, SCEs	+	Statistically significant increases at 48.8 and 73.2 mg/kg. HID = 24.4 mg/kg
DEB, i.p., i.v. injection	Mouse SCEs in bone marrow cells, alveolar macrophages and liver cells	+	Positive SCE induction in all cell types.
DEB, 1 hr aerosol inhalation, i.p. injection.	Mouse and Chinese hamsters, SCEs in bone marrow cells	+	Positive in mice, LED = 20-30 mg/kg (based on blood concentration). Hamster less sensitive.
EBD, i.p. injection	Mouse, dominant lethal mutations	-	Single EBD dose of 120 mg/kg

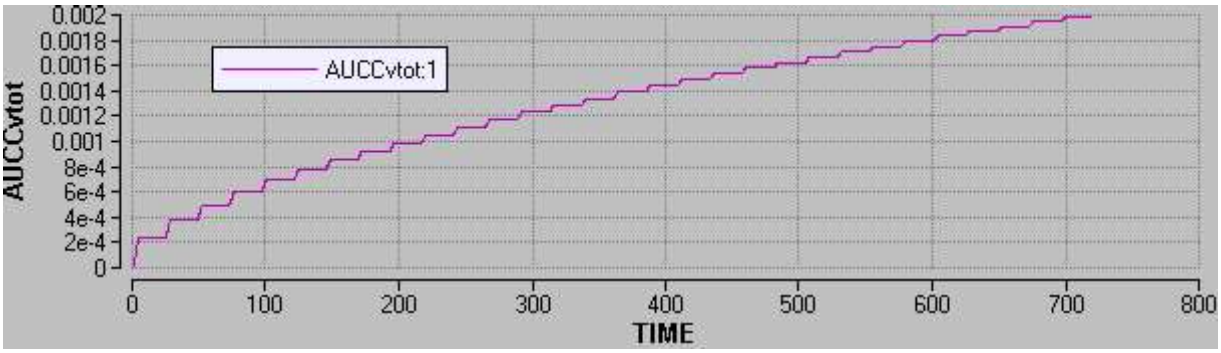
TABLE A1. GENOTOXICITY OF 1, 3-BUTADIENE AND METABOLITES
(ADAPTED FROM ALBERTINI 1999 AND ALBERTINI ET AL., 2010).

Compound	Test System	Results	Comments
Human cytogenetics in vivo			
BD occupational exposure	Cas -	±	+ for $GST^{-/-}$ genotype
BD occupational exposure	SCEs	±	
BD occupational exposure	MN	-	
BD occupational exposure	Comet Assay	-	
BD occupational exposure	*hprt* T-cell (Autoradiography)	+	Variant frequencies significantly associated with occupational longevity (N = 29, R^2 = 0.107, P < 0.046), Wickliffe et al., 2009.
BD occupational exposure	*hprt* T-cell (Cloning Assay)	-	
BD occupational exposure	*ras* oncoprotein	-	

A.5 PBPK Modeling Data

A general summary of the PBPK models and related reports in the literature is given in Table A2. Of the available models, the one that seemed the most developed in view of relevant metabolites covered in mice and rats was that of Kohn and Melnick (2001). Unfortunately, due to the untimely death of the senior author we were unable to secure the actual model code for this model and were limited to the published report. The values given for the physiological parameters for mice and rats are reproduced in Table A3. Average reported values for alveolar ventilation rates of 20.2 and 20.0 $L/hr/kg^{0.7}$ for mice and rats, respectively were used in the model. For cardiac output the values used were 15.3 and 14.7 $L/hr/kg^{0.7}$, for mice and rats respectively. Typical body weights were 0.025 to 0.030 kg for mice and 0.215 to 0.360 kg for rats. Model partition coefficients are shown in Table A4. The biochemical parameters are listed in Table A5. The activities of P450 and epoxide hydrolase (EH) in mice and rats were multiplied by 30, 9, and 9 mg of microsomal protein per gram of tissue for liver, lung, and kidney, respectively. The glutathione *S*-transferase activities were multiplied by 82.8 or 108 mg of cytosolic protein per gram of tissue for mice and rats, respectively. Michaelis-Menten kinetics were used for P450 and EH and the ordered bi-bi rate law was used for GST.

The results of PBPK simulations of Doerr et al (1996) are shown in Table A6. Daily i.p. doses of BMO are administered to a young mouse over 30 days (720 hr). The cumulative AUC for DEB in the mixed venous blood (Cvtot) is divided by 30 to give the dose metric of μMhr/d, which is then analyzed by the benchmark dose method (Table A7) to obtain a $BMDL_{05}$. A Berkeley Madonna graph of the 30 days simulation of the 0.09 mmol/kg mid dose is shown in the Figure below. The units are AUC_{DEB} in mixed venous blood Mhr versus time in hours. The terminal value (0.002Mhr) corresponds to the 1985 μMhr value in Table A5 obtained from the tabular output of the same simulation.



An example of code for the OEHHA implementation of the Kohn and Melnick (2001) butadiene model is shown after the tables.

TABLE A2. SUMMARY OF BUTADIENE PBPK AND RELATED MODELING LITERATURE.

Study	Species	Chemicals modeled	Key parameters	Comments or other factors
Hattis & Wasson, 1987	Mice, Rats	BD	Pb = 0.35 Pf = 118.2 Plvrg = 5.4 Pm = 5.26 P_{450} Vmax = 400µmol/kg-hr (mice), 200µmol/kg-hr (rats) Km = 5.0 µM	3 compartment model liver combined with vessel rich group. Model runs in moles, minutes, liters and Vmax = 1.46 x 10^{-6} mol/min (rat)
Csanady et al., 1992	Mice, Rats, Humans	BD, BMO	P_{450} Vmax/Km = 157-1295; EH Vmax/Km = 3.6-35; GST Vmax/Km = 4.3-17 nmol/mg protein/min/mM, all values for liver	2-compartment kinetic model for BD and BMO metabolism in vitro: BD gas and liquid, BMO gas and liquid.
Johanson & Filser, 1993	Mice, Rats	BD, BMO, GSH (liver)	BD Pb = 3.03; Pf = 7.2; Pmusc = 0.24; Pl = 0.31; Pkid = 0.30; Pbrain = 0.14; BMO Pb = 83.4; Pf = 1.85; Pmusc = 0.72; Pl = 0.65; Pkid = 0.84; Pbrain = 0.62.	Closed chamber experiments simulated.
Evelo et al., 1993	Mice, Rats	BD	Pb = 1.184, 0.603 Pf = 32.36; Pl = 2.675; Pmusc = 1.871; Pkidney = 1.69; Plung = 1.272; Pbrain = 2.355; Pvrg = 2.02	2-compartment lung with gas exchange in alveoli, metabolism in bronchi and alveoli; Mice Vmax liver = 318, pulmonary = 70, bronchi = 77 µmol/hr-kg, Km = 8 µM

TABLE A2. SUMMARY OF BUTADIENE PBPK AND RELATED MODELING LITERATURE.

Study	Species	Chemicals modeled	Key parameters	Comments or other factors
Kohn & Melnick, 1993	Mice, Rats, Humans	BD, BMO	BD Pb = 1.5; BD Pf = 118.2; BD Pl = 5.49; BD Pmusc = 5.26; BD Pviscera = 5.34; BMO Pb = 60; BMO Pf = 1.81; BMO Pl = 0.6545; BMO Pmusc = 0.6533; BMO Pviscera = 0.6348	Sensitivity Analysis; Vmax BD P_{450} = 155.4 (mouse), 35.4 (rat), 70.8 (human) nmol/hr-mg prot., liver microsomal protein = 11.6, 16.8, 14.5 g/L, Km = 2, 3.75, 5.14 µM, respectively.
Medinsky et al., 1994	Mice, Rats	BD, BMO	BD Pb = 1.49, 1.34; BD Pf = 14.9, 14.3; BD Pl = 0.799, 1.01 BD Pm = 0.99, 2.99 BMO Pb = 50.4, 36.6; BMO Pf = 2.74, 2.49, BMO Pl = 1.43, 1.15 BMO Pm = 0.39, 0.64 (rats and mice, respectively.)	BD liver and lung oxidation; BMO liver oxidation, hydrolysis, and conjugation. Liver oxidation Vmax/Km = 16.5, 169 µmol/hr/kg/µM, rats and mice, respectively.
Johanson & Filser,1996	Mice, Rats, Humans	BD,BMO,GSH (liver)	BD Km = 83 µM GST Km(BMO) = 100 mM	Intrahepatic oxidation of BD and hydrolysis of BMO
Csanady et al., 1996	Mice, Rats, Humans	BD,BMO,DEB	Rats BD Vmax = 220 µmol/kg-hr, Km = 36 µM; Mice BD Vmax = 400 µmol/kg-hr, Km = 26 µM; BMO k_{P450} = 0.00126 L/hr; DEB k_{elim} = 0.0046 L/hr	Hemoglobin adducts from BMO reaction with N-terminal valine:2.9E-5 L/hr/g Hb

TABLE A2. SUMMARY OF BUTADIENE PBPK AND RELATED MODELING LITERATURE.

Study	Species	Chemicals modeled	Key parameters	Comments or other factors
Sweeney et al., 1997	Mice, Rats	BD, BMO, DEB in Liver and Lung;	DEB P_{liver} = 1.53, P_{kidney} = 1.41, P_{muscle} = 1.82, P_{fat} = 2.20; Mice BD Liver Vmax = 338 µmol/kg-hr, Km = 2.0µM, Lung Vmax = 21.6 µmol/kg-hr, Km = 5.01 µM; Liver DEB EH Vmax = 4193µmol/kg-hr, Km = 8100 µM; GST Vmax = 5.03×10^4 µmol/kg-d, Km = 6400 µM	Mice BMO Liver P_{450} Vmax = 176.6 µmol/kg-hr, Km = 145 µM, EH Vmax= 754 µmol/kg-hr, Km = 1590 µM, GST = 1.54×10^5 µmol/kg-hr, Km = 3.53×10^4 µM
Kohn & Melnick, 2000	Mice, Rats	BD, BMO, DEB	BD Pb = 1.95 BD Pf = 10.8 BMO Pb = 56.8 BMO Pf = 2.25 DEB Pf = 2.19 BD liver Vmax/Km = 1292, 578 nmol/min/mg protein/mM for mice and rats, respectively	Diffusion-limited model, liver, lung and kidney metabolism P_{450}, EH, GST; P_{450}-EH complex ER bound.
Kohn & Melnick, 2001	Mice, Rats	BD, BMO, DEB, BDD, EBD	BD Pb = 1.95 BD Pf = 10.8 BMO Pb = 56.8 BMO Pf = 2.25 DEB Pf = 2.19 BDD Pf = 0.573 EDB Pf = 0.496	Diffusion-limited model, liver, lung and kidney metabolism P_{450}, EH, GST; P_{450}-EH complex ER bound.

TABLE A2. SUMMARY OF BUTADIENE PBPK AND RELATED MODELING LITERATURE.

Study	Species	Chemicals modeled	Key parameters	Comments or other factors
Sweeney et al., 2001	Human	BD,BMO, DEB,BDD,EBD	Vmax/Km: BD→BMO, 0.0132/0.7; BD→DEB, 0.031/880; BMO→BDD, 1.4/540; BMO→GS_{conj}, 2.7/10,400; DEB→GS_{conj}, 0.4/3390; BDD→EBD, 0.031/880; DEB→EBD, 9.2/4605; EBD→Erythritol, 4.6/4605; EBD→GS_{conj}, 0.2/339, µmol/mg prot.-hr/µM.	Tissue/blood partition coefficients for BDD and EBD assumed to be 1.0. Sensitivity analysis (SA) for exhaled BD (2hr human exposure to 5 ppm BD): BD blood/air = 0.36; alveolar ventilation = -0.36; cardiac output = 0.28; Qliver = -0.40; Qfat = -0.23. SA for DEB AUC: Vmax EB→DEB = -0.98;Vliver = -0.96; Km DEB→EBD = 0.94; Vmax DEB→EBD = -0.93; Vmax BMO→BDD = -0.87, microsomal protein liver = -0.80; BD blood/air = 0.78.
Smith et al. 2001	Humans	BD 3 compartment model fit to data from human subjects, N = 133	BD uptake µg/kg; kmet /min, CYP2E1 genotype, phenotype	BD uptake and rate of metabolism not related in this analysis. No significant differences in uptake or kmet with genetic makeup.

TABLE A2. SUMMARY OF BUTADIENE PBPK AND RELATED MODELING LITERATURE.

Study	Species	Chemicals modeled	Key parameters	Comments or other factors
Mezzetti et al., 2003	Humans	BD 3-compartment model fit to data from human subjects, N= 130 8 parameters analyzed	1120 parameters sampled, the most sensitive: W_{wp_i} the weight fraction of the well perfused tissues; P_{fat}, the fat/blood partition coeff; P_{wp} = wp/blood partition coeff.	Bayesian Analysis Model, MCMC analysis. Subgroups analyzed: males, females; age<30yr; age ≥30 yr; African-American; Hispanic; Asian, Caucasian
Brochot et al., 2007	Humans	BD, BMO, DEB, BDD, EBD	BD Pb = 1.22 BD Pf = 18.4 BD P_{450} Kmet = 0.19 ± 0.06 /min	Global sensitivity analysis
Pery & Bois, 2009	Human	BD	Pb = 0.653 Pf = 22.0 Kmet = 0.3 L/min	23 tissue compartments PBPK model coupled to PD model of carcinogenicity
Beaudouin et al., 2010	Humans, N = 133	BD	BD P_{450} Vmax = 2.28 x 10^{-5} mmol/min/mg microsomal protein, Km = 0.39 mM	Acute and chronic (lifetime) exposures modeled. Human inter-individual variability in exhaled BD well described, within 95% CI: median x 0.3 to 1.6.

Table A3. Physiological Parameter Values for Kohn & Melnick (2001) PBPK Model for Butadiene and Metabolites

Tissue compartment volumes, % body weight	Mouse	Rat
Liver	5.5	3.7
Lung (bronchi)	0.6	0.52
Alveolar	0.5	0.515
Kidney	1.67	1.48
GI Tract	7.5	7.5
Viscera	3.93	14.3
Fat	6.0	5.4
Muscle and skin	64.5	54.2
Blood	6.0	5.4
Capillary blood volume, % tissue volume		
Liver	11.0	13.8
Lung	11.0	18.0
Kidney	10.2	16.0
GI tract	2.9	2.65
Viscera	7.1	7.1
Fat	3.0	2.0
Muscle and skin	1.3	2.0
Blood flow rate, % cardiac output		
Liver (hepatic artery only)	4.4	3.9
Kidney	16.3	13.3
GI tract	18.1	18.1
Viscera	22.4	24.8
Fat	5.0	6.5
Muscle and skin	33.8	33.4

TABLE A4. PARTITION COEFFICIENTS FOR KOHN & MELNICK (2001) PBPK MODEL FOR BUTADIENE AND METABOLITES

Partition Coefficient	Butadiene	Epoxybutene	Butenediol	Epoxybutanediol	Diepoxybutane
Blood:air	1.95	56.8	-	-	-
Liver:blood	0.595	0.984	1.04	0.903	1.41
Lung:blood	0.615	0.977	1.107	0.958	1.41
Kidney:blood	0.472	0.842	0.962	0.833	1.54
GI tract:blood	0.446	0.908	1.22	1.06	1.41
Viscera:blood	0.446	0.908	1.22	1.06	1.41
Fat	10.8	2.25	0.573	0.496	2.19
Muscle and Skin:blood	0.564	0.736	1.139	0.986	1.82

TABLE A5. BIOCHEMICAL PARAMETERS FOR KOHN & MELNICK (2001) PBPK MODEL FOR BUTADIENE AND METABOLITES

	Mouse Liver	Rat Liver	Mouse Lung	Rat Lung	Mouse Kidney	Rat Kidney
Butadiene						
P450 Vmax	155	130	139	9.6	1430	30
P450 Km	0.002	0.00375	0.00501	0.00775	0.00501	0.00216
Epoxybutene						
P450 Vmax	45.1	24.3	10.2	9.84	48.6	12.6
P450 Km	0.0156	0.145	0.0156	0.145	0.0156	0.145
EH Vmax	347	584	34.8	42.8	113	14.7
EH Km	1.59	0.26	1.59	0.7	1.59	0.7
GST Vmax	6420	4260	720	196	960	494
GST Kmx, adjusted	3.59	2.59	3.59	4.94	3.59	4.39
Butenediol						
P450 Vmax	16.3	67.1	1.0	31.5	1.0	85.0
P450 Km	0.0156	0.145	0.0156	0.145	0.0156	0.145
GST Vmax	3280	1230	491	276	1070	658
GST Kmx	34	34	34	34	34	34
Epoxybutanediol						
EH Vmax	363	1150	69.5	169	10.0	152
EH Km	8.1	2.76	7.5	7.1	7.5	7.1
GST Vmax	2260	271	50.0	100	50.0	138
GST Kmx	6.40	4.17	6.40	4.17	6.40	4.17
Diepoxybutane						
EH Vmax	1920	3170	10.0	1160	35.2	1000
EH Km	8.1	2.76	7.5	7.1	7.5	7.1
GST Vmax	9720	1940	100	100	100	100
GST Kmx, adjusted	6.40	4.17	6.40	4.17	6.40	4.17
Cysteine						
Tissue cysteine	0.193	0.195	0.171	0.127	0.280	0.326
γ-GCS Vmax	420	396	54	50	7920	6080

Table Vmax values in nmol/hr/mg protein, Km values in mM.

TABLE A6. PBPK MODELING OT THE DOERR ET AL. (1996) DATA ON OVARIAN ATROPHY IN MICE (MODEL BASED ON KOHN AND MELNICK, 2001)

BMO i.p. dose mmol/kg-d x 30 d	AUC DEB in blood µM hr (30 d)	AUC DEB in blood µM hr/day	Hb adducts nmol THBV/g globin-day
0.005	449	15.0	2.43
0.02	1046	34.9	21.8
0.09	1985	66.2	41.4
0.36	2717	90.6	56.7
1.43	3971	132.4	82.9

TABLE A7. BENCHMARK DOSE ANALYSIS OF AUC DEB AND HB ADDUCT DOSE METRICS WITH THE DOERR ET AL. (1996) DATA SET ON OVARIAN AND UTERINE ATROPHY IN MICE INDUCED BY PARENTERAL ADMINISTRATION OF EPOXYBUTENE (BMO).

Model, continuous, site	Fit Statistic, P	BMD_{05} µMhr/d	$BMDL_{05}$ µMhr/d
Polynomial, ovary	0.919	57.4	20.5
Power, ovary	0.0284 n.s.	2688	1765
Polynomial, uterus	0.84	103.1	37.9
		BMD_{05} nmol Hb/g-d	$BMDL_{05}$ nmol Hb/g-d
Hill, ovary	0.661	31.75	18.3
Polynomial, ovary	0.9225	34.81	15.60
Polynomial, uterus	0.80	58.2	23.9

Table A8 Ovarian Quantal Toxicity Data (NTP, 1993)

Dose group	9 months	15 months	24 months	N
0	0/10	0/10	4/49	69
6.25	0/10	0/10	19/49	69
20.0	0/10	0/10	32/48	68
62.5	0/10	9/10	42/50	70
200.0	9/10	7/10	43/50	70
625.0	8/8	2/2	69/79	89
$BMCL_{05}$	3.44	0.65	0.00054	435

Table A9 Ovarian Toxicity Continuous Data for Weighted Analysis (Time Adjustment)

Dose group, Xi, ppm	Yi, %	Wi, weight time in months*
0	0	9
0	0	15
0	8.46	24
6.25	0	9
6.25	0	15
6.25	38.78	24
20	0	9
20	0	15
20	66.67	24
62.5	0	9
62.5	90.0	15
62.5	84.0	24
200	90.0	9
200	70.0	15
200	86.0	24
625	100.0	9
625	100.0	15
625	87.3	24

Note:* weighting by $X^2 = \sum_i W_{i(Yi - Y(Xi, P1 \ldots Pm))}^2$, $Y = a - b/(1 + c(X))^d$, fitted parameters $a = 93.52 \pm 0.236$, $b = 89.23 \pm 0.2933$, $c = 0.01558 \pm 0.000632$, $d = 1.7097 \pm 0.05887$ (SD).

Table A10 Ovarian Continuous to Quantal Conversion

Dose group	Y predicted ,% with parameters a, b, c, d	Adjusted quantal response for BMC analysis	Observed at 24 months, %	Observed average 9-24 months, %
0	4.29	3/69	8.16	2.8
6.25	17.4	12/69	38.78	12.5
20.0	37.4	25/68	66.67	22.2
62.5	65.6	46/70	84.0	58.0
200.0	85.6	60/70	86.0	82.0
625.0	91.98	82/89	87.3	95.8

Table A11. Continuous Benchmark Analysis of Adjusted Quantal Response from Time Weighted Regression*

Model	X^2, P	BMC_{05} ppm	$BMCL_{05}$ ppm	$BMLC_{05}$ ppm continuous
Log Logistic	1.13, 0.8896	2.05	1.58	0.28
Log Probit	**1.70, 0.6364**	**2.04**	**1.009**	**0.18**
Multistage	58.35, -	7.54	6.16	n.s.
Multistage	10.19, 0.017	4.10	3.37	Without top dose, n.s.

Note:* BMDS version 2.2

TABLE A 12. BENCHMARK DOSE ANALYSIS OF FETAL WEIGHT DATA FROM HACKETT ET AL. (1987) AND GREEN (2003) RE-ANALYSIS.

Data Set	BMC_{05}	$BMCL_{05}$	Variance assumption	Fit*	Model	Comment
Hackett et al. (1987), total males and females	44.4 183.9	20.0 111.2	Equal Unequal	Exact No	Hill Hill	Best fit
	57.6 89.6	45.9 62.2	Equal Unequal	Exact No	Polynomial Polynomial	Nonmonotonic
Male fetuses	39.5 28.5	19.3 13.4	Equal Unequal	Exact Yes	Hill Hill	Best fit
Green (2003), total males and females	40.3 172.5	19.2 48.0	Equal Unequal	Exact No	Hill Hill	Best fit
	58.2 54.4	46.7 44.4	Equal Unequal	Exact No	Polynomial Polynomial	Nonmonotonic
Male fetuses	37.2 22.6	**17.7** 9.6	Equal Unequal	Exact Yes	Hill Hill	**Best fit overall**

Note * Exact = predicted values equal observed by table and plot, all absolute value residuals <3E-7, Yes = test 4 for fit, A3 vs. fitted, all absolute value residuals <2 . All values obtained with BMDS version 2.3.1.

The following model code is an example of OEHHA implementation of the Kohn and Melnick (2001) butadiene model in Berkeley Madonna v. 8.3.9. In Berkeley Madonna lines preceded by semi colons or enclosed in curved brackets are not executed.

```
METHOD Stiff

STARTTIME = 0
STOPTIME = 720
DT = 0.0005
DTOUT = 0.25
;Butadiene multimetabolite mouse model based on Kohn & Melnick (Chemico-Biol. Interact. 135-136:285-301(2001)). Symbols: A = mass of BD in moles, AB = BMO, AC = DEB, AD = BDD; AE = BDE; f = fat, l = liver, m = muscle, vrg = vessel rich group, br = bronchi, pu = alveoli, uo = uterus-ovary, kid, k = kidney, cap = tissue capillary bed; exh = exhaled, perit = peritoneum,C = concentration, Cv = concentration leaving tissue, Cvtot = mixed venous concentration, AUC = area under the time x concentration curve, V = volume, Q = flow, P = partition coeff.,Vmax = metabolic rate, Km = affinity constant, P450 = oxidase; EH = epoxide hydrolase, GST = glutathione sulfotransferase, BW = body weight for adult or young mouse for 30 day simulations, Amet = amount metabolized
{butadiene, moles}
init Af = 0
Limit Af >= 0
init Al = 0
Limit Al >= 0
init Am = 0
Limit Am >= 0
init Avrg = 0
Limit Avrg >= 0
init Abr = 0
Limit Abr >= 0
init Apu = 0
Limit Apu >= 0
init Auo = 0
Limit Auo >= 0
init AUCvtot = 0
Limit AUCvtot >= 0
init Aexh = 0
Limit Aexh >= 0
init Akid = 0
Limit Akid >= 0

init Afcap = 0
Limit Afcap >= 0
init Alcap = 0
Limit Alcap >= 0
init Amcap = 0
Limit Amcap >= 0
init Avrgcap = 0
Limit Avrgcap >= 0
;init Abrcap = 0
;init Apucap = 0
init Auocap = 0
```

```
Limit Auocap >= 0
init Akidcap = 0
Limit Akidcap >= 0

{butadienemonoxide moles}
init ABperit = 0
init ABf = 0
Limit ABf >= 0
init ABl = 0
Limit ABl >= 0
init ABlfree = 0
init ABm = 0
Limit ABm >= 0
init ABvrg = 0
Limit ABvrg >= 0
init ABbr = 0
Limit ABbr >= 0
init ABbrfree = 0
init ABpu = 0
Limit ABpu >= 0
init ABpufree = 0
init ABuo = 0
Limit ABuo >= 0
init AUCBuo = 0
Limit AUCBuo >= 0
init AUCBvtot = 0
Limit AUCBvtot >= 0
init ABkid = 0
Limit ABkid >= 0
init ABkidfree = 0

init ABfcap = 0
Limit ABfcap >= 0
init ABlcap = 0
Limit ABlcap >= 0
init ABmcap = 0
Limit ABmcap >= 0
init ABvrgcap = 0
Limit ABvrgcap >= 0
;init ABbrcap = 0
;init ABpucap = 0
init ABuocap = 0
Limit ABuocap >= 0
init ABkidcap = 0
Limit ABkidcap >= 0

{diepoxybutane moles}
init ACperit = 0
init ACf = 0
Limit ACf >= 0
init ACl = 0
Limit ACl >= 0
init AClfree = 0
init ACm = 0
Limit ACm >= 0
init ACvrg = 0
```

```
Limit ACvrg >= 0
init ACbr = 0
Limit ACbr >= 0
init ACbrfree = 0
init ACpu = 0
Limit ACpu >= 0
init ACpufree = 0
init ACuo = 0
Limit ACuo >= 0
init AUCCuo = 0
Limit AUCCuo >= 0
init AUCCvtot = 0
Limit AUCCvtot >= 0
init ACkid = 0
Limit ACkid >= 0
init ACkidfree = 0

init ACfcap = 0
init AClcap = 0
init ACmcap = 0
init ACvrgcap = 0
;init ACbrcap = 0
;init ACpucap = 0
init ACuocap = 0
init ACkidcap = 0

{dihydroxybutene}
init ADf = 0
Limit ADf >= 0
init ADl = 0
Limit ADl >= 0
init ADm = 0
Limit ADm >= 0
init ADvrg = 0
Limit ADvrg >= 0
init ADbr = 0
Limit ADvrg >= 0
init ADpu = 0
Limit ADpu >= 0
init ADuo = 0
Limit ADuo >= 0
init AUCDvtot = 0
init ADkid = 0
Limit ADkid >= 0

init ADfcap = 0
init ADlcap = 0
init ADmcap = 0
init ADvrgcap = 0
;init ADbrcap = 0
;init ADpucap = 0
init ADuocap = 0
init ADkidcap = 0

{epoxybutanediol}
init AEf = 0
```

```
Limit AEf >= 0
init AEl = 0
Limit AEl >= 0
init AElfree = 0
init AEm = 0
Limit AEm >= 0
init AEvrg = 0
Limit AEvrg >= 0
init AEbr = 0
init AEbrfree = 0
Limit AEvrg >= 0
init AEpu = 0
Limit AEpu >= 0
init AEpufree = 0
init AEuo = 0
Limit AEuo >= 0
init AUCEvtot = 0
init AEkid = 0
Limit AEkid >= 0
init AEkidfree = 0

init AEfcap = 0
init AElcap = 0
init AEmcap = 0
init AEvrgcap = 0
;init AEbrcap = 0
;init AEpucap = 0
init AEuocap = 0
init AEkidcap = 0

{moles of butadiene metabolized}
init Ametl = 0
init Ametpu = 0
init Ametbr = 0
init Ametk = 0

{moles of butadienemonoxide metabolized}
init ABmetl1 = 0
Limit ABmetl1 >= 0
init ABmetl2 = 0
Limit ABmetl2 >= 0
init ABmetpu1 = 0
Limit ABmetpu1 >= 0
init ABmetpu2 = 0
Limit ABmetpu2 >= 0
init ABmetbr1 = 0
Limit ABmetbr1 >= 0
init ABmetbr2 = 0
Limit ABmetbr2 >= 0
init ABmetl3 = 0
Limit ABmetl3 >= 0
init ABmetpu3 = 0
Limit ABmetpu3 >= 0
init ABmetbr3 = 0
Limit ABmetbr3 >= 0
```

```
{moles of dihydroxybutene metabolized}
init ADmetpu6 = 0
init ADmetbr6 = 0
init ADmetl6 = 0

{moles of diepoxybutane metabolized}
init ACmetpu4 = 0
init ACmetbr4 = 0
init ACmetl4 = 0

{Cysteine metabolism, moles, mol/L}
init AFl = Ccysl*Vl
init AFlu = Ccyslu*Vlu
init AFkid = Ccyskid*Vkid
Ccysl = 1.93E-4
Ccyslu = 1.71E-4
Ccyskid = 2.8E-4
Vmax10lC = 420E-9
Vmax10l = Vmax10lC*CPL*Vl
Vmax10luC = 54E-9
Vmax10lu = Vmax10luC*CPLu*Vlu
Vmax10kidC = 7920E-9
Vmax10kid = Vmax10kidC*CPLu*Vkid
Kmcys = 3.5E-4
Kl = 2.3E-3
Kl0 = 1.5*Vl
Klu0 = 1.5*Vlu
Kkid0 = 1.5*Vkid

{Glutathione metabolism, moles, mol/L}
init AGl = CGSHl*Vl
Limit AGl >= 0
init AGlu = CGSHlu*Vlu
Limit AGlu >= 0
init AGkid = CGSHkid*Vkid
Limit AGkid >= 0
CGSHl = 5E-3
CGSHlu = 1E-3
CGSHkid = 2E-3
CGl = AGl/Vl
Limit CGl >= 0
CGlu = AGlu/Vlu
Limit CGlu >= 0
CGkid = AGkid/Vkid
Limit CGkid >= 0
Ka = 3E-3

{Adduct formation}
init Adduct = 0

{tissue flows L/hr}
Qtot = 15.3*BW^0.7
Qalv = 20.2*BW^0.7
Qf = 0.05*Qtot
Ql = 0.044*Qtot
Qkid = 0.163*Qtot
```

```
Qm = Qtot - (Qf + Ql + Qvrg + Quo + Qkid)
Qvrg = 0.389*Qtot
Qpu = 0.928*Qtot
Qbr = 0.072*Qtot
Quo = 0.016*Qtot

{tissue volumes, L}
Vf = 0.06*BW
Vl = 0.055*BW
Vkid = 0.0167*BW
Vm = BW - (Vf + Vl + Vvrg + Vlu + Vuo + Vkid)
Vvrg = 0.1143*BW
Vlu = 0.011*BW
Vpu = 0.454*Vlu
Vbr = 0.545*Vlu
Vuo = 0.001*BW
;BW = 0.030
BW = 0.01263 + 3.69E-4*(T/24) - 5.59E-6*(T/24)^2

{capillary blood volumes, L}
Vfcap = 0.03*Vf
Vlcap = 0.11*Vl
;Vbrcap = 0.11*Vbr
;Vpucap = 0.11*Vpu
Vkidcap = 0.102*Vkid
Vvrgcap = 0.071*Vvrg
Vuocap = 0.071*Vuo
Vmcap = 0.013*Vm

{blood/air and tissue/blood partition coefficients, butadiene}
Pb = 1.95
Pl = 0.595
Pf = 10.8
Pkid = 0.472
Pm = 0.564
Pvrg = 0.472
Ppu = 0.615
Pbr = 0.615
Puo = 0.446
Pibd = 1.183

{blood/air and tissue/blood partition coefficients, butadienemonoxide}
PBb = 56.8
PBl = 0.984
PBkid = 0.842
PBf = 2.25
PBm = 0.736
PBvrg = 0.842
PBpu = 0.977
PBbr = 0.977
PBuo = 0.908
Pibmo = 2.125

{blood/air and tissue/blood partition coefficients, diepoxybutane}
PCl = 4.41
PCkid = 1.54
```

PCf = 2.19
PCm = 1.82
PCvrg = 1.54
PCpu = 1.41
PCbr = 1.41
PCuo = 1.41
Pideb = 1.174

{blood/air and tissue/blood partition coefficients, dihydroxybutene}
PDl = 1.04
PDkid = 0.833
PDf = 0.573
PDm = 1.139
PDvrg = 0.962
PDpu = 1.107
PDbr = 1.107
PDuo = 1.22
Pidhb = 1.198

{blood/air and tissue/blood partition coefficients, epoxybutanediol}
PEl = 0.903
PEkid = 1.06
PEf = 0.496
PEm = 0.986
PEvrg = 1.06
PEpu = 0.833
PEbr = 0.833
PEuo = 1.06
Piebd = 1.237

{butadiene oxidation metabolic parameters, mol/hr, mol/L}
Vmaxlu = 139E-9*9.0E3*Vlu
Vmaxbr = 0.50*Vmaxlu
Vmaxpu = 0.50*Vmaxlu
Kmlu = 5.01E-6
Vmaxl = 155.0E-9*30.0E3*Vl
Km = 2.0E-6
VmaxkC = 1430E-9
Vmaxk = VmaxkC*Vkid*30.0E3
Kmk = Kmlu
MPL = 3.0E4
MPLu = 9.0E3

{butadienemonoxide metabolic parameters, mol/hr, mol/L, /hr; 1 = hydrolysis EH, 2 = conjugation GST, 3 = oxidation P450}
;EH
Vmaxl1 = 347.0E-9*30.0E3*Vl
Km1 = 1.59E-3
Vmaxlu1C = 34.8E-9
Vmaxbr1 = Vmaxlu1C*Vbr*9.0E3
Vmaxpu1 = Vmaxlu1C*Vpu*9.0E3
Kmlu1 = 1.59E-3
Vmaxk1C = 113E-9
Vmaxk1 = Vmaxk1C*Vkid*9.0E3
Kmk1 = Kmlu1
krel = 3.76

R = 0.052

;GST
Vmaxl2C = 6420E-9
Vmaxl2 = Vmaxl2C*Vl*8.28E4
Km2 =3.59E-3
Vmaxlu2C = 720.0E-9
Vmaxbr2 = Vmaxlu2C*Vbr*8.28E4
Vmaxpu2 = Vmaxlu2C*Vpu*8.28E4
Kmlu2 = 3.59E-3
Vmaxk2C = 960.0E-9
Vmaxk2 = Vmaxk2C*Vkid*8.28E4
Kmk2 = 3.59E-3
CPL = 8.28E4
CPLu = 8.28E4
Kmgsh = 1.0E-3

;P450
Vmaxl3 = 45.1E-9*30.0E3*Vl
Vmaxlu3C = 10.2E-9
Vmaxpu3 = Vmaxlu3C*Vpu*9.0E3
Vmaxbr3 = Vmaxlu3C*Vbr*9.0E3
Km3 = 1.56E-5
Kmlu3 = Km3
Kmk3 = Km3
Vmaxk3C = 48.6E-9
Vmaxk3 = Vmaxk3C*Vkid*9.0E3

{Diepoxybutane (DEB) metabolic parameters, 4 = EH, 5 = GST, mol/hr, mol/L}
Vmaxl4C = 1920E-9
Vmaxl4 = Vmaxl4C*Vl*30E3
Km4 = 8.1E-3
Vmaxlu4C = 10E-9
Vmaxbr4 = Vmaxlu4C*Vbr*9.0E3
Vmaxpu4 = Vmaxlu4C*Vpu*9.0E3
Kmlu4 = 7.5E-3
Vmaxk4C = 35.2E-9
Vmaxk4 = Vmaxk4C*Vkid*9.0E3
Kmk4 = Kmlu4
k4rel = 9.75

Vmaxl5C = 9720E-9
Vmaxl5 = Vmaxl5C*Vl*CPL
Km5 = 6.4E-3
Vmaxlu5C = 100E-9
Vmaxbr5 = Vmaxlu5C*Vbr*CPlu
Vmaxpu5 = Vmaxlu5C*Vpu*CPlu
Vmaxk5C = 100E-9
Vmaxk5 = Vmaxk5C*Vkid*CPlu

{Dihydroxybutene (DHB) metabolic parameters, 6 = P450, 7 = GST, mnol/hr, mol/L}
Vmaxl6C = 16.3E-9
Vmaxl6 = Vmaxl6C*Vl*30E3
Km6 = 1.56E-5
Vmaxlu6C = 1.0E-9
Vmaxbr6 = Vmaxlu6C*Vbr*9.0E3

```
Vmaxpu6 = Vmaxlu6C*Vpu*9.0E3
Vmaxk6C = 1.0E-9
Vmaxk6 = Vmaxk6C*Vkid*9.0E3

Vmaxl7C = 3480E-9
Vmaxl7 = Vmaxl7C*Vl*CPL
Km7 = 34E-3
Vmaxlu7C = 491E-9
Vmaxbr7 = Vmaxlu7C*Vbr*CPlu
Vmaxpu7 = Vmaxlu7C*Vpu*CPlu
Vmaxk7C = 1070E-9
Vmaxk7 = Vmaxk7C*Vkid*CPlu

{Epoxybutanediol metabolic parameters 8 = EH, 9 = GST}
Vmaxl8C = 363E-9
Vmaxl8 = Vmaxl8C*Vl*30E3
Km8 = 8.1E-3
Vmaxlu8C = 69.5E-9
Vmaxbr8 = Vmaxlu8C*Vbr*9.0E3
Vmaxpu8 = Vmaxlu8C*Vpu*9.0E3
Kmlu8 = 7.5E-3
Vmaxk8C = 10E-9
Vmaxk8 = Vmaxk8C*Vkid*9.0E3
Kmk8 = Kmlu8
k8rel = 50.6

Vmaxl9C = 2260E-9
Vmaxl9 = Vmaxl9C*Vl*CPL
Km9 = 6.4E-3
Vmaxlu9C = 50E-9
Vmaxbr9 = Vmaxlu9C*Vbr*CPlu
Vmaxpu9 = Vmaxlu9C*Vpu*CPlu
Vmaxk9C = 50E-9
Vmaxk9 = Vmaxk9C*Vkid*CPlu

Kadduct = 1E-4

Kip = 1.25
T = TIME
{exposure in ppm converted to moles}
Cair = IF TIME <= 6 THEN 0*(1E-6/25.45) ELSE 0

{calculated concentrations of butadiene}
Cart = (Qpu*Cvpu + Qbr*Cvbr)/Qtot
Cvf = Af/(Vf*Pf)
Cvl = Al/(Vl*Pl)
Cvkid = Akid/(Vkid*Pkid)
Cvm = Am/(Vm*Pm)
Cvvrg = Avrg/(Vvrg*Pvrg)
Cvpu = Apu/(Vpu*Ppu)
Cvbr = Abr/(Vbr*Pbr)
Cvuo = Auo/(Vuo*Puo)
Cvtot = (Ql*Cvl + Qf*Cvf + Qm*Cvm + Qvrg*Cvvrg + Quo*Cvuo + Qkid*Cvkid)/Qpu
Cvtotg = Cvtot*MWBD*1000
Cvipu = (Qalv*Cair + Qpu*Cvtot)/((Qalv/Pb) + Qpu)
Cexh = Cvipu/Pb
```

MWBD = 54.1

{calculated concentrations of butadienemonoxide}
CBart = (Qpu*CBvpu + Qbr*CBvbr)/Qtot
CBvf = ABf/(Vf*PBf)
CBvl = ABl/(Vl*PBl)
CBvkid = ABkid/(Vkid*Pkid)
CBvm = ABm/(Vm*PBm)
CBvvrg = ABvrg/(Vvrg*PBvrg)
CBvpu = ABpu/(Vpu*PBpu)
CBvbr = ABbr/(Vbr*PBbr)
CBvuo = ABuo/(Vuo*PBuo)
CBvtot = (Ql*CBvl + Qf*CBvf + Qm*CBvm + Qvrg*CBvvrg + Quo*CBvuo + Qkid*CBvkid)/Qtot
CBvtotg = CBvtot*MWEB*1000
CBair = CBvtot/PBb
CBvipu = (Qalv*CBair + Qpu*CBvtot)/((Qalv/PBb) + Qpu)
CBexh = CBvipu/PBb
MWEB = 70.1

{calculated concentrations of diepoxybutane}
CCart = (Qpu*CCvpu + Qbr*CCvbr)/Qtot
CCvf = ACf/(Vf*PCf)
CCvl = ACl/(Vl*PCl)
CCvkid = ACkid/(Vkid*PCkid)
CCvm = ACm/(Vm*PCm)
CCvvrg = ACvrg/(Vvrg*PCvrg)
CCvpu = ACpu/(Vpu*PCpu)
CCvbr = ACbr/(Vbr*PCbr)
CCvuo = ACuo/(Vuo*PCuo)
CCvtot = (Ql*CCvl +Qf*CCvf + Qm*CCvm + Qvrg*CCvvrg + Quo*CCvuo + Qkid*CCvkid)/Qtot
CCvtotg = CCvtot*MWDEB*1000
CCvipu = (Qalv + Qpu*CCvtot)/(Qalv + Qpu)
MWDEB = 86.0

{calculated concentrations of dihydroxybutene}
CDart = (Qpu*CDvpu + Qbr*CDvbr)/Qtot
CDvf = ADf/(Vf*PDf)
CDvl = ADl/(Vl*PDl)
CDvkid = ADkid/(Vkid*PDkid)
CDvm = ADm/(Vm*PDm)
CDvvrg = ADvrg/(Vvrg*PDvrg)
CDvpu = ADpu/(Vpu*PDpu)
CDvbr = ADbr/(Vbr*PDbr)
CDvuo = ADuo/(Vuo*PDuo)
CDvtot = (Ql*CDvl + Qf*CDvf + Qm*CDvm + Qvrg*CDvvrg + Quo*CDvuo + Qkid*CDvkid)/Qtot
CDvtotg = CDvtot*MWDHB*1000
CDvipu = (Qalv + Qpu*CDvtot)/(Qalv +Qpu)
MWDHB = 72.0

{calculated concentrations of epoxybutanediol}
CEart = (Qpu*CEvpu + Qbr*CEvbr)/Qtot
CEvf = AEf/(Vf*PEf)
CEvl = AEl/(Vl*PEl)
CEvkid = AEkid/(Vkid*PEkid)
CEvm = AEm/(Vm*PEm)

```
CEvvrg = AEvrg/(Vvrg*PEvrg)
CEvpu = AEpu/(Vpu*PEpu)
CEvbr = AEbr/(Vbr*PEbr)
CEvuo = AEuo/(Vuo*PEuo)
CEvtot = (Ql*CEvl + Qf*CEvf + Qm*CEvm + Qvrg*CEvvrg + Quo*CEvuo + Qkid*CEvkid)/Qtot
CEvtotg = CEvtot*MWEBD*1000
CEvipu = (Qalv + Qpu*CEvtot)/(Qalv +Qpu)
MWEBD = 102.1

{differential equations for butadiene uptake and metabolism}
d/dt(Apu) = Qpu*(Cvipu - Cvpu) - Vmaxpu*Cvpu/(Kmlu + Cvpu)
d/dt(Abr) = Qbr*(Cart - Cvbr) - Vmaxbr * Cvbr/(Kmlu + Cvbr)
d/dt(Alcap) = Ql*(Cart - Alcap/Vlcap) - Ql*Pibd*(Cart - Cvl)
d/dt(Al) = Ql*Pibd*(Alcap/Vlcap - Cvl) - Vmaxl*Cvl/(Km + Cvl)
d/dt(Akidcap) = Qkid*(Cart - Akidcap/Vkidcap) - Qkid*Pibd*(Cart - Cvkid)
d/dt(Akid) = Qkid*Pibd*(Cart - Cvkid) - Vmaxk*Cvkid/(Kmk + Cvkid)
d/dt(Afcap) = Qf*(Cart - Afcap/Vfcap) - Qf*Pibd*(Cart - Cvf)
d/dt(Af) = Qf*Pibd*(Cart - Cvf)
d/dt(Amcap) = Qm*(Cart - Amcap/Vmcap) - Qm*Pibd*(Cart - Cvm)
d/dt(Am) = Qm*Pibd*(Cart - Cvm)
d/dt(Avrgcap) = Qvrg*(Cart - Avrgcap/Vvrgcap) - Qvrg*Pibd*(Cart - Cvvrg)
d/dt(Avrg) = Qvrg*Pibd*(Cart - Cvvrg)
d/dt(Auocap) = Quo*(Cart - Auocap/Vuocap) - Quo*Pibd*(Cart - Cvuo)
d/dt(Auo) = Quo*Pibd*(Cart - Cvuo)
d/dt(AUCvtot) = Cvtot
d/dt(Aexh) = Cexh*0.15

{amount of butadiene metabolized in liver and lung}
d/dt(Ametl)  = Vmaxl*Cvl/(Km + Cvl)
d/dt(Ametpu) = Vmaxpu*Cvpu/(Kmlu + Cvpu)
d/dt(Ametbr) = Vmaxbr*Cvbr/(Kmlu + Cvbr)
d/dt(Ametk) = Vmaxk*Cvkid/(Kmk + Cvkid)

{differential equations for BMO metabolism}
d/dt(ABperit) = PULSE(1.31*9.0E-5*BW,0,24) -ABperit*Kip
init AUCABperit = 0
d/dt(AUCABperit) = ABperit

d/dt(ABpufree) = ABpu*krel

d/dt(ABpu) = Qpu*(CBart - CBvpu) + Vmaxpu*Cvpu/(Kmlu + Cvpu) - Vmaxpu1*ABpufree/(Km1*Vpu +
ABpufree) - Vmaxpu1*ABpu/(R*Km1*Vpu + ABpu) - Vmaxpu2*CBvpu*CGSHlu/(Kmlu2*Kmgsh +
CBvpu*Kmgsh + CGSHlu*Kmlu2 + CBvpu*CGSHlu) - Vmaxpu3*CBvpu/(Kmlu3 + CBvpu)

d/dt(ABbrfree) = ABbr*krel

d/dt(ABbr) = Qbr*(CBart - CBvbr) + Vmaxbr * Cvbr/(Kmlu + Cvbr) - Vmaxbr1*ABbrfree/(Km1*Vbr +
ABbrfree) - Vmaxbr1*ABbr/(R*Km1*Vbr + ABbr) -Vmaxbr2*CBvbr*CGSHlu/(Kmlu2*Kmgsh +
CBvbr*Kmgsh + CGSHlu*Kmlu2 + CGSHlu*CBvbr) - Vmaxbr3*CBvbr/(Kmlu3 + CBvbr) + ABperit*Kip

d/dt(ABlcap) = Ql*(CBart - ABlcap/Vlcap) - Ql*Pibmo*(CBart - CBvl)

d/dt(ABlfree) = ABl*krel
```

d/dt(ABl) = Ql*Pibmo*(CBart - CBvl) + Vmaxl*Cvl/(Km + Cvl) - Vmaxl1*ABlfree/(Km1*Vl + ABlfree) - Vmaxl1*ABl/(R*Km1*Vl + ABl) - Vmaxl2*CBvl*CGSHl/(Km2*Kmgsh + CBvl*Kmgsh + CGSHl*Km2 + CGSHl*CBvl) - Vmaxl3*Cbvl/(Km3 + CBvl)

d/dt(ABkidcap) = Qkid*(CBart - ABkidcap/Vkidcap) - Qkid*Pibmo*(CBart - CBvkid)

d/dt(ABkidfree) = ABkid*krel

d/dt(ABkid) = Qkid*Pibmo*(CBart - CBvkid) + Vmaxk*Cvkid/(Kmk + Cvkid) - Vmaxk1*ABkidfree/(Km1*Vkid + ABkidfree) - Vmaxk1*ABkid/(R*Km1*Vkid + ABkid) - Vmaxk2*CBvkid*CGSHkid/(Kmk2*Kmgsh + CBvkid*Kmgsh + CGSHkid*Kmk2 + CGSHkid*CBvkid) - Vmaxk3*CBvkid/(Kmk3 + CBvkid)

d/dt(ABfcap) = Qf*(CBart - ABfcap/Vfcap) - Qf*Pibmo*(CBart - CBvf)
d/dt(ABf) = Qf*Pibmo*(CBart - CBvf)

d/dt(ABmcap) = Qm*(CBart - ABmcap/Vmcap) - Qm*Pibmo*(CBart - CBvm)
d/dt(ABm) = Qm*Pibmo*(CBart - CBvm)

d/dt(ABvrgcap) = Qvrg*(CBart - ABvrgcap/Vvrgcap) - Qvrg*Pibmo*(CBart - CBvvrg)
d/dt(ABvrg) = Qvrg*pibmo*(CBart - CBvvrg)

d/dt(ABuocap) = Quo*(CBart - ABuocap/Vuocap) - Quo*Pibmo*(CBart - CBvuo)
d/dt(ABuo) = Quo*Pibmo*(CBart - CBvuo)

{Hb and DNA adducts based on styrene oxide induced formation rates}
init HB1 = 0
d/dt(HB1) = CCart*kher ; mole /hr/g Hb
kher = 3.2E-5 ; L/hr/g Hb
Ter = 960 ; lifetime of RBC in hr
HB = (1E9)*HB1*(1 - (T/(2*Ter))) ; nmol/g Hb
init DNA1 = 0
d/dt(DNA1) = CCart*kfdna - DNA*keldna/1E9
DNA = DNA1*1E9 ; nmol/gDNA
kfdna = 9.6E-5 ; N7 DNA adducts/gDNA/hr
keldna = 0.0077 ; elimination of DNA adducts /hr

{AUCs for butadienemonoxide}
d/dt(AUCBuo) = CBvuo
d/dt(AUCBvtot) = CBvtot

{amounts of butadienemonoxide metabolized}
d/dt(ABmetl1) = Vmaxl1*ABlfree/(Km1*Vl + ABlfree) + Vmaxl1*ABl/(R*Km1*Vl + ABl)
d/dt(ABmetl2) = Vmaxl2*CBvl*CGSHl/(Km2*Kmgsh + CBvl*Kmgsh + CGSHl*Km2 + CGSHl*CBvl)

d/dt(ABmetpu1) = Vmaxpu1*ABpufree/(Km1*Vpu + ABpufree) + Vmaxpu1*ABpu/(R*Km1*Vpu + ABpu)
d/dt(ABmetpu2) = Vmaxpu2*CBvpu*CGSHlu/(Km2*Kmgsh + CBvpu*Kmgsh + CGSHlu*Km2 + CGSHlu*CBvpu)

d/dt(ABmetbr1) = Vmaxbr1*ABbrfree/(Km1*Vbr + ABbrfree) + Vmaxbr1*ABbr/(R*Km1*Vbr + ABbr)
d/dt(ABmetbr2) = Vmaxbr2*CBvbr*CGSHlu/(Km2*Kmgsh + CBvbr*Kmgsh + CGSHlu*Km2 + CGSHlu*CBvbr)

d/dt(ABmetl3) = Vmaxl3*CBvl/(Km3 + CBvl)
d/dt(ABmetpu3) = Vmaxpu3*CBvpu/(Km3 + CBVpu)
d/dt(ABmetbr3) = Vmaxbr3*CBvbr/(Km3 + CBvbr)

```
init ABmetk1 = 0
init ABmetk2 = 0
init ABmetk3 = 0
d/dt(ABmetk1) = Vmaxk1*ABkidfree/(Km1*Vkid + ABkidfree) + Vmaxk1*ABkid/(R*Km1*Vkid + ABkid)
d/dt(ABmetk2) = Vmaxk2*CBvkid*CGSHkid/(Km2*Kmgsh + CBvkid*Kmgsh + CGSHkid*Km2 +
CGSHkid*CBvkid)
d/dt(ABmetk3) = Vmaxk3*CBvkid/(Km3 + CBvkid)


{differential equations for diepoxybutane}
d/dt(ACperit) = PULSE(0*BW,0,24) -ACperit*Kip

d/dt(ACpufree) = ACpu*k4rel

d/dt(ACpu) = Qpu*(CCart - CCvpu) + Vmaxpu3*CBvpu/(Km3 + CBvpu) - Vmaxpu4*ACpufree/(Kmlu4*Vpu
+ ACpufree) - Vmaxpu4*ACpu/(R*Kmlu4*Vpu + ACpu) - Vmaxpu5*CCvpu*CGSHlu/(Km5*Kmgsh +
CCvpu*Kmgsh + CGSHlu*Km5 + CGSHlu*CCvpu)

d/dt(ACbrfree) = ACbr*k4rel

d/dt(ACbr) = Qbr*(CCart - CCvbr) + Vmaxbr3*CBvbr/(Km3 + CBvbr)  - Vmaxbr4*ACbrfree/(Kmlu4*Vbr +
ACbrfree) - Vmaxbr4*ACbr/(R*Kmlu4*Vbr + ACbr) - Vmaxbr5*CCvbr*CGSHlu/(Km5*Kmgsh +
CCvbr*Kmgsh + CGSHlu*Km5 + CGSHlu*CCvbr) + ACperit*Kip

d/dt(AClfree) = ACl*k4rel

d/dt(AClcap) = Ql*(CCart - AClcap/Vlcap) - Ql*Pideb*(CCart - CCvl)
d/dt(ACl) = Ql*Pideb*(CCart - CCvl) + Vmaxl3*CBvl/(Km3 + CBvl) - Vmaxl4*AClfree/(Km4*Vl + AClfree) -
Vmaxl4*ACl/(R*Km4*Vl + ACl) - Vmaxl5*CCvl*CGSHl/(Km5*Kmgsh + CCvl*Kmgsh + CGSHl*Km5 +
CGSHl*CCvl)

d/dt(ACkidfree) = ACkid*k4rel

d/dt(ACkidcap) = Qkid*(CCart - ACkidcap/Vlcap) - Ql*Pideb*(CCart - CCvkid)
d/dt(ACkid) = Qkid*Pideb*(CCart - CCvkid) + Vmaxk3*CBvkid/(Km3 + CBvkid) -
Vmaxk4*ACkidfree/(Kmlu4*Vkid + ACkidfree) - Vmaxk4*ACkid/(R*Kmlu4*Vkid + ACkid) -
Vmaxk5*CCvkid*CGSHkid/(Km5*Kmgsh + CCvkid*Kmgsh + CGSHkid*Km5 + CGSHkid*CCvkid)

d/dt(ACfcap) = Qf*(CCart - ACfcap/Vfcap) - Qf*Pideb*(CCart - CCvf)
d/dt(ACf) = Qf*Pideb*(CCart - CCvf)

d/dt(ACmcap) = Qm*(CCart - ACmcap/Vmcap) - Qm*Pideb*(CCart - CCvm)
d/dt(ACm) = Qm*Pideb*(CCart - CCvm)

d/dt(ACvrgcap) = Qvrg*(CCart - ACvrgcap/Vvrgcap) - Qvrg*Pideb*(CCart - CCvvrg)
d/dt(ACvrg) = Qvrg*Pideb*(CCart - CCvvrg)

d/dt(ACuocap) = Quo*(CCart - ACuocap/Vuocap) - Quo*Pideb*(CCart - CCvuo)
d/dt(ACuo) = Quo*Pideb*(CCart - CCvuo)

{metabolism of diepoxybutane to epoxybutanediol}
d/dt(ACmetpu4) = Vmaxpu4*ACpufree/(Kmlu4*Vpu + ACpufree) + Vmaxpu4*ACpu/(R*Kmlu4*Vpu +
ACpu)

d/dt(ACmetbr4) = Vmaxbr4*ACbrfree/(Kmlu4*Vbr + ACbrfree) + Vmaxbr4*ACbr/(R*Kmlu4*Vbr + ACbr)
```

```
d/dt(ACmetl4) =  Vmaxl4*AClfree/(Km4*Vl + AClfree) + Vmaxl4*ACl/(R*Km4*Vl + ACl)
init ACmetk4 = 0
d/dt(ACmetk4) = Vmaxk4*ACkidfree/(Kmlu4*Vkid + ACkidfree) + Vmaxk4*ACkid/(R*Kmlu4*Vkid + ACkid)

{AUCs for diepoxybutane}
d/dt(AUCCuo) = CCvuo
d/dt(AUCCvtot) = CCvtot

{metabolism of diepoxybutane to DEB-SG}
init ACmetpu5 = 0
init ACmetbr5 = 0
init ACmetl5 = 0
Limit ACmetl5 >= 0
init ACmetk5 = 0

d/dt(ACmetpu5) = Vmaxpu5*CCvpu*CGSHlu/(Km5*Kmgsh + CCvpu*Kmgsh + CGSHlu*Km5 +
CGSHlu*CCvpu)
d/dt(ACmetbr5) = Vmaxbr5*CCvbr*CGSHlu/(Km5*Kmgsh + CCvbr*Kmgsh + CGSHlu*Km5 +
CGSHlu*CCvbr)
d/dt(ACmetl5) = Vmaxl5*CCvl*CGSHl/(Km5*Kmgsh + CCvl*Kmgsh + CGSHl*Km5 + CGSHl*CCvl)
d/dt(ACmetk5) = Vmaxk5*CCvkid*CGSHkid/(Km5*Kmgsh + CCvkid*Kmgsh + CGSHkid*Km5 +
CGSHkid*CCvkid)


{differential equations for dihydroxybutene}
d/dt(ADpu) = Qpu*(CDart - CDvpu) + Vmaxpu1*ABpufree/(Km1*Vpu + ABpufree) +
Vmaxpu1*ABpu/(R*Km1*Vpu + ABpu)  - Vmaxpu6*CDvpu/(Km6 + CDvpu) -
Vmaxpu7*CDvpu*CGSHlu/(Km7*Kmgsh + CDvpu*Kmgsh + CGSHlu*Km7 + CGSHlu*CDvpu)

d/dt(ADbr) = Qbr*(CDart - CDvbr) + Vmaxbr1*ABbrfree/(Km1*Vbr + ABbrfree) +
Vmaxbr1*ABbr/(R*Km1*Vbr + ABbr) - Vmaxbr6*CDvbr/(Km6 + CDvbr) -
Vmaxbr7*CDvbr*CGSHlu/(Km7*Kmgsh + CDvbr*Kmgsh + CGSHlu*Km7 + CGSHlu*CDvbr)

d/dt(ADlcap) = Ql*(CDart - ADlcap/Vlcap) - Ql*Pidhb*(CDart - CDvl)
d/dt(ADl) = Ql*Pidhb*(CDart - CDvl) + Vmaxl1*ABlfree/(Km1*Vl + ABlfree) + Vmaxl1*ABl/(R*Km1*Vl +
ABl)  - Vmaxl6*CDvl/(Km6 + CDvl) - Vmaxl7*CDvl*CGSHl/(Km7*Kmgsh + CDvl*Kmgsh + CGSHl*Km7 +
CGSHl*CDvl)

d/dt(ADkidcap) = Qkid*(CDart - ADkidcap/Vkidcap) - Qkid*Pidhb*(CDart - CDvkid)
d/dt(ADkid) = Qkid*Pidhb*(CDart - CDvkid) +  Vmaxk1*ABkidfree/(Km1*Vkid + ABkidfree) +
Vmaxk1*ABkid/(R*Km1*Vkid + ABkid)  - Vmaxl6*CDvkid/(Km6 + CDvkid) -
Vmaxl7*CDvkid*CGSHkid/(Km7*Kmgsh + CDvkid*Kmgsh + CGSHkid*Km7 + CGSHkid*CDvkid)

d/dt(ADfcap) = Qf*(CDart - ADfcap/Vfcap) - Qf*Pidhb*(CDart - CDvf)
d/dt(ADf) = Qf*Pidhb*(CDart-CDvf)

d/dt(ADmcap) = Qm*(CDart - ADmcap/Vmcap) - Qm*Pidhb*(CDart - CDvm)
d/dt(ADm) = Qm*Pidhb*(CDart - CDvm)

d/dt(ADvrgcap) = Qvrg*(CDart - ADvrgcap/Vvrgcap) - Qvrg*Pidhb*(CDart - CDvvrg)
d/dt(ADvrg) = Qvrg*Pidhb*(CDart - CDvvrg)

d/dt(ADuocap) = Quo*(CDart - ADuocap/Vuocap) - Quo*Pidhb*(CDart - CDvuo)
d/dt(ADuo) = Quo*Pidhb*(CDart - CDvuo)
```

```
d/dt(AUCDvtot) = CDvtot
init (AUCDvuo) = 0
d/dt(AUCDvuo) = CDvuo

{metabolism of DHB to EBD }
d/dt(ADmetpu6) = Vmaxpu6*CDvpu/(Km6 + CDvpu)
d/dt(ADmetbr6) = Vmaxbr6*CDvbr/(Km6 + CDvbr)
d/dt(ADmetl6) = Vmaxl6*CDvl/(Km6 + CDvl)
init ADmetk6 = 0
d/dt(ADmetk6) = Vmaxk6*CDvkid/(Km6 + CDvkid)

{metabolism of DHB to DHB-SG conjugate}
init ADmetpu7 = 0
init ADmetbr7 = 0
init ADmetl7 = 0
init ADmetk7 = 0

d/dt(ADmetpu7) = Vmaxpu7*CDvpu*CGSHlu/(Km7*Kmgsh + CDvpu*Kmgsh + CGSHlu*Km7 +
CGSHlu*CDvpu)
d/dt(ADmetbr7) = Vmaxbr7*CDvbr*CGSHlu/(Km7*Kmgsh + CDvbr*Kmgsh + CGSHlu*Km7 +
CGSHlu*CDvbr)
d/dt(ADmetl7) = Vmaxl7*CDvl*CGSHl/(Km7*Kmgsh + CDvl*Kmgsh + CGSHl*Km7 + CGSHl*CDvl)
d/dt(ADmetk7) = Vmaxl7*CDvkid*CGSHkid/(Km7*Kmgsh + CDvkid*Kmgsh + CGSHkid*Km7 +
CGSHkid*CDvkid)


{differential equations for epoxybutanediol}
d/dt(AEpufree) = AEpu*k8rel

d/dt(AEpu) = Qpu*(CEart - CEvpu) +  Vmaxpu4*ACpufree/(Kmlu4*Vpu + ACpufree) +
Vmaxpu4*ACpu/(R*Kmlu4*Vpu + ACpu) + Vmaxpu6*CDvpu/(Km6 + CDvpu) -
Vmaxpu8*AEpufree/(Km8*Vpu + AEpufree) - Vmaxpu8*AEpu/(R*Km8*Vpu + AEpu) -
Vmaxpu9*CEvpu*CGSHlu/(Km9*Kmgsh + CEvpu*Kmgsh + CGSHlu*Km9 + CGSHlu*CEvpu)

d/dt(AEbrfree) = AEbr*k8rel

d/dt(AEbr) = Qbr*(CEart - CEvbr) + Vmaxbr4*ACbrfree/(Kmlu4*Vbr + ACbrfree) +
Vmaxbr4*ACbr/(R*Kmlu4*Vbr + ACbr) +  Vmaxbr6*CDvbr/(Km6 + CDvbr)  - Vmaxbr8*AEbrfree/(Km8*Vbr
+ AEbrfree) - Vmaxbr8*AEbr/(R*Km8*Vbr + AEbr) - Vmaxbr9*CEvbr*CGSHlu/(Km9*Kmgsh +
CEvbr*Kmgsh + CGSHlu*Km9 + CGSHlu*CEvbr)

d/dt(AElfree) = AEl*k8rel

d/dt(AElcap) = Ql*(CEart - AElcap/Vlcap) - Ql*Piebd*(CEart - CEvl)
d/dt(AEl) = Ql*Piebd*(CEart - CEvl) + Vmaxl4*AClfree/(Km4*Vl + AClfree) + Vmaxl4*ACl/(R*Km4*Vl +
ACl) + Vmaxl6*CDvl/(Km6 + CDvl) - Vmaxl8*AElfree/(Km8*Vl + AElfree) - Vmaxl8*AEl/(R*Km8*Vl + AEl) -
Vmaxl9*CEvl*CGSHl/(Km9*Kmgsh + CEvl*Kmgsh + CGSHl*Km9 + CGSHl*CEvl)

d/dt(AEkidfree) = AEkid*k8rel

d/dt(AEkidcap) = Qkid*(CEart - AEkidcap/Vkidcap) - Qkid*Piebd*(CEart - CEvkid)
d/dt(AEkid) = Qkid*Pidhb*(CEart - CEvkid) +  Vmaxk4*ACkidfree/(Kmlu4*Vkid + ACkidfree) +
Vmaxk4*ACkid/(R*Kmlu4*Vkid + ACkid)  + Vmaxl6*CDvkid/(Km6 + CDvkid) -
Vmaxk8*AEkidfree/(Km8*Vkid + AEkidfree) - Vmaxk8*AEkid/(R*Km8*Vkid + AEkid) -
Vmaxl9*CEvkid*CGSHkid/(Km9*Kmgsh + CEvkid*Kmgsh + CGSHkid*Km9 + CGSHkid*CEvkid)
```

```
d/dt(AEfcap) = Qf*(CEart - AEfcap/Vfcap) - Qf*Piebd*(CEart - CEvf)
d/dt(AEf) = Qf*Piebd*(CEart-CEvf)

d/dt(AEmcap) = Qm*(CEart - AEmcap/Vmcap) - Qm*Piebd*(CEart - CEvm)
d/dt(AEm) = Qm*Piebd*(CEart - CEvm)

d/dt(AEvrgcap) = Qvrg*(CEart - AEvrgcap/Vvrgcap) - Qvrg*Piebd*(CEart - CEvvrg)
d/dt(AEvrg) = Qvrg*Piebd*(CEart - CEvvrg)

d/dt(AEuocap) = Quo*(CEart - AEuocap/Vuocap) - Quo*Piebd*(CEart - CEvuo)
d/dt(AEuo) = Quo*Piebd*(CEart - CEvuo)

d/dt(AUCEvtot) = CEvtot
init (AUCEvuo) = 0
d/dt(AUCEvuo) = CEvuo

{metabolism of  epoxybutanediol to erythitol}
init AEmetpu8 = 0
init AEmetbr8 = 0
init AEmetl8 = 0
init AEmetk8 = 0
d/dt(AEmetpu8) =  Vmaxpu8*AEpufree/(Km8*Vpu + AEpufree) + Vmaxpu8*AEpu/(R*Km8*Vpu + AEpu)
d/dt(AEmetbr8) = Vmaxbr8*AEbrfree/(Km8*Vbr + AEbrfree) + Vmaxbr8*AEbr/(R*Km8*Vbr + AEbr)
d/dt(AEmetl8) = Vmaxl8*AElfree/(Km8*Vl + AElfree) + Vmaxl8*AEl/(R*Km8*Vl + AEl)
init AEmetk8 = 0
d/dt(AEmetk8) = Vmaxk8*AEkidfree/(Km8*Vkid + AEkidfree) + Vmaxk8*AEkid/(R*Km8*Vkid + AEkid)

{metabolism of EBD to EBD-SG}
init AEmetpu9 = 0
init AEmetbr9 = 0
init AEmetl9 = 0
init AEmetk9 = 0

d/dt(AEmetpu9) = Vmaxpu9*CEvpu*CGSHlu/(Km9*Kmgsh + CEvpu*Kmgsh + CGSHlu*Km9 +
CGSHlu*CEvpu)
d/dt(AEmetbr9) = Vmaxbr9*CEvbr*CGSHlu/(Km9*Kmgsh + CEvbr*Kmgsh + CGSHlu*Km9 +
CGSHlu*CEvbr)
d/dt(AEmetl9) = Vmaxl9*CEvl*CGSHl/(Km9*Kmgsh + CEvl*Kmgsh + CGSHl*Km9 + CGSHl*CEvl)
d/dt(AEmetk9) = Vmaxl9*CEvkid*CGSHkid/(Km9*Kmgsh + CEvkid*Kmgsh + CGSHkid*Km9 +
CGSHkid*CEvkid)

{differential equations for cysteine metabolism}
d/dt(AFl) = Kl0 - Vmax10l*AFl/((Kmcys*Vl + AFl)*(1 + AGl/(KI*Vl)))
d/dt(AFlu) = Klu0 - Vmax10lu*AFlu/((Kmcys*Vlu + AFlu)*(1 + AGlu/(KI*Vlu)))
d/dt(AFkid) = Kkid0 - Vmax10kid*AFkid/((Kmcys*Vkid + AFkid)*(1 + AGkid/(KI*Vkid)))

{differential equations for glutathione metabolism}
d/dt(AGl) = Vmax10l*AFl/((Kmcys*Vl + AFl)*(1 + AGl/(KI*Vl))) - ABmetl2 - ACmetl5 - ADmetl7- AEmetl9
d/dt(AGlu) = Vmax10lu*AFlu/((Kmcys*Vlu + AFlu)*(1 + AGlu/(KI*Vlu))) - ABmetpu2 - ABmetbr2 -
ACmetpu5 - ACmetbr5 - ADmetpu7 - ADmetbr7 - AEmetpu9 - AEmetbr9
d/dt(AGkid) = Vmax10kid*AFkid/((Kmcys*Vkid + AFkid)*(1 + AGkid/(KI*Vkid))) - ABmetk2 - ACmetk5 -
ADmetk7 - AEmetk9

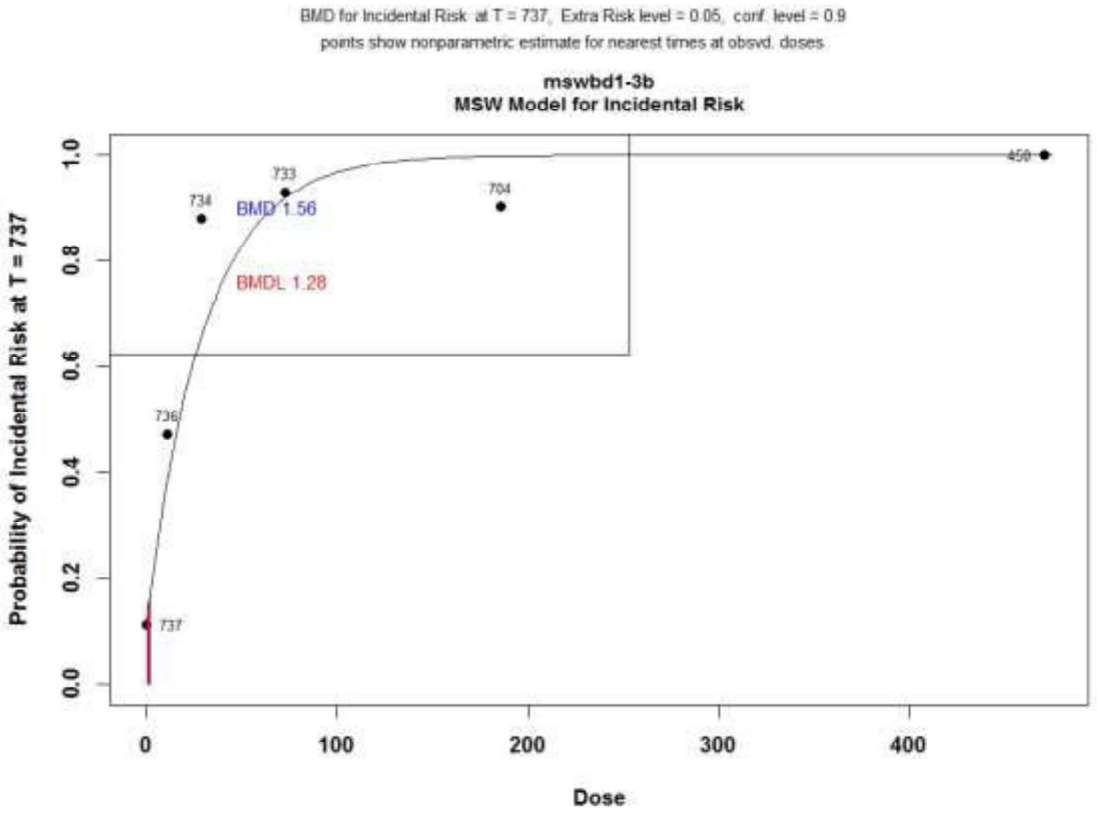
{differential equation for  Hb adduct formation, pmol/g Hb-ppm-hr}
d/dt(Adduct) = CEvtot*Kadduct*1E12/(476.7*8000)
; Mass balance
```

```
MassA = Af + Al + Am + Avrg + Abr + Apu + Auo + Aexh + Akid
MassB = ABf + ABl + ABm + ABvrg + ABbr + ABpu + ABuo + ABkid
MassBfree = ABlfree + ABpufree + ABbrfree + ABkidfree
MassC = ACf + ACl + ACm + ACvrg + ACbr + ACpu + ACuo + ACkid
MassCfree = AClfree + ACpufree + ACbrfree + ACkidfree
MassD = ADf + ADl + ADm + ADvrg + ADbr + ADpu + ADuo + ADkid
MassE = AEf + AEl + AEm + AEvrg + AEbr + AEpu + AEuo + AEkid
MassEfree = AElfree + AEpufree + AEbrfree + AEkidfree
Massfree = MassBfree + MassCfree + MassEfree
MassG2 = ABmetl2 + ABmetpu2 + ABmetbr2 + ABmetk2
MassG5 = ACmetl5 + ACmetpu5 + ACmetbr5 + ACmetk5
MassG7 = ADmetl7 + ADmetpu7 + ADmetbr7 + ADmetk7
MassG9 = AEmetl9 + AEmetpu9 + AEmetbr9 + AEmetk9
MassG = MassG2 + MassG5 + MassG7 + MassG9
MassE8 = AEmetl8 + AEmetpu8 + AEmetbr8 + AEmetk8
TotMass = MassA + MassB + MassC + MassD + MassE + MassG + MassE8 + Massfree
init Inh = 0
d/dt(Inh) = Cair*Qalv
```

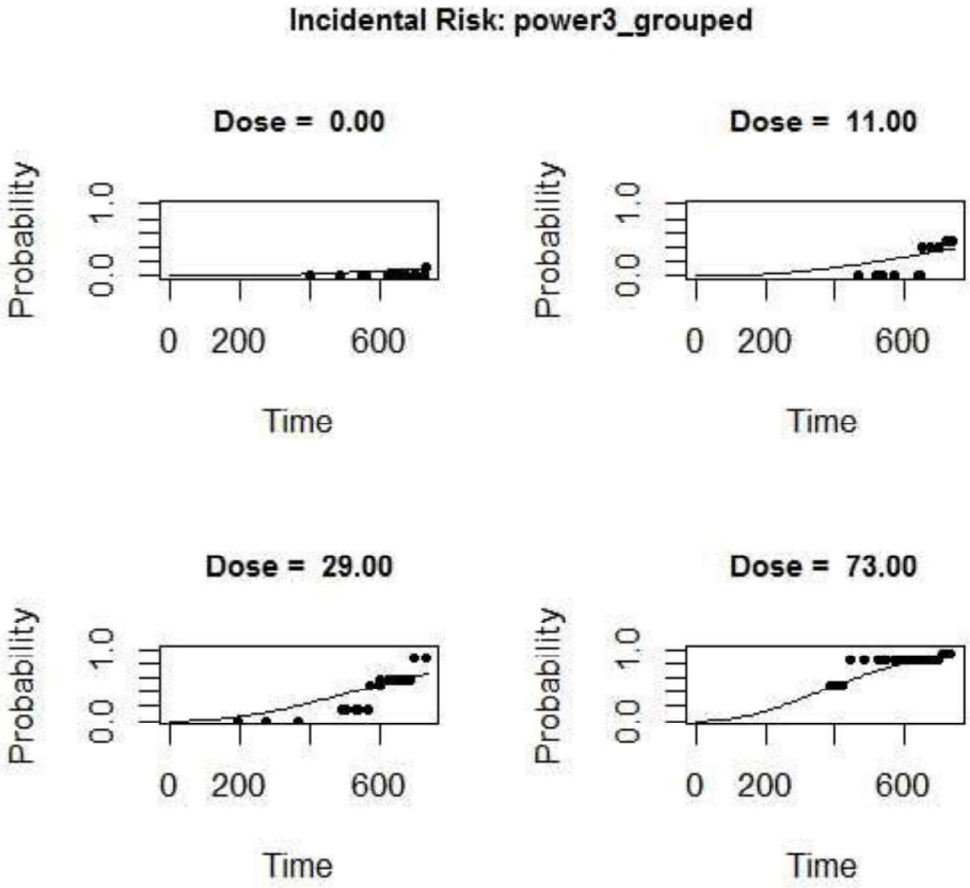
APPENDIX B

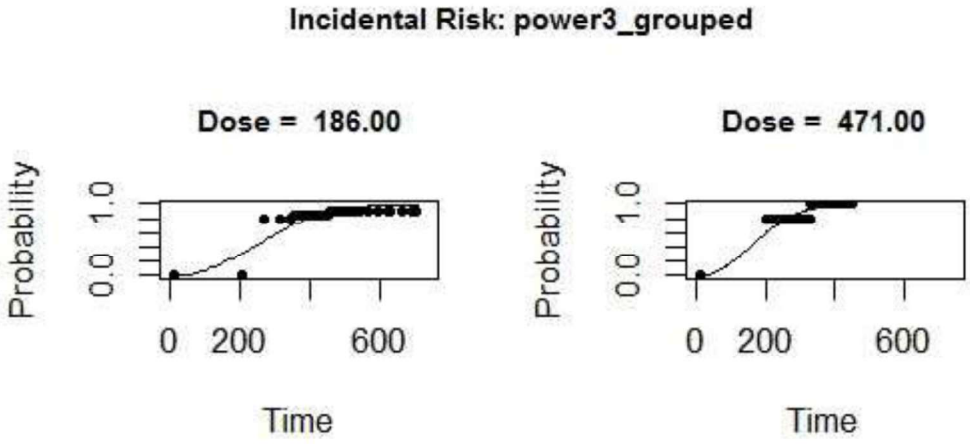
This appendix contains the goodness of fit (gof) plots for the Multistage Weibull model (MSW) fits to the 24 month mouse ovarian atrophy data in NTP (1993). The plots are generated in the statistical program R using slightly modified input files that were used in the main MSW analysis.

Appendix B1. GOFPLOT: DR Plot for Incidental Risk of Ovarian Atrophy in Mice Versus Butadiene Exposure ppm for 24 months. Solid line is Multistage Weibull Model Prediction, Point are Nonparametric Model Estimates. BMD and BMDL are for 95% Lower Bounds on 5% Response Level. Points Closer to Line Indicate Better Model Fit.

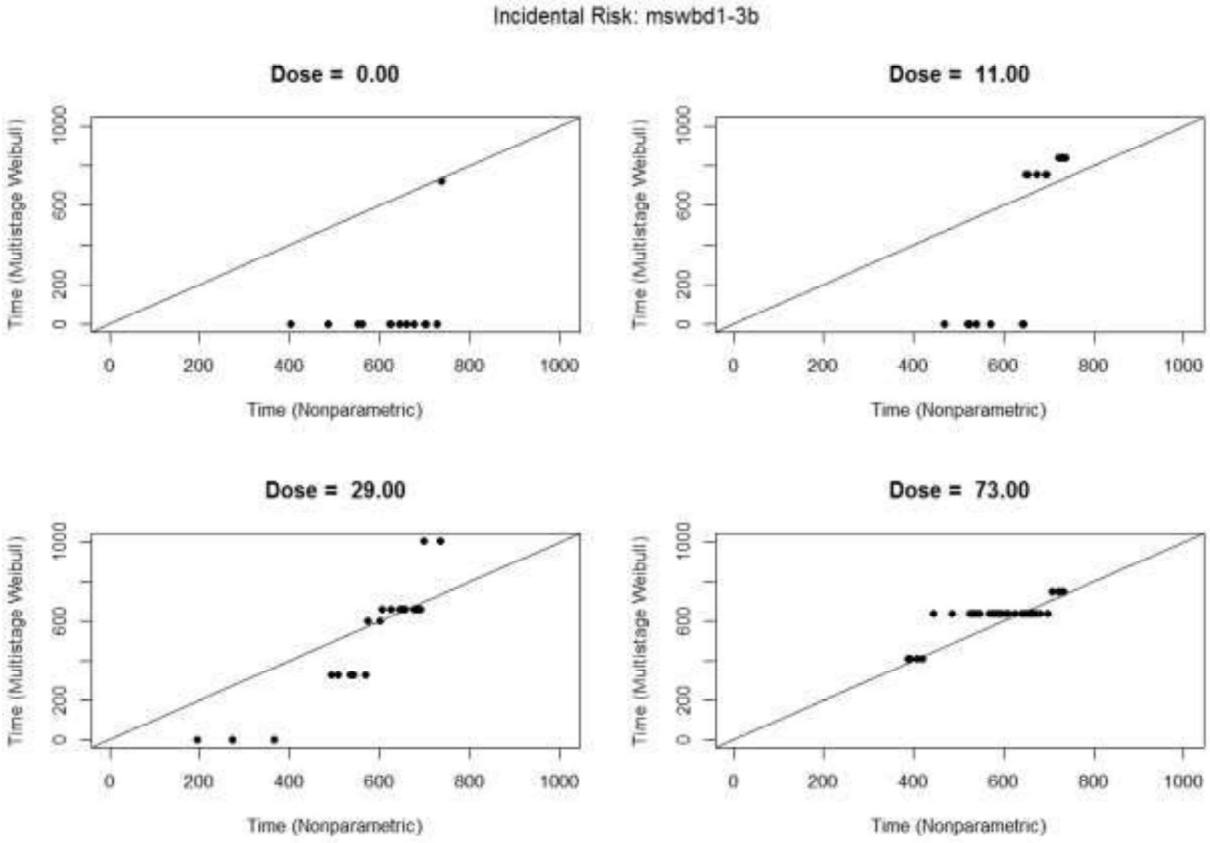

BMD for Incidental Risk at T = 737, Extra Risk level = 0.05, conf. level = 0.9
points show nonparametric estimate for nearest times at obsvd. doses
mswbd1-3b
MSW Model for Incidental Risk
Probability of Incidental Risk at T = 737
Dose
BMD 1.56
BMDL 1.28
734
733
704
450
736
737
0.0
0.2
0.4
0.6
0.8
1.0
0
100
200
300
400

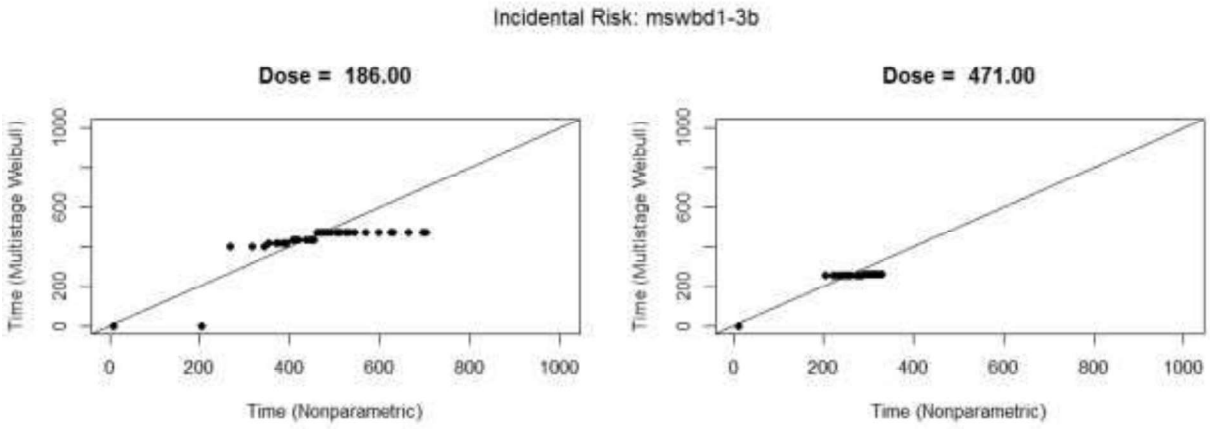
Appendix B2. GOFPLOT: PR Plot. Probability of Ovarian Atrophy in Butadiene Exposed Mice by Multistage Weibull Model (Solid Line) versus Time for Butadiene Internal Doses nM Diepoxybutane in Blood. Points Represent Nonparametric Model Estimates. More Points Closer to the Line Indicates Better Model Fit.



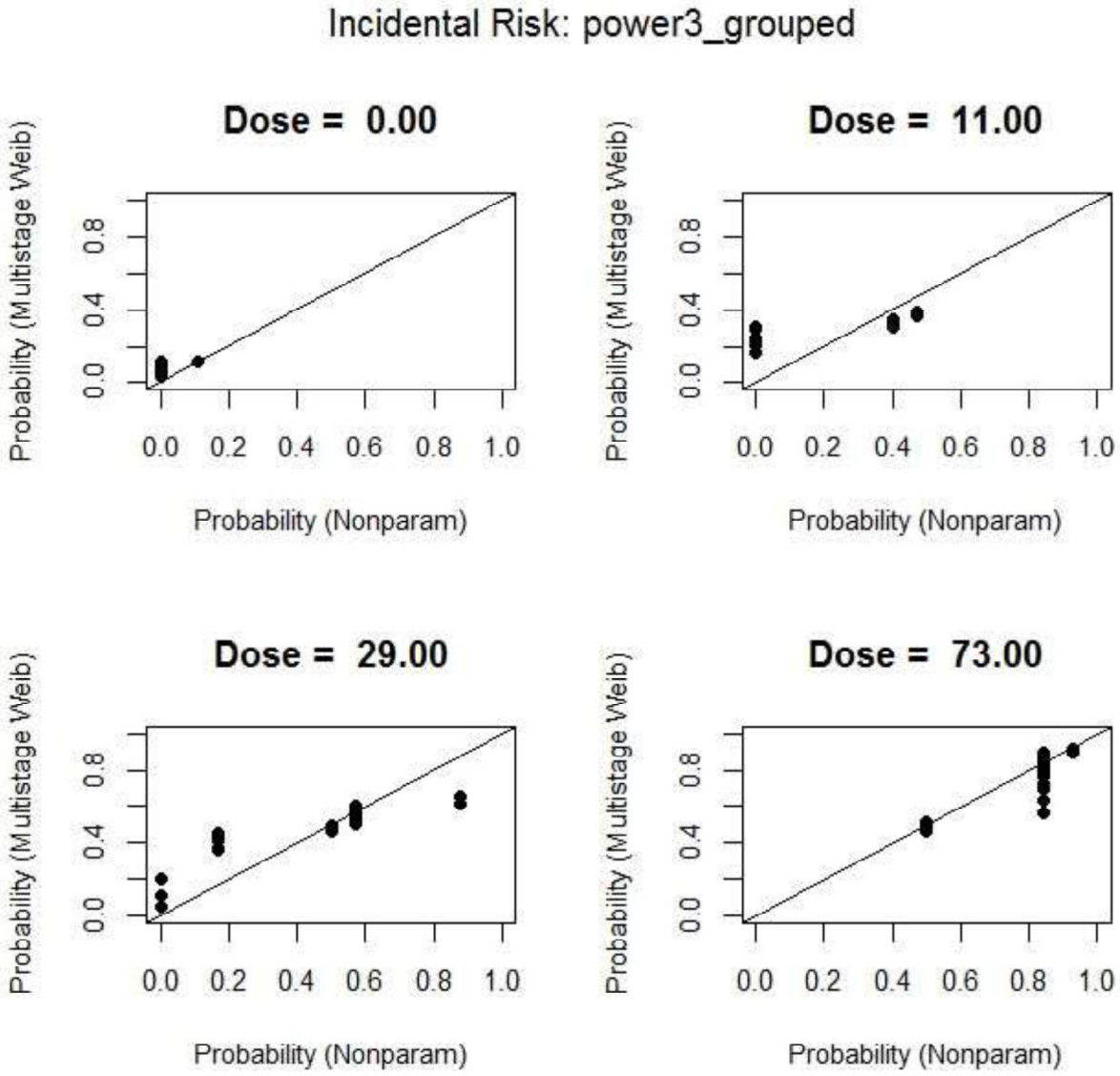

Incidental Risk: power3_grouped
Dose = 186.00
Probability
0.0
1.0
0
200
600
Time
Dose = 471.00
Probability
0.0
1.0
0
200
600
Time

Appendix B3. GOFPLOT: QQ Plot. Incidental Risk of Ovarian Atrophy in Butadiene Exposed Mice. Time-Multistage Weibull Model versus Time-Nonparametric Model Estimates for Internal Blood Diepoxybutane nM. Solid line is for Equivalence of Model Predictions. More Points Closer to Line Indicates Better Model Fit.




Incidental Risk: mswbd1-3b
Dose = 186.00
Dose = 471.00
Time (Multistage Weibull)
Time (Nonparametric)
0
200
400
600
800
1000

Appendix B4. GOFPLOT: PP Plot. . Incidental Risk of Ovarian Atrophy in Butadiene Exposed Mice. Probability-Multistage Weibull Model versus Probability-Nonparametric Model Estimates for Internal Blood Diepoxybutane nM. Solid line is for Equivalence of Model Predictions. More Points Closer to Line Indicates Better Model Fit.



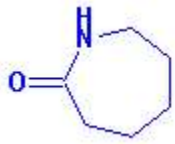
Caprolactam Reference Exposure Levels

(Aerosol, Vapor & Particulate)

(Aminocaproic lactam; epsilon-Caprolactam; Hexahydro-2H-azepin-2-one;

2-Oxohexamethylenimine; 2-Ketohexamethylenimine)

CAS 105-60-2



1 Summary

The Office of Environmental Health Hazard Assessment (OEHHA) is required to develop guidelines for conducting health risk assessments under the Air Toxics Hot Spots Program (Health and Safety Code Section 44360 (b) (2)). OEHHA developed a Technical Support Document (TSD) in response to this statutory requirement that describes acute, 8-hour and chronic RELs and was adopted in December 2008. The TSD presents methodology reflecting the latest scientific knowledge and techniques, and in particular explicitly includes consideration of possible differential effects on the health of infants, children and other sensitive subpopulations, in accordance with the mandate of the Children's Environmental Health Protection Act (Senate Bill 25, Escutia, chapter 731, statutes of 1999, Health and Safety Code Sections 39669.5 *et seq.*). These guidelines have been used to develop the following RELs for caprolactam: this document will be added to Appendix D of the TSD.

Exposure to caprolactam has been found to cause upper respiratory and eye irritation in both animals and humans. Exposure causes inflammation of the nasal and laryngeal epithelium in exposed rodents. The site-of-contact nature of the lesion to the most sensitive cells lining the upper respiratory tract indicates that caprolactam is primarily a direct-acting irritant, rather than a chemical requiring metabolic activation in nasal mucosa to cause tissue injury. Although there is no evidence for reproductive or developmental effects at levels that produce sensory irritation, considerably higher doses administered orally to pregnant rats have resulted in reduced weight of offspring. Literature summarized and referenced in this document covers the relevant published literature for caprolactam through Fall 2011.

1.1 Acute REL Summary

Acute 1-Hour inhalation reference exposure level	**50 µg/m^3 (11 ppb)**
Critical effect(s)	Increased eye blink frequency in humans
Hazard index target(s)	Eyes

1.2 8-Hour REL Summary

8-Hour inhalation reference exposure level	**7 µg/m^3 (1.4 ppb)**
Critical effect(s)	Inflammatory changes of nasal and laryngeal epithelium in rodents
Hazard index target(s)	Upper respiratory system

1.3 Chronic REL Summary

Chronic inhalation reference exposure level	**2.2 µg/m^3 (0.5 ppb)**
Critical effect(s)	Inflammatory changes of nasal and laryngeal epithelium in rodents
Hazard index target(s)	Upper respiratory system

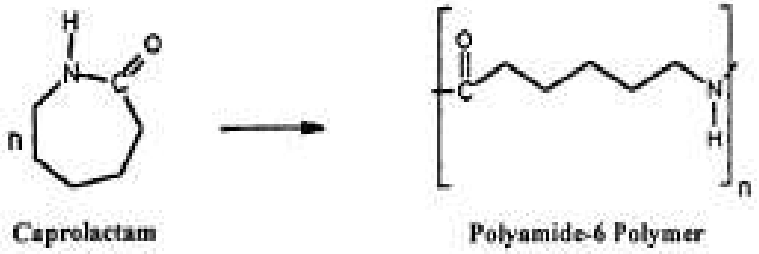
2 Physical and Chemical Properties [from HSDB (2006), unless noted otherwise]

Description	A semi-volatile white, hygroscopic, crystalline solid or flakes with unpleasant odor
Molecular formula	$C_6H_{11}NO$
Molecular weight	133.16 g/mol
Density	1.05 g/cm^3 @ 25 °C
Boiling point	270 °C
Melting point	69.3 °C
Vapor pressure	0.0011 mm Hg @ 20 ºC (68ºF) 0.0021 mm Hg @ 25 °C (77ºF), saturated vapor concentration = 13 mg/m^3 0.153 Pa @ 20 ºC, and 0.275 Pa @ 25 °C (Zaitsau et al., 2006)
Odor threshold	≤0.15 mg/m^3 (Ziegler et al., 2008)
Solubility	Very soluble in water, benzene, diethyl ether, and ethanol. Soluble in chlorinated solvents, petroleum distillates, and cyclohexene
Conversion factor	1 ppm = 4.63 mg/m^3 (as vapor) @ 25 °C

3 Occurrence and Major Uses

Caprolactam is the monomer used in the polymerization process to manufacture synthetic fibers and resins, known as Nylon-6 (Cooper et al., 1993; NPG, 2007). Nylon-6 was first developed for commercial use in the 1930's. This type of nylon has also been called polyamide-6, which refers to the type of polymer produced by the interaction of an amino group of one caprolactam molecule and a carboxylic group of another caprolactam molecule to give a protein-like structure. The reaction, shown in Figure 1, entails a ring-opening polymerization:

FIGURE 1. RING OPENING POLYMERIZATION OF CAPROLACTAM (LANDER, 2002)



Nylon-6 is the most widely used type of nylon, representing more than 60% in volume of all nylon types used worldwide (NPG, 2007). U.S. EPA (2006) notes in their IUR

(Inventory Update Reporting) that the aggregated national production volume of caprolactam was 1 billion lbs and greater in 2006. Nylon-6 is found in many products, such as in:

- Carpets, rugs and home textiles
- Engineering plastics (automotive, E&E, equipment housing)
- Tire cord (for reinforcement of heavy-duty tires)
- Textiles (apparel, hosiery, lingerie, sportswear, swimwear, casual wear, fashion wear, socks, umbrellas, luggage, tents, parachutes, sleeping bags, etc.)
- Film (food packaging, industrial packaging, medical applications)

Bongard (2000) reported that about 75% of manufactured Nylon-6 is used in fibers (textile, industrial, carpet) and 25% in engineering plastics and food packaging film. It was expected that this ratio would gradually change more in favor of plastics and film over time. Minor uses of caprolactam include use as a solvent in paint, and for the synthesis of the amino acid lysine (IARC, 1999; Bradley et al., 2004). Another common type of nylon known as Nylon-6,6 is produced from hexamethylene diamine and adipic acid and does not contain caprolactam (Hegde et al., 2004).

In industrial processes, exposure occurs during the production of the caprolactam monomer when the monomer is polymerized, extruded, chilled, or cut into pellets, or when the polymer pellets are re-melted, re-extruded, and drawn into fiber or film (ACGIH, 2003). Exposure may also occur during recycling of waste Nylon-6 carpets, which can be reprocessed in full back to its raw material (NPG, 2007). The monomer vaporizes from the heated processes and condenses as fume (i.e., a cloud of small particles suspended in air) (ACGIH, 2003). In early industrial studies, in which high concentrations of caprolactam were recorded in workplace air, contact of the fume with cooler surfaces resulted in formation of light feathery flakes (Hohensee, 1951; Kelman, 1986). Exposure is primarily as an aerosol, although the vapor form would also be expected to be present at concentrations relevant to the RELs (ACGIH, 2003). In the ambient air, caprolactam has been observed as a fine aerosol collected on $PM_{2.5}$ filters as a result of the probable release from a facility that used caprolactam as a raw material (Cheng et al., 2006). Wilkins et al. (1993) found caprolactam in floor dust following a thermal desorption process to analyze VOC emission profiles. Thus, caprolactam also appears to adsorb onto dust particles.

Measurable levels of caprolactam have been found primarily in indoor air as a result of release of the vapor or particulate from carpeting containing Nylon-6 (IWMB, 2003). Caprolactam may also migrate into foods packaged in Nylon-6 film (Bradley et al., 2004). Caprolactam was detected in foodstuffs packaged in Nylon-6 in the range of 2.8 to 13 mg/kg.

The polymerization process of caprolactam to nylon polymer is not 100 percent efficient, thus allowing some of the un-polymerized caprolactam into the final product. Goldblatt et al. (1954) noted that the polymerized fiber contains approximately one percent of the unreacted caprolactam monomer. A more recent study suggests that total caprolactam contaminants, plus lesser amounts of its various oligomers, are present at 1% or less in some Nylon-6 products (Venema et al., 1993). These oligomers found following

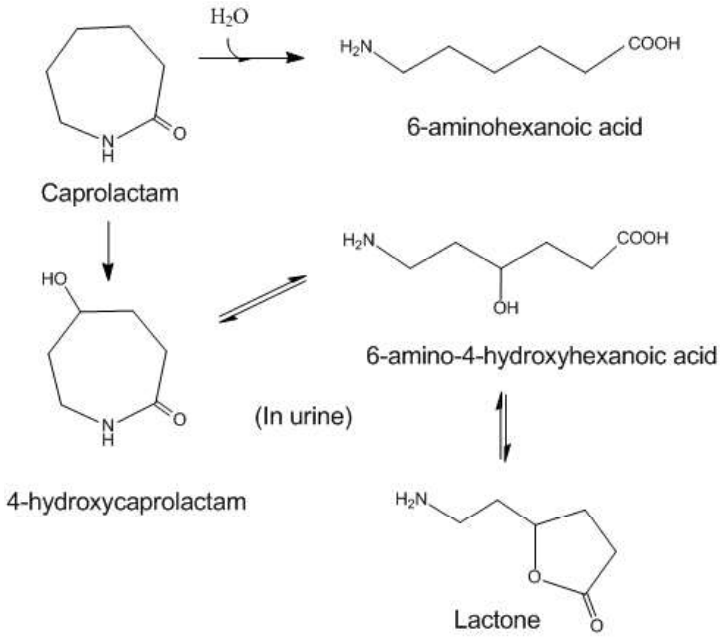
polymerization include cyclic oligomers (i.e., the cyclic dimer, trimer and tetramer, etc.), as well as some linear oligomers (Krajnik et al., 1982; Ballistreri et al., 1987; Bonifaci et al., 1991; Venema et al., 1993). No investigations regarding the health effects of caprolactam oligomers could be located in the literature. *In vitro* cytotoxicity testing with polymers and their corresponding monomers, one of which was the monomer vinylcaprolactam, showed that the monomers can have much greater cytotoxicity with respect to the corresponding polymers (Vihola et al., 2005). The authors stated that the polymers tested in this study were 156,000 to 1,500,000 g/mol. Whether caprolactam and its oligomers would show a similar pattern of cytotoxicity was unclear from this study.

Based on the measured emission rate of caprolactam from carpet samples, modeled air concentrations for office and classroom scenarios ranged from 39 to 450 µg/m^3 (IWMB, 2003). A chamber study found caprolactam emissions from some polyamide carpets resulted in chamber concentrations ranging from 6 to 97 µg/m^3 on the 28th day of chamber testing (Wilke et al., 2004). In indoor monitoring studies, caprolactam was detected in all floor dust samples collected during an indoor air study in nine public buildings (Wilkins et al., 1993). In another study, the average caprolactam concentration in a new California portable classroom during school hours over 8 weeks following installation of a Nylon-6 broadloom carpet was 22.2 µg/m^3 (range: 10.6 - 30.1 µg/m^3) (Hodgson et al., 2004). The emission rate of caprolactam following installation of the carpet was about 5 mg/h prior to occupancy, and dropped to 3 mg/h 27 weeks after first occupancy. Similar portable classrooms that installed upgraded carpets containing Nylon-6,6 emitted low to non-detectable concentrations of caprolactam (maximum: 1.4 µg/m^3).

4 Metabolism

In rats, Kirk et al. (1987) observed that approximately 16% of ingested caprolactam in diet was excreted in urine as 4-hydroxycaprolactam and a small amount as the non-hydroxylated acid, 6-aminohexanoic acid (Figure 2). Following a single oral dose of [^{14}C]caprolactam in male rats, 77.6% of the radioactivity was excreted in urine, 3.5% in the feces, and 1.5% in the expired air in 24 hrs (Unger et al., 1981). The half-life of disappearance of radioactivity from the blood was 3.0 hr. Similar to the findings by Kirk et al., Unger et al. (1981) observed two metabolites following oral administration, which comprised 79.3 and 17.7% of the total urinary radioactivity. However, Unger et al. made no attempt to identify these urinary metabolites. Unchanged caprolactam represented only 2.3% of the total urinary radioactivity. The radiolabeled caprolactam was widely distributed among the tissues of the rat, including the brain, with concentrations mostly similar to that in the blood. The radioactivity was consistently lower in fat relative to the blood in the first 24 hrs, indicating a low affinity of caprolactam and its metabolites for adipose tissue.

FIGURE 2. METABOLISM OF CAPROLACTAM



Oral delivery of [^{14}C]caprolactam in male and female mice also showed that the chemical is rapidly absorbed from the stomach and freely distributed into all tissues (Waddell et al., 1984). Almost all radioactivity was eliminated in 24 hours, although some retention of radioactivity during this time was noted in the brain, nasal epithelium, olfactory lobe of the brain, liver, optic lens and Harderian gland. In pregnant mice, sites of localization of the radiolabel were similar to non-pregnant mice, with the exception that some residual radioactivity was also noted in the umbilical cord, amnion, and yolk sac. No radioactivity was retained in any other fetal tissues. It was speculated that metabolism of caprolactam in the nasal tissue may produce a metabolite that was slow to clear. The apparent retention of radioactivity in the olfactory bulb was thought to represent an artifact caused by the washing of radioactivity from the nasal epithelium by hexane during the freezing procedure.

5 Acute Toxicity of Caprolactam

5.1 Acute Toxicity to Adult Humans

Occupational exposure to caprolactam emitted during Nylon-6 processes is known to cause acute eye and upper respiratory tract irritation (Hohensee, 1951; Ferguson and Wheeler, 1973; Kelman, 1986). Dermal irritation and dermatitis also occur in occupational settings with short-term and repeated exposure to the solid form of caprolactam, or caprolactam particulate that has “condensed” (sic) onto surfaces from the airborne vapor or aerosol phase (Hohensee, 1951; Ferguson and Wheeler, 1973; Kelman, 1986; NIOSH, 1995a).

Two published studies, an industrial observational exposure study by Ferguson and Wheeler (1973), and a chamber controlled human exposure study by Ziegler et al. (2008) examined the acute sensory irritant effects resulting from directly measured concentrations of caprolactam. These two studies are summarized and assessed for REL development below. No peer-reviewed studies have been conducted specifically examining toxicological effects of caprolactam released from finished products that contain the chemical (e.g., finished Nylon-6 carpets).

Additionally, several case reports of workers heavily exposed to caprolactam developing seizures are summarized in this section. This is a particular concern given that, in general, children are more vulnerable than adults to the neurologic effects of chemicals. Because caprolactam is a respiratory irritant, the available data for the potential of caprolactam also acting as a sensitizing agent for allergic responses is presented. Lastly, the basis for caprolactam occupational exposure limits (e.g., ACGIH and NIOSH) is summarized at the end of this section.

Ferguson and Wheeler (1973)

Ferguson and Wheeler (1973) exposed 5 healthy unacclimated male worker "volunteers" at a caprolactam polymerization plant. Exposures were to caprolactam vapor at concentrations of 10, 14, 25, and 104 ppm (46, 65, 116, and 482 mg/m^3, respectively) while subjects were standing or conversing for several minutes downwind from a known emission source. The smoking status of the workers was not reported. 'Unacclimated' was defined as workers who were experienced employees of the work environment, but reportedly were not continuously exposed in their ordinary duties. Although the authors report exposure was to the "vapor" form of caprolactam, the concentrations were above the saturated vapor concentration of 13 mg/m^3, indicating that exposure included caprolactam aerosol.

Air sampling for the exposures was area level rather than personal monitoring and was set at a height of about 60 inches from the floor and was averaged over a minimum of 30 minutes (Ferguson and Wheeler, 1973). The instrumentation for these exposures was presumably the same used for estimating 8-hour time weighted average concentrations in the second part of the study: a liquid absorption train that consisted of three flasks in series set up to collect the caprolactam in measured volumes of air. The flasks were half-filled with water and connected with one another by fritted glass delivery tubes. The train was connected to a fixed vacuum supply through a wet test meter. A similar arrangement was also employed that used gas traps rather than flasks, and a portable vacuum pump was used as a vacuum source. Two-mm glass beads were used in the first trap as a sparger. Both sampling techniques were considered effective, as no caprolactam was found in the last trap in either train. Analysis was by gas chromatography (GC) with a flame ionization detector.

The sampling and analytics methods above are presented in detail because of the implications for error in exposure assessment. This air sampling technique was a commonly used method in the 1970's, but some particulates could have been missed or lost due to the use of fritted glass (Gill, 2011). Further, using GC for analysis of

caprolactam is less sensitive than using high pressure liquid chromatography (HPLC) because the solvent peak tends to interfere with detection of caprolactam (Nau et al., 1984; Gill, 2011). Current methods for caprolactam air sampling recommended by OSHA include XAD resins or other absorbents, and analysis using HPLC and mass spectrometry (OSHA, 1988).

Most or all of the subjects in the Ferguson and Wheeler study reported transient nasal and throat irritation at all concentrations, including 4 out of 5 individuals exposed to 10 ppm (46 mg/m^3). Eye irritation was noted only in one volunteer at the highest concentration. The authors did not indicate whether throat irritation was a result of mouth-breathing (due to the unpleasant odor and/or nasal irritation) by those exposed. The degree of discomfort felt by the workers was considered dose-responsive, but was not quantified, reportedly due to wide differences in the degree of discomfort among the individual subjects. Thus, scalar functions that had been used in an attempt to evaluate degrees of discomfort were not presented. Some of the study participants also were exposed to similar concentrations for up to 30 min, but the sensory effects were not clearly stated or quantified. Brief exposure to 400-1200 ppm caprolactam was described as “extremely irritating”, resulting in a “choking” response.

A similar acute exposure study was arranged at a caprolactam monomer plant, although specific conditions of the exposure were not presented by the authors (Ferguson and Wheeler, 1973). In that part of the study, 14 ppm (65 mg/m^3) did not result in distress or discomfort. The authors speculated that the conditions of 100% humidity at the monomer plant (the polymer plant was described as having near normal humidity) may have been a factor in reducing sensory irritation. The authors also noted that caprolactam concentrations at the monomer plant appeared to be more uniform, suggesting that the greater variability in the concentration at the polymer plant might have resulted in brief high exposures leading to sensory irritation. The authors, however, did not present quantitative data documenting the variation in caprolactam concentration during the acute exposures.

Ferguson and Wheeler concluded that the irritant response threshold for the workers was at or near 10 ppm (46 mg/m^3) caprolactam, and that 5 ppm (23 mg/m^3) would be 50% of the discomfort threshold and somewhat below the no-effect level. The authors further state that additional support for their worker threshold value of 5 ppm is based on their findings of no reported distress among the employees in active and semi-active areas at concentrations up to about 7 ppm, although this did not appear to reflect responses to a systematic survey of the workforce (discussed in Section 6.1).

Ziegler et al. (2008)

Ziegler et al. (2008) conducted chamber exposures of 20 adult subjects (10 men and 10 women) to 0, 0.15, 0.5, and 5 mg/m^3 caprolactam vapor for 6 hours on 4 successive days. The stated study goal was to address possible chemosensory effects of caprolactam at low concentrations reflecting the indoor environment. Chemosensory subjective effects were assessed by a standardized questionnaire. Objective measures of exposure were assessed by eye blink frequency using a standard manual counting

procedure and a new semi-automated method; conjunctival hyperemia (eye redness) based on digital slit lamp photographs taken during exposure; and by nasal resistance using active anterior rhinometry before and after exposures. Except for nasal resistance, the questionnaire and objective tests were given at time 0 (i.e., just after entering the chamber), 1 hr, 3 hrs and 6 hrs during exposure. Nasal resistance was measured only at baseline and once more at the end of the exposure period at 6 hrs.

Two techniques were used to determine eye blink frequency at each time point during caprolactam exposures, a manual count method followed immediately by a semi-automated approach. For the manual method, Ziegler et al. digitally recorded the eyes of the participants for a specified duration under dim lighting conditions. The recording was later reviewed in a double blind fashion and the number of eye blinks manually recorded. The second method involves a neon light shining on the eye surface of the participants and a sensor records the change in beam length that reflects back when the participant blinks. The authors noted in their report that the semi-automated method is still in the testing phase and its applicability and reproducibility needs to be verified in further studies. The manual method is a traditional procedure used in many studies to record eye blinks. OEHHA concurred with Ziegler et al. that for eye blink frequency, greater confidence should be placed on the findings using the standard manual method.

The questionnaire consisted of 29 items related to sensory irritant symptoms and perceptions (e.g., odor). This multi-item battery was used to generate a total daily score. Six adjectives were presented for rating the intensity of symptoms on a Likert-type scale from zero (not at all) to 5 (very severe). The 29 items were also categorized into seven subscores for assessment. The subscores include: 1) non-specific symptoms: *feeling of weakness, headache, dizziness, felling of being unwell*; 2) not classified: *blurred vision, irritation to the throat, skin irritation*; 3) sensations of bad taste: *very unpleasant taste in the mouth, unpleasant taste, foul taste*; 4) respiratory symptoms: *pressure on the chest, coughing, dyspnea*; 5) olfactory symptoms: *perception of bad air, foul smell, unpleasant smell, stink*; 6) nasal irritation: *nasal irritation, itching nose, dry nose, runny nose, burning nose*; 7) irritation to the eyes: *tiredness of the eyes, itchy eyes, burning eyes, eye irritation, dry eyes, watery eyes, redness of the eyes*. A second section evaluating well-being (i.e., tension, tiredness, annoyance and general well-being) was rated on a visual analog scale from one (no symptoms) to seven (severe symptoms).

Ziegler et al. (1998) found that caprolactam exposure was associated with a statistically significant increase in the subjects' detection of an unpleasant odor beginning at 0.15 mg/m^3. However, at 5 mg/m^3 the average intensity score of 1.2 was only slightly pronounced (i.e., between "barely" (1) and "somewhat" (2) for an odor nuisance). Subscores for eye and nasal irritation and eye/nasal irritation combined showed no statistically significant concentration-response relationships using the analysis of variance (ANOVA) test. Discounting odor nuisance, there were no statistically significant differences among the other individual symptoms and subscores associated with caprolactam exposure. At 5 mg/m^3 the total symptom score based on all 29 acute symptom items was significantly elevated ($p \leq 0.05$). No statistically significant increase or decrease in the total symptom score was observed in the course of the day. Thus,

these results do not indicate any adaptation or habituation processes in the course of the 6 hour exposure.

For the three objective measures of sensory irritation, the authors found no statistically significant concentration-response relationships by the ANOVA test, but noted there was a “non-significant trend” towards higher blink frequency and nasal resistance associated with increasing caprolactam concentrations. As noted below, there appear to be statistical issues with these analyses that could have obscured effects of caprolactam.

Because there was little variation over time among most of the subjective and objective measures during the six hours of exposure, the authors had combined the data collected at time 0 (i.e., just after entering the chamber), 1 hr, 3 hrs and 6 hrs for their statistical analyses. OEHHA obtained the individual raw data, kindly provided by Dr. Ziegler, with the primary goal of running several statistical analyses on the data collected at 1 hour of exposure, the exposure duration that forms the basis of an acute REL, as well as the other time points. The combined data collected up to 6 hrs of exposure were also analyzed by OEHHA.

For statistical evaluation of the raw data, we used the non-parametric Page’s trend test to verify any associations between caprolactam exposure among both the objective and subjective endpoints. In the Page’s trend test, the response for each ordered category (caprolactam concentration in this case) is ranked for each participant. Ranking is based on an ordinal scale (i.e., 1, 2, 3 and 4 since there are four exposure concentrations). For example, over ordered doses, if a person's blink response is 24, 15, 70 and 90 blinks/90 sec for the 0, 0.15, 0.5 and 5 mg/m^3 caprolactam concentrations, respectively, then the participants’ ranks are 2-1-3-4. The ranks for each dose are then summed over all the individuals and those sums are used to calculate an L-statistic and corresponding p-value to determine if an association between caprolactam concentration and eye blink frequency exists.

Ziegler et al. originally used a parametric repeated measures ANOVA for their statistical analysis of normally distributed data and a non-parametric Kruskal-Wallis ANOVA for non-normally distributed data, although they did not specify which outcomes each was applied to in every situation. To avoid any assumptions of normality in this data, we chose non-parametric methods. For this set of data, Page’s trend test is a more appropriate non-parametric method for assessing the possibility of a dose-response relationship. This is because Page’s test is able to use the order of the dose categories to assess whether a general trend in response is present over increasing dose, which is essentially the question of interest. Moreover, Page’s trend test accounts for multiple measurements of the same subjects at different exposure times (i.e., repeated measures) and the within-subject correlation in values that such a design creates, whereas the Kruskal-Wallis test does not. In the instances where a statistically significant trend ($p \leq 0.05$) was found, we utilized the Wilcoxon signed-rank test to identify any statistically significant differences at $p \leq 0.05$ between the control exposure and each dose group.

Table 1 presents the statistical results for eye redness and nasal resistance based on Page's trend test. No statistically significant dose-response relationship was found for the eye redness score at 1 hour of exposure. In addition, no dose-response relationship was found at the other time points of 0, 3 and 6 hours (data not shown). Nasal resistance was also not statistically significantly affected by the 6 hour exposure to caprolactam. Nasal resistance values in Table 1 represent the difference between resistance just before entering the exposure chamber and resistance at the end of the 6 hr exposures. A negative mean for nasal resistance (0 and 0.15 mg/m^3 caprolactam exposures) indicates resistance was less at the end of 6 hr exposure than before entering the chamber. In addition to mean, standard deviation, and interquartile range (IQR), mean rankings for each dose group are shown because the rankings are what Page's test ultimately utilizes. Though the L-statistic is calculated using the sum of ranks for each dose group, the mean is provided here to keep ranks on the original ordinal 1 to 4 scale for ease of comprehension.

TABLE 1. PAGE'S TREND TEST RESULTS (MEAN ± STANDARD DEVIATION, MEDIAN, INTERQUARTILE RANGE AND MEAN RANK) FOR EYE REDNESS AT 1 HOUR OF CAPROLACTAM EXPOSURE, AND FOR NASAL RESISTANCE AT 6 HOURS OF CAPROLACTAM EXPOSURE, PERFORMED BY OEHHA

Outcome & Statistic	Caprolactam concentration (mg/m^3)				Page's trend test result
	0	0.15	0.5	5.0	
Eye redness score[a]					
Mean±SD	2.00±0.00[b]	2.00±0.00[b]	2.00±0.00[b]	2.05±0.15	p=0.64
Median	2	2	2	2	
IQR	0	0	0	0	
Mean rank	2.45	2.45	2.45	2.65	
Nasal resistance[c]					
Mean±SD	-0.049±0.21	-0.029±0.22	0.013±0.12	0.020±0.12	p>0.99
Median	0.00	0.04	0.03	0.01	
IQR	0.14	0.09	0.09	0.09	
Mean rank	2.45	2.45	2.75	2.35	

[a] Score ratings for eye redness were: (1) very slight, (2) slight, (3) moderate, (4) severe
[b] No standard deviation or IQR because all subjects rated a (2) for slight eye redness
[c] Nasal resistance presented in units of kPa/L/sec. Nasal resistance values in Table 1 are different from those presented in the original paper by Ziegler et al. (2008). The correct formula for calculating nasal resistance used in Table 1: LRxRR/(LR+RR) was inadvertently calculated as LRxRR/LR+RR in the original paper, where LR is left nostril resistance and RR is right nostril resistance (A. Ziegler, personal communication). Nevertheless, use of either formula resulted in the same outcome: no effect of caprolactam on nasal resistance.

Based on the manual method for recording eye blinks, the Page's trend test confirmed a statistically significant association for increasing caprolactam exposure and eye blink frequency at 1 hour of exposure (Table 2). The Wilcoxon sign-rank test showed that exposure to 5 mg/m^3 caprolactam resulted in a statistically significant increase (p=0.01) in eye blink frequency compared to the control group. A concentration-response association was not observed at 0 hour (defined by Ziegler et al. as within 5 minutes after entering the chamber). For reasons not specified in the Ziegler study, only 4 to 8 individuals were assessed by the manual eye blink count method at each caprolactam concentration during the 3 and 6 hour exposure effects assessment. OEHHA did not consider this to be a sufficient number of individuals for statistical analysis for these exposure durations.

Applying Page's trend test to the novel semi-automated approach for estimating eye blink frequency, a concentration-response association was not observed at 0 or 1 hour of exposure (Table 2). A statistically significant association for increasing caprolactam exposure and eye blink frequency was observed at 3 and 6 hours of exposure, and for the 0, 1, 3, and 6 hour eye blink data when they were combined. In all cases when an association was found at p<0.05 using the Page's trend test, the Wilcoxon sign rank test observed a statistically significant difference (p<0.05) between the control exposure and the 5 mg/m^3 exposure. No other statistically significant comparisons between exposure concentrations were found.

TABLE 2. PAGE'S TREND TEST RESULTS (MEAN ± STANDARD DEVIATION (SD), MEDIAN, INTERQUARTILE RANGE (IQR) AND MEAN RANK) BY OEHHA FOR EYE BLINK FREQUENCY

Exposure time & Statistic	Caprolactam concentration (mg/m^3)				Page's trend test result
	0	0.15	**0.5**	**5.0**	
Manual method					
0 hr[a]					
Mean±SD	25.6±19.9	27.3±23.2	24.0±18.1	30.4±23.1	p=0.88
Median	18.5	18.0	19.0	26.0	
IQR	15.5	22.5	15.8	28.0	
Mean rank	2.53	2.48	2.38	2.63	
1 hr					
Mean±SD	18.7±11.8	25.2±24.6	23.5±14.7	34.4±29.2	p=0.002
Median	17.0	18.0	21.5	26.0	
IQR	12.8	22.0	19.0	29.8	
Mean rank	1.90	2.38	2.58	3.15[b]	
Semi-automated method					
0 hr[a]					
Mean±SD	21.9±14.4	25.2±24.2	23.8±20.4	28.4±20.6	p=0.15
Median	20.5	17.5	19.5	27.0	
IQR	10.5	18.5	13.8	24.5	
Mean rank	2.38	2.28	2.40	2.95	
1 hr					
Mean±SD	18.0±10.5	25.5±25.3	22.8±14.6	29.7±25.8	p=0.23
Median	14.0	20.5	19.0	21.5	
IQR	13.5	29.0	14.0	27.3	
Mean rank	2.15	2.63	2.53	2.70	
3 hr					
Mean±SD	21.5±21.0	19.4±14.9	18.2±13.0	29.1±25.0	p=0.01
Median	15.5	17.5	16.5	22.5	
IQR	16.5	14.5	11.3	20.5	
Mean rank	2.18	2.28	2.28	3.28[c]	
6 hr					
Mean±SD	16.5±11.4	21.2±19.7	18.9±18.1	25.9±21.8	p<0.001
Median	14.5	16.0	13.0	15.5	
IQR	15.5	22.0	14.8	22.3	
Mean rank	1.88	2.30	2.28	3.55[d]	
Combined					
Mean±SD	19.5±10.8	22.8±20.0	20.9±15.2	28.2±21.0	p=0.02
Median	17.3	18.4	15.8	23.3	
IQR	9.1	17.3	10.0	22.5	
Mean rank	2.28	2.30	2.10	3.33[e]	

[a] "0 hour" exposure means eye blink data collection started within 5 minutes after entering the chamber
[b] Sign rank test: control (0 mg/m^3) different from 5 mg/m^3 group (p=0.01)
[c] Sign rank test: control (0 mg/m^3) different from 5 mg/m^3 group (p=0.02)
[d] Sign rank test: control (0 mg/m^3) different from 5 mg/m^3 group (p=0.01)
[e] Sign rank test: control (0 mg/m^3) different from 5 mg/m^3 group (p=0.01)

For the subjective questionnaire subscores at one hour of exposure, we found a statistically significant concentration-response relationship (p=0.02) for perceived eye irritation (Table 3) by the Page's trend test, consistent with the objective eye blink measure. The 5.0 mg/m^3 exposure differed from the control group (p<0.05) by the sign-rank test. A statistically significant trend was also verified at 6 hours of exposure, but the ensuing sign-rank test comparing control vs. 5.0 mg/m^3 groups was not statistically significant (data not shown). There was no concentration-response relationship at 0 or 3 hours (data not shown).

Combining the 0, 1, 3 and 6 hr eye irritation subscore measurements for statistical analysis, as Ziegler et al. (2008) had done in the original report, also yielded a statistically significant association by the Page's trend test (p=0.002) (data not shown in Table 3). Using the sign-rank test, the control group was different from both the 5 mg/m^3 group (p=0.01) and the 0.5 mg/m^3 group (p=0.03).

The subjective nasal irritation score at one hour of exposure did not demonstrate a statistically significant concentration-response relationship at 1 hour of exposure (Table 3). No statistically significant concentration-response was observed at any of the other time points (0, 3 and 6 hours), or when all the time point data was combined (data not shown in Table 3).

TABLE 3. PAGE'S TREND TEST RESULTS (MEAN ± STANDARD DEVIATION (SD), MEDIAN, INTERQUARTILE RANGE (IQR), AND MEAN RANK) PERFORMED BY OEHHA FOR SELECTED SUBJECTIVE QUESTIONNAIRE RESULTS AT 1 HOUR OF EXPOSURE: EYE AND NOSE IRRITATION SUBSCORES, ODOR NUISANCE SUBSCORE, AND TOTAL SYMPTOM AND COMPLAINT SCORE OF 29 QUESTIONS WITH AND WITHOUT ODOR SUBSCORE[A].

Outcome & Statistic	Caprolactam concentration (mg/m^3)				Page's trend test result
	0	0.15	0.5	5.0	
Eye irritation					
Mean±SD	0.18±0.24	0.26±0.50	0.34±0.48	0.36±0.44	p=0.02
Median	0.14	0.00	0.21	0.21	
IQR	0.29	0.18	0.32	0.46	
Mean rank	2.13	2.18	2.83	2.88[b]	
Nose irritation					
Mean±SD	0.14±0.23	0.18±0.28	0.18±0.31	0.24±0.33	p=0.42
Median	0	0	0	0	
IQR	0.25	0.20	0.20	0.45	
Mean rank	2.30	2.53	2.53	2.65	
Odor nuisance					
Mean±SD	0.10±0.22	0.20±0.30	0.24 ±0.30	1.09±0.90	p<0.001
Median	0	0	0	1	
IQR	0	0.31	0.50	0.94	
Mean rank	1.83	2.15	2.40[c]	3.63[c]	
Total score					
Mean±SD	0.13±0.16	0.19±0.33	0.21±0.26	0.37±0.32	p<0.001
Median	0.07	0.07	0.12	0.22	
IQR	0.16	0.13	0.16	0.44	
Mean rank	1.83	2.15	2.68	3.35[d]	
Total score w/o odor					
Mean±SD	0.13±0.17	0.18±0.36	0.20±0.28	0.26±0.31	p=0.003
Median	0.08	0.06	0.10	0.12	
IQR	0.19	0.07	0.09	0.28	
Mean rank	2.00	2.18	2.73	3.10[e]	

[a] Score ratings were: (0) not at all, (1) barely, (2) somewhat, (3) quite pronounced, (4) severe, and (5) very severe
[b] Control (0 mg/m^3) group different from 5 mg/m^3 group by the sign-rank test (p=0.02)
[c] *Control* (0 mg/m^3) group different from the 5 mg/m^3 (p<0.001) and 0.5 mg/m^3 group (p=0.04) by the sign-rank test
[d] Control (0 mg/m^3) group different from 5 mg/m^3 group by the sign-rank test (p<0.001)
[e] Control (0 mg/m^3) group different from 5 mg/m^3 group by the sign-rank test (p=0.01)

For the odor subscore, a significant concentration-response relationship was observed (Table 3). Ziegler et al. observed a difference between no exposure and all three exposure groups when odor response data collected at 0 (just after entering the chamber), 1, 3, and 6 hrs of exposure were combined. Utilizing just the one hour

questionnaire data, however, we observed a statistically significant difference only for the 0.5 and 5.0 mg/m^3 exposures compared to the control exposure.

The total symptom and complaint score was evaluated both with and without the odor responses. The latter analysis was performed in order to evaluate how strong a driver odor was for the total subjective complaint score. Ziegler et al. had observed a statistically significant difference at $p<0.05$ between the non-exposed and the 5 mg/m^3 caprolactam exposure groups when the questionnaire data (including the odor questions) was combined from all four time points. Using Page's trend test, OEHHA found a statistically significant concentration-response relationship at 1 hour of exposure, when the odor subscore was included (Table 3). The sign-rank test showed a difference in response between the control and the 5 mg/m^3 exposure ($p<0.001$). When the odor questions were excluded, there was still a significant concentration-response relationship at one hour of exposure ($p=0.003$). The sign-rank test for odor-excluded scores indicated a statistically significant difference between the control and 5 mg/m^3 exposures ($p=0.009$).

A benchmark concentration analysis was carried out by OEHHA using U.S. EPA (2009c) continuous modeling methodology on the eye blink frequency data (Table 2) and eye irritation data from Table 3. For the eye blink and eye irritation datasets, continuous modeling demonstrated a significant dose-related trend ($p<0.05$, test for difference among dose groups), but was unable to provide a fit to the data (chi-square test for goodness of fit, where $p\geq0.10$ for acceptability) using the available models. Specifically, the models could not be fit to the data because one or more of the observed means was not positioned reasonably close enough to the estimated means.

OEHHA applied the Spearman rho test to look for correlations in response to caprolactam concentration between the eye blink frequency and subjective eye irritation score at 1 hour of exposure. First, individual caprolactam responses were characterized by comparing response at the 5 mg/m^3 dose to response at the baseline 0 mg/m^3 dose. For subjective eye irritation, an absolute measure of response was calculated by simply subtracting an individual's control dose response from their high dose response. For eye blink, however, wide intra-individual and inter-individual variation in blink frequencies made simple differences difficult to compare. In this case, we calculated relative responses in blink frequency by dividing a subject's high dose caprolactam eye blink frequency by their control blink frequency to yield a measure of relative response to caprolactam. Comparing relative blink increase (manual method) with absolute eye irritation increase at 1 hour of exposure, we found that responses are correlated (Spearman rho coefficient=0.54, $p=0.01$).

OEHHA used the same approach in applying the Spearman rho test for correlation between eye irritation score and odor score. Because the odor of caprolactam was apparent to the participants the subjective eye irritation score may be influenced by the odor, similar to what has been observed for other airborne chemicals with unpleasant odors (Dalton, 2003). As with eye irritation, odor response was calculated by subtracting control odor score from high dose odor score. At 1 hour of exposure, no correlation was found for absolute eye irritation score vs. absolute odor score

(Spearman rho coefficient=0.04, *p*=0.86). Finally, the Spearman rho test was also applied to relative eye blink frequency vs. absolute odor score at 1 hour of exposure. No correlation was observed (Spearman's rho coefficient=0.20, *p*=0.41). These results indicate that eye blink responses and eye irritation responses are correlated, but neither is correlated with odor.

No correlation was apparent between eye blink response and eye redness response (Spearman's rho =0.38, *p*=0.10), which was also calculated by taking the difference of an individual's high dose and control redness scores. However, this is not inconsistent with reports by other investigators. For example, Lang et al. (2008) observed eye redness at the same level of formaldehyde exposure that caused increased eye blink frequency in one exposure scenario (0.5 ppm formaldehyde with 1.0 ppm peaks), but did not observe eye redness in a similar scenario that caused increased eye blink rate (0.5 ppm formaldehyde with 1.0 ppm peaks + ethyl acetate as an odor masking agent). These data suggest eye blink frequency is a more consistent and sensitive indicator of eye irritation than eye redness.

Case Reports and Human Sensitization Studies

We identified three peer-reviewed published case reports of workers heavily exposed to caprolactam developing seizures and other severe symptoms. The exposure levels in these reports were not quantified, however the descriptions suggest that the exposures could be considerably higher than typical occupational exposures.

Tuma et al. (1981) reported the case of a 22-year-old man who developed dermatitis of the hands and feet, nausea and vomiting, leukocytosis, and "grand mal" (i.e., generalized tonic-clonic) seizures three days after being transferred to a section of a plastics plant that involved caprolactam use. The caprolactam dust coated his clothing and exposed areas of skin when he arrived at the hospital. Dermal inflammation was also noted on the buttocks and thighs. The authors did not indicate that any respiratory distress was present; a chest roentgenogram was reported to be normal. After a few days of observation in the hospital, the skin lesions manifested desquamation (peeling) and erythema (redness and swelling), although the other symptoms had cleared. A comprehensive neurological investigation identified no underlying organic CNS abnormalities, consistent with the seizures having been a consequence of the work-related caprolactam exposure.

In a second case report from South Korea translated from Korean by OEHHA, two young men were hospitalized with nausea, vomiting, dermatitis on the hands and feet, and tonic-clonic seizures following occupational exposure to caprolactam (Woo et al., 1998). The men had been packaging caprolactam, one for two days and the other for four days, working inside a caprolactam containment vessel. Laboratory testing documented leukocytosis and hyperglycemia. Brain CT scanning and EEG testing were reportedly normal. No further symptoms or seizures were seen over the two months after exposure. The authors concluded that the skin lesions and unexplained generalized tonic-clonic seizures in the men strongly indicated a causal effect of caprolactam intoxication.

In a third case report translated from Chinese by OEHHA, three workers in a Chinese plant were taken to a hospital emergency room with symptoms of dizziness, nausea and vomiting following handling or moving plastic bags containing chemical raw materials including caprolactam (Chen, 2002). Two of the workers (both of whom were working shirt-less) displayed tonic-clonic seizures, opisthotonus, froth around the mouth, upward-turned eyeballs, and a post-ictal altered mental status. There was no mention of any respiratory or dermal symptoms in the exposed workers. Physiological and hematological exams were generally normal. Urine caprolactam concentrations were stated to be 2.9-3.7 g/L, and 13.6-15.4 g of caprolactam was leached from the workers' clothing. Data on caprolactam metabolism indicate that only about 2% is excreted unmetabolized in urine. Although metabolism could be saturated with high exposure, the g/L amounts in the urine do not seem biologically plausible. More likely, the reported units of measure are incorrect. The colorimetric method used to estimate the urine caprolactam concentration appears to use mg/L as the unit of measure (Zhou, 1976), which would be a more reasonable caprolactam urine concentration in the workers in this case report.

Chen (2002) noted the two patients recovered and were released after a four-day hospitalization. It had been an extremely hot day (heat stroke was ruled out clinically) and the authors speculated that sweat facilitated the dermal absorption of caprolactam, particularly in the two workers that were shirt-less. The workers had a previous caprolactam exposure without reported symptoms.

These case reports suggest that neurotoxicity can be an important endpoint in humans heavily exposed to caprolactam. Moreover, dermal absorption can be an important exposure pathway and may also lead to dermatitis. Relevant to these human case reports, studies in rabbits show that concentrated caprolactam (50% aqueous caprolactam solution) placed on the skin can cause local irritation and be absorbed, leading to convulsions and death (Haskell Laboratory, 1950). Other animal studies with different exposure routes have also observed caprolactam-caused seizures (Goldblatt 1954; Gross 1984, reviewing the Eastern European literature). These animal studies will be discussed in greater detail in Section 5.3 to follow.

A review by Gross (1984) of the eastern European occupational studies conducted in the 1960s and 1970s suggests a significant number of workers may develop "hypersensitivity" to caprolactam. However, the methodology was not adequately described in these studies and there was co-exposure to other chemicals. Exposure studies conducted in the West, some of which were not peer-reviewed, indicated caprolactam solutions of 1-5% did not cause skin irritation or act as a skin sensitizing agent.

Goldblatt et al. (1954) applied a 5% aqueous caprolactam solution to the skin of the inner forearms of six normal persons (4 men, 2 women) as a patch test left in contact for 48 hours. Goldblatt et al. also applied a 5% caprolactam solution in either alcohol or olive oil to the same area on volunteers and allowed to dry. The process was repeated daily for four days. In all cases, no irritant effects were produced. The authors

concluded that caprolactam is not a skin irritant following these short-term exposures, and no evidence was found that it could act as a sensitizing or dermatitis agent.

In a study carried out in Haskell Laboratory in 1941 that was not published in a peer-reviewed journal, three human volunteers had a 1% aqueous solution of caprolactam applied to the skin (Haskell Laboratory, 1950). No skin irritation was reportedly produced. No other methods or descriptive information was provided.

In another non-peer-reviewed study (i.e., not published in a peer-reviewed journal) conducted in 1952-53 and recently reported to the U.S. EPA (2009a), a patch test was conducted in 204 human subjects to determine whether or not Nylon-6 containing 3-5% water-extractable caprolactam and dimers would produce primary skin irritation and/or sensitization in occupational exposures. No primary irritation or allergic sensitization was observed in the tested subjects. No other methods or descriptive information was provided. Animal data related to the question of sensitization from this study is summarized in Section 5.3.

In contrast to these negative human experimental studies there have been case reports consistent with caprolactam-related contact dermatitis. A worker with 29 years of experience in a Nylon-6 factory presented with an 18-month history of dermatitis (Aguirre et al., 1995). Patch testing with a 5% aqueous solution of caprolactam was positive for contact dermatitis. The lesions completely resolved following 2-month leave from work. In another case report, a woman developed dermatitis at a skin site where blue polyamide-6 suture thread had been removed following 10 days of placement following a dermatological procedure (Hausen, 2003). She had already undergone more than 40 similar procedures in the past. Patch testing was positive for caprolactam and the blue dye (acid blue 158) used in the thread. The patient, who was a hairdresser for 17 years, also had positive testing for ammonium persulfate and 2,5-diaminotoluene, two chemicals she was exposed to occupationally.

Occupational Exposure Limit Values for Caprolactam

The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) currently have recommended occupational exposure limits for caprolactam (Table 4). The ACGIH (2003) recommends summing both aerosol and vapor forms of caprolactam together to determine the total airborne concentration. NIOSH has two caprolactam recommendations, one for the ‘dust’ (NIOSH, 1995a) to describe the solid or particulate form of caprolactam that may cause dermal irritation and another for the “vapor” (NIOSH, 1995b) that refers to both airborne aerosol and vapor forms. Both sets of recommended limit values by NIOSH and ACGIH are influenced by the published findings by Ferguson and Wheeler (1973) that reported no irritation of any kind, or any other signs and symptoms of discomfort and malaise, in workers below 7 ppm (32 mg/m^3).

TABLE 4. SUMMARY OF THE ACGIH AND NIOSH LIMIT VALUES FOR CAPROLACTAM

Agency	Occupational Exposure Value
ACGIH	TLV-TWA, 5 mg/m^3, as inhalable aerosol and vapor
ACGIH	TLV-STEL, no specific data on which to base a TLV-STEL
NIOSH	REL-TWA, 1 mg/m^3, dust
NIOSH	REL-TWA, 0.22 ppm (1 mg/m^3), vapor
NIOSH	REL-STEL, 3 mg/m^3, dust
NIOSH	REL-STEL, 0.66 ppm (3 mg/m^3), vapor

The ACGIH (2003) has recommended a combined caprolactam aerosol and vapor threshold limit value (TLV) of 5 mg/m^3 (1.08 ppm) as a time-weight average (TWA) for a normal 8-hr workday and a 40-hr workweek. The ACGIH (2003) did not find that sufficient data were available to recommend skin or sensitization notations.

NIOSH (1995b) has established a recommended exposure limit (REL) for caprolactam vapor of 0.22 ppm (1 mg/m^3) as a TWA for up to a 10-hr workday and a 40-hr workweek, and 0.66 ppm (3 mg/m^3) as a short-term exposure limit (STEL). These lower recommended values, compared to ACGIH values, are intended to prevent early signs of irritation in some workers. Based on available human exposure responses, primarily Ferguson and Wheeler (1973), NIOSH felt a sufficient margin of safety was warranted to prevent such outcomes due to caprolactam vapor.

For caprolactam dust, NIOSH (1995a) recommended an REL value of 1 mg/m^3, and a STEL of 3 mg/m^3. These exposure levels appear to be largely based on an unpublished letter to the ACGIH TLV committee in 1972 when occupational limits were being determined by that body for caprolactam (Ferguson and Wheeler, 1973; ACGIH, 2001). In this letter, airborne caprolactam dust was reported to be irritating to the skin of some individuals at 5 mg/m^3, but adequate protection was provided by a limit of 1 mg/m^3 particularly when this was combined with respirator use. From this description, it may be inferred that the exposure limits for caprolactam as airborne dust were designed to lead to lower deposition onto surfaces that facilitate direct dermal contact and dermal irritation. As stated previously, however, airborne vapors are likely to lead to surface condensation as well.

The U.S. Occupational Safety and Health Administration (OSHA) has promulgated a permissible exposure limit (PEL) neither for caprolactam vapor nor caprolactam dust. Cal/OSHA, however, in 1973 promulgated a PEL of 1 mg/m^3 and STEL of 3 mg/m^3 for caprolactam dust (Cal/OSHA, 2011). For the vapor form, the Cal/OSHA PEL is 5 ppm (20 mg/m^3) and the STEL, 10 ppm (40 mg/m^3). These occupational limit values were

likely adopted from earlier ACGIH (2001) limit values for caprolactam before they were revised by the ACGIH in 2003.

The ACGIH (2001) originally had higher exposure limits that mirrored Ferguson and Wheeler's conclusion that a worker threshold value of 5 ppm (23 mg/m^3) is recommended based on the absence of reported distress among those working at concentrations up to 7 ppm. The subsequent reduction of the ACGIH (2003) exposure limit to well below this worker threshold value suggests that that organization no longer accepted the findings by Ferguson and Wheeler (1973) in this regard.

5.2 Acute Toxicity to Infants and Children

No studies were located regarding acute toxicity to infants and children exposed to caprolactam. We found no studies of inhalation exposure to young or pregnant animals that could shed insight into acute toxicity in infants and children. In pregnant mice, oral delivery of radiolabeled caprolactam was rapidly absorbed from the stomach and freely distributed into all tissues, including the fetuses (Waddell et al., 1984). Some residual radioactivity was noted in the umbilical cord, amnion, and yolk sac. No radioactivity was retained in any other fetal tissues.

5.3 Acute Toxicity to Experimental Animals

Relatively few peer-reviewed studies of acute caprolactam exposure in experimental animals have been conducted. Acute inhalation, oral, and parenteral exposure studies are summarized below, including some non-peer-reviewed studies, to provide the full spectrum of effects resulting from acute intoxication from caprolactam exposure. Due to caprolactam's respiratory irritant action, dermal and inhalation sensitization studies are also reviewed. None of the sensitization studies was peer-reviewed. A summary of the animal toxicity findings, including acute and multi-day exposures, is presented in Table 5 at the end of this section.

The BASF Chemical Company conducted unpublished acute exposure studies in the 1960s and 70s that were reported by Ritz et al. (2002). In the rat, an oral LD_{50} of 1155 mg/kg is reported. Symptoms of acute intoxication were tonoclonic convulsions. In an acute toxicity study on rats and mice, the NTP (1982) administered caprolactam in corn oil by gavage to groups of five males and five females. The LD_{50} for male and female mice were 2070 and 2490 mg/kg, respectively. The LD_{50} for male and female rats were 1650 and 1210 mg/kg, respectively. No signs or symptoms of toxicity were discussed.

Goldblatt et al. (1954) observed 66% mortality in rats injected intraperitoneally with 800 mg/kg caprolactam with the appearance of delayed spasms. Lower non-fatal doses (500-600 mg/kg) resulted in tremors, apprehension, depression of temperature, and occasional chromodacryorrhea. Concentrations of 900 mg/kg and above proved fatal and resulted in epileptiform convulsions, salivation, and bleeding from the nares. Goldblatt et al. (1954) also injected rabbits intravenously with non-fatal doses of caprolactam ranging from 100 to 300 mg/kg. The effects were severe including

mydriasis, salivation, accelerated respiration, tremors, opisthotonic-like muscle contractions, and convulsions. The latter end-point has already been summarized previously in relation to human case reports of caprolactam-associated seizures.

Similar results were observed in the foreign toxicology literature (published mainly in Russian and German) of the 1950s and 1960s and reported in a review by Gross (1984). Caprolactam LD_{50} studies in experimental animals and exposure to high doses of caprolactam by intravenous and intraperitoneal injection produced tremors, epileptiform convulsions, salivation and bleeding from the nostrils. In an unpublished study by Haskell Laboratory (1950), an approximate lethal dose of 3375 mg/kg was observed in rats administered by gavage. Rats receiving 1500 mg/kg developed convulsions and some showed slight bleeding from the nose and mouth.

In an unpublished industrial study, four-hour exposure of rats to 5,250, 8,350, or 10,120 mg/m^3 caprolactam aerosol via a head-nose inhalation system resulted in eyelid closure, shallow to spasmodic breathing, and mild to strong defense reactions (BASF, 1985). After exposure, steppage gait, bloody nasal secretions, spasmodic breathing, marked tremor, and bloody lacrimation were observed. LC_{50}s of 9,600 and 7,080 mg/m^3 were recorded for male and female rats, respectively. In rats that died, general circulatory congestion, elevated hyperemia of the lung, moderate to severe fatty degeneration of the liver, and ischemic tubular nephrosis in the renal cortex were found. No additional deaths occurred after one day post-exposure and all surviving animals appeared normal 3 days post-exposure. Histopathological examination of the organs in surviving rats 14 days post-exposure was described as “unremarkable”.

In another unpublished[1] study, two rats exposed to a nominal particle caprolactam concentration expressed as 14,000 ppm (sic) for 17 min showed signs of general discomfort and inflammation around the eyes and nose (Haskell Laboratory, 1950). Note that particle exposures should be expressed in mg/m^3, which in this case would be approximately 65,000 mg/m^3. No gross pathology or micropathology was detected at sacrifice following a nine-day observation period.

The U. S. Consumer Product Safety Commission contracted a study of sensory and pulmonary irritation in Swiss-Webster mice exposed to compounds emitted from carpet and carpet-related products, including caprolactam (CPSC, 1996). The animals were placed in a head-only glass plethysmograph and exposed to 13.5 mg/m^3 caprolactam vapor, the highest attainable exposure concentration. The study protocol called for a one hour exposure, followed by a recovery period of 15 minutes in clean air, then exposure to the same concentration of caprolactam for another hour.

Sensory irritation was defined by a 12% or greater group decrease in the mean respiratory frequency, the minimum level of respiratory depression needed to classify an exposure as having a positive sensory irritation response (CPSC, 1996). By this approach, no measurable sensory irritation or reduction in respiratory rate was observed in the mice during the caprolactam exposure. However, the CPSC (1996) notes that measurable respiratory irritation in mice using this method usually occurs at levels 10 to 100 times higher than levels which would result in irritation in humans.

Inhalation and Dermal Sensitization/Irritation Studies

We consider sensitization here under acute exposure effects because the anamnestic response is manifested with an acute re-challenge, even though the process of sensitization itself may require repeated subacute or even chronic exposures.

In a skin absorption study, a 50% aqueous solution of caprolactam was applied to a shaved area between the shoulder blades of rabbits (Haskell Laboratory, 1950). The approximate lethal dose was 3375 mg/kg producing pathology similar to hypovolemic shock. Clinical observations included tremors, convulsions, and bleeding from the mouth and nose analogous to those observed in rats receiving oral doses. Edema and congestion of the skin at the site of application was noted, which may have increased dermal absorption as a result of skin damage. This study was not published in a peer-reviewed journal.

Gross (1984) reviewed the eastern European literature conducted in the 1970s concerning dermal sensitization studies in animals. It was claimed in these studies that both intracutaneous and dermal application of caprolactam in guinea pigs resulted in "sensitization." In the case of intracutaneous injections, the development of contact dermatitis was interpreted as indicative of successful sensitization. In one of two cases, it was claimed guinea pigs became sensitized to caprolactam by inhalation. However, other studies described below could not reproduce assertions of inhalation sensitization.

In an unpublished report submitted to U. S. EPA, groups of four male albino guinea pigs were exposed for 30 min on 5 consecutive days to 3, 10, or 30 mg/m^3 aerosols (1.5 micron) generated from a 15% aqueous caprolactam solution (U. S. EPA, 1994b; Rinehart et al., 1997). On day 19, 26, 33 and 40, animals were challenged for 30 min with 30 mg/m^3 caprolactam. Animals were monitored with whole-body plethysmography for indications of irritation and coughing, and pulmonary hypersensitivity was monitored using respiratory frequency, tidal volume, and airway constriction as criteria for effect. Caprolactam failed to induce immediate or delayed pulmonary hypersensitivity with this protocol, which has been positive for ovalbumin and trimellitic anhydride. In addition, there was no evidence of respiratory tract irritation at any exposure concentration.

In unpublished work carried out by the BASF Chemical Company, guinea pigs were exposed to repeated epicutaneous application (50% ether solution; 10 times) or intracutaneous injection (0.1% in physiological NaCl solution) (Ritz et al., 2002). Neither treatment caused local irritation or sensitization to the skin.

In an unpublished study carried out in 1941, a skin irritation test with a 66% aqueous solution of caprolactam was conducted in 10 albino guinea pigs (Haskell Laboratory, 1950). Initial application of the aqueous caprolactam solution to unbroken shaved skin resulted in erythema in one animal, faint erythema in two other animals, and negative results in the remaining 7 animals. The researchers concluded caprolactam produced only mild dermal irritation in the guinea pigs.

To further test for sensitization, a maximization test was conducted that consisted of a series of 6 treatments of a 66% aqueous solution of caprolactam to broken skin, or 6 intradermal injections of 0.1 ml of a 0.1% aqueous solution (Haskell Laboratory, 1950). This was followed by a rest period of two weeks, and then the 66% aqueous caprolactam solution was again applied to the unbroken skin at the same site as the original application. Seven of ten animals manifested dermal reactions indicating that sensitization had occurred. A final intradermal injection and application to broken skin likewise showed an increase in intensity of the reaction consistent with sensitization. Although the sensitization potential is limited by using an irritant concentration for challenge treatment, the researchers considered caprolactam should be considered a mild sensitizer on the basis of the strength of the reaction they observed.

In a similar (unpublished) maximization test protocol, 20 female guinea pigs received intradermal application of caprolactam (3.0% w/v) in water, or topical application of caprolactam (75% w/v) in water (Springborn Laboratories Inc., 1991). Challenge responses in the induced animals were compared to those of the controls. Blood samples were obtained prior to study initiation and following the challenge for evaluation of standard hematology parameters. Additionally, plasma histamine was determined for selected test and control animals following challenge. Based on the concurrent mild dermal reaction in the control group animals and the fading of reactions from 24 to 48 hours, caprolactam was not considered to be a contact sensitizer in that study.

In a Buehler test in rabbits, induction test animals were patched with 25% w/v caprolactam in water 3 times within 3 weeks (Springborn Laboratories Inc., 1991). In the challenge phase, the test group animals received 25% w/v caprolactam in water in a patch. Ten animals each were used in the challenge control and the rechallenge control groups. Dermal reaction was scored 24 and 48 hours after removal of the patch. Minimal dermal reaction was observed in both the test animals and negative control animals after the challenge as well as after the rechallenge. Mean dermal scores were also comparable between both groups. The skin sensitization potential of caprolactam was limited by using an irritant concentration for the challenge treatment. Therefore, caprolactam was not considered to be a contact sensitizer under the test conditions chosen. This study was also not published in a peer-reviewed journal.

In a dermal sensitization test by Rinehart et al. (1997), groups of 20 female albino guinea pigs were tested with 25% aqueous caprolactam solution using either the traditional modified Buehler or maximization test designs. Groups of 5 guinea pigs were treated with 5% DNCB (probably 1-Chloro-2,4-Dinitrobenzene) as a positive control. After the second challenge dose had been evaluated, blood samples were obtained for measurements of leukocytes, differential counts and plasma histamine levels. Neither test regimen showed positive results for animals treated with caprolactam. There were no body weight changes or any effects on hematologic components or plasma histamine levels caused by treatment with caprolactam. This study was reported in the journal only in abstract form.

A report of a skin sensitization test conducted on up to 6 guinea pigs and 4 dogs at the end of a subchronic inhalation exposure regimen was submitted to U. S. EPA (U. S.

EPA, 2009a). This study (not published in a peer-reviewed journal) was conducted in 1952-53 and only recently reported to the U.S. EPA. All animals were exposed to 444 mg/m^3 caprolactam as a fume (i.e., a solid suspension generated by heating caprolactam in air) 6 hrs/day for 43 exposures. Half of the guinea pigs and 3 of the dogs were then exposed to 1020 mg/m^3 on exposures 44 through 67 or 73. Observations were made one-hour, 24-hours, and 48 hours after patch application. Both guinea pigs and dogs acquired skin sensitization. No descriptive information was provided that clarify the severity of the response (although it was reported to be "mild").

In summary, acute caprolactam exposure in animals produced severe neurological effects. Caprolactam given orally by gavage, injected intravenously or intraperitoneally, or applied to the skin, can cause convulsions. Inhalation studies at lethal or near-lethal concentrations resulted in severe tremors. Dermal and inhalation sensitization test were mostly negative. Dermal sensitization has been noted in some studies, however, although interpretation of these is complicated by dermal irritation effects. A concern with the overall acute data is that most of these reports were not published in a peer-reviewed journal, and results were often insufficiently reported or published.

TABLE 5. EFFECTS OF CAPROLACTAM EXPOSURE IN EXPERIMENTAL ANIMALS

Species	Exposure	Response	Reference
Inhalation Studies (Detailed summaries in Section 5.3 and 6.3)			
Rats	65,000 mg/m^3, nominal exposure concentration, 17 min	Signs of general discomfort, eye and nose inflammation	Haskell Laboratory, 1950
Mice	13.5 mg/m^3, 2 hrs	RD_{50} study No measurable sensory irritation or reduction in respiratory rate	CPSC, 1996
Rats	0, 5250, 8350, 10,120 mg/m^3 for 4 hrs	LC_{50} = 9600 mg/m^3 (males) LC_{50} = 7080 mg/m^3 (females) Eyelid closure, spasmodic breathing, steppage gait, marked tremor, bloody eye and nasal secretions	BASF, 1985
Rats	Nominal exposure to 13,900 mg/m^3 for 2 hrs, then 1-2 hr exposures to 12,500 to 31,500 mg/m^3 on 5 successive days	General discomfort, eye and nasal inflammation during exposure. Slight lung edema and spleen congestion 3 days after exposure	Haskell Laboratory, 1950

Species	Exposure	Response	Reference
Guinea pigs	0, 3, 10, 30 mg/m^3 30 min/day for 5 days Challenge on day 19, 26, 33 and 40 with 30 mg/m^3 for 30 min	No indication of sensory irritation, coughing or pulmonary hypersensitivity as measured by whole body plethysmography	Rinehart et al., 1997
Guinea pigs	118-261 mg/m^3 for 7 hr/day for 7 days	Observed for irritant effects: Occasional cough seen	Goldblatt et al., (1954)
Guinea pigs	51 mg/m^3 5-8 hr/day for 26-30 days	Slight irritation of nasal and tracheal mucosa	Hohensee et al. (1951)
Dogs, guinea pigs, rats, rabbits	444 mg/m^3 6 hrs/day for 43 exposures, then 1020 mg/m^3 6 hr/day for 23 to 29 more exposures	Dogs: aggravated sores and eyes. Low blood pressure, tremors, weakness, coughing, dense froth around mouth at 1020 mg/m^3. Rabbits: slight corneal damage and eye irritation. Rats: no specific toxic findings Guinea pigs: nephritis	Conducted in 1952-53. Summarized in U.S. EPA, 2009a
Rats	0, 24, 70, 243 mg/m^3 5 days/wk, 13 wks	Treatment-related red facial stains, clear nasal discharge, moist rales, labored breathing. Nasal respiratory and olfactory mucosal lesions, and laryngeal tissue lesions.	Reinhold et al., 1998
Oral Gavage Studies (Detailed summaries in Section 5.3)			
Rats	No exposure dose information provided	LD_{50} = 1155 mg/kg Tonic-clonic convulsions	Summarized in Ritz et al., 2002
Rats & mice	Rats: 681, 1000, 1470, 2150 & 3160 mg/kg Mice: 1000, 1470, 2150, 3160 & 4640 mg/kg	Male rat LD_{50} = 1650 mg/kg Female rat LD_{50} = 1210 mg/kg Male mice LD_{50} = 2070 mg/kg Female mice LD_{50} = 2490 mg/kg Symptoms not described	NTP, 1982
Rats	Detailed exposure dose information not provided	LD_{50} = 3375 mg/kg 1500 mg/kg resulted in convulsions, bleeding from mouth and nose	Haskell Laboratory, 1950

Species	Exposure	Response	Reference
Dermal Toxicity and Sensitization Studies (Detailed summaries in Section 5.3)			
Rabbit	50% aqueous solution of caprolactam applied to shaved area of skin	LD_{50} = 3375 mg/kg Tremors, convulsions, bleeding from mouth and nose, skin damage at site of application	Haskell Laboratory, 1950
Guinea pigs	10 epicutaneous applications of 50% aqueous solution, or 10 intracutaneous injection of 0.1% aqueous solution	Neither treatment caused local irritation or sensitization to the skin	Summarized in Ritz et al., 2002
Guinea pigs	Maximization test with 6 skin applications of 66% aqueous solution, or 6 intradermal injections of 0.1% aqueous solution	Initial application produced erythema in some animals. Re-exposure of caprolactam by both methods after 2 wk rest period resulted in mild sensitization	Haskell Laboratory, 1950
Guinea pigs	Maximization test with 75% aqueous caprolactam solution	Dermal reaction in control animals. Challenge application produced no sensitization or increased plasma histamine	Springborn Laboratories Inc., 1991
Rabbits	Buehler patch test with 25% aqueous caprolactam solution	Comparable minimal dermal reaction in test and negative control animals after challenge and rechallenge	Springborn Laboratories Inc., 1991
Guinea pigs	Buehler and maximization tests with 25% aqueous caprolactam solution	After challenge and rechallenge, no positive results for sensitization, or change in body weight, plasma histamine, leukocytes or differential counts	Rinehart et al., 1997
Guinea pigs & dogs	Skin patch test following 43 exposures at 444 mg/m^3, and 23 to 29 additional exposure at 1020 mg/m^3	Observations made at one hour and 24 and 48 hours after patch application. Mild skin sensitization was observed. Caprolactam patch concentration not stated.	US EPA (2009)_ [an 8(a) submission to US EPA]

6 Chronic Toxicity of Caprolactam

6.1 Chronic Toxicity to Adult Humans

Occupational exposure to caprolactam is known to cause dermal, eye and upper respiratory tract irritation with acute or recurrent acute exposure, but occupational studies with prolonged caprolactam exposure in workers were considered by OEHHA to be inadequate for use as the basis of a chronic REL.

Gross (1984) summarized the early foreign literature regarding industrial exposure to caprolactam. With a few exceptions, the pertinent publications were Russian. These reports describe diverse complaints and abnormalities of the various organ systems in people exposed in factories producing nylon. The exposures in no instance were only to caprolactam. Exposure to caprolactam was commonly associated with exposure to dinyl oxides, such as diphenyl oxide. Other chemicals often associated with caprolactam exposures were cyclohexane, cyclohexanol, cyclohexanone, benzene, acetone, and trichloroethylene.

In a report from Germany translated from German by OEHHA, end of shift complaints by workers exposed to caprolactam at a factory included irritability, nervousness, heartburn, bloating, nose bleeds, upper airway inflammation, and dry and chapped lips and noses (Hohensee, 1951). Exposure included both the vapor and crystal, or dust, forms of caprolactam. Headache in response to the odor and unpleasant taste of the caprolactam vapor was also reported. All these symptoms subsided after a short (but unspecified duration) stay in fresh air. Factory inspection of the caprolactam concentration in the spinning room revealed a concentration of 61 mg/m^3, while the concentration in the laboratory room was 16-17 mg/m^3.

Although Ferguson and Wheeler (1973) were primarily focused on acute effects of airborne caprolactam exposure, the researchers also took 8-hr time-weighted average (TWA) measurements at two facilities and reviewed medical records. Other than dermal injuries resulting from direct contact to concentrated caprolactam solutions, no general health problems requiring medical follow-up were found in a review of medical records collected during the 18 years of plant operation. In addition, no worker had been removed or asked to be removed from exposure to caprolactam vapor for health reasons during plant operation.

At the caprolactam polymer plant, approximate 8-hr time-weighted average (TWA) air samples were collected from various locations in a work area over five days (Ferguson and Wheeler, 1973). The 8-hr TWA air concentrations of caprolactam vapor during working hours were 3.2 ppm (14.8 mg/m^3) with a range of 1.3 to 6.9 ppm (6.0 to 31.9 mg/m^3) at location 1, and 1.1 ppm with a range of <0.5 to 4.5 ppm (<2.3 to 20.8 mg/m^3) at location 2. Based on the percent time worked in specific locations of the caprolactam-contaminated rooms, the worker exposure durations were estimated to be about 15 to 45 min at location 1, and 1 to 4 hrs at location 2. At the caprolactam monomer plant, 8-hr TWA caprolactam vapor concentrations at various sites over a 3-week period were collected. The concentration of caprolactam sampled at various

worksite locations ranged from 0.2 to 17.6 ppm (0.9 to 81.5 mg/m^3). Worker exposure durations in the caprolactam-contaminated areas ranged from 10 min to almost 3 hrs.

From the 8-hr TWA data collected, Ferguson and Wheeler (1973) concluded that working atmospheric concentrations up to about 7 ppm (32 mg/m^3) at the caprolactam polymer plant generally resulted in no reported distress of interviewed workers in active and semi-active areas. This data supported their estimate of a worker irritant response threshold of 5 ppm (23 mg/m^3) based on the acute exposure portion of their study.

There are significant deficiencies in the Ferguson and Wheeler report that prevent it from use as the basis of an OEHHA chronic REL. As also noted by the U.S. EPA RfD/RfC Work Group, significant deficiencies included lack of information on the number of workers and the average duration and distribution of exposure (U. S. EPA, 1994b). Also, no historical air levels are given, all exposures are determined from area rather than personal samplers, and no attempt was made to reconstruct individual exposure histories.

Kelman (1986) conducted a clinical and occupational history of eight workers, seven of which were smokers, at a Nylon-6 manufacturing plant. Several of the workers (number not given) had complained of "some degree" of eye, nose, and throat irritation, although it was unclear from the study if the irritation was chronic in nature. All but one reported peeling of the skin on the hands. Five workers showed abnormal maximal expiratory flow volumes. The author considered the lung function tests unremarkable when the smoking history of the workers was taken into account. Blood and urine samples were collected for assessment of hematological, hepatic and renal functions. No evidence of systemic toxicity was found.

Exposure by Kelman (1986) was described as caprolactam vapor from heat-curing ovens, which subsequently condensed into a fume in the workplace air. Contact of the fume with cooler surfaces resulted in the formation of light feathery flakes. Average worker exposure was 4.8 years (range 9 months to 13 years) and mean atmospheric caprolactam dust concentrations at the time of the study were 84 mg/m^3 (range: 22-168 mg/m^3) for static samplers and 68 mg/m^3 (range: 6-131 mg/m^3) for personal samplers. Recovery of caprolactam vapor from distilled-water bubblers was considered negligible, which the authors interpreted as indicating exposure was limited to caprolactam dust. The caprolactam dose and exposure durations for individual workers were not provided in this study, and a characterization of the caprolactam particle sizes was not performed. The reference to formation of "light feathery flakes" suggests that some part of the caprolactam was in particle sizes too large to be inhaled and may not be relevant for inhalation exposure.

Billmaier et al. (1992) conducted an industrial exposure study of selected workers in two caprolactam plants, Chesterfield and Hopewell. Forty-nine workers were selected (27 smokers/ex-smokers) with 63 controls (workers not working in caprolactam areas, 42 smokers). The controls were matched to the exposed workers (all males) for age, race and smoking status. The workers selected had an average work exposure of 18.7 years (range: 8.2-31.7 years) against matched controls. The level of caprolactam in the

work areas was determined mainly by personnel monitoring. The monitoring method detected total caprolactam and did not differentiate between various states of the material. In operations where caprolactam or the polymer is heated and/or wet or in water solution, the airborne caprolactam was assumed to be in the vapor state [OEHHA notes that this description suggests much of the caprolactam may also be in aerosol form, especially at concentrations above the saturated vapor concentration of 13 mg/m^3]. The average concentrations from occasional monitoring over the previous 10 years at the Chesterfield plant averaged 4.5 mg/m^3 in the Polymer 25 area and 9.9 mg/m^3 in the Spinning 26 area (area monitoring only). Short term measurements of 15-59 minutes during specific plant operations that represented maximum short-term exposures to caprolactam ranged up to 34.8 mg/m^3. For the Hopewell plant, the levels were 4.2-7.8 mg/m^3 from occasional monitoring over 10 years, and an average of 17 mg/m^3 with a range of 2.3-30.8 mg/m^3 from short term measurements.

Pulmonary function tests were obtained by Billmaier et al. (1992) from all exposed and control workers. Pulmonary function tests began in 1978. "Nurses notes" used were from Chesterfield workers. These notes were obtained from workers who were ill, injured, had a physical examination or a return to work examination, or others over a period of 11 years. Only a few episodes of injury or illness were noted in the medical records that were specifically related to caprolactam exposure. One employee reported dermatitis on two separate occasions, and another employee reported dermal irritation following direct exposure to a lactam-containing solution. A third employee complained of eye irritation on one occasion and reportedly inhaled partially polymerized nylon flakes on another occasion, leading to nausea. No specific caprolactam exposure-related nose or throat symptomatology was reported. However, "symptoms" recorded in the notes may not have been assessed as this was optional.

There were no significant differences between exposed workers and their controls in the pulmonary function tests or lung function over the years (Billmaier et al., 1992). Wide differences were shown in the initial (using a Collins Eagle spirometer from 1980 to 1988) and last (using a Puritan Bennet spirometer which replaced the Collins Eagle spirometer) FEV_1/FVC ratios between smokers (n=21), ex-smokers (n=12) and non-smokers (n=7) but not between smokers and controls. The measurement of FEV_1/FVC ratios is sensitive to changes in lower airway function. The authors concluded that there would be differences in the FEV_1/FVC ratios between the exposed workers and their controls if they were present.

OEHHA notes several uncertainties with Billmaier et al. (1992) that preclude it from use as the basis of a chronic REL. Differences in the FEV_1/FVC ratios in smokers, ex-smokers and non-smokers may be due to the fact that tobacco smoke is inhaled deeply and reaches the lower airways. Caprolactam vapor may not be inhaled as deeply because it is a water soluble gas and will primarily deposit in the upper airways. Other toxicological studies summarized in this document indicate the endpoint for caprolactam exposure is the upper respiratory tract. Thus, FEV_1/FVC ratios may not be an effective measure of caprolactam effects. U.S. EPA (1994b) also notes that the spirometry performed was not in accordance with current guidelines and quality assurance procedures.

Another weakness in Billmaier et al. is that individual worker exposure histories could not be clearly determined due to high variability in caprolactam levels and changes in job responsibilities throughout the workday. As noted earlier, the irritation data from "nurses' notes" are probably unreliable and were apparently not collected systematically for all workers. Finally, the authors did not conduct a survey of the workers regarding sensory irritation symptoms or examine the upper respiratory tract for signs of inflammation.

Occupational studies of caprolactam workers have been conducted in China and were translated from Chinese into English by OEHHA. An occupational study of the health effects of caprolactam was conducted in 154 exposed workers at a Chinese caprolactam production plant (Li, 1996). The mean age of the exposed workers (111 men, 43 women) was 36.0 years (18 to 56 years of age), and the average working time at the facility was 15.7 years (1 to 22 years). The exposure group was divided into Extraction Section workers and Steaming and Packaging Section workers for assessment of health effects. Another 91 workers in the same plant but with no history of exposure (58 men, 33 women) was the control group. Their mean age was 38.1 years (17-55 years of age), and an average working time of 14.8 years (1 to 20 years).

Area air monitoring data for caprolactam over a ten year period from 1983 to 1992 were presented, with 19 to 28 samples collected per year for a total of 249 samples (Li, 1996). The concentration range over this time period was 0.5 to 110.0 mg/m^3 with a geometric mean of 9.2 mg/m^3. In the most recent year of sampling, 1992, the range was 0.6 to 6.5 mg/m^3 with a geometric mean of 2.0 mg/m^3. Statistically significant health effects and area air monitoring concentrations are presented in Table 6 for each work section of the facility. No air monitoring data were collected for the control group.

TABLE 6. WORKPLACE CAPROLACTAM AIR CONCENTRATIONS AND WORKER SIGNS AND SYMPTOMS OF EXPOSURE.

Section	Geometric Mean and Concentration Range (mg/m^3)	Significant Health Effects Compared to Control Group
Extraction Section workers	11.8 (2.1 - 110.0) (n=92 air samples)	0.01<*p*<0.05: dizziness, insomnia, nosebleed, dermal lesions, reduced leukocytes P<0.01: nasal symptoms
Steaming Section workers	8.5 (0.5 – 98.6) (n=80 air samples)	0.01<*p*<0.05: nasal symptoms, dermal lesions, reduced leukocytes
Packaging Section workers	6.7 (0.5 – 38.6) (n=77 air samples)	

Health effects related to caprolactam exposure included dermal symptoms such as dry, smooth, cracked, scaling and peeling skin. Nasal symptoms included dryness, rhinitis and sinusitis. A reduction in leukocytes was observed, defined as <4.0x10^9/L. Li (1996) noted that workers that inhaled high concentrations of caprolactam experienced a sense of "tight chest". The author surmised that this symptom was possibly due to laryngeal

mucosal or tracheal/bronchial irritation resulting in contraction. Leukocyte classification, liver function, ECG, hemoglobin and urinalysis were considered normal in the exposed workers. The authors speculated that exposure to other chemicals in the factory did not have an impact on the health of the workers.

The occupational exposure study by Li (1996) provided a large cohort of exposed workers of sufficient exposure durations. However, the lack of personal air monitoring data make it problematic for OEHHA to establish a point of departure based on the geometric means presented. Historical air sampling for the previous 10 years is included in the paper, with the earlier years of sampling resulting in the highest exposures. Individual exposure histories including the earlier years of higher exposure would have been useful. Although the author indicated that co-exposure to other chemicals was not a concern, the caprolactam extraction process is known to include solvents such as benzene, toluene and chlorinated hydrocarbons (Ritz et al., 2002). Benzene is a known hematotoxic agent. The briefness of the report and the lack of a caprolactam air concentration for the control group are other deficiencies that prevent the study from use as the basis of a REL.

The health effects of caprolactam were investigated in workers at a different Chinese caprolactam production plant by Xu et al. (1997) (translated from Chinese by OEHHA). The mean age of the exposed workers (77 men, 48 women) was 29.3 years (20 to 57 years of age), and the average working time at the plant was 9.4 years (1 to 36 years). From the same plant, 120 workers (56 men, 64 women) with no history of poisoning or exposure to caprolactam dust were selected as the control group. Their mean age was 33.1 years (20 to 49 years of age), and an average working time of 12.6 years (1 to 28 years). The smoking rate for control males (55.36%) was slightly higher than the smoking rate for exposed males (43.06%). None of the women in the study smoked.

In the Xu et al., (1997) study, two air samples each were collected at four work stations with potential exposure to caprolactam. A dust sampler was used to collect caprolactam and measurement was by weighing the filter paper. The average air concentration of caprolactam at the work stations was 3.79 mg/m^3 (range: 0 to 7.93 mg/m^3). No air samples were collected in the control areas. Statistically significant ($p<0.05$) increases in insomnia, nausea and loss of appetite was reported by the exposed workers. Other questions (headache, dreams, stomach ache and back pain) were similar to controls.

Biochemical indicators of liver and kidney function and a peripheral blood micronucleus test were similar to control values (Xu et al., 1997). A peripheral blood lymphocyte chromosomal aberration test showed no difference from control values. However, exposed smokers showed a statistically significantly higher chromosomal aberration rate (2.50% vs. 1.36%, $P<0.05$) than smoking control group workers. No difference was seen between non-smoking exposed and control workers. The authors suggested a synergistic action for higher chromosomal aberration rate may exist with smoking and caprolactam exposure. In females, a higher rate of dysmenorrhea (i.e., painful menstruation) was observed in exposed vs. controls (37.5% vs. 17.5%, $p<0.01$). No

difference was seen between exposed and control groups regarding other menstrual disorders or pregnancy and delivery complications.

The study by Xu et al. (1997) did not ascertain sensory and dermal irritation, one of the most common complaints with industrial exposure to caprolactam in other studies. Air sampling collected particles (i.e., caprolactam dust), but not the vapor form of caprolactam that may have been present in the air. The dust sampler would reflect total airborne particulate matter, not just caprolactam. It was unclear from the report if the workers were exposed to other forms of particulate matter. The authors suggest some level of exposure to other chemicals used during the extraction process occurred, but was not measured. Historical air sampling data were not presented.

Another health study was conducted in a Chinese combined caprolactam production and Nylon-6 polymerization facility (Lan et al., 1998). In this report, the caprolactam concentration was purported to be below 5.6 mg/m^3 in each caprolactam work area, but how the air samples were collected and analyzed was not described nor was the mean and range of caprolactam concentrations presented. The authors reported statistically significant increases ($p<0.01$) in dizziness, headache, fatigue, insomnia, memory loss, loss of appetite, skin itching, and bleeding gums in the exposure group of 104 workers compared to a control group of 77 workers from a pharmaceutical factory. Dry nose was also present in the exposed group ($0.01<p<0.05$).

The workers in the Lan et al. (1998) study had an average work history of 4 years at the factory, and had an average age of 24.85 years. The control group had an average work history of 6 years and an average age of 30.20 years. Drinking and smoking histories were similar between the two groups. Other survey results, including liver function, blood tests, ECG, and chest x-ray, were normal in the exposed group. The authors indicated poor industrial hygiene among the workers likely resulted in both inhalation and dermal exposure to caprolactam.

Limited case reports of allergic contact dermatitis resulting from repeated exposure to caprolactam followed by an acute re-challenge response have been published. These have been summarized previously.

There are also data from a chronic oral human exposure protocol. In that study, investigating caprolactam as a weight-reducing agent, groups of obese patients received either placebo (n = 26), 3 g (n = 62) or 6 g (n = 28) of caprolactam daily as wafers or as tablets for 18 months (Riedl et al., 1963). The study participants were also instructed to eat a 1000-calorie weight-loss diet. The subjects receiving the placebo manifested no reduction in weight, while subjects treated with 3 and 6 gm caprolactam per day showed weight reductions averaging about 0.025 and 0.05 kg/day, respectively.

Those administered caprolactam showed minimal adverse effects other than weight loss. Of note, however, thirst was reported by one patient and a rash was observed in one patient. Factoring in body weights at the beginning of the study, average daily caprolactam intake of patients administered 3 g caprolactam daily was approximately 26 and 28 mg/kg body weight for males and females, respectively. The average daily

intake of patients administered 6 g caprolactam was approximately 52 and 56 mg/kg body weight for males and females, respectively.

Riedl *et al*. (1963) also investigated the effects of caprolactam on intermediary metabolism when obese patients were administered 1 g glucose per kg body weight. Caprolactam treatment was not clearly specified, but appeared to also consist of 3 or 6 g doses per day for at least two months prior to glucose loading. Blood lactic acid levels were reduced in those patients receiving caprolactam. Blood sugar and levels of citric acid and non-esterified fatty acids in blood were unaffected by caprolactam treatment.

A summary of the human exposure findings discussed in this document is presented in Table 7 below.

TABLE 7. EFFECTS OF CAPROLACTAM IN HUMANS

Caprolactam Exposure	Response	Reference
Exposure chamber studies and occupational surveys (Detailed summaries in Section 5.1 and 6.1		
20 participants, controlled chamber exposures to 0, 0.15, 0.5, 5 mg/m^3 for 6 hrs	Positive trend for eye blink and irritation with increasing concentration; increased eye blink and irritation at 5 mg/m^3. Positive trend for odor annoyance with increasing concentration; increased odor annoyance at 0.15 mg/m^3	Ziegler et al. 2008
5 non-acclimated workers, 46, 65, 116, 482 mg/m^3 from uncontrolled source for several minutes	Transient nasal and throat irritation in most or all participants at all concentrations. Eye irritation in 1 or 5 participants at 482 mg/m^3	Ferguson & Wheeler, 1973
61 mg/m^3 in spinning room, 16-17 mg/m^3 in laboratory.	Irritability, nervousness, heartburn, bloating, headache, nose bleeds, upper airway inflammation, dry and chapped lips and noses, unpleasant taste in the mouth.	Hohensee, 1951
8 workers, 4.8 yr mean exposure to mean of 68 mg/m^3 at time of study with personal samplers	Complaints of eye, nose and throat irritation from some workers, 7 of 8 workers had dermatitis	Kelman, 1986
49 workers, 63 controls 18.7 yr work history, 4.5 mg/m^3 and 9.9 mg/m^3 in 2 areas by occasional monitoring over 10 years	Reliance on nurse's notes, no formal interviews of workers. 3 reports of dermatitis, 1 report of occasional eye irritation with nausea from inhalation of caprolactam flakes.	Billmaier et al. 1986

Caprolactam Exposure	Response	Reference
154 workers, 91 controls 15.7 yr work history, area sampling over 10 yrs in 3 areas: geometric mean 11.8, 8.5, and 6.7 mg/m^3	Nasal dryness, rhinitis, sinusitis, nosebleed, dermatitis, dizziness, insomnia, reduced leukocytes.	Li, 1996
125 workers, 120 controls, 12.6 yr work history, mean of 3.79 mg/m^3 at time of study	Insomnia, nausea, loss of appetite, dysmenorrhea in female workers, increased peripheral blood lymphocyte chromosomal aberrations in smoking workers vs. control smoking workers.	Xu et al. 1997
Human case reports of occupational exposure (Detailed summaries in Section 5.1)		
1 worker, 3-days to unknown exposure, but caprolactam coated his clothing and skin	Dermatitis of hands and feet, nausea and vomiting, leukocytosis, tonic-clonic seizures.	Tuma et al. 1981
3 workers, unknown exposure, but caprolactam dust covered clothing	Dizziness, nausea and vomiting, tonic-clonic seizures, opisthotonus, brief coma. Caprolactam in urine: 2.9-3.7 g/L	Chen, 2002
2 workers, 2-4 day exposure to unknown concentration	Dermatitis of hands and feet, nausea and vomiting, leukocytosis, hyperglycemia, tonic-clonic seizures.	Woo et al. 1998
Sensitization studies and allergic contact dermatitis reports (Detailed summaries in Section 5.1)		
Patch test of 6 normal participants with 5% caprolactam solution, repeated daily for 4 days	No skin irritant effects produced	Goldblatt et al. 1954
1% aqueous caprolactam solution applied to 3 participants	No skin irritant effects produced	Haskell Laboratory, 1950
Patch test of 204 participants with 3-5% caprolactam solution	No skin irritant effects produced	Summarized by U.S. EPA, 2009
Worker with 29 yr experience at Nylon-6 factory	Presented with dermatitis for last 18 months; patch test with 5% aqueous caprolactam solution positive for allergic contact dermatitis.	Aguirre et al. 1995
Suture thread made of Nylon-6 used in patient that had undergone 40 operations for removing skin tumors	Patch testing with caprolactam solution positive for allergic contact dermatitis.	Hausen, 2003

6.2 Chronic Toxicity to Infants and Children

No toxicity studies were located regarding prolonged animal inhalation exposure to caprolactam beginning at a young age.

In an animal three-generation developmental study, reductions in body weight and food consumption were not found in first-generation (P_1) rats exposed to caprolactam in feed, but were observed in the second- (P_2) and third-generation (P_3) rats treated with caprolactam (Serota et al., 1988). The P_1 rats were young adults (approximately 6 weeks old) upon initiation of treatment. Since the P_2 and P_3 animals were exposed both *in utero* and through the early growth phase, the decreased body weights noted in the P_2 and P_3 animals were most likely due to the time in the life span at which treatment began.

6.3 Chronic Toxicity to Experimental Animals

Only a few peer-reviewed, multi-day inhalation studies were found in the literature, and no chronic inhalation studies have been performed. Only one comprehensive subchronic inhalation study by Reinhold et al. (1998) has been conducted and is assessed below. Multi-day inhalation and long-term oral studies are also reviewed, many of which were unpublished industry studies, in order to provide a more complete picture of toxic effects resulting from long-term exposure to caprolactam.

Reinhold et al. (1998) subchronic inhalation study

In a 13-week study, Sprague-Dawley CD rats (10/dose/sex) were exposed to caprolactam aerosol (mass median aerodynamic diameter = 3 µm; geometric standard deviation = 1.7) at a concentration of 0, 24, 70, and 243 mg/m^3 for 6 hours/day, 5 days/week (Reinhold et al., 1998). A second group of rats (10/dose/sex) was similarly exposed but euthanized following a 4-week clean air recovery period. Beginning the second week of exposure, treatment-related increases in respiratory (labored breathing) and secretory (nasal discharge) signs were noted in all groups during the caprolactam exposures (Table 7). The quantitative data presented in Table 7 were obtained from the original Huntingdon Life Sciences report by Hoffman (1997) from which the peer-reviewed Reinhold et al. (1998) study was derived. The number of animals exhibiting labored breathing decreased with time in the low- and mid-dose animals, and was not apparent in these two groups after the 36th exposure (approximately week 8 of exposure). Anywhere from 2 to 10 percent of the high exposure animals exhibited labored breathing up to the end of exposure at 13 weeks.

Detailed weekly physical exams noted an exposure-related trend toward an increased incidence of red staining (facial area), clear nasal discharge, and moist rales (Table 8). The incidence of moist rales was highest between the second and eighth week of exposure, where up to 9 out of 40 rats in the 243 mg/m^3 exposure group exhibited this symptom. None of the rats in the 24 mg/m^3 exposure group displayed moist rales during the weekly physical exams.

TABLE 8. SUMMARY OF SIGNIFICANT FINDINGS FROM IN-LIFE PHYSICAL EXAMINATIONS AND DAILY OBSERVATIONS, MALES AND FEMALES COMBINED[A]

	Exposure Group (mg/m^3)			
	0	**24**	**70**	**243**
In-life physical exam findings at week 13 # exhibiting condition out of 40 animals				
General animal condition within normal limits	21	14	8	0
Red facial stains	1	10	17	24
Clear nasal discharge	7	11	20	32
Moist rales	0	0	1	3
In-chamber observations, 6th to 26th exposure Percentage of animals exhibiting symptoms[b]				
Labored breathing	0	8.1	12.9	17.0

[a] The data in this Table was obtained from the Huntingdon Life Sciences industry report by Hoffman (1997)
[b] Animals exhibiting labored breathing presented as a mean percentage because the number of animals observed daily varied anywhere from 20 to 40 animals.

A neurotoxicity evaluation was conducted just prior to sacrifice based on a functional observational battery including tests for neuromuscular function and coordination, central nervous system activity and excitability, sensorimotor responses, and autonomic function. No evidence of neurotoxicity was observed based on these observational criteria.

At the 13-week terminal sacrifice, no evidence of ophthalmoscopic lesions, clinical pathology, organ weight changes, or macroscopic pathology was observed. Microscopic evaluation by Reinhold et al. observed treatment-related changes only in the nasoturbinal tissues and the larynx and are presented in Table 9. No apparent treatment-related microscopic changes were observed in other regions of the respiratory system including the trachea, main stem bronchi and lungs. Table 9 also shows the type of the nasal and laryngeal tissue lesions, and the pathologist grading of the severity of those lesions. The graded responses in males and females were similar, so the data were combined.

In the nasal region, respiratory epithelium showed a treatment-related increase in goblet cell hypertrophy/hyperplasia, and olfactory epithelium showed a treatment-related increase in incidence of intracytoplasmic eosinophilic material. In almost all of the control animals minimal changes were observed in the respiratory mucosa (19 of 20 rats), and minimal or slight changes were observed in the olfactory mucosa (17 of 20 rats). Thus, the increased severity of the nasal responses with increasing caprolactam concentration was superimposed on the low-level changes that were present in nearly all rat groups. In the larynx, no lesions were apparent in the control animals (Table 9). With caprolactam exposure, laryngeal tissues manifested a dose-related increased incidence and severity of squamous or squamoid metaplasia or hyperplasia of the pseudostratified columnar epithelium covering the ventral seromucous gland. In five

rats exposed to the highest caprolactam concentration of 243 mg/m^3, minimal laryngeal keratinization of the metaplastic epithelium was observed.

TABLE 9. SUMMARY OF FINDINGS IN NASOTURBINAL AND LARYNGEAL TISSUES AT THE 13-WEEK TERMINAL SACRIFICE, MALES AND FEMALES COMBINED[A]

	Exposure Group (mg/m^3)			
	0	**24**	**70**	**243**
Number Examined	20	20	20	20
Nasal respiratory mucosa[b]				
No change[c]	1	0	0	0
Minimal	5	7	2	0
Slight	14	9	9	8
Moderate	0	4	9	12
Nasal olfactory mucosa[d]				
No change[c]	3	5	2	0
Minimal	17	13	10	3
Slight	0	2	6	3
Moderate	0	0	2	10
Moderately severe	0	0	0	4
Laryngeal tissue[e]				
No change[c]	20	15	8	0
Minimal	0	5	12	12
Slight	0	0	0	8

[a] Nasal and larynx lesions were categorically graded in Reinhold et al. on a scale from lowest to highest severity, as minimal, slight, moderate, or moderately severe. Further quantitative description and statistical analysis of the pathology findings was not presented.
[b] Goblet cell hypertrophy/hyperplasia
[c] Grade labeled "No Change" was not specifically presented in the original pathology tables of Reinhold et al., but was inferred by OEHHA as the number examined minus total number of animals exhibiting minimal or greater cellular changes
[d] Intracytoplasmic eosinophilic material in epithelial cells
[e] Squamous/squamoid, metaplasia/hyperplasia of the pseudostratified columnar epithelium covering the ventral seromucous gland.

Benchmark concentration (BMC) modeling was performed on the treatment-related upper respiratory tract endpoints shown in Table 8 using U.S EPA benchmark dose modeling software (2009c). Only the moderate grade or above lesions in each exposure group were used for BMC modeling of nasal respiratory mucosal lesions because these changes were of a higher severity grade than any of the control lesions (the latter were likely to be age-related). In other words, the moderate and above severity categories of nasal changes were designated as an exposure-related effect for the purposes of the BMC analysis. The resulting dichotomous dose-response input

data for BMC modeling for the 0, 24, 70 and 243 mg/m^3 exposure groups were: 0 out of 20 rats, 4 out of 20 rats, 9 out of 20 rats, and 12 out of 20 rats, respectively.

A similar approach was taken in modeling nasal olfactory mucosal changes, where minimal grade age-related lesions were found in the control animals (Table 9). Thus changes greater than minimal (slight, moderate, and moderately severe) were treated as the exposure outcome in BMC modeling. The resulting dichotomous dose-response data for the olfactory mucosa lesions in the 0, 24, 70 and 243 mg/m^3 exposure groups were: 0 out of 20 rats, 2 out of 20 rats, 8 out of 20 rats, and 17 out of 20 rats, respectively.

No age-related lesions were observed in laryngeal tissue of control animals (Table 9). For BMC modeling of laryngeal tissue change, therefore, minimal and slight grades of the non-keratinized lesions were combined for the analysis. The resulting dichotomous dose-response data for the laryngeal tissue lesions in the 0, 24, 70 and 243 mg/m^3 exposure groups were: 0 out of 20 rats, 5 out of 20 rats, 12 out of 20 rats, and 20 out of 20 rats, respectively.

$BMCL_{05}$s (the 95% lower confidence limit of the dose producing a 5% response rate) for the nasal respiratory and olfactory changes and the non-keratinized laryngeal tissue changes found at terminal sacrifice are shown in Table 10. The BMC modeling results used to derive the $BMCL_{05}$s is presented in Appendix A. The $BMCL_{05}$ is used as the point of departure for REL derivation. Using a $BMCL_{05}$ as a point of departure is particularly advantageous when exposure data does not clearly manifest a NOAEL, as is the case with the data from Reinhold et al. (1998) (Table 9). For each endpoint, the $BMCL_{05}$ was derived from the models that provided the best visual and statistical fit to the data, particularly in the low dose region of the line where the $BMCL_{05}$ resides. Following U.S. EPA guidelines, we chose the model with the lowest AIC (Akaike information criterion) in instances where various model fits to the data were similar.

TABLE 10. $BMCL_{05}$S FOR THE TOXIC ENDPOINTS IN THE 13-WEEK INHALATION EXPOSURE STUDY IN RATS (REINHOLD ET AL., 1998).

Endpoint	$BMCL_{05}$ (model)	BMC_{05}[a] (mg/m^3)	*P* Value	AIC
Nasal respiratory mucosa lesions	3.6 mg/m^3 (log-logistic)	5.9	0.78	77.53
Nasal olfactory mucosa lesions	12 mg/m^3 (log-probit)	17	0.99	60.85
Laryngeal tissue lesions	2.8 mg/m^3 (multistage)	5.3	0.94	53.59

[a] The BMC_{05} represents the modeled concentration resulting in a 5% response rate for the endpoint

Table 11 displays the frequency of upper airway lesions present in the 4-week recovery group. The nasal mucosal changes related to injury due to caprolactam exposure (that is, at a level above that seen in controls) were still apparent in the two highest exposure groups, indicating incomplete recovery following 4-weeks in clean air. Moderate grade

goblet cell hypertrophy/hyperlasia in the nasal respiratory mucosa was still present in rats exposed to 70 and 243 mg/m^3. Moderate and moderately severe intracytoplasmic eosinophilic material was still present in the 70 and 243 mg/m^3 groups. In the laryngeal tissue, recovery of the high exposure group also was not complete at 4-weeks post-exposure. Only one rat in the mid-dose group showed squamous/squamoid metaplasia/hyperplasia of the pseudostratified columnar epithelium. Keratinization of the metaplastic epithelium was absent in the four-week recovery group.

TABLE 11. INCIDENCES OF MICROSCOPIC FINDINGS OF NASOTURBINAL AND LARYNX LESIONS IN THE 4-WEEK RECOVERY GROUP[A]

	Exposure Group (mg/m^3)			
	0	**24**	**70**	**243**
Number Examined	20	20	20	20
Nasal respiratory mucosa[b]				
No change[c]	1	2	2	1
Minimal	10	9	4	4
Slight	9	9	8	10
Moderate	0	0	6	5
Nasal olfactory mucosa[d]				
No change[c]	2	1	3	0
Minimal	15	17	10	1
Slight	2	2	3	4
Moderate	0	0	4	13
Moderately severe	0	0	0	2
Laryngeal tissue[e]				
No change[c]	20	20	19	17
Minimal	0	0	1	3

[a] Nasal and larynx lesions were categorically graded in Reinhold et al. on a scale from lowest to highest severity, as minimal, slight, moderate, or moderately severe. Statistical analysis of the pathology findings was not presented.
[b] Goblet cell hypertrophy/hyperplasia
[c] Grade labeled "No Change" was not presented in the original pathology tables of Reinhold et al., but was inferred by OEHHA as the number examined minus total number of animals exhibiting minimal or greater micropathological changes
[d] Intracytoplasmic eosinophilic material in epithelial cells
[e] Squamous/squamoid, metaplasia/hyperplasia of the pseudostratified columnar epithelium covering the ventral seromucous gland.

Reinhold et al. (1998) report that the background incidence of the nasoturbinal findings were considered by the pathologist to be within normal limits for test animals of this age and strain. The increase in incidence and severity of the nasoturbinal and squamous metaplastic/hyperplastic laryngeal findings in caprolactam-treated rats was stated to be a "localized adaptive response to a minimal irritant effect" and attributed to particulate

exposure rather than an adverse toxicological response to the test material in the nasal passages. The only toxicologically relevant finding considered by the authors due to caprolactam exposure was the keratinization in the larynx; they viewed 70 and 243 mg/m^3 as a NOAEL and a LOAEL, respectively.

Because the authors did not consider the nasal and laryngeal changes relevant for toxicological consideration, further review of these particular types of lesions by other pathologists is summarized below.

Increased goblet cell (i.e., mucous cell) hypertrophy/hyperplasia in respiratory mucosa has been frequently observed in the anterior nasal cavity of rodents in response to repeated inhalation of irritants (Renne et al., 2007; Renne et al., 2009). It develops from hypertrophic epithelium with typical goblet cells distended with secretory droplets. This region of the nose is one of the most sensitive sites in rodents due to high volume of air flow through the ventral aspect of the nasal cavity over the nasal and maxillary turbinates.

Eosinophilic deposits, or globules, like those found in the olfactory epithelial cells of the Reinhold et al. study occasionally have been described by other researchers in otherwise normal epithelium of untreated rats, but such changes are more frequently observed in aged animals (Morgan, 1991; Harkema et al., 2006; Renne et al., 2009). These deposits occur often in the epithelial sustentacular cells and are considered dilated endoplasmic reticulum containing proteinaceous material and not a dysplastic (i.e., abnormal) alteration. They have often been referred to as hyaline droplets or hyaline degeneration (Harkema et al., 2006). The lesion increases in severity and extent with age and exposure to specific irritants, such as dimethylamine and cigarette smoke (Morgan, 1991). The mechanism by which such lesions appear in aging rats, and the nature of the response to irritants, is not understood. Intracellular eosinophilic deposits also have been observed in other studies in nasal respiratory mucosa and in other respiratory tract epithelium (Morgan, 1991; Renne et al., 2009), but either was not found in the Reinhold et al. animals, or was found in comparable incidence and severity in rats from both control and exposure groups.

The region of the larynx investigated by Reinhold et al.(1998), the pseudostratified columnar epithelium on the ventral floor of the larynx at the base of the epiglottis, is especially sensitive to inhaled materials (Renne and Gideon, 2006; Renne et al., 2009). Squamous metaplasia as noted by Renne et al. (2009) may occur in association with acute and/or chronic inflammation or in the process of regeneration. Laryngeal squamous metaplasia has been characterized as a classic example of indirect metaplasia (Osimitz et al., 2007). Inhalation of an irritant damages sensitive respiratory or transitional epithelium, so that cells that proliferate to replace the lost cells produce a replacement epithelium that is better adapted to the new environment.

In an expert workshop to evaluate larynx squamous metaplasia, a similar conclusion was made. This type of epithelial change is a result of transformation of the pre-existing epithelium to a squamous epithelium, with or without keritinization (Kaufmann et al., 2009). The lesion was classified as the morphologic correlate of an adaptive process

from a more sensitive to a more resistant type of epithelium, which is indicative of local irritation. Focal, minor metaplastic changes that may also occasionally occur in control animals were considered "non-adverse", while moderate to severe squamous metaplasia should be considered adverse as it may be associated with dysfunction. In humans, this dysfunction may result in hoarseness and an altered coughing reflex. In the rats exposed to caprolactam, exposure to the low and mid-level concentrations resulted in only a "minimal" grading for larynx metaplasia (Table 9).

For an assessment of adversity (equivalent term to "toxicity"), Kaufman et al. (2009) felt it was more relevant to observe dysfunction of an organ or tissue (e.g., by test designed to measure mucociliary clearance). For the rats in the Reinhold et al. (1998) study, adverse effects were apparent in terms of treatment-related increases in labored breathing, nasal discharge, red staining of the facial area, clear nasal discharge, and moist rales that began after approximately 1-2 weeks of exposure.

An earlier paper by Osimitz et al. (2007) suggested that laryngeal squamous metaplasia should not be used as an endpoint for quantitative risk assessment, as it is well-differentiated, reversible, and generally lacking signs of progression. This, in the opinion of the workshop panel cited earlier (Kaufmann et al., 2009), was not an approach supported by data. All available information, according to that expert panel, should be carefully considered by the pathologist, including other related health effects that are evaluated as "adverse".

Other multi-day inhalation exposure studies

Several published and unpublished multi-day inhalation studies have been conducted with caprolactam. However, these studies generally lacked complete methodology descriptions and only provided brief overviews of their findings. As much pertinent data are summarized below as could be found for each of these studies.

Goldblatt et al., (1954) exposed three guinea pigs to 118 - 261 mg/m^3 caprolactam "dust" for 7 hr/day for 7 days and reported no adverse effects other than occasional cough. No other toxicological exams were apparently performed, other than observing for signs of irritation. The majority of the caprolactam particles formed for the study were reported to be below 5 µm in size.

Hohensee et al. (1951) exposed up to 10 guinea pigs to 51 mg/m^3 caprolactam 5-8 hr/day for 26-30 days. No external pathologic changes or evidence of convulsions were noted during the exposures. Pathological and histological examination of a few of the animals revealed compound-related slight inflammation of the nasal mucosa and tracheal mucosa. However, no information was provided on the nature or extent of the inflammation or whether controls were free of this involvement.

In a multi-day unpublished industry study, two rats were exposed to a nominal concentration reported as 3000 ppm (equivalent to 13,900 mg/m^3 caprolactam particles for 2 hrs, followed five days later by a series of five nominal 1 to 2 hr exposures ranging from 2700 to 6800 ppm (equivalent to12,500 to 31,500 mg/m^3 on successive days

(Haskell Laboratory, 1950). The exposure concentrations were expressed in ppm in the report. OEHHA notes that particle exposures should be expressed in mg/m^3 as shown above in parentheses. Nominal exposure entails calculating the loss of material to the gassing chamber when heated and the rate of air flow. No direct measurement of airborne caprolactam concentration is performed. Nominal estimates of air concentration often over-estimate actual air concentrations. General discomfort and inflammation around the eyes and nose were observed during the exposures. Gross and microscopic pathological examination three days following the last exposure showed slight lung edema and congestion of the spleen, but no pathology in any other organs.

In another unpublished study, 4 dogs, 6 guinea pigs, 6 rats and 2 rabbits were exposed subchronically to caprolactam fumes generated by heating the chemical in air. This study was conducted in 1952-53 and only recently reported to the U.S. EPA (2009a). The composition of the fume was not evaluated and it was unclear from the report if the exposures were nominal or dynamic exposures. The authors and laboratory conducting the experiment are not identified and the document was labeled 'company sanitized'. All animals were exposed to 444 mg/m^3 6 hrs/day for 43 exposures. Half of the guinea pigs, rat and rabbits, and 3 of the dogs, were then exposed to 1020 mg/m^3 on exposures 44 through 67 or 73.

In dogs, the fumes seemed to aggravate open sores and especially infections and soreness of the eyes (U. S. EPA, 2009a). Two of the four dogs displayed occasional muscle tremors during exposure to the low concentration of caprolactam. One of these dogs displayed severe muscle tremors, weakness, coughing with a dense white froth around the mouth when exposed to the high concentration during exposures 46 through 67. In all cases, the dogs were normal the next morning after exposure. One dog had a significant lowering of systolic pressure and pulse pressure but otherwise no other significant changes in weight, blood sugar, cholesterol, BUN, thymol turbidity or hematology. Gross pathology showed an indication of either acute duodenitis or gastroenteritis in two dogs, but it was suggested this was an aggravation of an existing gastro-intestinal disorder. Microscopic examination revealed no changes that were attributable to caprolactam.

The study reported that one rabbit of the two rabbits exposed showed slight corneal damage and both rabbits showed mild irritation of the conjunctiva in both eyes (U. S. EPA, 2009a). No gross or microscopic pathology was observed in the rats or rabbits. In guinea pigs, one of the six had a lung reaction to a foreign body and a kidney showed evidence of regeneration of tubules. Another guinea pig had nephritis. A third guinea pig displayed consolidation of the apex of the right lung. No other gross or microscopic changes were detected in the remaining 3 guinea pigs.

Long-term oral exposure studies

Although no chronic inhalation experimental animal exposure studies have been conducted for caprolactam, the NTP (1982) performed a chronic oral exposure study in rodents examining both cancer and noncancer endpoints. A comprehensive 90-day

oral exposure study in dogs is also summarized to provide toxicological information for a non-rodent species.

A two-year caprolactam carcinogenesis bioassay feeding study was conducted by the NTP (1982). Caprolactam was incorporated in the diet of male and female rats at concentrations of 3,750 ppm or 7,500 ppm, and in the diet of male and female mice at concentrations of 7,500 and 15,000 ppm. Mean body weights of all dosed groups were decreased compared to their respective control groups throughout the two-year study. Feed consumption was inversely related to dose in rats, but caprolactam in the feed of mice had no effect on feed consumption. Growth curves for rats and mice are presented in graphical form by the NTP, but statistical analysis on mean body weight gain and feed consumption was not performed. The NTP concluded that the dose-related decrements in mean body weight gains indicate that it is highly likely that animals in the study were receiving the maximum tolerated doses of caprolactam.

Histopathologic examination did not find any compound-related effects in nasal tissues, larynx, esophagus, stomach, or any other tissues and organs. Other than the dose-related decrements in feed consumption and body weight gains, the NTP concluded there was no evidence of nonneoplastic lesions associated with oral administration of caprolactam as demonstrated by histopathologic examination of rats and mice in this study. Table 12 presents the estimated range of daily caprolactam intake in feed, assuming 100% absorption, for each dose group during the study.

TABLE 12. ESTIMATED RANGE OF DAILY INTAKE[A] OF CAPROLACTAM IN MG/KG BODY WEIGHT DURING A TWO-YEAR FEEDING STUDY (NTP, 1982).

Species	Males		Females	
	Low Dose	High Dose	Low Dose	High Dose
Rat	210 - 400	400 - 670	260 - 370	440 - 670
Mouse	790 - 1100	2200 - 2400	1200 - 1800	3100 - 3900

[a] Caprolactam intake range for each dose group of each species was based on a week in the second year of the study with the lowest mg/kg body weight intake, and on week 4 feed consumption, the period of growth with the highest mg/kg body weight intake.

An unpublished 90-day oral exposure study in beagle dogs conducted by Burdock et al. (1984) resulted in analogous findings to those observed in rats and mice of the NTP study. Three groups of eight dogs (4 each per sex) were fed at dose levels of 0.1%, 0.5% and 1.0% caprolactam in the diet. These percentages of caprolactam in the diet were equivalent to an average of 32, 164 and 292 mg/kg/day caprolactam consumed by males, respectively, and 33, 158, 389 mg/kg/day caprolactam consumed by females, respectively. A control group of equal size was fed a basal diet only. At the conclusion of 90 days on study, the only significant finding was a slightly lower mean body weight of the 1.0% females compared to controls. A similar change was not observed for the males, and total food consumption was comparable between groups of both sexes. No difference from controls was observed in absolute or relative organ weights for any group. Gross and microscopic examination of tissues and organs revealed no

remarkable findings. Ophthalmologic findings were negative. No dose-related changes were observed for hematologic and serum chemistry samples.

7 Developmental and Reproductive Toxicity

Gross (1984) summarized the foreign language literature, almost exclusively in Russian, examining the gynecological effects of caprolactam in female workers. Most of this work was published between the 1950s and 1970s. Specific caprolactam exposure concentrations were not given, although in one instance concentrations between 100 to 400 mg/m^3 were reported during the charging and pouring of the melting tanks, and between 1 to 10 mg/m^3 at other times. The abnormalities found in excess over those of the control groups consisted of dysmenorrhea (i.e., painful menstruation) and menorrhagia (i.e., excessive uterine bleeding), oligomenorrhea (i.e., markedly reduced menstrual flow), and prolongation of the exfoliative phase. The obstetrical complications that were found to be excessive compared to those of controls consisted of post-partum hemorrhage, toxemia of pregnancy, premature birth, and inadequate uterine contractions during labor.

Gross (1984) noted that high temperatures, high humidity and noise level were likely contributory factors to the abnormalities described in female workers. Co-exposure to other chemicals, including dinyl oxides, benzene, cyclohexane, cyclohexanol, cyclohexanone, acetone, and trichloroethylene, were also possible contributory factors.

In a more recent investigation, a retrospective reproductive and development study was conducted in 312 female workers in a Chinese Nylon-6 manufacturing facility (Liu et al., 1988). This study was translated from Chinese into English by OEHHA. The workers were compared to a group of 302 female workers in a textile factory with no contact with caprolactam or other chemicals. The noise level in the two facilities was similar. All workers had worked in the facility for more than one year, and caprolactam exposure was said to be below 10 mg/m^3, except for a few measurements slightly higher than this level. Specific exposure concentrations were not provided. In the caprolactam-exposed women, primary infertility ($0.005<p<0.05$), and pregnancy hypertension ($p<0.005$) was greater compared to the control group. Other measures of pregnancy function and fetal development were similar to controls. Abnormal menstrual function, including abnormal menstrual cycles, was higher in the caprolactam-exposed female workers ($p<0.005$), although no difference was seen between the two groups regarding symptoms of dysmenorrhea.

No studies were located investigating the developmental and reproductive toxicity of caprolactam by the inhalation route in experimental animals.

In oral exposure studies, (Gad et al., 1987) dosed pregnant rats by gavage with caprolactam at 100, 500, or 1,000 mg/kg/day on gestation days 6-15. Increased maternal mortality was observed at the highest dose. A dose-related decrease in mean maternal body weight was observed with a statistically significant reduction ($p\leq0.05$) in total body weight at the highest dose level (a 10 and 11% reduction on gestational days 15 and 20, respectively). A statistically significant reduction ($p\leq0.05$) in mean weight

change was observed during the treatment period at the two highest doses (5.2 and 2.3% mean weight gain at the mid- and high-dose, respectively, compared to a 13.4% weight gain for the control group). Food consumption was reduced in the two highest dose groups. The mean incidence of resorptions was increased at the highest dose.

No dose-related skeletal anomalies or major malformations were noted among the offspring of any exposure group. An apparent dose-related increase in the mean number of skeletal variants per litter was observed, including incomplete ossification of the skull or vertebral column and the presence of extra ribs. However, no statistically significant difference in skeletal variation values between treated groups and the control group were noted.

Gad et al. (1987) also dosed pregnant rabbits by gavage with caprolactam at 50, 150, or 250 mg/kg/day on gestational days 6-28. Sixteen percent mortality and statistically significantly decreased overall maternal body weight gain were observed at the highest dose. Corrected weight gain (i.e., weight gain minus weight of gravid uterus) was statistically significantly lower (p<0.05) from day 6 to 29 of gestation in the 150 mg/kg group. Absolute maternal body weights were unaffected in this mid-dose group. Mean fetal weights were statistically significantly reduced (p<0.05) by 12% in each of the two highest dose groups compared to controls. The incidence of major malformations was unaffected by caprolactam treatment. Minor skeletal anomalies included an increased incidence of unilateral or bilateral thirteenth ribs in the highest dose group.

Gad et al. (1987) concluded that caprolactam given by gavage to two species up to levels that caused severe maternal toxicity did not support a finding of the compound causing either embyotoxicity or teratogenicity. Fetotoxicity was evidenced in rabbits by lower fetal weights at the two highest doses, and an increased incidence of 13th ribs at the highest dose level.

In a multi-generation study, rats were given a 1,000, 5,000, or 10,000 mg caprolactam/kg diet (ppm) over three generations (Serota et al., 1988). Each generation was treated over a 10-week period. Consistently lower mean body weights and food consumption were observed in both P_2 and P_3 parental generations at 5,000 and 10,000 ppm, but body weights were unaffected in P_1 animals at all dose levels. The mean body weight changes were statistically significant (p≤0.05) in all high dose groups at all time points with weight reductions in both males and females ranging from 10 to 21% compared to controls. For mid-dose animals, a statistically significant change in mean body weight occurred only in P_2 males, a 13% reduction compared to controls, during week four of exposure.

Dose-related reductions of fetal body weights were observed in all filial generations. For example, statistically significant differences (p≤0.05) noted in F_{1a} and F_{1b} high dose groups (17 to 23% reductions compared to controls) and occasionally in mid-dose groups (11 to 14% reductions in F_{1b} offspring only compared to controls). Based on mean body weight and mean food consumption values at week 10 in P_1 females, caprolactam in the diet at 1000, 5000 and 10,000 ppm was equivalent to a daily dose of 700, 3500 and 5600 mg/kg caprolactam, respectively.

No treatment-related effect on gross appearance, gross pathology, survival rate or number of pups was observed. A slight increase in the severity of spontaneous nephropathy was observed on histopathologic examination of males in the high-dose group of the first parental generation.

Serota et al. (1988) concluded that caprolactam in the diet at the two highest exposures resulted in decreases in body weight in both pups and parental animals in utero through weaning. Similar effects on food consumption were also noted. Body weights were unaffected in P_1 animals at all dose levels, and reduced food consumption was observed only at week 10 in P_1 females. No effects were evident on reproductive performance or offspring survival, and only minimal kidney toxicity was observed in males at the highest dose level.

In other oral exposure studies, Salamone (1989) reported no sperm abnormality in male mice treated with 222, 333, 500, 750, or 1,125 mg/kg caprolactam by gavage daily for five days, although mortality was evident at the highest dose. Following the fifth gavage with 1,125 mg/kg caprolactam, the mice immediately became motionless. In four of the nine mice treated, this inactivity was followed 10 min later by racing around the cage and death within seconds. These deaths are probably related to the method of oral treatment because exposure of mice up to 2200 to 2400 mg/kg caprolactam in feed for two years by the NTP (1982) did not result in an increase in mortality. A similar study in male rats did not observe DNA damage to spermatocytes following an oral dose of 750 mg/kg caprolactam (Working, 1989).

The primary finding of the two developmental/reproductive toxicity oral exposure studies was that caprolactam may be fetotoxic due to reduced fetal body weight. Reductions in fetal weight in the gavage study occurred at the same dose levels that reductions in maternal food consumption and body weight occurred. Based on this gavage study, the concomitant reduction in both maternal body weight and fetal weight make it difficult for OEHHA to conclude that caprolactam is exclusively fetotoxic. However, body weights of P_1 rats in the multi-generation study were not reduced by caprolactam exposure yet resulted in reduced fetal weights in F_{1a} and F_{1b} offspring. This finding indicates a fetotoxic LOAEL of 5000 ppm caprolactam in feed, which is equivalent to a maternal daily dose of 3500 mg/kg. The calculated NOAEL is 700 mg/kg.

Assuming 100% pulmonary absorption, the NOAEL is equivalent to an air concentration of 2500 mg/m^3 (700 mg/kg x 70 kg body wt. / 20 m^3/day) in a route-to-route extrapolation. For comparison, brief human exposures to lower caprolactam concentrations in the range of 1900 to 5600 mg/m^3 (400 to 1200 ppm) have been characterized as extremely irritating, and subchronic exposures of rats to air concentrations as low as 24 mg/m^3 have resulted in labored breathing and nasal secretory discharge. Applying a 100-fold uncertainty factor (10-fold UF each for interspecies and intraspecies extrapolation) for extrapolation from an animal developmental study to human exposure would produce a proposed REL of 25 mg/m^3. The acute and chronic RELs of 50 $\mu g/m^3$ and 2.2 $\mu g/m^3$, respectively, are considerably lower than that derived from the oral multi-generation animal study.

8 These findings show that the oral dose at which fetotoxicity occurs is likely not relevant to air concentrations of caprolactam for REL derivation due to upper respiratory tract injury occurring at lower concentrations. The acute, 8-hour and chronic RELs developed in this document based on caprolactam air exposures would be protective for reproductive/developmental effects. Therefore, OEHHA is using pulmonary and sensory irritation endpoints for the caprolactam inhalation RELs.

8. REL Derivations

8.1 Derivation of the Acute Inhalation Reference Exposure Level (1-hour exposure)

As noted above, only two human studies exist that examined the acute sensory irritant effects in association with quantified concentrations of caprolactam. Because of limitations in the occupational study (Ferguson and Wheeler, 1973), an acute REL cannot be derived reliably from this study. The second acute exposure report was the chamber study by Ziegler et al. (2008). OEHHA applied a non-parametric test, Page's trend test, to the individual human data provided to us by Dr. Ziegler, as noted previously. We observed a statistically significant (p<0.05) dose-response relationship for eye blink frequency and subjective eye irritation at one hour of exposure. Both measures of sensory eye irritation were increased in subjects exposed to 5 mg/m^3 compared to the non-exposed group.

Walker et al. (2001) suggested that the increased rating of eye irritation and eye blink frequency with exposure to an irritant are manifestations of the same underlying event of ocular trigeminal nerve activation. Objective measures such as eye blink frequency are less susceptible to cognitive biases than subjective ratings of eye irritation. Eye blink frequency also had a more robust response at 5 mg/m^3 than eye irritation, indicating eye blink frequency is a more sensitive measure of caprolactam exposure. Thus, the acute REL is based on increased eye blink frequency, with eye irritation as supporting evidence for the REL.

Study	Ziegler et al., 2008
Study population	20 human adults: 10 male, 10 female
Exposure method	Whole body chamber
Exposure duration	1 hour
Critical effects	Increased eye blink frequency
LOAEL	5 mg/m^3
NOAEL	0.5 mg/m^3
Time adjusted exposure	0.5 mg/m^3 (irritant: no adjustment applied)
LOAEL uncertainty factor	1
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default: human study)
Toxicodynamic (UF_{A-d})	1 (default: human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (site of contact; no systemic effects)
Toxicodynamic (UF_{H-d})	10
Cumulative uncertainty factor	10
Acute reference exposure level	0.05 mg/m^3 (0.011 ppm)

We applied a NOAEL/LOAEL approach to the statistically significant increase in eye blink frequency, rather than using benchmark modeling. BMC analysis using continuous model methodology could not fit the eye blink data to a model. Likely, the

low- and mid-exposure levels, with their slight increase in response over control values and large variances, were not different enough from the controls to provide a good curve fit with the available models. We did not apply a time adjustment to the NOAEL from Ziegler et al. since we used the exposure data collected at 1 hour of exposure.

Chemicals that have effects limited to the extrathoracic region (i.e., nose and larynx), including caprolactam, are not predicted to be much different kinetically in children compared to adults when dosimetric adjustments are made (OEHHA, 2008). Thus, no UF_{H-k} is applied for intraspecies toxicokinetic variation among individuals. Only normal individuals without allergic rhinitis or other respiratory symptoms were investigated by Ziegler et al. Thus, a UF_{H-d} of 10 is applied to the REL derivation to address the human variation in the intraspecies toxicodynamic response to respiratory irritants, including potential exacerbation of asthma in children and adults. The total UF = 10 applied to the NOAEL results in an acute REL = 0.05 mg/m^3.

Consistent findings of seizures in heavily exposed adult workers and in experimental animal studies merit concern for exposure in children, who may be more sensitive than adults to chemicals that have neurological effects. OEHHA believes an acute REL protective of eye irritant effects will be sufficient to protect children from the neurological effects, and that an additional UF beyond the cumulative intraspecies UF = 10 is not necessary. Worker exposure to unspecified high levels of caprolactam may produce tonic-clonic seizures, but the exposure levels necessary to cause this neurological effect are above estimated exposures in the range of 22 to 168 mg/m^3 that have resulted in dermal, eye and respiratory irritation in workers (Kelman, 1986; Ferguson and Wheeler, 1973; Hohensee, 1951). In rats, airborne exposure at g/m^3 levels resulted in tremors, while intraperitoneal injections of 900 mg/kg and above produced convulsions. The quantified exposure levels in these animal studies where these neurological effects were found were substantially higher than the NOAEL for eye irritation of 0.05 mg/m^3 derived from the work by Ziegler et al. (2008). The considerably lower NOAEL for eye irritation supports the application of a 10-fold intraspecies toxicodynamic UF as sufficient to protect children from any neurological effects resulting from acute caprolactam exposure.

Subjective eye irritation increased with increasing caprolactam exposure, although the irritation score did not rise sharply with exposure concentration (i.e., mean eye irritation scores were between 0 (not at all) and 1 (barely) for all caprolactam exposures). Typically, when the sensory irritant threshold is reached the graded response should rise steeply. Over a range of hardly more than one order of magnitude of concentration, sensory irritation may increase from “barely detectable” to “painful irritation” (Cain et al., 2006; Nielsen et al., 2007). Such a steep rise in the graded response was not apparent for caprolactam in this study, suggesting the sensory irritant threshold was not reached in all or most participants of the study, or that eye irritation is not as sensitive a measure of caprolactam exposure as eye blink frequency.

We also observed differences between the control group and the 5 mg/m^3 exposure group for total subjective symptom and complaint score (both with and without the odor subscore). We prefer to base a REL on an objective endpoint (i.e., eye blink frequency)

because the total symptom and complaint score are subjective measures and lacked independence for many of the questions. In other words, many of the questions discussed in Section 5.1 above were asking the same question in different ways.

8.2 Derivation of the 8-Hour Inhalation Reference Exposure Level

Study	Reinhold et al. 1998
Study population	Sprague-Dawley CD rats (10 animals/sex/group)
Exposure method	Discontinuous whole-body inhalation exposure to 0, 24, 70, and 243 mg/m^3 caprolactam aerosol
Critical effects	Upper airway lesions of nasal and laryngeal epithelium
LOAEL	24 mg/m^3
NOAEL	Not observed
BMCL$_{05}$	3 mg/m^3
Exposure continuity	6 hours per day, 5 days/week
Exposure duration	13 weeks
Average experimental exposure	1.607 mg/m^3 (3 mg/m^3 x 6/8 x 5/7)
Human equivalent concentration	0.402 mg/m^3 (for extrathoracic respiratory effects, RGDR = 0.25
LOAEL uncertainty factor	1 (BMCL$_{05}$ used as point of departure)
Subchronic uncertainty factor	2 (for 13 wk exposure in rodents) (see below)
Interspecies uncertainty factor	
Toxicokinetic (UF$_{A-k}$)	1
Toxicodynamic (UF$_{A-d}$)	√10 (default: no toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF$_{H-k}$)	1 (site of contact; no systemic effects)
Toxicodynamic (UF$_{H-d}$)	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	60
8-Hour reference exposure level	7 µg/m^3 (1.4 ppb)

The comprehensive subchronic exposure study in rats by Reinhold et al. (1998) is the basis of the 8-hour REL, resulting in a level of 7 µg/m^3 (rounded up to one significant figure from 6.70 µg/m^3), or 1.4 ppb (rounded to 2 significant figures to avoid large rounding errors because the first digit is a 1). The occupational studies of long-term exposure to caprolactam were considered by OEHHA to be inadequate for use as a point of departure for the 8-hour REL, which pertains to repeated 8 hr exposures, and the chronic REL (see Section 6.1 for reviews of the occupational studies).

In deriving 8-hr and chronic RELs, issues concerning the presence of unaccounted gas phase caprolactam in the Reinhold et al. study, and the phase of caprolactam that exists in the ambient air are considered. One of the uncertainties in the Reinhold et al. (1998) study is that the method used to measure the exposure levels in the chamber only captured the aerosol fraction, leaving any of the caprolactam that may have

partitioned into the vapor phase unmeasured. This could lead to an underestimation of the respirable caprolactam in the chamber. If the caprolactam concentration to which the rats were exposed was underestimated, it would mean that the point of departure for the chronic and 8-hour RELs could be too low. Therefore, OEHHA attempted to evaluate how much unmeasured vapor could have been present in the exposure chambers.

In the original Huntingdon Life Sciences report by Hoffman (1997) from which the peer-reviewed Reinhold et al. (1998) study was derived, it was stated that a very minor amount (<3 ppm) of unmeasured caprolactam vapor may have been present in the caprolactam aerosol atmospheres. The analysis of caprolactam by Reinhold et al. used gravimetric sampling to estimate the caprolactam concentrations in the test chambers. Air drawn from the chambers passed through glass-fiber filters mounted open-faced in a filter holder. The gravimetric concentration was calculated based on the weight of the filter papers before and after sample collection, and the known volume of air that passed through the filter papers. Any caprolactam vapor would have passed through the filter papers and not been measured.

There is supporting data that indicates the method used by Reinhold et al. to generate the caprolactam atmospheres produces predominantly caprolactam aerosol and dry particles, and that any additional amount of caprolactam vapor generation is small enough to be disregarded for REL derivation. Nau et al. (1984) investigated the effects of temperature and humidity on sample collection of airborne caprolactam aerosol and fume (a dry suspension resulting from condensation products). In their study, caprolactam was dissolved in water in a 1:1 to 1:0.2 solution (water to caprolactam) by weight and then aerosolized in a test chamber under different conditions of temperature and humidity. The chamber concentrations generated were between 2.7 and 40 mg/m^3. Reinhold et al. (1998) had used a similar method to generate caprolactam aerosols.

Caprolactam sample collection by Nau et al. (1984) consisted of the tandem utilization of a glass fiber filter followed by a XAD-2 resin tube to collect the particles. At the end of the sample train, two water impingers collected any caprolactam that escaped the filter and XAD-2 resin. Presumably, caprolactam gas and some very small caprolactam particles would pass through the glass fiber filter and would be captured in the XAD-2 resin tube or water impingers. Under exposure conditions similar to that used by Reinhold et al. (20-27°C, 21-74% relative humidity), only a mean total of 0.8% of the caprolactam was trapped by the XAD-2 resin tube and water impingers, with about 99% of the caprolactam trapped on the filter and filter support. These data show that estimating the 8-hour and chronic RELs based on the gravimetric concentrations estimated by Reinhold et al. are valid.

The other consideration to be addressed is the proportion of caprolactam found in the gas phase and the diameter range of caprolactam particles that would be found in the ambient air environment following release of caprolactam from an emission source. This information is important in determining the region of the respiratory tract that would be impacted by inhaled caprolactam. Little evidence could be found in the literature regarding the phase of caprolactam found in the environment, or the size of the particles

if they were in the solid phase. In an air quality study by Cheng et al. (2006) caprolactam aerosol was detected on $PM_{2.5}$ filters, but the level of caprolactam gas present in the air, or caprolactam particles greater than $PM_{2.5}$, was not measured.

In the Reinhold et al. study, the authors aerosolized an aqueous caprolactam solution for the exposures, which had an MMAD of 3.0 µm and a geometric standard deviation of 1.7 µm. The mammalian nose is an effective filter for a large fraction of particles above 1 µm in diameter (Stuart, 1984; Swift and Strong, 1996; Yeh et al., 1996). So it is not surprising that upper respiratory system was the target of caprolactam exposure.

At the level of the 8-hour and chronic RELs, it can be expected that a significant fraction of caprolactam would be in a gas phase because the RELs are considerably below the airborne saturation level of 13 mg/m^3. Very water-soluble gases, including caprolactam, also deposit in the upper respiratory tract (OEHHA, 2008). However, if very small caprolactam particles are released or formed in the ambient air, some may bypass the upper respiratory system when inhaled and deposit largely in the tracheobronchial regions, or even reach the alveoli. The available data in experimental animals indicate the upper respiratory system is the target of inhaled caprolactam, unless exposure to massive amounts of caprolactam occurs. No occupational studies have documented pulmonary dysfunction (i.e., lower respiratory tract) as a result of caprolactam exposure. Based on the limited data available, OEHHA concludes that both vapor and particle phase caprolactam predominantly deposits in the upper respiratory tract, and that using the most sensitive endpoint of upper respiratory tract lesions determined by Reinhold et al. (1998) should be considered protective of the lower respiratory tract as well.

The 8-hr REL derivation is based on a $BMCL_{05}$ = 3 mg/m^3 (rounded from 2.8 mg/m^3, see Table 9) for a pathology grading of minimal and slight increases in squamous/squamoid metaplasia/hyperplasia in the larynx of male and female rats exposed to caprolactam aerosol for 13 weeks (Reinhold et al., 1998). The $BMCL_{05}$ for exacerbation of changes to the respiratory and olfactory nasal mucosa resulted in essentially the same value (respiratory $BMCL_{05}$ = 4 mg/m^3) or was slightly greater (olfactory $BMCL_{05}$ = 12 mg/m^3).

Reinhold et al. (1998) regarded laryngeal keratinization of the metaplastic epithelium to be the primary adverse effect, resulting in a NOAEL of 70 mg/m^3. The other effects in the upper respiratory system were considered by the researchers to be normal adaptive responses to an irritant, which they did not consider a toxicological endpoint. However, OEHHA RELs include health protection against mild irritant/inflammatory effects. These types of mild inflammatory changes are primary endpoints of toxicity as indicated in the Revised Air Toxics Hot Spots Program Technical Support Document for the Derivation of Noncancer Reference Exposure Levels and RELs for Six Chemicals (OEHHA, 2008). The irritant-related microscopic changes in the upper respiratory tract, combined with the observations of respiratory irritation/inflammation (nasal discharge, moist rales, red staining around the face) and labored breathing in all caprolactam-treated groups presented in detail in the original Huntingdon Life Sciences report by Hoffman (1997), support the lack of an observed NOAEL in the principal study.

The $BMCL_{05}$ = 3 mg/m^3 was adjusted to an average experimental exposure of 1.6 mg/m^3 for eight-hour exposures, seven days/week. The concentration at the $BMCL_{05}$ is below the saturated vapor concentration of caprolactam of 13 mg/m^3 at 25ºC. Thus, a greater proportion of caprolactam may be in gaseous form rather than the aerosol form used in the study. Although no studies have been conducted comparing the potency of gaseous or aerosol forms of caprolactam, the evidence in this document indicates both forms are expected to have the same toxicological endpoints.

Given that the predominant form humans will be exposed to at the level of the RELs will likely be the gaseous form, a regional gas dose ratio (RGDR) approach will be used for the human equivalent concentration (HEC) adjustment. The RGDR of 0.25 was calculated using US EPA methodology (OEHHA, 2008) for extrapolation from rat and human exposure. The equation for gases with respiratory effects is:

$$RGDR = (MVa/MVh) / (SAa/SAh) \quad \text{Eq. 8-1}$$

Where:

MVa = animal minute volume
MVh = human minute volume
SAa = animal surface area for lung region of concern
SAh = human surface area for lung region of concern

Surface areas for the region of concern, the extrathoracic region, for rat (15 cm^2) and human (200 cm^2) were obtained from Table F.1.1 in OEHHA (2008). Minute volume for rats was calculated using Eq. 8-2 below, using intercept (b_0) and slope (b_1) values from Table F.1.2 in OEHHA (2008). Body weight (BW) for both male and female rats combined (0.323 kg) was averaged over the 13-week exposure duration from body weight tables in Reinhold et al. (1998) and the authors' unpublished industrial data (Hoffman, 1997).

$$\log_e(MV) = b_0 + b_1 \log_e(BW) \quad \text{Eq. 8-2}$$

Where

BW = 0.323 kg; b_0 = -0.578; b_1 = 0.821
loge(MV) = -0.578 + 0.821 loge(0.323 kg)
MV = 0.222 L/min or 222 ml/min

For humans, an average adult male and female combined MV of 11,944 ml/min was estimated using breathing rate data from US EPA (2009b).

Thus:

RGDR = (222 ml/min/11,944 ml/min) / (15cm^2/200 cm^2)
RGDR = 0.0186 / 0.075
RGDR = 0.25

A subchronic UF = 2 was incorporated into the REL derivation for extrapolation from 13-week exposure in the rats to chronic exposure. Although 13 weeks of exposure is 12.5% of the 2-year life expectancy of rats, which would entail use of a subchronic UF = 1 for >12% of lifetime exposure, U.S. EPA (1994a) recommends using a subchronic adjustment factor for all 13-week studies regardless of species. OEHHA has typically used a subchronic UF = √10 for 13-week exposure studies in rats and mice. However, for rodent studies of this exposure duration a subchronic UF = 2 for upper respiratory irritants, when the resulting injury is considered mild, is appropriate.

The basis for using a subchronic UF = 2 was derived from the numerous rodent studies with formaldehyde (OEHHA, 2008). Comparison of 13-week exposure studies with studies of longer duration up to 2 years shows that the NOAELs and LOAELs for upper airway injury are often the same, with only a 2-fold difference between chronic and 13-week study NOAELs and LOAELs in some cases. The 2-fold lower NOAELs and LOAELs were often a result of the choice of the formaldehyde exposure concentration used in the studies.

The severity of the upper respiratory tract injury also supports a subchronic UF = 2. The pathology grading of the upper respiratory tract resulting from caprolactam exposure indicates only a mild increase in injury. The exacerbation by caprolactam exposure of normal nasal olfactory tissue degeneration was small, increasing from minimal to slight at the lowest dose of 24 mg/m^3. The laryngeal tissue damage caused by caprolactam was minimal, at best, at the low dose. Overall, only a few cases of moderately severe tissue injury were observed, occurring in the high concentration exposure group in olfactory tissue. In addition, all animals survived to the end of the study and the treatment-related labored breathing and nasal discharge generally decreased in incidence during the second half of the study.

We did not apply an interspecies toxicokinetic $UF_{A\text{-}k}$. Hybrid computational fluid dynamics and PBPK modeling for predicting nasal tissue dose metrics show that the predicted dose to the epithelium of the total nasal cavity following inhalation of an organic gas is similar, or slightly greater, in humans compared to rats (Frederick et al., 2001). Also, injury occurred to regions of the upper respiratory tract that are most sensitive to both chemical and mechanical irritants (primarily due to airflow characteristics) which indicates that caprolactam is primarily a direct-acting irritant, rather than a chemical requiring metabolic activation in nasal mucosa to cause tissue injury (Kilgour et al., 2000; Harkema et al., 2006; Renne et al., 2007; Kaufmann et al., 2009). In particular, Kaufmann et al. (2009) indicated the rat larynx may be more sensitive to inhaled irritant gases due to air flow characteristics than other species such as humans, monkeys and dogs. Therefore, the human equivalency concentration (HEC) adjustment for upper respiratory tract injury should also be sufficient for any residual interspecies toxicokinetics differences.

We applied a default interspecies $UF_{A\text{-}d}$ of √10 to compensate for the absence of data on pharmacodynamic differences between species. Specifically, only one comprehensive animal inhalation study in rats has been performed with caprolactam.

The toxicokinetic data for inspired upper respiratory irritants in humans suggest low interindividual variation and no dosimetry differences between adults and children (OEHHA, 2008). Thus, no UF_{H-k} is applied for intraspecies toxicokinetic variation among individuals.

While caprolactam is irritating to the upper respiratory tract, initiation or exacerbation of asthma by caprolactam has not been characterized. However, data summarized by OEHHA (2008) show asthmatics may be more sensitive to the effects of respiratory irritants than non-asthmatic individuals. Thus, an intraspecies toxicodynamic UF of 10 is applied to address the diversity in the human population, including children with asthma. Of equal concern are the consistent findings of seizures in heavily exposed adult workers and in experimental animal data. Children may be more sensitive than adults to chemicals that have neurological effects, and the finding of neurotoxicity in workers additionally supports the application of a 10-fold intraspecies toxicodynamic UF. Application of the cumulative UF = 60 to the human equivalent concentration of 0.402 mg/m^3 resulted in an 8-hour REL of 7 µg/m^3 (1.4 ppb) for caprolactam.

8.3 Derivation of the Chronic Inhalation Reference Exposure Level

Study	Reinhold et al. 1998
Study population	Sprague-Dawley CD rats (10 animals/sex/group)
Exposure method	Discontinuous whole-body inhalation exposure to 0, 24, 70, and 243 mg/m3 caprolactam aerosol
Critical effects	Upper airway lesions of nasal and laryngeal epithelium
LOAEL	24 mg/m^3
NOAEL	Not observed
$BMCL_{05}$	3 mg/m^3
Exposure continuity	6 hours per day, 5 days/week
Exposure duration	13 weeks
Average experimental exposure	0.536 mg/m^3 (3 mg/m^3 x 6/24 hr x 5/7 days)
Human equivalent concentration	0.134 mg/m^3 (for extrathoracic respiratory effects, RGDR = 0.25
LOAEL uncertainty factor	1 ($BMCL_{05}$ used as point of departure)
Subchronic uncertainty factor	2 (for13 wk exposure in rodents)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1
Toxicodynamic (UF_{A-d})	√10 (default: no toxicodynamic data)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (site of contact; no systemic effects)
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	60
Chronic reference exposure level	2.2 µg/m^3 (0.5 ppb)

The chronic REL is based on the same study as the 8-hr REL. The chronic REL derivation is the same as that used for the 8-hr REL, with the exception that the average experimental exposure is based on continuous, 24 hr/day exposure. The resulting human equivalent concentration is reduced to 0.134 mg/m^3. The application of uncertainty factors was the same for both 8-hr and chronic RELs, resulting in a chronic REL of 2.2 µg/m^3 (rounded to two significant figures from 2.23 µg/m^3 to avoid rounding errors because the first digit is a 2), or 0.5 ppb (rounded to one significant figure from 0.48 ppb).

8.4 Data Strengths and Limitations for Development of the REL

Significant strengths for the caprolactam RELs include: (1) the use of a well-conducted subchronic animal study with histopathological analysis, and (2) independent studies demonstrating comparable key irritant effects (nasal and throat irritation) in humans and experimental animals. Major areas of uncertainty are: (1) the lack of comprehensive human inhalation dose-response data for long-term exposures, (2) no inhalation developmental/reproduction toxicity data, although sufficient oral developmental/reproduction data exist (However, when converted to an air concentration, the level that causes fetotoxicity is greater than the level that results in severe pulmonary injury), (3) the absence of a NOAEL in the subchronic study, and (4) no chronic animal inhalation exposure studies.

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Appendix A

Benchmark Concentration (BMC) Modeling of the Upper Respiratory Tract Lesions Resulting from Subchronic Caprolactam Exposure in Rats (Reinhold et al., 1998)

Pathologist-graded lesions in the nasal and laryngeal airways provided dose-response data for BMC modeling. Males and females were combined, given that no apparent gender differences were noted from the endpoint responses. US EPA does not as yet recommend an approved protocol for modeling categorical data such as lesion grades. So the Reinhold data were modeled as dichotomous data (i.e., all lesions of severity categories found in both control and treated animals were designated as not treatment-related; all lesions of severity categories found in treated animals that were greater than that found in control animals were designated as a treatment-related effect).

Per US EPA protocol, P-values ≤ 0.1 indicate that the model is a poor fit to the data and recommended not to be used for BMC determination. US EPA also states that P-values identify those models that are consistent with the experimental results, but should not be compared among the various models. The Akaike Information Criterion (AIC) can be used to compare models. Generally, the model with the lowest AIC is considered the preferential model, although other considerations such as model fit to the low end of the concentration curve where the $BMCL_{05}$ resides are also taken into account. Three regions of the upper respiratory tract (nasal olfactory mucosa, nasal respiratory mucosa and laryngeal epithelial tissue) at sacrifice provided dose response data on which to run BMC modeling:

1) **Incidence of epithelial intracytoplasmic eosinophilic material in nasal olfactory mucosa**

Minimal-grade lesions were present in most animals in the control group. Caprolactam exposed animals exhibited slight, moderate and moderately severe lesions, which we considered exposure-related. The P-values and AIC indicate the log-probit and log-logistic models show the best fit to the data, particularly at the low end of the dose-response curve where the BMC_{05} lies (models highlighted in bold in Table A-1). The BMC_{05} are nearly identical for these two models but the log-probit has a smaller range between the MLE and the BMC_{05} suggesting greater confidence with this model at the low concentration end where the $BMCL_{05}$ resides, even though the log-logistic model fit produces a slightly smaller AIC. Thus, the log-probit model was chosen as the basis for the point of departure for this endpoint.

TABLE A-1. BENCHMARK CONCENTRATION RESULTS MODELING INCIDENCE (SLIGHT, MODERATE AND MODERATELY SEVERE GRADES COMBINED) OF EPITHELIUM-INTRACYTOPLASMIC EOSINOPHILIC MATERIAL IN NASAL OLFACTORY MUCOSA.

Method	$BMCL_{05}$	BMC_{05}	P-value	AIC
Probit	18	25	0.11	66.457
Log-probit (slope restricted ≥ 1)	**12**	**17**	**0.99**	**60.845**
Logistic	18	26	0.097	66.925
Log-logistic(slope restricted ≥ 1)	**5.6**	**16**	**0.99**	**60.834**
Weibull (power ≥ 1)	5.3	11	0.90	61.038
Gamma (power ≥ 1)	5.3	12	0.93	60.984
Quantal-linear	5.2	7.2	0.90	59.495
Quantal-quadratic	29	36	0.055	67.148
Multistage (2nd degree)	5.3	8.8	0.85	61.180

FIGURE A-1: LOG-PROBIT MODEL FIT TO NASAL OLFACTORY MUCOSA LESION INCIDENCE DATA

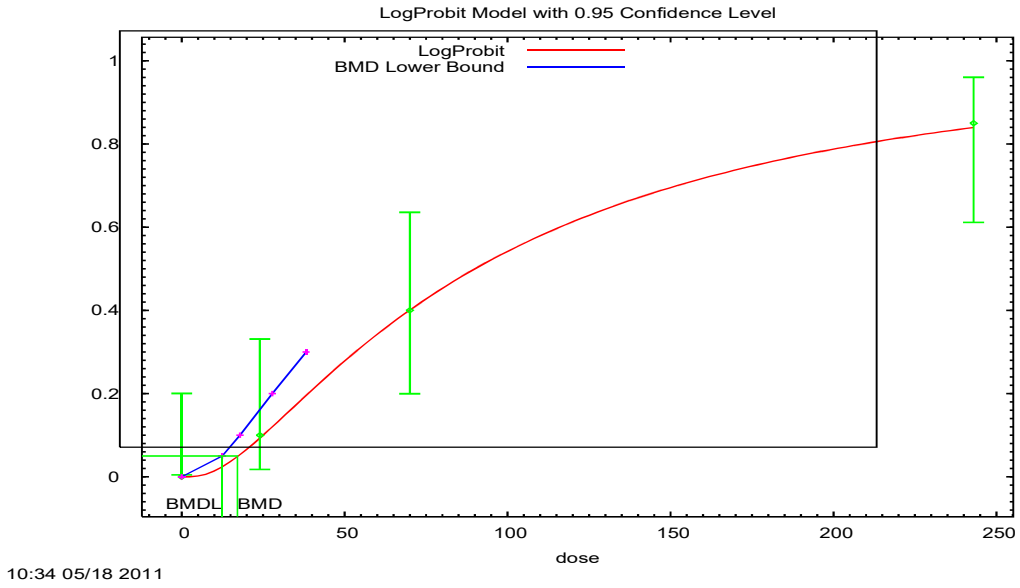
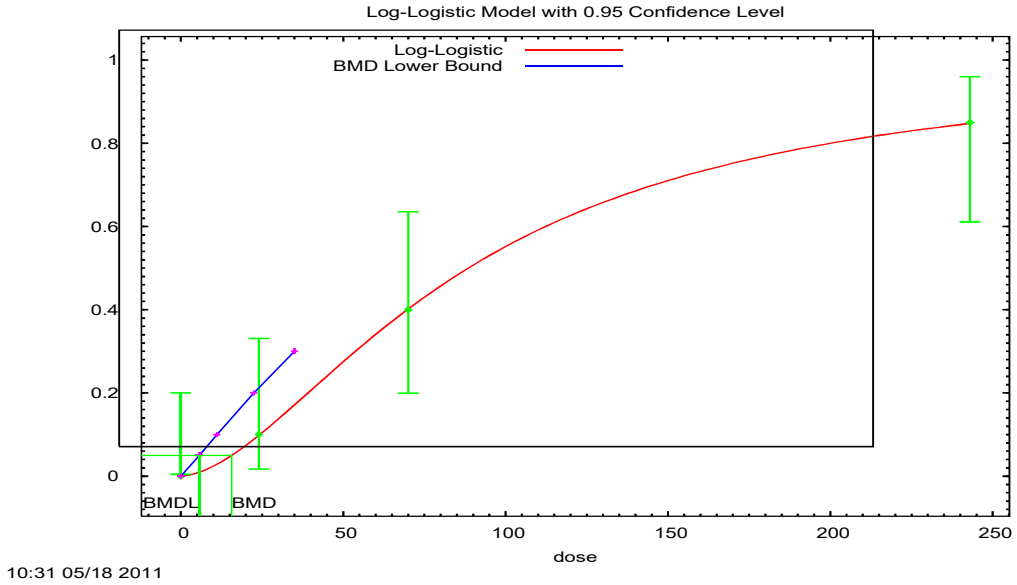


FIGURE A-2: LOG-LOGISTIC MODEL FIT TO NASAL OLFACTORY MUCOSA LESION INCIDENCE DATA



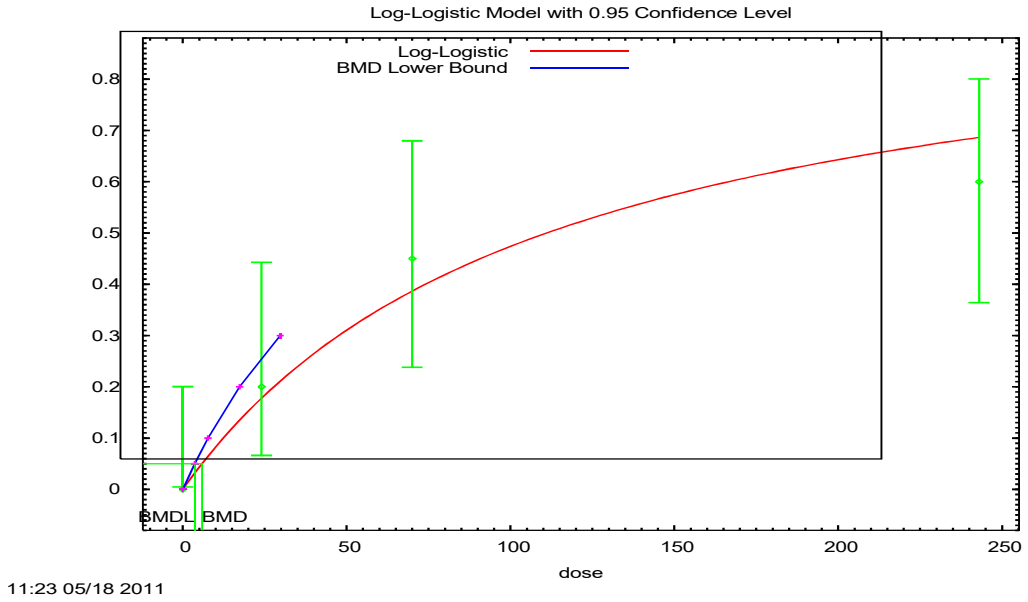
2) Incidence of goblet cell hypertrophy/hyperplasia in respiratory nasal mucosa

Minimal and slight lesions of the nasal respiratory epithelium were present in control animals. Moderate-grade lesions were present in caprolactam-exposed animals and considered exposure-related. Models in Table A-2 with P-values <0.10 are not considered a good fit to the data. Among the remaining models, the log-logistic model (shown in bold in Table A-2) had the lowest AIC and best fit to the data, thus we chose the $BMCL_{05}$ from the log-logistic model as the point of departure for this endpoint.

TABLE A-2: BMC RESULTS MODELING MODERATE-GRADE INCIDENCE OF GOBLET CELL HYPERTROPHY/HYPERPLASIA IN RESPIRATORY NASAL MUCOSA.

Method	$BMCL_{05}$	BMC_{05}	P-value	AIC
Probit	21	29	0.024	88.321
Log-probit (slope restricted ≥ 1)	15	24	0.026	86.384
Logistic	22	31	0.022	88.643
Log-logistic (slope restricted ≥ 1)	**3.6**	**5.9**	**0.78**	**77.525**
Weibull (power ≥ 1)	6.8	9.4	0.21	80.650
Gamma (power ≥ 1)	6.8	9.4	0.21	80.650
Quantal-linear	6.8	9.4	0.21	80.650
Quantal-quadratic	45	59	0.017	88.507
Multistage (2nd degree)	6.8	9.4	0.21	80.650

FIGURE A-3: LOG-LOGISTIC MODEL FIT TO NASAL RESPIRATORY MUCOSA LESION INCIDENCE DATA



3) Incidence of squamous/squamid metaplasia/hyperplasia of laryngeal tissue

Minimal and slight severity levels present in caprolactam-exposed animals were considered exposure-related. The model that provided a low AIC, best p-value and best fit to the data at the low concentration end of the curve was the multistage model (Table A-3). Although the quantal-linear model produced a lower AIC, the line fit to the data point at the low end of the curve (24 mg/m^3) was not quite as good as that provided by the multistage model (Figures A-4 and A-5). Thus, we chose the multistage model as the basis for the point of departure for this endpoint.

TABLE 3. BENCHMARK CONCENTRATION RESULTS MODELING INCIDENCE OF (MINIMAL AND SLIGHT COMBINED) SQUAMOUS/SQUAMID METAPLASIA/HYPERPLASIA OF LARYNGEAL TISSUE

Method	$BMCL_{05}$	BMC_{05}	P-value	AIC
Probit	8.3	12.6	0.33	56.43
Log-probit (slope restricted ≥ 1)	6.7	11.9	0.52	55.20
Logistic	8.9	13.6	0.29	56.92
Log-logistic (slope restricted ≥ 1)	3.9	10.7	0.44	55.80
Weibull (power ≥ 1)	2.7	7.2	0.84	53.85
Gamma (power ≥ 1)	2.7	7.8	0.79	54.06
Quantal-linear	**2.6**	**3.6**	**0.82**	**52.92**
Quantal-quadratic	12.2	14.9	0.33	54.27
Multistage (2nd degree)	**2.8**	**5.3**	**0.94**	**53.59**

FIGURE A-4: MULTISTAGE MODEL FIT TO LARYNGEAL LESION INCIDENCE DATA

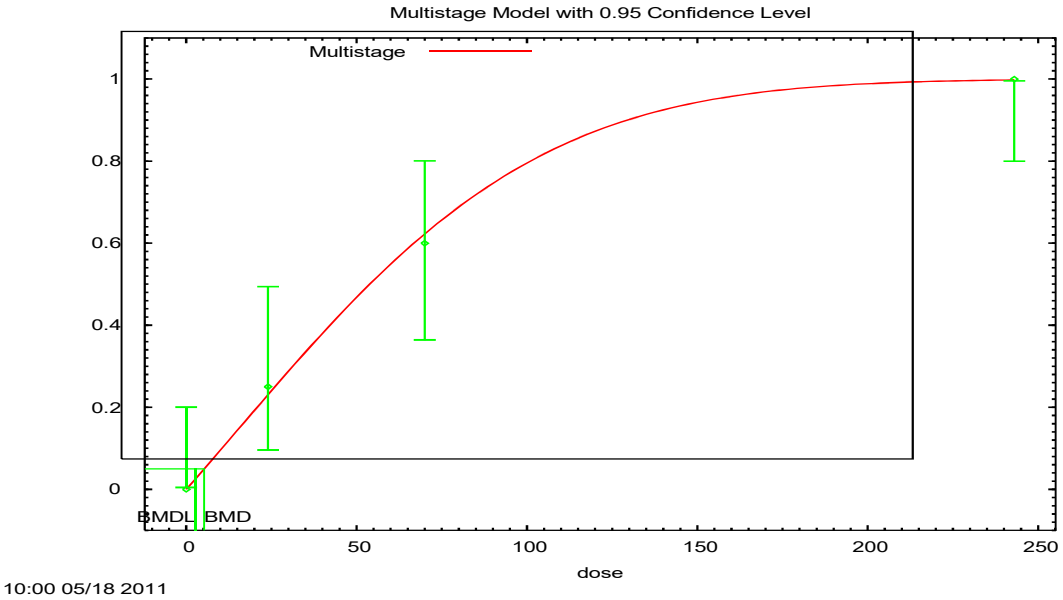
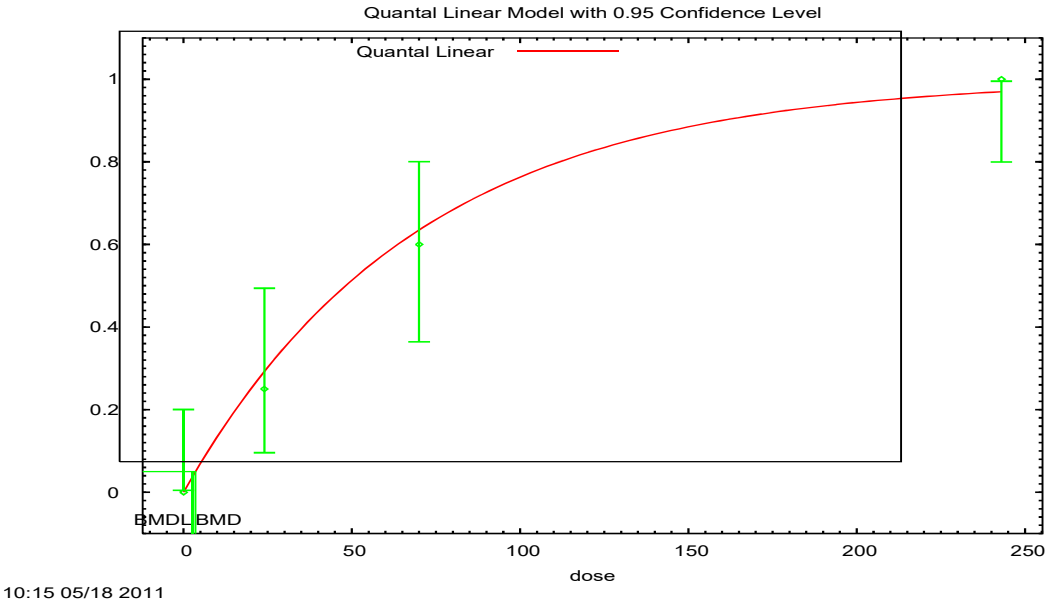


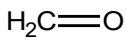
FIGURE A-5: QUANTAL LINEAR MODEL FIT TO LARYNGEAL LESION INCIDENCE DATA



Formaldehyde Reference Exposure Levels

(Methanal, oxomethane, methylene oxide)

CAS 50-00-0



1. Summary

The non-cancer adverse health effects of formaldehyde are largely a manifestation of its ability to irritate mucous membranes. As a result of its solubility in water and high reactivity, formaldehyde is efficiently absorbed into the mucus layers protecting the eyes and respiratory tract where it rapidly reacts, leading primarily to localized irritation. Acute high exposure may lead to eye, nose and throat irritation, and in the respiratory tract, nasal obstruction, pulmonary edema and dyspnea. Prolonged or repeated exposures have been associated with allergic sensitization, respiratory symptoms (coughing, wheezing, shortness of breath), histopathological changes in respiratory epithelium, and decrements in lung function. Children, especially those with diagnosed asthma, may be more likely to show impaired pulmonary function and symptoms than are adults following chronic exposure to formaldehyde. The studies reviewed for this document include those published through the Spring of 2008.

1.1 Formaldehyde Acute REL

Reference Exposure Level	**55 μg/m³ (44 ppb)**
Critical effect(s)	Mild and moderate eye irritation
Hazard Index target(s)	Eye irritation

1.2 Formaldehyde 8-Hour REL

Reference Exposure Level	**9 μg/m³ (7 ppb)**
Critical effect(s)	Nasal obstruction and discomfort, lower airway discomfort, and eye irritation
Hazard Index target(s)	Respiratory

1.3 Formaldehyde Chronic REL

Reference Exposure Level	**9 μg/m³ (7 ppb)**
Critical effect(s)	Nasal obstruction and discomfort, lower airway discomfort, and eye irritation
Hazard Index target(s)	Respiratory

2. Physical & Chemical Properties (ATSDR, 1999)

Description	Colorless gas
Molecular formula	CH_2O
Molecular weight	30.03 g/mol
Density	0.815 g/L @ -20° C
Boiling point	-19.5° C
Melting point	-92° C
Vapor pressure	3883 mm Hg @ 25° C
Flashpoint	300° C
Explosive limits	7% - 73%
Solubility	soluble in water, alcohol, ether and other polar solvents
Odor threshold	0.05-0.5 ppm
Metabolites	formic acid
Conversion factor	1 ppm in air = 1.24 mg/m^3 @ 25° C

3. Occurrence and Major Uses

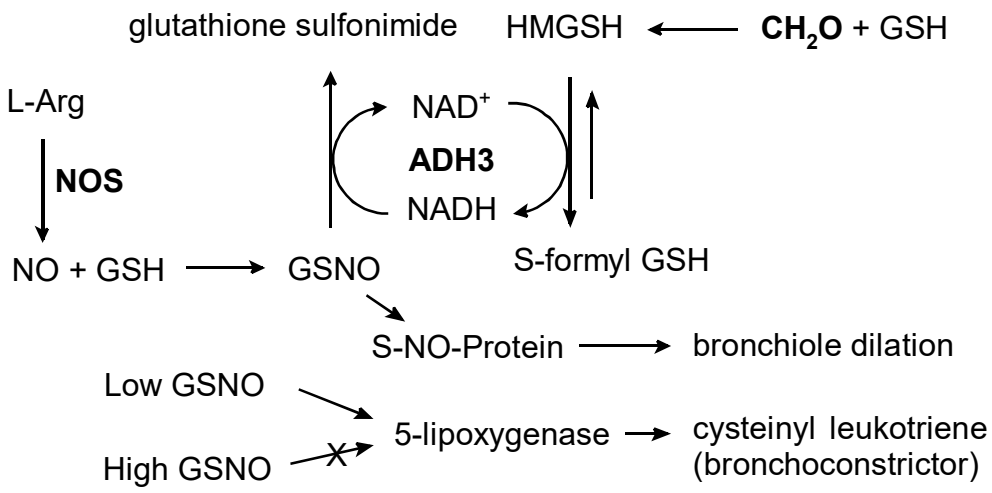
Formaldehyde has four major applications: as an intermediate in the manufacture of melamine, polyacetal, and phenolic resins; as an intermediate in the production of industrial chemicals; as a bactericide or fungicide; and as a component in the manufacture of end-use consumer products. Phenol-formaldehyde resins are used in the production of plywood, particleboard, foam insulation, and a wide variety of molded or extruded plastic items. Formaldehyde is also used as a preservative, a hardening and reducing agent, a corrosion inhibitor, a sterilizing agent, and in embalming fluids. Indoor sources include upholstery, permanent press fabrics, carpets, pesticide formulations, urea-formaldehyde foam insulation, and cardboard and paper products. Outdoor sources include emissions from fuel combustion (motor vehicles), industrial fuel combustion (power generators), oil refining processes, and other uses (copper plating, incinerators, etc.). The largest portion of outdoor ambient formaldehyde results from photochemical oxidation of a number of reactive organic gases in the atmosphere (CARB, 2006). According to the California Toxics Inventory (CARB, 2005a), the mean statewide ambient level of formaldehyde in 2004 was 2.69 ppb, with the highest levels (3.76 ppb) reported for the South Coast Air Basin. The California Air Resources Board (CARB) reported statewide emissions of 20,251 tons from stationary and mobile sources (CARB, 2005b).

4. Metabolism

Inhaled formaldehyde reacts rapidly at the site of contact and is efficiently absorbed in the respiratory tract. A portion of the formaldehyde entering the fluid layer covering the respiratory epithelium, the respiratory tract lining fluid (RTLF), is reversibly hydrated to methylene glycol. Among other components, the RTLF is rich in antioxidants including glutathione (Cross et al., 1994) with which formaldehyde may reversibly react to form *S*-hydroxymethylglutathione. Both the hydrated and unreacted formaldehyde may be absorbed into the epithelial layer where there is further opportunity for formaldehyde to bind to glutathione. This glutathione conjugate in turn is oxidized to *S*-formylglutathione by formaldehyde dehydrogenase. Hydrolysis of *S*-formylglutathione yields formate and glutathione. Formic acid may be eliminated in urine and feces, or dehydrogenated to CO_2 and exhaled. The presence of glutathione and formaldehyde dehydrogenase in epithelial cells of the respiratory tract varies with location and influences the amount of formaldehyde reaching the blood. While glutathione-bound formaldehyde is rapidly metabolized, free formaldehyde in cells can form DNA-protein cross-links (Franks, 2005).

Formaldehyde dehydrogenase (ADH3), although central to the metabolism of formaldehyde, has a broad specificity that includes the structurally related compound, S-nitrosoglutathione (GSNO), an endogenous bronchodilator and reservoir of nitric oxide (NO) activity (Jensen et al., 1998). In cultured cells, formaldehyde appears to trigger ADH3-mediated GSNO reduction by enzyme-bound cofactor recycling (Staab et al., 2008). As shown in Figure 1, the *S*-hydroxymethylglutathione (HMGSH) formed spontaneously from formaldehyde and glutathione is oxidized by ADH3 with the formation of NADH that may then participate in the ADH3-mediated reduction of GSNO (Thompson and Grafstrom, 2008). (Because of its participation in this reaction, ADH3 is also known as GSNO reductase.) This reductive pathway results in low levels of GSNO that in turn stimulate the production and activity of 5-lipoxygenase, the rate-limiting enzyme in the synthesis of powerful bronchoconstrictors, the cysteinyl leukotrienes. On the other hand, high levels of GSNO inhibit this enzyme and thus the synthesis of the bronchoconstrictors (Zaman et al., 2006). Up-regulation of the degradation of GSNO has been demonstrated in mouse lung following inhalation of formaldehyde (Yi et al., 2007), while low levels of GSNO in the lungs have been associated with severe asthma attacks in children (Gaston et al., 1998) and airway hyperactivity in mice (Que et al., 2005). These results suggest that the potential association of formaldehyde exposure with asthma-like respiratory symptoms is in part due to its effects on NO via the enhanced degradation of GSNO. Nitric oxide has multiple functions in the lungs, from its participation in the regulation of airway and vascular tone to mucin secretion and mucociliary clearance (Reynaert et al., 2005). The dysregulation of NO by formaldehyde helps to explain the variety and variability in the toxic manifestations following formaldehyde inhalation.

FIGURE 4 FORMALDEHYDE DRIVEN REDUCTION OF GSNO



Oxidation of the glutathione conjugate of formaldehyde, HMGSH, by ADH3 generates NADH that drives the reduction of GSNO, also by ADH3, thereby reducing the nitric oxide available for bronchiole dilation. Low GSNO levels stimulate, but high GSNO levels inhibit 5-lipoxygenase production of cysteinyl leukotriene.

5. Acute Toxicity of Formaldehyde

The acute effects of formaldehyde exposure appear to be largely a result of its irritant properties. However, some individuals experience symptoms following acute exposures that are a result of previous sensitization following acute high formaldehyde exposure, or long term low level exposures. For this reason, some of the studies included in this section describe manifestations of toxicity in which acute exposure was the precipitating event but in which the contribution of previous exposures or sensitization is unknown. Sensitization manifests as heightened responsiveness and may be of an immunological nature with the development of formaldehyde-specific IgE or IgG (e.g. Thrasher et al. 1987). Alternatively, heightened responsiveness may be neurologically mediated with involvement of the hypothalamic/pituitary/adrenal axis (Sorg et al., 2001a,b). In addition, genetic variation among individuals in the alcohol dehydrogenases mentioned above affects individual responses to formaldehyde. This is especially germane to studies in which the effects include symptoms such as bronchoconstriction and airway hyperreactivity, and in which there is unexpected individual variation.

Many of the studies described in this document have evaluated the relationship between formaldehyde inhalation and clinically-diagnosed asthma or asthma-like symptoms. Asthma is a chronic disease of airway obstruction resulting in variable airflow that has classically been considered to involve both airway inflammation and airway hyperresponsiveness. Asthma manifests as a characteristic cough, wheeze, and shortness of breath due to spasmodic contractions of the bronchi and mucus hypersecretion. These symptoms may or may not reflect an underlying allergic response. As shown in the study by Que et al. (2005), the hyperresponsiveness and

the inflammation are not necessarily coupled. Although the RELs presented in this document are not based on studies that used asthma as the critical endpoint, uncertainty factors were applied in the REL estimates to explicitly consider the potential of formaldehyde to cause or exacerbate asthma-like wheeze and cough symptoms, especially in asthmatic children. We have therefore included discussion of recent work that provides a biochemical mechanism by which formaldehyde exposure is linked to at least one symptom of asthma, bronchoconstriction. The bronchoconstrictive effects of formaldehyde exposure may be partially responsible for the lower airway discomfort reported in the study upon which the 8-hour and chronic RELs are based.

5.1 Acute Toxicity to Adult Humans

In small human studies, exposure to formaldehyde (1-3 ppm) has resulted in eye and upper respiratory tract irritation (Weber-Tschopp et al., 1977; Kulle et al., 1987). Most people cannot tolerate exposures to more than 5 ppm formaldehyde in air; above 10-20 ppm symptoms become severe and shortness of breath occurs (Feinman, 1988). High concentrations of formaldehyde may result in nasal obstruction, pulmonary edema, choking, dyspnea, and chest tightness (Porter, 1975; Solomons and Cochrane, 1984).

A few human case studies report severe pulmonary symptoms. A medical intern with known atopy and exposure to reportedly high (but unspecified) levels of formaldehyde over a period of 1 week developed dyspnea, chest tightness, and edema, following a subsequent 2 hour exposure to formaldehyde (Porter, 1975). Five workers exposed to formaldehyde from newly installed urea-formaldehyde chipboard in a poorly ventilated basement experienced intolerable eye and upper respiratory tract irritation, choking, marked dyspnea, and nasal obstruction (Solomons and Cochrane, 1984). However, the concentration of formaldehyde and the contribution of other airborne chemicals were unknown in both reports.

Numerous acute controlled and occupational human exposure studies have been conducted with both asthmatic and normal subjects to investigate formaldehyde's irritative and pulmonary effects (Frigas et al., 1984; Sheppard et al., 1984; Sauder et al., 1986; Schachter et al., 1986; Kulle et al., 1987; Sauder et al., 1987; Schachter et al., 1987; Witek et al., 1987; Uba et al., 1989; Harving et al., 1990; Akbar-Khanzadeh et al., 1994). Short exercise sessions during exposure on a bicycle ergometer were included in some of the studies. Concentrations of formaldehyde in the human exposure studies ranged as high as 3 ppm for up to 3 hours. The major findings in these studies were mild to moderate eye and upper respiratory tract irritation typical of mild discomfort from formaldehyde exposure.

Chemosensory irritation and subjective symptoms following exposure to formaldehyde at concentrations relevant to the workplace were examined by Lang et al. (2008) in 11 male and 10 female volunteers. Each subject was exposed for 4 hours to a randomized sequence of ten exposure conditions. These included exposures at concentrations of 0, 0.15, 0.3 and 0.5 ppm, exposures at 0.3 and 0.5 ppm that included four transient peak exposures at 0.6 and 1.0 ppm, respectively, and exposures in the presence of 10 ppm ethyl acetate of 0, 0.3, 0.5, and 0.5 ppm with 1.0 ppm peaks.

Objective measures of irritation included conjunctival redness, blinking frequency, nasal flow resistance, pulmonary function, and reaction times. The participant's subjective evaluation of physical and mental wellbeing was assessed by questionnaire before, during and after each day's exposure. To assess the potential influence of personality traits on subjective responses, each subject's positive or negative affectivity was evaluated with PANAS (Positive and Negative Affectivity Schedule) that consists of 10 positive affects (interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active) and 10 negative affects (distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid). Participants are asked to rate items on a scale from 1 to 5, based on the strength of emotion where 1 = "very slightly or not at all," and 5 = "extremely". Subjective ratings of eye irritation and olfactory symptoms were significantly higher than control at 0.3 ppm. However, when negative affectivity (anxiety) was included as a covariate, eye and olfactory irritation at this exposure level were no longer significant. Conjunctival irritation and blinking frequency, objective measures of irritation, were significantly elevated only with exposure to 0.5 ppm with peaks of 1.0 ppm ($p < 0.05$). The authors considered this level to be a LOAEL. However, at 0.5 ppm without 1.0 ppm peaks, conjuctival irritation and blinking were not significantly increased so this was considered a NOAEL for these effects. There were no statistically significant changes in nasal resistance, pulmonary function or reaction time. While there were large inter-individual differences in complaints or reports of wellbeing, there were no significant treatment effects. This study identified eye irritation as the most sensitive endpoint, with personality traits, such as negative affectivity, as a modifying factor.

In a human irritation study by Weber-Tschopp et al. (1977), 33 subjects were exposed to formaldehyde at concentrations ranging from 0.03-3.2 ppm (0.04-4.0 mg/m^3) for 35 minutes. Thresholds were 1.2 ppm (1.5 mg/m^3) for eye and nose irritation, 1.7 ppm (2.1 mg/m^3) for eye blinking, and 2.1 ppm (2.6 mg/m^3) for throat irritation.

Kulle et al. (1987) exposed nonasthmatic humans to up to 3.0 ppm (3.7 mg/m^3) formaldehyde in a controlled environmental chamber for 3 hours. Significant dose-response relationships were seen with odor and eye irritation (Table 5.1) as ranked on symptom questionnaires as none, mild, moderate or severe. Irritation was assessed in this manner prior to exposure, at the end of exposure, and again 24 hour after exposure.

TABLE 5.1 MEAN SYMPTOM DIFFERENCE (T180-T0) ± SE WITH FORMALDEHYDE* (FROM KULLE ET AL., 1987)

	Formaldehyde conc. (ppm)				P value
	0.0	1.0	2.0	3.0	
Odor sensation	0.00 ± 0.00	0.22 ± 0.15	0.44 ± 0.18	1.00 ± 0.29	<0.0001
Nose/throat irritation	0.00 ± 0.00	0.11 ± 0.11	0.33 ± 0.17	0.22 ± 0.15	0.054
Eye irritation	0.00 ± 0.00	0.44 ± 0.24	0.89 ± 0.26	1.44 ± 0.18	<0.0001
Chest discomfort	0.00 ± 0.00	0.00 ± 0.00	0.11 ± 0.11	0.00 ± 0.00	0.62
Cough	0.00 ± 0.00	0.11 ± 0.11	0.00 ± 0.00	0.00 ± 0.00	0.11
Headache	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.11 ± 0.11	0.33

*Presence and severity of symptoms scored as: 0 = none; 1 = mild (present but not annoying); 2 = moderate (annoying); 3 = severe (debilitating). Data from Table II.

At 0.5 ppm for 3 hours, none of 9 subjects had eye irritation. At 1.0 ppm, 3 of 19 subjects reported mild eye irritation and one experienced moderate irritation. At 2.0 ppm, 6 subjects reported mild and 4 reported moderate eye irritation. Measured nasal flow resistance was increased at 3.0 ppm but not at 2.0 ppm (2.5 mg/m^3). With respect to the lower respiratory tract, there were no significant decrements in pulmonary function nor increases in methacholine induced bronchial reactivity as a result of 3-hour exposures to 0.5-3.0 ppm (0.6-3.7 mg/m^3) formaldehyde at rest or during exercise, including 24 hours post exposure.

Eleven healthy subjects and nine patients with formalin skin sensitization were exposed to 0.5 mg/m³ (0.4 ppm) formaldehyde for 2 hours (Pazdrak et al., 1993). Nasal lavage was performed prior to and 5 to 10 minutes, 4 hours, and 18 hours after exposure. Rhinitis was reported and increases in the number and proportion of eosinophils, elevated albumin and increased protein levels were noted in nasal lavage fluid 4 and 18 hours after exposure. No differences were found between patients with skin sensitization and healthy subjects.

In a study by Green et al. (1987), volunteer asthmatic and normal subjects exposed to formaldehyde displayed decrements in pulmonary function. Exposure to 3 ppm formaldehyde for 1 hour resulted in clinically significant reductions of forced expiratory volume in one second (FEV_1) (defined as > 20% or more) and FEV_1/forced vital capacity (FVC) (ratio 70% or less) in 5 individuals in the study (2 of 16 asthmatics, 2 of 22 normal subjects, and one clinically normal subject with hyperactive airways). Of these individuals, 3 had reductions of FEV_1 of 20% or more during exposure. One of 22 asthmatics had a greater than 20% reduction in FEV_1 (-25.8%) at 17 minutes into exposure following a 15 minute moderate exercise session (minute ventilation [V_E] = 30-40 l/min), which, according to the authors, was low enough to prevent exercise-induced bronchospasm. One of 22 normal subjects also exhibited a greater than 20% clinically significant reduction in FEV_1 (-24.4%) and in FEV_1/FVC, which occurred at 47 minutes into exposure to 3 ppm formaldehyde. These reductions occurred following a second 15- minute heavy-exercise session (V_E = 60-70 l/min) near the end of the 1 hour exposure period. A third asymptomatic "normal" subject with hyperactive airways had a clinically significant reduction of FEV_1 (-20.5%) at 17 minutes, following the first heavy exercise session. This subject exhibited occult airway hyperactivity and was excluded from analysis with the other exposure groups due to his respiratory condition. Subjects exhibiting reductions in FEV_1 of greater than 20% following exposure also exhibited FEV_1/FVC ratios of less than 70%. However, none of the subjects in the study exhibited a clinically significant reduction of 50% or greater in airway conductance (SG_{aw}) during exposure to 3 ppm formaldehyde.

Kriebel et al. (2001) conducted a subchronic epidemiological study of 38 anatomy class students who, on average, were exposed to a geometric mean of 0.70 ± 2.13 ppm for 2 hours per week over 14 weeks. After class, eye, nose and throat irritation was significantly elevated compared with pre-laboratory session exposures, with a one unit increase in symptom intensity/ppm of formaldehyde. Peak expiratory flow (PEF) was found to decrease by 1%/ppm formaldehyde during the most recent exposure. Changes in PEF and symptom intensity following formaldehyde exposure were most

pronounced during the first weeks of the semester but attenuated with time, suggesting partial acclimatization.

Rhinitis and a wide range of respiratory symptoms can result from exposure to formaldehyde. Some studies have reported that workers exposed to low concentrations may develop severe prolonged asthma attacks after prior exposure; this suggests that they may have become sensitized (Feinman, 1988). However, in adults, an association between formaldehyde exposure and allergic sensitization through IgE- and IgG-mediated mechanisms has been observed only inconsistently (Thrasher et al., 1987; Krakowiak et al., 1998; Wantke et al., 2000; Kim et al., 2001).

Formaldehyde provocation of human subjects, occupationally exposed to formaldehyde and suffering from respiratory symptoms such as wheezing, shortness of breath, or rhinitis, occasionally resulted in pulmonary function decrements (2 to 33% response rate) consistent with immediate, delayed, or both immediate and delayed bronchoconstriction (Hendrick and Lane, 1977; Wallenstein et al., 1978; Burge et al., 1985; Nordman et al., 1985). While some of the concentrations of formaldehyde that elicited a positive response following provocation tests (6 to 20.7 ppm) were quite high, the authors of these studies suggested that formaldehyde-induced bronchial hyperreactivity is due to specific sensitization to the gas. However, none of these studies was able to detect antibodies to formaldehyde which would support that sensitization to formaldehyde occurs through an immunologic pathway. Alternatively, the wheezing and shortness of breath may be related to the formaldehyde-stimulated depletion of the bronchodilator, GSNO, in the airways.

In controlled studies with asthmatics from urea-formaldehyde insulated homes, formaldehyde concentrations equal to or greater than those found in indoor environments have not resulted in hematologic or immunologic abnormalities. These tests include: blood count and differential, erythrocyte sedimentation rate; lymphocyte subpopulations (E-rosetting, T3, T4, T8, B73.1, Fc receptor positive lymphocytes and large granular lymphocytes); lymphocyte response to phytohemagglutinin and formalin-treated red blood cells; serum antibody against the Thomsen-Friedenrich RBC antigen and against formalin-RBC; and natural killer, interferon-boosted natural killer, and antibody-dependent cell-mediated cytotoxicity (Pross et al., 1987). While six of the studies cited above reported decrements in lung function associated with short-term formaldehyde exposure among at least some of the asthmatic subjects, a number of other exposure studies of patients with asthma have failed to demonstrate that exposure to formaldehyde results in onset or aggravation of the patients' asthmatic symptoms (Sheppard et al., 1984; Sauder et al., 1987; Harving et al., 1990; Krakowiak et al., 1998).

The effects of formaldehyde on asthmatics may be dependent on previous, repeated exposure to formaldehyde. Burge et al. (1985) found that 3 out of 15 occupationally exposed workers challenged with formaldehyde vapors at concentrations from 1.5 ppm to 20.6 ppm for brief durations exhibited late asthmatic reactions. Six other subjects had immediate asthmatic reactions likely due to irritant effects. Asthmatic responses (decreased PEF, FVC, and FEV_1) were observed in 12 occupationally-exposed workers

challenged with 2.0 ppm (2.5 mg/m^3) formaldehyde (Nordman et al., 1985). Similarly, asthmatic responses were observed in 5 of 28 hemodialysis workers occupationally exposed to formalin and challenged with formaldehyde vapors (concentration not measured) (Hendrick and Lane, 1977). In asthmatics not occupationally exposed to formaldehyde, Sheppard et al. (1984) found that a 10-minute challenge with 3 ppm formaldehyde coupled with moderate exercise did not induce significant changes in airway resistance or thoracic gas volume.

Gorski et al. (1992) evaluated the production of active oxygen species by neutrophils in 18 persons exposed to 0.5 mg/m^3 formaldehyde for 2 hours. All 13 subjects who had allergic contact dermatitis (tested positive to formaldehyde in skin patch) exhibited significantly higher chemiluminescence of granulocytes isolated from whole blood 30 minutes and 24 hours post-exposure than the individuals who were not formaldehyde sensitive. Thus, the immune cellular response of skin-sensitized individuals to an inhalation exposure to formaldehyde indicates increased production of active oxygen species. This is consistent with increasing evidence that endogenous or exogenous reactive oxygen and reactive nitrogen species are responsible for the airway inflammation of asthma (Sugiura and Ichinose, 2008).

In addition to its effects on the respiratory tract, the irritant properties of formaldehyde also manifest as ocular irritation. In an anatomy dissecting laboratory, formaldehyde levels were found to peak at 0.62 ppm, with a gradual decrease to 0.11 ppm. Formaldehyde-related irritation of the eyes, nose, throat, airways and skin was reported by 59% of the students. These effects were significantly ($p < 0.001$) higher among wearers of contact lenses compared with students without glasses or wearing glasses (Tanaka et al., 2003). The ability of contact lenses to trap and concentrate volatile compounds, and to extend the exposure time by limiting the eye's normal self-cleansing, may make contact lens wearers more susceptible to ocular exposure and irritation by formaldehyde.

5.2 Acute Toxicity to Infants and Children

No studies of the effects of acute exposure to formaldehyde in children or young experimental animals were located. However, as noted above for adults, there is evidence that following acute exposure to formaldehyde, asthmatics and others previously sensitized to formaldehyde may be more likely to show respiratory symptoms such as wheezing, shortness of breath, rhinitis, and/or decrements in pulmonary function consistent with immediate and/or delayed bronchoconstriction (Nordman et al., 1985; Burge et al., 1985; Hendrick and Lane, 1977; Wallenstein et al., 1978). Furthermore, some asthmatics may respond with significant reductions in lung function due to the irritant effects on asthma, sensitized or not. Additionally, the depletion of the endogenous bronchodilator, GSNO, following formaldehyde exposure may be particularly important in children. Gaston et al. (1998) compared concentrations of tracheal S-nitrosothiol concentrations in eight asthmatic children in respiratory failure with those of 21 non-asthmatic children undergoing elective surgery. In asthmatic children, the metabolism of GSNO was accelerated and the mean S-nitrosothiol concentrations significantly lower compared to normal children (65 ± 45 vs 502 ± 429

nmol/l). Thus asthmatic children, with low levels of GSNO, are expected to be unusually vulnerable to any further depletion of GSNO caused by formaldehyde.

The potential association between formaldehyde exposure and asthma is of special concern for children since, as noted in OEHHA (2001): "*OEHHA considers asthma to impact children more than adults. Children have higher prevalence rates of asthma than do adults (Mannino et al., 1998). In addition, asthma episodes can be more severe due to the smaller airways of children, and result in more hospitalizations in children, particularly from the ages of 0 to 4 years, than in adults (Mannino et al., 1998).*" Thus children, particularly asthmatic children, may be at greater risk from acute exposure to formaldehyde.

5.3 Acute Toxicity to Experimental Animals

Acute exposures of experimental animals to formaldehyde are associated with changes in pulmonary function (decreased respiratory rate, increased airway reactivity and resistance) at low concentrations, while pulmonary edema and death have been reported at high concentrations. Neurochemical and neurobehavioral changes have also been observed.

In 72 rats exposed to approximately 600-1,700 mg/m^3 (500-1,400 ppm) formaldehyde vapor for 30 minutes, the LC_{50} was found to be 1,000 mg/m^3 (800 ppm) (Skog, 1950). The first deaths did not occur until 6 hours after cessation of exposure. Respiratory difficulty lasted several days after exposure and the last of 49 rats died after 15 days of purulent bronchitis and diffuse bronchopneumonia. Three weeks following exposure, histological examinations of the 23 surviving animals revealed bronchitis, pulmonary microhemorrhages, and edema. No changes were seen in other organs.

A multispecies study by Salem and Cullumbine (1960) showed that a 10-hour exposure to 15.4 ppm (19 mg/m^3) formaldehyde vapor killed 3 out of 5 rabbits, 8 of 20 guinea pigs, and 17 of 50 mice. The report stated that formaldehyde exposure resulted in delayed lethality.

Alarie (1981) determined the 10 minute LC_{50} for formaldehyde in mice to be 2,162 ppm (95% confidence interval, 1,687-2,770 ppm). The post-exposure observation period was 3 hours. From the concentration mortality graph provided in the report, an MLE_{05} and BC_{05} of 1,440 ppm and 778 ppm, respectively, could be estimated for a 10-minute formaldehyde exposure. However, as indicated in the previous reports, delayed deaths occur with formaldehyde which suggests that the 3-hour post-exposure observation period used in this study may not have been long enough.

In other lethality studies, Nagornyi et al.(1979) determined a 4-hour formaldehyde LC_{50} in rats and mice to be 588 mg/m^3 (474 ppm) and 505 mg/m^3 (407 ppm), respectively. However, the raw data for this study were not included in the report. Horton et al. (1963) observed that a 2-hour exposure of mice to 0.9 mg/l (900 mg/m^3) formaldehyde resulted in deaths from massive pulmonary hemorrhage and edema, but a 2 hour exposure to 0.14 mg/l (140 mg/m^3) did not produce signs of "substantial distress."

Swiecichowski et al., (1993) exposed groups of five to seven guinea pigs to 0.86, 3.4, 9.4, 31.1 ppm (1.1, 4.2, 11.6, 38.6 mg/m^3) formaldehyde for 2 hours, or to 0.11, 0.31, 0.59, 1.05 ppm (0.14, 0.38, 0.73, 1.30 mg/m^3) formaldehyde for 8 hours. An 8-hour exposure to levels greater than or equal to 0.3 ppm ($\geq$ 0.4 mg/m^3) formaldehyde was sufficient to produce a significant increase in airway reactivity. Similar effects occurred after greater than 9 ppm (> 11 mg/m^3) formaldehyde for the 2-hour exposure group. Formaldehyde exposure also heightened airway smooth muscle responsiveness to acetylcholine (or carbachol) *ex vivo*. No inflammation or epithelial damage was seen up to 4 days after exposure. The researchers suggest that duration of exposure is important to the induction of airway hyperreactivity and that prolonged (8-hour), low-level exposures may generate abnormal physiologic responses in the airways not detectable after acute (2-hour) exposures.

Male F-344 rats, 7-9 weeks old, were exposed to 0.5, 2, 6 or 15 ppm formaldehyde for 6 hours per day for 1 to 4 days (Monteiro-Riviere and Popp, 1986). Effects noted in the rat nasal respiratory epithelium with 0.5 or 2 ppm were limited to altered cilia with occasional wing-like projections on the ends of the ciliary shafts. Effects noted at 6 ppm for 1 day were autophagic vacuoles in some basal cells, neutrophils in the basal and suprabasal layers, and hypertrophy of goblet and ciliated cells. Loss of microvilli in ciliated cells was noted at all exposure concentrations.

Rats were exposed to 0, 5, 10 or 20 ppm formaldehyde for 3 hours per day on 2 consecutive days (Boja et al., 1985). Decreased motor activity and neurochemical changes in dopamine and 5-hydroxytryptamine neurons were reported.

The effects of formaldehyde inhalation on open-field behavior in mice were examined by Malek et al. (2004) 2 and 24 hours after a single 2-hour exposure to 0, 1.1, 2.3 or 5.2 ppm. Two hours after exposure there were significant decreases in rearing and in several measures of exploratory behavior, with evidence of dose-dependence in all dose groups compared with controls. At 24 hours, there were still significant differences between dosed and control mice but the dose-dependence was no longer evident.

Nielson et al. (1999) analyzed the breathing patterns of Balb/c mice exposed to 0.2-13 ppm formaldehyde and found a concentration-dependent decrease in respiratory rate of 32.9%/log concentration. In the range of 0.3-4.0 ppm, the decrease in respiratory rates was attributable to sensory irritation. Above 4.0 ppm, bronchoconstriction also contributed to the decreased breathing rate. The authors suggest a NOEL of 0.3 ppm for these effects in mice.

Amdur (1960) exposed groups of 4 to 18 guinea pigs to formaldehyde at 0.05, 0.31, 0.58, 1.22, 3.6, 11.0, or 49 ppm formaldehyde for one hour. Resistance to flow and lung compliance were calculated from measures of intrapleural pressure, tidal volume, and rate of flow to the lungs at the end of exposure and one hour later. Resistance and compliance were significantly different from the control level for the 0.31 ppm exposure ($p<0.05$) and increasingly significant at higher concentrations. One hour later, only the 49 ppm exposure remained significant ($p<0.01$). In addition, the tracheas of groups of 6 to 10 guinea pigs were cannulated and exposed for one hour to 0.90, 5.2, 20, or 50 ppm

formaldehyde, and 1.14 or 3.6 ppm formaldehyde with 10 mg/m^3 sodium chloride. With the protective effect of the trachea bypassed, the resistance and compliance changed substantially. The addition of sodium chloride further enhanced the effect, including a significant effect after one hour for the 1.14 ppm formaldehyde exposure. These results show that formaldehyde that reaches the lungs has a marked effect on airways resistance and compliance in addition to an effect on the upper airways.

Riedel et al. (1996) studied the influence of formaldehyde exposure on allergic sensitization in guinea pigs. Three groups of guinea pigs (12/group) were exposed to clean air or two different formaldehyde concentrations (0.13 and 0.25 ppm) over five consecutive days. Following exposure, the animals were sensitized to allergen by inhalation of 0.5% ovalbumin (OA). Three weeks later the animals were subjected to bronchial provocation with OA and specific anti-OA-IgGl (reaginic) antibodies in serum were measured. In another group of six animals, the respiratory tract was examined histologically for signs of inflammation directly after the end of formaldehyde or clean air exposure. In the group exposed to 0.25 ppm formaldehyde, 10/12 animals were found to be sensitized to OA (positive reaction on specific provocation) vs. 3/12 animals in the control group ($P < 0.01$). Furthermore, compressed air measurements of specific bronchial provocation and serum anti-OA-antibodies were significantly higher in the 0.25 ppm formaldehyde group than in controls. The median for compressed air measurement was 0.35 ml for the formaldehyde-exposed group vs. 0.09 ml for the controls ($p< 0.01$), indicating increased bronchial obstruction. The median for the anti-OA-IgGl measured in the formaldehyde-exposed group was 13 vs. less than 10 EU in the controls, ($p < 0.05$), indicating enhanced sensitization. In the group exposed to 0.13 ppm formaldehyde, no significant difference was found compared to the control group. Histological examination found edema of the bronchial mucosa, but there was no sign of inflammation of the lower airways in formaldehyde-exposed guinea pigs. The investigators concluded that short-term exposure to a low concentration of formaldehyde (0.25 ppm) can significantly enhance sensitization to inhaled allergens in the guinea pig.

As described in Section 5, the main formaldehyde-metabolizing enzyme, ADH3, also reduces the endogenous bronchodilator GSNO. To examine the role of GSNO and ADH3 (known in this study as GSNO reductase, GSNOR) in airway tone and asthma, Que et al. (2005) used wild type mice and mice with a targeted deletion of GSNOR ($GSNOR^{-/-}$). Following a challenge with allergen (ovalbumin), GSNOR activity in bronchoalveolar lavage fluid from wild type mice increased significantly ($p < 0.05$) compared to buffer (PBS) controls, while as expected, no GSNOR activity was detected in the $GSNOR^{-/-}$ mice with either treatment. Levels of S-nitrosothiols (SNO) were assayed in homogenates of lung tissues from both types of mouse and found to be barely detectable with PBS treatment. However, after ovalbumin challenge, SNO levels were significantly higher ($p < 0.02$) in $GSNOR^{-/-}$ mice compared to wild type, indicating metabolism of SNOs by GSNOR under "asthmatic-like" conditions in wild type mice. Metabolism of GSNO results in a loss of bronchodilation capacity. Deletion of GSNOR had no effect on NO generation by NO synthase as there were no differences between wild type and $GSNOR^{-/-}$ mice in nitrate or nitrite levels regardless of treatment. To investigate the effects of deletion of GSNOR on airway hyper-responsivness, pulmonary

resistance was measured at baseline (PBS) and after methacholine challenge, with and without ovalbumin treatment. At baseline, there was no difference among mouse types and treatments, while at higher methacholine levels (100-1000 µg/kg), pulmonary resistance was found to be significantly lower ($p < 0.001$) in $GSNOR^{-/-}$ mice than in wild type, presumably due to higher GSNO levels that enhance bronchodilation. Importantly, ovalbumin caused a marked increase in airway responsiveness in wild type mice but had little effect in $GSNOR^{-/-}$ mice. This indicates that GSNOR regulates basal airway tone as well as hyper-responsiveness to both allergen challenge and bronchoconstrictor agonists. It is also noteworthy that the total number and composition of leukocytes, levels of interleukin-13 and total serum IgE were comparable between wild type and $GSNOR^{-/-}$ mice. This indicates that protection from asthma in the $GSNOR^{-/-}$ mice is not a result of a suppressed response to allergen, and that SNOs, especially GSNO, can preserve airway patency in the presence of inflammation. Thus the inflammatory response is not linked to hyper-responsiveness as long as adequate levels of GSNO are maintained.

A connection between formaldehyde and the activity of GSNOR described in the study above by Que et al., was outlined by Thompson and Grafstrom (2008) and supported by Yi et al. (2007) and Staab et al. (2008). In the study by Yi and associates, groups of 6 mice were exposed to formaldehyde at 0, 1, or 3 mg/m^3 continuously for 72 hours. Following exposure, lungs were isolated to allow measurement of GSNOR mRNA levels by RT-PCR, and enzymatic activity with GSNO. Formaldehyde at 3 mg/m^3 significantly increased the numbers of GSNOR transcripts compared to control (0.58 vs 0.4 GSNOR/ß actin; $p < 0.05$), while GSNOR reduction of GSNO showed a significant dose-dependent increase with formaldehyde concentration ($p < 0.01$). The stimulation of GSNO reduction by formaldehyde was also observed by Staab et al. (2008) in an in vitro study using recombinant human GSNOR. In this study, GSNO levels in buccal carcinoma cells were reduced in a dose-dependent fashion following a 1 hour exposure to formaldehyde in the 1-5 mM range with significance at 5 mM ($p < 0.05$). The results from this study support a model in which formaldehyde (as the glutathione conjugate, HMGSH) is oxidized by GSNOR (ADH3) in the presence of high levels of NAD^+, producing NADH. This process was found to be accelerated by high levels of GSNO. GSNO is in turn reduced with the oxidation of NADH to form glutathione sulfonimide. Formaldehyde thus depletes cellular SNO (in the form of GSNO) which results in dysregulation of NO signaling pathways.

6. Chronic Toxicity of Formaldehyde

6.1 Chronic Toxicity to Adult Humans

Formaldehyde primarily affects the mucous membranes of the upper airways and eyes. Exposed populations that have been studied include embalmers, residents in houses insulated with urea-formaldehyde foam, anatomy class students, histology technicians, wood and pulpmill workers, and asthmatics. A number of studies describing these effects have been briefly summarized below. For the sake of brevity, only the studies that best represent the given effects are presented. Formaldehyde is also a recognized carcinogen (IARC, 2006), however, this document will address only its non-carcinogenic properties.

In the study chosen for determination of the 8-hour and chronic RELs, nasal obstruction and discharge, and frequency of cough, wheezing, and symptoms of bronchitis were reported in 66 workers in a formaldehyde production plant exposed for 1-36 years (mean = 10 years) to a mean concentration of 0.21 ppm (0.26 mg/m^3) formaldehyde (Wilhelmsson and Holmstrom, 1992). All workers were exposed almost exclusively to formaldehyde, the concentrations of which were measured in the ambient air of the worksite with personal sampling equipment. Referents consisted of 36 office workers in a government office with exposure to a mean concentration of 0.07 ppm (0.09 mg/m^3) formaldehyde, and no industrial solvent or dust exposure. Symptom data, collected by questionnaire, were separated into general and work-related, and allowed identification of individuals with atopy and mucosal hyperreactivity. The critical effects from chronic exposure to formaldehyde in this study included nasal obstruction, lower airway discomfort, and eczema or itching. The frequency of reported lower airway discomfort (intermittent cough, wheezing, or symptoms of chronic bronchitis) was significantly higher among formaldehyde-exposed vs non-exposed workers (44 vs 14%; $p < 0.01$) (Table 6.1). Work-related nasal discomfort also was significantly higher in the formaldehyde group (53%) compared with the referent group (3%; $p < 0.001$). Similarly, work-related eye discomfort was 20% in the formaldehyde group but nonexistent among referents. The significant increase in symptoms of nasal discomfort in exposed workers did not correlate with total serum IgE antibody levels. However, two exposed workers, who complained of nasal discomfort, had elevated IgE levels. The investigators concluded that formaldehyde can induce nonspecific nasal hypersensitivity.

TABLE 6.1.1 SYMPTOMS OF FORMALDEHYDE EXPOSURE VS REFERENCE GROUP (FROM WILHELMSSON AND HOLMSTROM, 1992)

	Formaldehyde	**Reference**	**Rate difference**	
	% (n=66)	% (n=36)	%	95% CI
General nasal discomfort	67	25	42	24-60
Workplace nasal discomfort	53	3	50	37-63
General lower airway discomfort	44	14	30	14-47
Workplace lower airway discomfort	33	3	28	15-40
General eye discomfort	24	6	18	6-36
General skin discomfort	36	11	25	10-41

In a cross-sectional study supportive of these results, Edling et al. (1988) reported histopathological changes in nasal mucosa of workers (n=75) occupationally exposed to formaldehyde (one wood laminating plant) or formaldehyde plus wood dust (two particle board plants). Ambient formaldehyde measurements in these three composite wood processing plants between 1975 and 1983 gave a time-weighted average (TWA) of 0.1-1.1 mg/m^3 (0.08- 0.89 ppm) with peaks of up to 5 mg/m^3 (4 ppm). The exposed workers were compared on the basis of medical and work histories, clinical examinations and nasal biopsies to 25 workers selected with regard to age and smoking habits but without occupational formaldehyde exposure.

Based on the histories, there was a high frequency of eye and upper airway symptoms among workers. Nasal symptoms (running nose and crusting) associated with formaldehyde exposure were reported in 60% of the workers, while 75% complained of lacrimation. Clinical examinations revealed grossly normal nasal mucosa in 75% of the cases while 25% had swollen or dry changes, or both, to the nasal mucosa. Histological examination (Table 6.2) revealed that only 3 of the 75 formaldehyde-exposed workers had normal, ciliated pseudostratified epithelium. Squamous metaplasia was reportedly observed in 59, while 6 showed mild dysplasia, and in 8 there was loss of ciliated cells and goblet cell hyperplasia. The histological grading showed a significantly higher score for nasal lesions among workers with formaldehyde exposure when compared with the referents (2.9 versus 1.8; $p < 0.05$). Exposed smokers had a higher, but non-significant, score than ex-smokers and non-smokers.

While the mean exposure time was 10.5 years (range 1-39 yr), there was no discernable difference among histology scores as a function of years of employment. The histology scores were also not different between workers in the particle board plants, exposed to both formaldehyde and wood dust, and workers in the laminate plant with exposure only to formaldehyde. The authors thus attribute the pathological changes in the nasal mucosa and the other adverse effects to formaldehyde alone in the 0.1-1.1 mg/m^3 range.

TABLE 6.1.2 DISTRIBUTION OF HISTOLOGICAL CHARACTERISTICS ASSOCIATED WITH FORMALDEHYDE EXPOSURE (FROM EDLING ET AL., 1988)

Histological characteristic	Grading score	Point score	Workers	%
Normal respiratory epithelium	0	0	3	4
Loss of ciliated cells	1	1	8	11
Mixed cuboidal/squamous epithelium, metaplasia	2	2	24	32
Stratified squamous epithelium	3	3	18	24
Keratosis	4	4	16	21
Budding of epithelium	add 1	5	0	0
Mild or moderate dysplasia	6	6	6	8
Severe dysplasia	7	7	0	0
Carcinoma	8	8	0	0

Histological changes in the nasal mucosa of formaldehyde-exposed workers were also reported by Boysen et al. (1990). In this study, nasal biopses were collected from 37

workers with 5 or more years of occupational formaldehyde exposure (0.5 - > 2 ppm) and compared with age-matched, unexposed controls who otherwise had similar environmental exposures and smoking habits. Histological changes in the nasal epithelium were scored as indicated in Table 6.1.3.

TABLE 6.1.3 TYPES OF NASAL EPITHELIA AND SCORING (FROM BOYSEN ET AL., 1990)

Types of epithelia	Histological score
Pseudostratified columnar	0
Stratified cuboidal	1
Mixed stratified cuboidal/stratified squamous	2
Stratified squamous, non-keratinizing	3
Stratified squamous, keratinizing	4
Dysplasia	5

As shown by the histological scoring in Table 6.1.4 below, metaplastic changes in the nasal epithelium were more pronounced in the formaldehyde-exposed workers although this difference did not reach statistical significance.

TABLE 6.1.4 HISTOLOGICAL SCORES OF NASAL EPITHELIA

		Histological score						
	No	**0**	**1**	**2**	**3**	**4**	**5**	**Mean**
Exposed	37	3	16	5	9	1	3	1.9
Controls	37	5	17	10	5	0	0	1.4

Rhinoscopical examination revealed hyperplastic nasal mucosa in 9 of 37 formaldehyde-exposed workers but in only 4 of the controls. In addition, the incidence of subjective nasal complaints was significantly ($p < 0.01$) higher in the exposed group. While the small size of this study, and the small amount of the nasal mucosa accessible to biopsy limited its ability to detect formaldehyde- related histopathology, the results are consistent with the histopathologies reported by Edling et al. above.

In another occupational health study (Grammer et al., 1990), 37 workers, who were exposed for an unspecified duration to formaldehyde concentrations in the range of 0.003 to 0.073 ppm, reported ocular irritation. However, no significant serum levels of IgE or IgG antibodies to formaldehyde-human serum albumin were detected.

Kerfoot and Mooney (1975) reported that estimated formaldehyde exposures of 0.25-1.39 ppm evoked numerous complaints of upper respiratory tract and eye irritation among seven embalmers at six different funeral homes. Three of the seven embalmers in this study reportedly had asthma. Levine et al. (1984) examined the death certificates of 1477 Ontario undertakers. Exposure measurements taken from a group of West Virginia embalmers were used as exposure estimates for the embalming process, ranging from 0.3-0.9 ppm (average 1-hour exposure) and 0.4-2.1 ppm (peak 30-minute exposure). Mortality due to non-malignant diseases was significantly

elevated due to a two-fold excess of deaths related to the digestive system. The authors suggest increased alcoholism could have contributed to this increase.

Ritchie and Lehnen (1987) reported a dose-dependent increase in health complaints (eye and throat irritation, and headaches) in 2000 residents living in 397 mobile and 494 conventional homes. Complaints of symptoms of irritation were noted at concentrations of 0.1 ppm formaldehyde or above. Similarly, Liu et al. (1991) found that exposure to 0.09 ppm (0.135 mg/m^3) formaldehyde exacerbated chronic respiratory and allergy problems in residents living in mobile homes.

Employees of mobile day-care centers (66 subjects) reported increased incidence of eye, nose and throat irritation, unnatural thirst, headaches, abnormal tiredness, menstrual disorders, and increased use of analgesics as compared to control workers (Olsen and Dossing, 1982). The mean formaldehyde concentration in these mobile units was 0.29 ppm (0.43 mg/m^3) (range = 0.24 - 0.55 mg/m^3). The exposed workers were exposed in these units for a minimum of 3 months. A control group of 26 subjects in different institutions was exposed to a mean concentration of 0.05 ppm (0.08 mg/m^3) formaldehyde.

Occupants of houses insulated with urea-formaldehyde foam insulation (UFFI) (1726 subjects) were compared with control subjects (720 subjects) for subjective measures of irritation, measures of pulmonary function (FVC, FEV_1, FEF_{25-75}, FEF_{50}), nasal airway resistance, odor threshold for pyridine, nasal cytology, and hypersensitivity skin-patch testing (Broder et al., 1988). The mean length of time of exposure to UFFI was 4.6 years. The mean concentration of formaldehyde in the UFFI-exposed group was 0.043 ppm, compared with 0.035 ppm for the controls. A significant increase in symptoms of eye, nose and throat irritation was observed in subjects from UFFI homes, compared with controls. No other differences from control measurements were observed.

Alexandersson and Hedenstierna (1989) evaluated symptoms of irritation, spirometry, and immunoglobulin levels in 34 wood workers exposed to formaldehyde over a four-year period. Exposure to 0.4 - 0.5 ppm formaldehyde resulted in significant decreases in FVC, FEV_1, and FEF_{25-75}. Removal from exposure for four weeks allowed for normalization of lung function in the non-smokers.

Kriebel et al. (2001) conducted a subchronic epidemiological study of 38 anatomy class students who, on average, were exposed to a geometric mean of 0.70 ± 2.13 ppm formaldehyde for two hours per week over fourteen weeks. After class, eye, nose and throat irritation was significantly elevated compared with pre-laboratory session exposures, with a one unit increase in symptom intensity/ppm formaldehyde. Peak respiratory flow (PEF) was found to decrease by 1%/ppm formaldehyde during the most recent exposure. Changes in PEF and symptom intensity following formaldehyde exposure were most pronounced during the first week of the semester but attenuated with time, suggesting partial acclimatization.

Histology technicians (280 subjects) were shown to have reduced pulmonary function, as measured by FVC, FEV_1, FEF_{25-75}, and FEF_{75-85}, compared with 486 controls

(Kilburn et al., 1989). The range of formaldehyde concentrations was 0.2 - 1.9 ppm, volatilized from formalin preservative solution.

Malaka and Kodama (1990) investigated the effects of formaldehyde exposure in plywood workers (93 exposed, 93 controls) exposed for 26.6 years, on average, to 1.13 ppm (range = 0.28 - 3.48 ppm). Fifty-three smokers were present in both exposed and control groups. Exposure assessment was divided into three categories: high (> 5 ppm), low (< 5 ppm), and none (reference group). Subjective irritation and pulmonary function tests were performed on each subject, and chest x-rays were taken of ten randomly selected volunteers from each group. Respiratory symptoms of irritation were found to be significantly increased in exposed individuals, compared with controls. In addition, exposed individuals exhibited significantly reduced FEV_1, FEV_1/FVC, and forced expiratory flow rate at 25% through 75% of FVC ($FEF_{25-75)}$, compared with controls. Forced vital capacity was not significantly reduced. Pulmonary function was not found to be different after a work shift, compared to the same measurement taken before the shift. No differences in chest x-rays were observed between exposed and control workers.

Occupational exposure to formaldehyde concentrations estimated to be 0.025 ppm (0.038 mg/m^3) for greater than six years resulted in complaints by 22 exposed workers of respiratory, gastrointestinal, musculoskeletal, and cardiovascular problems, and in elevated formic acid excretion in the urine (Srivastava et al., 1992). A control group of twenty seven workers unexposed to formaldehyde was used for comparison. A significantly higher incidence of abnormal chest x-rays was also observed in formaldehyde-exposed workers compared with controls.

Chemical plant workers (70 subjects) were exposed to a mean of 0.17 ppm (0.26 mg/m^3) formaldehyde for an unspecified duration (Holmstrom and Wilhelmsson, 1988). Compared with 36 control workers not exposed to formaldehyde, the exposed subjects exhibited a higher frequency of eye, nose, and deep airway discomfort. In addition, the exposed subjects had diminished olfactory ability, delayed mucociliary clearance, and decreased FVC.

Alexandersson et al. (1982) compared the irritant symptoms and pulmonary function of 47 carpentry workers exposed to a mean concentration of formaldehyde of 0.36 ppm (range = 0.04 - 1.25 ppm) with 20 unexposed controls. The average length of employment for the exposed workers was 5.9 years. Symptoms of eye and throat irritation as well as airway obstruction were more common in exposed workers. In addition, a significant reduction in FEV_1, FEV_1/FVC, and MMF was observed in exposed workers compared with controls.

Horvath et al. (1988) compared subjective irritation and pulmonary function in 109 workers exposed to formaldehyde with similar measures in a control group of 254 subjects. The formaldehyde concentrations for the exposed and control groups were 0.69 ppm (1.04 mg/m^3) and 0.05 ppm (0.08 mg/m^3), respectively. Mean formaldehyde concentration in the pre-shift testing facility and the state (Wisconsin) ambient outdoor - formaldehyde level were both 0.04 ppm (0.06 mg/m^3). Duration of formaldehyde

exposure was not stated. Subjects were evaluated pre- and post work-shift and compared with control subjects. Significant differences in symptoms of irritation, FEV_1, FEV_1/FVC ratio, FEF_{50}, FEF_{25}, and FEF_{75} were found when comparing exposed subjects' pre- and post work-shift values. However, the pre-workshift values were not different from controls.

The binding of formaldehyde to endogenous proteins creates haptens that can elicit an immune response. Chronic exposure to formaldehyde has been associated with immunological hypersensitivity as measured by elevated circulating IgG and IgE autoantibodies to human serum albumin (Thrasher et al., 1987). In addition, a decrease in the proportion of T-cells was observed, indicating altered immunity. Thrasher et al. (1990) later found that long-term exposure to formaldehyde was associated with autoantibodies, immune activation, and formaldehyde-albumin adducts in patients occupationally exposed, or residents of mobile homes or of homes containing particleboard sub-flooring. The authors suggest that the hypersensitivity induced by formaldehyde may account for a mechanism for asthma and other health complaints associated with formaldehyde exposure.

An epidemiological study of the effects of formaldehyde on 367 textile and shoe manufacturing workers employed for a mean duration of 12 years showed no significant association between formaldehyde exposure, pulmonary function (FVC, FEV_1, and PEF) in normal or asthmatic workers, and occurrence of specific IgE antibodies to formaldehyde (Gorski and Krakowiak, 1991). The concentrations of formaldehyde did not exceed 0.5 ppm (0.75 mg/m^3).

Workers (38 total) exposed for a mean duration of 7.8 years to 0.11 - 2.12 ppm (mean = 0.33 ppm) formaldehyde were studied for their symptomatology, lung function, and total IgG and IgE levels in the serum (Alexandersson and Hedenstierna, 1988). The control group consisted of 18 unexposed individuals. Significant decrements in pulmonary function, FVC ($p < 0.01$) and FEV_1 ($p < 0.05$)) were observed, compared with the controls. Eye, nose, and throat irritation was also reported more frequently by the exposed group. No correlation was found between duration of exposure, or formaldehyde concentration, and the presence of IgE and IgG antibodies.

As described in section 5.1, chronic or repeated exposure to formaldehyde may influence the response of asthmatics to acute or short-term challenges. In the study by Burge et al. (1985) late asthmatic reactions were noted in 3 out of 15 occupationally exposed workers after short-duration exposure to 1.5 – 20.6 ppm formaldehyde. Similarly, among workers with occupational exposure to formaldehyde, asthmatic responses (decreased PEF, FVC, and FEV_1) were reported in 12 workers challenged with 1.67 ppm (2.5 mg/m^3) formaldehyde (Nordman et al., 1985) and in 5 of 28 hemodialysis workers following challenge with formaldehyde vapors (concentration not measured) (Hendrick and Lane, 1977). In contrast, Sheppard et al. (1984) found that in asthmatics not occupationally exposed to formaldehyde, a 10-minute challenge with 3 ppm formaldehyde coupled with moderate exercise did not induce significant changes in airway resistance or thoracic gas volume. Thus individuals with chronic formaldehyde exposure may be at greater risk for adverse responses to acute exposures. These

individuals may have been sensitized immunologically, as in the cases of elevated circulating antibodies, or rendered neurologically hyperresponsive, following repeated or chronic exposures to formaldehyde (Sorg et al., 2001a,b).

6.2 Chronic Toxicity to Infants and Children

There are few studies that compare the effects of chronic formaldehyde exposure on children versus adults. Among those that do there is evidence that children are more susceptible to the adverse effects of chronic exposure. Krzyzanowski et al. (1990) assessed chronic pulmonary symptoms and function in 298 children (6-15 years of age) and 613 adults (> 15 years of age) in relation to measured formaldehyde levels in their homes. Information on pulmonary symptoms and doctor-diagnosed asthma and chronic bronchitis was collected by questionnaire. Pulmonary function was assessed as peak expiratory flow rates (PEFR) measured up to four times a day. The prevalence of chronic respiratory symptoms in children was not related to formaldehyde levels measured in tertiles (< 40, 41-60, > 60 ppb). However, doctor-diagnosed asthma and chronic bronchitis were more prevalent in houses with elevated formaldehyde (p for trend < 0.02). This effect was driven by the high disease prevalence observed in homes with kitchen formaldehyde levels >60 ppb, and was especially pronounced among children with concomitant exposure to environmental tobacco smoke (Table 6.2.1). By comparison, in adults, while the prevalence rates of chronic cough and wheeze were somewhat higher in houses with higher formaldehyde, none of the respiratory symptoms or diseases was significantly related to formaldehyde levels.

TABLE 6.2.1 PREVALENCE RATE (PER 100) OF DIAGNOSED BRONCHITIS AND ASTHMA IN CHILDREN WITH FORMALDEHYDE (FROM KRZYZANOWSKI ET AL., 1990)

	Formaldehyde (ppb)			P value
Bronchitis	**≤ 40 (N)**	**41-60 (N)**	**>60 (N)**	**X^2 trend**
Household mean	3.5 (258)	17.2 (29)	9.1 (11)	<0.02
Main room mean	3.2 (253)	15.6 (32)	9.1 (11)	<0.01
Bedroom mean	3.8 (262)	16.0 (25)	9.1 (11)	<0.04
Subject's bedroom	4.7 (256)	6.7 (30)	11.1 (9)	>0.35
Kitchen	3.5 (255)	0 (22)	28.6 (21)	<0.001
No ETS	4.3 (141)	0 (12)	10.0 (10)	>0.40
ETS	1.9 (106)	0 (10)	45.5 (11)	<0.001
Asthma				
All children	11.7 (256)	4.2 (24)	23.8 (21)	<0.03
No ETS	8.5 (142)	8.3 (12)	0 (10)	>0.50
ETS	15.1 (106)	0 (12)	45.5 (11)	<0.05

In a random effects model, Krzyzanowski et al. (1990) reported that lung function (PEFR) in children, but not adults, was significantly decreased by formaldehyde (coefficient ± SE: -1.28 ± 0.46 vs 0.09 ± 0.27). Measurements of PEFR in the morning suggested that children with asthma (n = 4) were more severely affected than healthy children (coefficient ± SE: -1.45 ± 0.53 vs 0.09 ± 0.15) (Table 6.2.2). Compared to children, the effects of formaldehyde on pulmonary function in adults were smaller,

transient, limited to morning measurements, and generally most pronounced among smokers exposed to the higher levels of formaldehyde. These studies suggest that children may be more susceptible to the effects of chronic formaldehyde exposure on lung function than are adults.

TABLE 6.2.2 RELATION OF PEFR (L/MIN) TO INDOOR FORMALDEHYDE (FROM KRZYZANOWSKI ET AL., 1990)

Factor	Child coefficient ± SE	Adult coefficient ± SE
HCHO house mean	-1.28 ± 0.46	0.09 ± 0.27
Morning vs bedtime	- 6.10 ± 3.0	-5.90 ± 1.10
HCHO bdrm mean/morning	0.09 ± 0.15	-0.07 ± 0.04
HCHO bdrm mean/morning/asthma	-1.45 ± 0.53	

Among studies of children only, a case-control study by Rumchev et al. (2002) examined risk factors for asthma among young children (6 mo- 3 yr). Cases included children with clinically-diagnosed asthma, and controls were children of the same age group without such a diagnosis. Formaldehyde levels were measured in the homes, once in summer and once in winter. Questionnaires were used to assess potential risk factors for asthma and to collect parental reports of respiratory symptoms characteristic of asthma (cough, shortness of breath, wheeze, runny nose, trouble breathing, and hay fever) in their children. Formaldehyde levels were higher in the homes of children exhibiting respiratory symptoms. Estimates of the relative risk for clinically-diagnosed asthma (odds ratios) were adjusted for measured indoor air pollutants, relative humidity, temperature, atopy, family history of asthma, age, gender, socioeconomic status, pets, smoke exposure, air conditioning, and gas appliances. Compared with children exposed to < 8 ppb, children in homes with formaldehyde levels > 49 ppb had a 39% higher risk of asthma ($p < 0.05$) after adjusting for common asthma risk factors.

Franklin et al. (2000) measured exhaled nitric oxide (eNO) levels in 224 children 6-13 years of age as an indicator of inflammation of the lower airways following chronic low-level formaldehyde exposure in the home. While there was no effect of formaldehyde on lung function measured by spirometry, eNO was significantly higher in children from homes with average formaldehyde levels ≥ 50 ppb compared with those from homes with levels ≤ 50 ppb (15.5 ppb eNO vs 8.7; $p = 0.02$).

Garrett et al. (1999) examined the association between formaldehyde levels at home (median 15.8 $\mu g/m^3$; maximum 139 $\mu g/m^3$) and atopy and allergic sensitization in 148 children, 7-14 years of age. The risk of atopy increased by 40% with each 10 $\mu g/m^3$ increase in bedroom formaldehyde. Two measures of allergic sensitization to twelve common environmental allergens, the number of positive skin prick tests and maximum wheal size, both showed linear associations with increasing maximum formaldehyde exposure levels. After adjusting for parental asthma and allergy, there was no evidence of an association between asthma in the children and formaldehyde levels. However, these data do suggest that formaldehyde levels commonly found in homes can enhance sensitization of children to common aeroallergens.

Of the numerous, primarily occupational, studies in adults, the NOAEL and LOAEL are 17 $\mu g/m^3$ (14 ppb) and 101 $\mu g/m^3$ (81 ppb), respectively, after adjustment for exposure continuity. These values are based on data on nasal and eye irritation as observed in Wilhelmsson and Holstrom (1992), and histological lesions in the nasal cavity as documented in Edling et al. (1988). However, studies in children, including the Krzyzanowski study above, indicate adverse health impacts in children at concentrations as low as 30 ppb. Wantke et al. (1996) reported that formaldehyde-specific IgE and respiratory symptoms were reduced when children transferred from schools with formaldehyde concentrations of 43 to 75 ppb to schools with concentrations of 23 to 29 ppb. While these human studies are not entirely consistent with each other, and there is potential for confounding in each, nevertheless, taken together, they suggest that children may be more sensitive to formaldehyde toxicity than adults.

A potential role for formaldehyde, GSNO and its metabolizing enzyme, GSNOR, in asthma is described in Section 5 above. The activity of GSNOR tends to be higher, and the levels of GSNO lower, in the lungs of asthmatics compared to non-asthmatics. This connection prompted Wu et al. (2007) to investigate whether genetic variation in GSNOR is associated with childhood asthma and atopy. The study group included 532 children, aged 4 to 17 with clinically diagnosed asthma, and their parents. Seven single nucleotide polymorphisms (SNPs) in GSNOR were genotyped in DNA extracted from lymphocytes to examine the relationship between common haplotypes and asthma. Atopy was determined with skin prick tests using a collection of 25 aeroallergens. Two of the GSNOR SNPs were associated with increased risk of asthma, but none was associated with atopy. Whereas a lower risk for asthma was associated with one (RR 0.77; 95% CI 0.61-0.97) or two (RR 0.66; 95% CI 0.44-0.99) copies of the minor A allele of SNP rs1154404, homozygosity for the major T allele of this SNP carried an increased risk of asthma. Homozygosity for the minor allele of SNP re28730619 also carried an increased risk of asthma (RR 1.60; 95% CI 1.13-2.26; p = 0.0077). In the haplotype analysis, children with the most common GSNOR haplotype (GTCGG), that contained the major T allele of rs1154404 and the minor G allele of rs28730619, were at increased risk of childhood asthma. These results thus suggest that variants in GSNOR genotype influence childhood asthma susceptibility.

It should be noted that while term neonates have high levels of reduced glutathione in the fluid lining the lungs, these levels drop rapidly after birth. However, among premature infants, glutathione levels are typically substantially below those of term infants (Grigg et al., 1993) and adults (Reise et al., 1997). As a result of low levels of a critical component of formaldehyde metabolism, glutathione, these infants may be at increased risk from formaldehyde exposure.

6.3 Chronic Toxicity to Experimental Animals

Studies of the effects of chronic formaldehyde exposure in experimental animals tend to focus on lesions in the upper respiratory tract and the hyperplastic or metaplastic changes observed in the respiratory epithelium. Systemic effects, such as changes in body or organ weight, or blood chemistry, appear to be secondary to the effects of the

olfactory irritation on feeding behavior. There is also evidence that repeated or long-term exposure to formaldehyde may cause neurologically-based hyperresponsiveness to formaldehyde (Sorg et al., 2001a) and altered expression of stress hormones (Sorg et al., 2001b).

In studies examining respiratory effects, Fischer-344 rats and B6C3F1 mice (120 animals/sex) were exposed to concentrations of 0, 2.0, 5.6, or 14.3 ppm formaldehyde vapor for 6 hours/day, 5 days/week for 24 months (Kerns et al., 1983). The exposure period was followed by up to six months of non-exposure. Interim sacrifices were conducted at 6, 12, 18, 24, 27, and 30 months. Both male and female rats in the 5.6 and 14.3 ppm groups demonstrated decreased body weights over the two-year period. At the 6 month sacrifice, the rats exposed to 14.3 ppm formaldehyde had non-neoplastic lesions of epithelial dysplasia in the nasal septum and turbinates. As the study progressed, epithelial dysplasia, squamous dysplasia, and mucopurulent rhinitis increased in severity and distribution in all exposure groups. In mice, cumulative survival decreased in males from 6 months to the end of the study. Serous rhinitis was detected at 6 months in the 14.3 ppm group of mice. Metaplastic and dysplastic changes were noted at 18 months in most rats in the 14.3 ppm group and in a few mice in the 5.6 ppm exposure group. By 24 months, the majority of mice in the 14.3 ppm group had metaplastic and dysplastic changes associated with serous rhinitis, in contrast to a few mice in the 5.6 ppm group and a few in the 2 ppm group (exact number not given).

Woutersen et al. (1989) exposed male Wistar rats (60 animals/group) 6 hours/day for 5 days/week to 0, 0.1, 1.0 and 10 ppm formaldehyde vapor for 28 months. Compound-related nasal lesions of the respiratory and olfactory epithelium were observed only in the 10 ppm group. In the respiratory epithelium, the lesions consisted of rhinitis, squamous metaplasia and basal cell/pseudoepithelial hyperplasia. In the olfactory region, the lesions included epithelial degeneration and rhinitis. No differences in behavior or mortality were noted among the various groups. However, growth retardation was observed in the 10 ppm group from day 14 onwards. In a parallel study, male Wistar rats were exposed to 0, 0.1, 1.0 and 10 ppm formaldehyde for 3 months followed by a 25-month observation period. Compound-related histopathological changes were found only in the noses of the 10 ppm group and comprised increased incidence of squamous metaplasia of the respiratory epithelium, and rhinitis.

In a chronic exposure study that primarily investigated aspects of nasal tumor development, Monticello et al. (1996) examined nasal cavities of male F-344 rats (0-10 ppm, 90 animals/group; 15 ppm, 147 animals) following exposure to 0, 0.7, 2, 6, 10, and 15 ppm formaldehyde for 6 hours/day, 5 days/week for 24 months. Treatment-related decreases in survival were apparent only in the 15 ppm group. Nasal lesions at the two highest doses included epithelial hypertrophy and hyperplasia, squamous metaplasia, and a mixed inflammatory cell infiltrate. Lesions in the 6 ppm group were minimal to absent and limited to focal squamous metaplasia in the anterior regions of the nasal cavity. No formaldehyde-induced lesions were observed in the 0.7 or 2 ppm groups.

Kamata et al. (1997) exposed 32 male F-344 rats/group to gaseous formaldehyde at 0, 0.3, 2, and 15 ppm 6 hours/day, 5 days/week for up to 28 weeks. A room control, non-exposed group was also included in the study. Five animals per group were randomly selected at the end of the 12, 18, and 24 months, and surviving animals at 28 months were sacrificed for full pathological evaluation. Behavioral effects related to sensory irritation were evident in the 15 ppm group. Significant decreases in food consumption, body weight and survival were also evident in this group. No exposure-related hematological findings were observed. Biochemical and organ weight examination revealed decreased triglyceride levels and absolute liver weights at the highest exposure, but was likely related to reduced food consumption. Abnormal histopathological findings were confined to the nasal cavity. Inflammatory cell infiltration, erosion or edema of the nasal cavity was evident in all groups, including controls. Significantly increased incidence of non-proliferative (squamous cell metaplasia without epithelial cell hyperplasia) and proliferative lesions (epithelial cell hyperplasia with squamous cell metaplasia) were observed in the nasal cavities beginning at 2 ppm. In the 0.3 ppm group, a non-significant increase in proliferative nasal lesions (4/20 animals) were observed in rats that were either sacrificed or died following the 18th month of exposure.

Rusch et al. (1983) exposed groups of 6 male cynomolgus monkeys, 20 male or female rats, and 10 male or female hamsters to 0, 0.2, 1.0, or 3.0 ppm (0, 0.24, 1.2, or 3.7 mg/m^3) formaldehyde vapor for 22 hours/day, 7 days/week for 26 weeks. There was no treatment-related mortality during the study. In monkeys, the most significant findings were hoarseness, congestion and squamous metaplasia of the nasal turbinates in 6/6 monkeys exposed to 2.95 ppm. There were no signs of toxicity in the lower exposure groups. In the rat, squamous metaplasia and basal cell hyperplasia of the nasal epithelia were significantly increased in rats exposed to 2.95 ppm. The same group exhibited decreased body weights and decreased liver weights. In contrast to monkeys and rats, hamsters did not show any signs of response to exposure, even at 2.95 ppm.

Kimbell et al. (1997) exposed male F-344 rats ($\leq$ 6/group) to 0, 0.7, 2, 6, 10, and 15 ppm 6 hr/day, 5 days/week for 6 months. Squamous metaplasia was not observed in any regions of the nasal cavity in any of the control, 0.7, or 2 ppm groups. However, the extent and incidence of squamous metaplasia in the nasal cavity increased with increasing dose beginning at 6 ppm.

In subchronic studies, Wilmer et al. (1989) found that intermittent (8 hours/day, 5 days/week) exposures of rats to 4 ppm formaldehyde for 13 weeks resulted in significant histological changes in the nasal septum and turbinates. In contrast, continuous exposure of rats for 13 weeks to 2 ppm formaldehyde did not produce significant lesions. This study revealed the concentration dependent nature of the nasal lesions caused by formaldehyde exposure. Zwart et al. (1988) exposed male and female Wistar rats (50 animals/group/sex) to 0, 0.3, 1, and 3 ppm formaldehyde vapor for 6 hr/day, 5 days/week for 13 weeks. Compound related histopathological nasal changes varying from epithelial disarrangement to epithelial hyperplasia and squamous metaplasia were found in the 3 ppm group, and were restricted to a small area of the

anterior respiratory epithelium. These changes were confirmed by electron microscopy and were not observed in other groups.

Woutersen et al. (1989) exposed rats (20 per group) to 0, 1, 10, or 20 ppm formaldehyde 6 hours/day, 5 days/week for 13 weeks. Rats exposed to 20 ppm displayed retarded growth, yellowing of the fur, and significant histological lesions in the respiratory epithelium. Exposure to 10 ppm did not affect growth, but resulted in significant histological lesions in the respiratory tract. No effects on specific organ weights, blood chemistries, liver glutathione levels, or urinalysis were detected at any level. No significant adverse effects were seen at the 1.0 ppm exposure level.

Appelman et al. (1988) found significant nasal lesions in rats (20 per group; 0, 0.1, 1.0, or 10.0 ppm) exposed to 10 ppm formaldehyde 6 hours/day, 5 days/week for 52 weeks, but exposure to 1.0 ppm or less for this period did not result in nasal histological lesions. However, the rats exposed to formaldehyde displayed decreased body weight in all groups compared with controls.

Apfelbach and Weiler (1991) determined that rats (5 exposed, 10 controls) exposed to 0.25 ppm (0.38 mg/m^3) formaldehyde for 130 days lost the olfactory ability to detect ethyl acetate odor.

Maronpot et al. (1986) exposed groups of 20 mice to 0, 2, 4, 10, 20, or 40 ppm formaldehyde 6 hours/day, 5 days/week, for 13 weeks. Histological lesions in the upper respiratory epithelium were seen in animals exposed to 10 ppm or greater. Exposure to 40 ppm was lethal to the mice.

A six-month exposure of rats to 0, 0.5, 3, and 15 ppm formaldehyde (3 rats per group) resulted in significantly elevated total lung cytochrome P450 in all formaldehyde-exposed groups (Dallas et al., 1989). The degree of P450 induction was highest after 4 days exposure and decreased slightly over the course of the experiment.

A series of studies have addressed the effects of long-term repeated exposures to formaldehyde on altered functioning of the hypothalamic-pituitary-adrenal (HPA) axis (Sorg et al., 2001b) and on neurobehavioral changes in rats (Sorg et al., 2001a). To study formaldehyde's effects on the HPA, Sorg et al. (2001b) measured corticosterone levels in the trunk blood of male Sprague-Dawley rats 20 or 60 min following acute chamber exposures to air or formaldehyde (0.7 or 2.4 ppm). All groups showed increased corticosterone levels above naive basal levels at 20 min followed by a return to baseline by 60 min, with no differences between treatment groups. A second experiment assessed the effects of repeated formaldehyde exposure (1 h/day, 5 days/week for 2 or 4 weeks) on basal corticosterone levels and those after a final challenge. Basal corticosterone levels were increased above naive values after 2 week exposure to air or 0.7 ppm formaldehyde. By 4 weeks, corticosterone levels in the air group returned to naive values, but remained elevated in the 0.7 ppm formaldehyde group. There were no differences in basal corticosterone levels among either 2.4 ppm exposed groups. After a final air or formaldehyde challenge, the 2 and 4 week air and 0.7 ppm formaldehyde groups had elevated corticosterone levels similar to their acute

response, while in the 2 and 4 week 2.4 ppm formaldehyde groups, corticosterone levels were higher than their acute response levels, indicating enhanced reactivity of the HPA axis to subsequent formaldehyde. It thus appears that repeated low-level formaldehyde exposure alters HPA axis functioning and the release of stress hormones. Since glucocorticoids may stimulate or inhibit the synthesis of surfactant-associated proteins in the lung (Liley et al., 1988), the alteration of HPA function may represent another pathway by which formaldehyde affects pulmonary function. For example, the pulmonary surfactants that regulate surface tension in the lungs are in turn regulated by surfactant-associated proteins. Reports of lower airway discomfort associated with chronic formaldehyde exposure may be related to the altered release or activity of these surfactant-associated proteins in the lung.

In another study of the effects of formaldehyde and the hypothalamus-pituitary-adrenal (HPA) axis, Sari et al. (2004) exposed female C3H/He mice to formaldehyde (0, 80, 400, 2000 ppb) by inhalation for 16 h/day, 5 days/week, for 12 weeks. Immunocytochemistry was used to examine corticotropin releasing hormone (CRH)-immunoreactive (ir) neurons in the hypothalamus, and adrenocorticotropin hormone (ACTH)-ir cells in the pituitary. RT-PCR was used to quantify ACTH rnRNA in the pituitary. Two groups of female mice were exposed, one of which comprised control mice with no allergen exposure. The other group was made allergic by injection of ovalbumin and alum prior to exposure to formaldehyde. Animals in the second group were further exposed to aerosolized ovalbumin as a booster four times during the exposure period. In the non-allergic group, formaldehyde caused a dose-dependent increase in the number of CRH-ir neurons with a similar pattern of increases in ACTHir cells and ACTH mRNA. The allergic mice showed an increase in basal levels of all these markers of HPA activity, and were responsive to the lowest concentration of formaldehyde. Thus at low levels of exposure, allergen and formaldehyde exposure exacerbate each other's effects on the stress response of the HPA.

7. Developmental and Reproductive Toxicity

In humans there are few data on the association of teratogenicity or adverse reproductive effects with formaldehyde exposure. Existing data do not suggest that formaldehyde, by inhalation or oral routes, produces significant teratogenic or reproductive effects (ATSDR, 1999).

A developmental toxicity study on formaldehyde was conducted by Martin (1990). Pregnant rats (25 per group) were exposed to 0, 2, 5, or 10 ppm formaldehyde for 6 hours/day, during days 6-15 of gestation. Although exposure to 10 ppm formaldehyde resulted in reduced food consumption and body weight gain in the maternal rats, no effects on the number, viability or normal development of the fetuses were seen. In addition, Saillenfait et al. (1989) exposed pregnant rats (25 per group) to 0, 5, 10, 20, or 40 ppm formaldehyde from days 6 - 20 of gestation. Maternal weight gain and fetal weight were significantly reduced in the 40 ppm exposure group. No significant fetotoxicity or teratogenic defects were observed at formaldehyde levels that were not also maternally toxic.

Evidence of embryotoxicity was reported by Kitaeva et al. (1990) in embryos of rats that had been exposed to formaldehyde by inhalation 4 h/d, 5 d/wk for 4 months. At 1.5 mg/m^3, but not at 0.5 mg/m^3, there was a significant increase in the proportion of degenerate embryos. By comparison, the bone marrow cells of the mothers appeared to be more sensitive to formaldehyde as shown by significant increases in the numbers of cells with aberrations, and the numbers of chromosomes with aberrations and aneuploidy at both dose levels.

In the context of developmental susceptibility to formaldehyde exposure, as noted above, the respiratory tract lining fluid (RTLF) protecting the lungs is often lower in glutathione levels than is the RTLF of adult lungs (Reise et al., 1997). This is especially true in premature infants who later develop chronic lung disease (Grigg et al., 1993). As glutathione is central to the lungs' antioxidant defenses, and is involved in the metabolism of inhaled formaldehyde, this relative deficiency may make the neonate's and infant's developing lungs more susceptible to toxic insult. It should be noted that ascorbate is also an important component of the lung's antioxidant defense, especially when glutathione levels are depressed (Jain et al., 1992). In healthy lungs, ascorbate helps to maintain glutathione levels. However, as is the case for glutathione, ascorbate levels in RTLF drop during the first week following birth (Vyas et al., 2001), potentially adding to the neonate's susceptibility to glutathione-reactive substances. Indeed, alterations in lung development following early life air toxicant exposure has been shown for environmental tobacco smoke (Wang and Pinkerton, 2007) and ozone (Plopper et al., 2007). Whether early life exposure to formaldehyde has similar effects on lung development remains to be demonstrated. However, there is concern that allergen exposure can modulate trophic interactions of conducting airway epithelial and interstitial wall components (Finkelstein and Johnston, 2004) and alter postnatal development of the airways (Plopper et al., 2007). This, coupled with the ability of formaldehyde to enhance the immune response to proteins/allergens with which it binds (Thrasher et al., 1987, 1990), may render developing lungs more susceptible to formaldehyde exposure. If evidence of such developmental effects associated with formaldehyde exposure becomes available, a re-evaluation of the REL for formaldehyde may be necessary.

8. Derivation of Reference Exposure Levels

8.1 Formaldehyde Acute Reference Exposure Level

Study	Kulle et al., 1987
Study population	19 nonasthmatic, nonsmoking humans
Exposure method	Whole body to 0.5-3.0 ppm
Exposure continuity	Single exposure per concentration
Exposure duration	3 hr
Critical effects	mild and moderate eye irritation
LOAEL	1 ppm
NOAEL	0.5 ppm
Benchmark concentration	0.44 ppm
Time-adjusted exposure	not applied
Human Equivalent Concentration	not applied
LOAEL uncertainty factor (UF_L)	not applied
Subchronic uncertainty factor (UFs)	not applied
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default, human study)
Toxicodynamic (UF_{A-d})	1 (default, human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (site of contact; no systemic effects)
Toxicodynamic (UF_{H-d})	10 (asthma exacerbation in children)
Cumulative uncertainty factor	10
Reference Exposure Level	**55 μg/m^3 (44 ppb)**

Acute Reference Exposure Levels are levels at which intermittent one-hour exposures are not expected to result in adverse health effects (see Section 5 of the Technical Support Document).

Kulle et al (1987) was chosen as the critical study for the determination of the acute REL as it used a sensitive endpoint, eye irritation. It featured human subjects showing significant ($p < 0.05$) responses with short-term exposures to a range of formaldehyde concentrations, and the data permitted the use of a benchmark concentration (BMC) approach. As described in the technical support document, OEHHA recommends the use of the BMC approach whenever the available data support it as the BMC method provides a more statistically sound estimate of the point of departure in the REL determination.

The proposed acute REL was based on a $BMCL_{05}$ for eye irritation, estimated using log-probit analysis (Crump, 1984). The $BMCL_{05}$ is defined as the 95% lower confidence

limit of the concentration expected to produce a response rate of 5%. The resulting $BMCL_{05}$ from this analysis was 0.44 ppm (0.53 mg/m^3) formaldehyde. The endpoint of eye irritancy appears to be more a function of formaldehyde concentration rather than duration of exposure (Yang et al., 2001), so no time correction factor was applied. An uncertainty factor (UF_{H-k}) of 1 was used since sensory irritation is not expected to involve large toxicokinetic differences among individuals. Although the toxicological endpoint is eye irritation, the REL should protect against all possible adverse effects. The respiratory irritant effect, with documented potential to exacerbate asthma, is clearly an effect with the potential to differentially impact infants and children. In addition, the ability of formaldehyde to exacerbate the immune response to aeroallergens is of especial concern during development of the lungs. The toxicodynamic component of the intraspecies uncertainty factor UF_{H-d} is therefore assigned an increased value of 10 to account for potential asthma exacerbation. These considerations are applied equally to the acute, 8-hour and chronic REL.

As noted in Section 5.1, contact lens wearers appear to be at greater risk for ocular irritation with formaldehyde exposure. However, since contact lens users, and infants and children are generally mutually exclusive groups, it is expected that with the ten-fold toxicodynamic UF_{H-d} described above, the acute REL should be adequately protective of these individuals as well.

8.2 Formaldehyde 8-Hour Reference Exposure Level

Study	Wilhelmsson and Holmstrom, 1992
Study population	66 chemical plant workers
Exposure method	Discontinuous occupational exposure
Exposure continuity	8 hr/day, 5 days/week (assumed)
Exposure duration	10 years (average); range 1-36 years
Critical effects	Nasal obstruction and discomfort, lower airway discomfort, and eye irritation.
LOAEL	Mean 0.26 mg/m^3 (range 0.05 – 0.6 mg/m^3) (described as exposed group)
NOAEL	Mean of 0.09 mg/m^3 (described as control group of office workers)
Benchmark concentration	not derived
Time-adjusted exposure	0.09 mg/m^3 (time adjustment not applied)
Human Equivalent Concentration	not applied
LOAEL uncertainty factor (UF_L)	1 (NOAEL observed)
Subchronic uncertainty factor (UFs)	not applied
Interspecies Uncertainty Factor	
Toxicokinetic (UF_{A-k})	1 (default, human study)
Toxicodynamic (UF_{A-d})	1 (default, human study)
Intraspecies Uncertainty Factor	
Toxicokinetic (UF_{H-k})	1 (site of contact; no systemic effects)
Toxicodynamic (UF_{H-d})	10 (asthma exacerbation in children)
Cumulative uncertainty factor	10
Reference Exposure Level	**9 μg/m^3 (7 ppb)**

The 8-hour Reference Exposure Level is a concentration at or below which adverse noncancer health effects would not be anticipated for repeated 8-hour exposures (see Section 6 in the Technical Support Document).

The 8-hour REL is based on the occupational study by Wilhelmsson and Holmstrom (1992). This study evaluated the effects of formaldehyde on the upper airways of adult human subjects exposed to a mean formaldehyde concentration of 0.26 mg/m^3 during the work day compared with a referent group exposed to 0.09 mg/m^3. The critical effects in this study included nasal obstruction and discomfort, lower airway discomfort, and eye irritation. A NOAEL and a LOAEL may be derived from these data but no other dose-response information was provided. This study included only adults, but there is evidence that children may be more susceptible to long term exposures to formaldehyde than are adults. Thus, in the absence of child-specific data, an intraspecies uncertainty factor of 10 for toxicodynamic variability and developmental susceptibility was applied.

For comparison, the 8-hour REL of 9 μg/m³ is similar to the value of 10 μg/m^3 based on increased pulmonary resistance in guinea pigs following an 8 hr exposure to 0.11 – 1.05 ppm formaldehyde (Swiecichowski et al., 1993). The NOAEL of 0.59 ppm in guinea pigs was adjusted to a Human Equivalent Concentration (HEC) of 0.49 ppm with a regional gas dose ratio (RGDR) of 0.826. Use of the HEC adjustment entails an interspecies uncertainty factor of 6, while an intraspecies uncertainty factor of 10 addresses toxicodynamic variability.

Study	Swiecichowski et al., 1993
Study population	25-35 adult male guinea pigs
Exposure method	Whole body exposure
Exposure continuity	
Exposure duration	8 hr
Critical effects	Increased specific pulmonary resistance
LOAEL	1.0 ppm
NOAEL	0.59 ppm
Benchmark concentration	not derived
Time-adjusted exposure	not applied
Human Equivalent Concentration	0.49 ppm (610 μg/m^3) (0.59 * RGDR 0.826 for pulmonary effects)
LOAEL uncertainty factor (UF_L)	1 (default: NOAEL observed)
Subchronic uncertainty factor (UFs)	not applied
Interspecies Uncertainty Factor	
Toxicokinetic (UF_{A-k})	6 (with HEC adjustment)
Toxicodynamic (UF_{A-d})	1 (with HEC adjustment)
Intraspecies Uncertainty Factor	
Toxicokinetic (UF_{H-k})	1 (no systemic effect)
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	60
Reference Exposure Level	**10 μg/m³ (8 ppb)**

8.3 Formaldehyde Chronic Reference Exposure Level

Study	Wilhelmsson and Holmstrom, 1992 supported by Edling et al., 1988
Study population	66 human chemical plant workers
Exposure method	Discontinuous occupational exposure
Exposure continuity	8 hr/day, 5 days/week (assumed)
Exposure duration	10 years (average); range 1-36 years
Critical effects	Nasal obstruction and discomfort, lower airway discomfort.
LOAEL	Mean 0.26 mg/m^3 (range 0.05 – 0.6 mg/m3) (described as exposed group)
NOAEL	Mean of 0.09 mg/m^3 (described as control group of office workers)
Benchmark concentration	not derived
Time-adjusted exposure	0.09 mg/m^3 for NOAEL group
Human Equivalent Concentration	not applied
LOAEL uncertainty factor (UF_L)	not applied
Subchronic uncertainty factor (UFs)	not applied
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default, human study)
Toxicodynamic (UF_{A-d})	1 (default, human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (no systemic effects)
Toxicodynamic (UF_{H-d})	10 (potential asthma exacerbation in children)
Cumulative uncertainty factor	10
Reference Exposure Level	**9 µg/m^3 (7 ppb)**

The chronic Reference Exposure Level is a concentration at which adverse noncancer health effects would not be expected from chronic exposures (see Section 7 in the Technical Support Document).

The study by Wilhelmsson and Holmstrom (1992) was selected for development of the chronic REL as it investigated long-term exposure to formaldehyde relatively free of other confounding exposures. From this study it was possible to determine both a NOAEL and a LOAEL. Since this study included only adults, a combined intraspecies uncertainty factor of 10 for toxicodynamic variability was applied to account for the possibly greater susceptibility of children with long term exposures to formaldehyde.

The susceptibility of young children was examined in a study by Rumchev et al. (2002) that compared children (mean age 25 mo) with a clinical diagnosis of asthma to children without this diagnosis. The LOAEL used (60 µg/m^3) represents the formaldehyde level at which the authors found a statistically elevated risk for asthma-related respiratory symptoms. For this comparison, the NOAEL was taken to be 30 µg/m^3, the lower end of the NOAEL range. Intraspecies uncertainty factors of 3.16 for potential

toxicodynamic variability and 1 for toxicokinetic differences give a cumulative uncertainty factor of 3.16 for an inhalation chronic REL of 10 μg/m^3 (8 ppb), similar to the chronic REL calculated from the critical study.

Study	Rumchev et al., 2002
Study population	88 asthmatic children (mean age 25 mo); 104 nonasthmatic controls (mean age 20 mo)
Exposure method	Ambient in home
Exposure continuity	Continuous assumed
Exposure duration	range 0.5-3 years
Critical effects	Parent-reported respiratory symptoms (cough, shortness of breath, wheeze, trouble breathing)
LOAEL	60 μg/m^3
NOAEL	30 μg/m^3 (lower limit of NOAEL range)
Benchmark concentration	not derived
Time-adjusted exposure	not applied
Human Equivalent Concentration	30 μg/m^3
LOAEL uncertainty factor (UF_L)	1
Subchronic uncertainty factor (UFs)	not applied
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default, human study)
Toxicodynamic (UF_{A-d})	1 (default, human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	1 (study performed in children)
Toxicodynamic (UF_{H-d})	√10 (inter-individual variation)
Cumulative uncertainty factor	√10
Reference Exposure Level	**10 μg/m^3 (8 ppb)**

The Rumchev study supports an association with exposure to formaldehyde and the observation of asthma symptoms (cough, shortness of breath, wheeze, trouble breathing) in children. However, it was not selected for REL development due to the difficulties in distinguishing asthma from other wheezing conditions in the clinical diagnoses in such a young population. There are additional uncertainties associated with the exposure continuity, and the possibility of observational and/or recall bias in the parental reports of respiratory symptoms characteristic of asthma.

For comparison with the chronic REL of 9 μg/m^3 (7 ppb) presented above, Table 8.3.1 below presents a summary of potential formaldehyde RELs based on chronic and subchronic animal studies originally presented in OEHHA (2000). The toxicological endpoint was nasal lesions, consisting principally of rhinitis, squamous metaplasia, and dyplasia of the respiratory epithelium.

The most striking observation is the similarity of potential RELs among the rat chronic studies (exposures ≥ 26 weeks) that contain a NOAEL. The range of RELs from these animal studies, 1.5 – 24.9 ppb, includes the proposed REL (7 ppb) based on a human

study. Another related observation is that the NOAEL and LOAEL are similar among all the studies, regardless of exposure duration. The NOAEL and LOAEL are generally in the range of 1 - 4 ppm and 1 – 10 ppm, respectively, with the exception of the study by Kamata et al. (1997) that may be due to the absence of a dose level between 2 and 0.3 ppm. It is also of interest that the studies of Rusch et al (1983) indicate that monkeys and rats are of about the same sensitivity. In addition, the results of the Rusch studies suggest that, at least for the endpoint of squamous metaplasia, formaldehyde concentration is more important than the total dose since these animals, receiving more continuous exposure, exhibited the same adverse effects seen in studies using more intermittent exposures.

ATSDR has estimated minimum risk levels (MRLs), defined as "an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncarcinogenic) over a specified duration of exposure" (ATSDR, 1999). For formaldehyde inhalation exposures they describe as "acute" (≤ 14 days), the MRL is 40 ppb based on a LOAEL of 0.4 ppm from a study by Pazdrak et al. (1993), and a 9-fold uncertainty factor (3 for use of a LOAEL; 3 for intraspecies variability). This exposure period is much longer than the acute REL of one hour, but the acute REL represents possibly repeated exposures. The MRL for an "intermediate" exposure period of 15-364 days is 30 ppb based on a NOAEL of 0.98 ppm for clinical signs of nasopharyngeal irritation and lesions in the nasal epithelium in monkeys (Rusch et al., 1983). A chronic MRL (≥ 365 d) of 8 ppb was developed based on damage to nasal epithelium in chemical factory workers (Holmstrom et al., 1989). This number is similar to the chronic REL of 7 ppb reported here. The MRLs are more similar to the chronic RELs developed by OEHHA in that they assume continuous exposure over the specified time period rather than regular but periodic exposures, as assumed for the 8-hour RELs considered above. For 8-hr exposures, NIOSH (1988) suggested a TWA 8-hr REL of 16 ppb based on sensory irritation.

8.4 Formaldehyde as a Toxic Air Contaminant

Formaldehyde was identified by the ARB as a toxic air contaminant (TAC) in accordance with sections 39660-39662 of the California Health and Safety Code on March 12, 1992 (Title 17, California Code of Regulations, section 93001)(CCR, 2007). In view of the differential impacts on infants and children identified in Section 6.2, OEHHA recommends that formaldehyde be listed as a toxic air contaminant which may disproportionately impact children pursuant to Health and Safety Code, Section 39669.5(c).

TABLE 8.3.1. SUMMARY OF CHRONIC AND SUBCHRONIC FORMALDEHYDE STUDIES IN EXPERIMENTAL ANIMALS

Study	Animal	Duration	Exposure	LOAEL ppm	NOAEL ppm	Time adj	DAF	LOAEL UF	UFak	UFad	UFhk	UFhd	UFsc	Cum UF	REL ppb	REL µg/m3
Woutersen 89	rat	28 mo	6 h 5 d	9.8	1	0.179	0.148	1	1	3.16	1	10	1	30	4.9	6.1
Kerns 83	rat	24 mo	6 h 5 d	2	n/a	0.357	0.296	6	1	3.16	1	10	1	200	1.5	1.8
Monticello 96	rat	24 mo	6 h 5 d	6.01	2.05	0.366	0.304	1	1	3.16	1	10	1	30	10.1	12.6
Kamata 97	rat	24-28 mo	6 h 5 d	2	0.3	0.054	0.044	1	1	3.16	1	10	1	30	1.5	1.8
Appelman 88	rat	52 wk	6 h 5 d	9.4	1	0.179	0.148	1	1	3.16	1	10	1	30	4.9	6.1
Rusch 83	rat	26 wk	22 h 7d	2.95	0.98	0.898	0.746	1	1	3.16	1	10	1	30	24.9	30.8
Kimbell 97	rat	26 wk	6 h 5 d	6	2	0.357	0.296	1	1	3.16	1	10	1	30	9.9	12.3
Wilmer 89	rat	13 wk	8 h 5 d	4	2	0.238	0.198	1	1	3.16	1	10	1	30	6.6	8.2
Woutersen 87	rat	13 wk	6 h 5 d	9.7	1	0.179	0.148	1	1	3.16	1	10	1	30	4.9	6.1
Zwart 88	rat	13 wk	6 h 5 d	2.98	1.01	0.180	0.15	1	1	3.16	1	10	1	30	5.0	6.2
Kerns 83	mouse	24 mo	6 h 5 d	5.6	2	0.357	0.296	1	2	3.16	1	10	1	60	4.9	6.1
Maronpot 86	mouse	13 wk	6 h 5 d	10.1	4.08	0.729	0.605	1	2	3.16	1	10	1	60	10.1	12.5
Rusch 83	monkey	26 wk	22 h 7d	2.95	0.98	0.898	not used	1	2	2	1	10	1	40	22.5	27.8

9. References

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Manganese and Compounds Reference Exposure Levels

1. Summary

Acute inhalation of high levels of manganese results in a nonspecific pulmonary edema, while chronic manganese inhalation leads to a characteristic neurotoxicity known as manganism with strong similarities to Parkinson's disease. Manganism is characterized by motor deficits (dystonia, altered gait, fine tremor, generalized rigidity) and may include psychiatric disturbances. At low manganese levels and in the absence of frank manganism, subtle deficits in cognitive and neurobehavioral functions have been reported in both adults and children. Neurodevelopmental deficits have been associated with early life exposure to excessive manganese and include impaired intellectual performance and behavioral disinhibition. The studies described in this document include those published through the Spring of 2008. The RELs below are applicable to all respirable inorganic manganese compounds.

1.1 Manganese Acute REL

An acute REL for manganese was not developed at this time.

1.2 Manganese 8-Hour REL

Reference Exposure Level	**0.17 µg/m^3**
Critical effect(s)	Impairment of neurobehavioral function in humans
Hazard index target	Nervous system

1.3 Manganese Chronic REL

Reference Exposure Level	**0.09 µg/m^3**
Critical effect(s)	Impairment of neurobehavioral function in humans
Hazard index target(s)	Nervous system

2. Physical and Chemical Properties

Table 2.1 Manganese and Manganese Species*

Molecular Formula	*Synonyms*	*Molecular Weight*	*CAS Reg. No.*
Mn	elemental manganese; colloidal manganese; cutaval	54.94 g/mol	7439-96-5
MnO	manganese oxide; manganese monoxide; manganosite	70.94 g/mol	1344-43-0
MnO_2	manganese dioxide; black manganese oxide	86.94 g/mol	1313-13-9
Mn_3O_4	manganese tetroxide; trimanganese tetraoxide; manganomanganic oxide	228.82 g/mol	1317-35-7
$MnCl_2$	manganese chloride; manganese dichloride; manganous chloride	125.84 g/mol	7773-01-5
$MnSO_4$	manganese sulfate	151.00 g/mol	7787-85-7
$KMnO_4$	potassium permanganate	158.03 g/mol	7724-64-7

Description	Lustrous, gray-pink metal (Mn); green (MnO), black (MnO_2) or pink ($MnCl_2$, $MnSO_4$), purple ($KMnO_4$) crystals; brownish-black powder (Mn_3O_4)
Molecular formula	see Table 2.1
Molecular weight	see Table 2.1
Density (in g/cm^3)	7.21-7.4 (Mn – depending on allotropic form); 5.43-5.46 (MnO); 4.88 (Mn_3O_4); 2.977 @ 25°C ($MnCl_2$)
Boiling point	2095°C (Mn); not available (MnO); not available (Mn_3O_4); 1190°C ($MnCl_2$); 850°C ($MnSO_4$)
Melting point	1246°C (Mn); 1839°C (MnO); 1567°C (Mn_3O_4); 650°C ($MnCl_2$) (CRC, 2005); 700°C ($MnSO_4$)
Vapor pressure	1 torr @ 1292°C (Mn); non-volatile at room temperature (Mn_3O_4); not available (MnO; $MnCl_2$)
Solubility	Sol. in dil. acids and aq. solns. of Na- or K-bicarbonate (Mn); sol. in NH_4Cl, insol. in H_2O (MnO); insol. in H_2O, HNO_3, or cold H_2SO_4 (MnO_2 (Merck, 1976)); insol. in H_2O, sol. in HCl (Mn_3O_4); 72.3 g/100 ml H_2O @ 25°C ($MnCl_2$); sol in 1 part H_2O ($MnSO_4$); 72.3 g/100 ml H_2O ($KMnO_4$)
Conversion factor	Not applicable (dusts or powders)

3. Occurrence and Major Uses

Metallic manganese is used in the manufacturing of steel, carbon steel, stainless steel, cast iron, and superalloys to increase hardness, stiffness, and strength (HSDB, 2006). Manganese chloride is used in dyeing, disinfecting, batteries, and as a paint drier and dietary supplement. Manganese oxide (MnO) is used in textile printing, ceramics, paints, colored glass, fertilizers, and as food additives and supplements. Manganese dioxide is used in batteries and may also be generated from the welding of manganese alloys. Use of manganese-containing welding rods is a major source of occupational exposure to welders. Manganese tetroxide may be generated in situations where other oxides of manganese are heated in air (NIOSH, 2005). Manganese is also released into the air during the erosion of manganese-containing rock and alloys. Relatively high levels of manganese have been measured in subways (428 ng/m^3 vs 9.7 ng/m^3 ambient), presumably from the frictional erosion of manganese-containing steel (Crump, 2000). As methylcyclopentadienyl manganese tricarbonyl (MMT), manganese has found use as an octane enhancer in some unleaded gasolines and is released during fuel combustion as manganese sulfate, phosphate, and oxides. Manganese exposure may also be significant among farm workers using the fungicide Maneb (manganese ethylene-bis-dithiocarbamate).

Manganese is present in ambient air as particles, often associated with other metals or organic material. The size of these particles depends on their source, history and contents. For example, Singh et al. (2002) compared the metal contents and size distributions of particles at two sites in the Los Angeles Basin, Downey, which is in the vicinity of downtown Los Angeles and Riverside, 70 km east of Los Angeles. In Downey, 7% of the manganese was in ultrafine particles ≤ 0.1 µm, 38% was in fine particles of 0.35-1.0 µm, and less than 20% in the coarse (PM 2.5-10 µm) fraction. By comparison, in Riverside, less than 2% of the manganese was in ultrafine PM (≤ 0.1 µm) 8% in the 0.35-1.0 range, while nearly 80% was in the 2.5-10 µm fraction (Table 3.1).

TABLE 3.1 PARTICLE SIZE AND MANGANESE DISTRIBUTION

Particle size (µm)	Downey	Riverside
2.5-10	18%	77%
1-2.5	21%	12%
0.35-1	38%	8%
0.1-0.35	16%	1.5%
≤ 0.1	7%	1.3%

In contrast to Riverside, manganese measured in other urban settings tends to be mainly in the respirable fine fraction. In urban aerosols in Seville, Spain, manganese was found predominantly in fine particles < 0.61 µm (44%), with smaller amounts in coarse particles (> 10 µm, 17.8%; 4.9-10 µm, 18.3%) (Espinoza et al., 2001). A bimodal distribution of sizes was also found for manganese-containing aerosols in

Tihany, Hungary. The bulk of the manganese was found bound to organic matter and silicates in particles of approximately 0.118 µm, with smaller amounts in the 1.4-2.8 µm range (Hlavay et al., 1998). In cities in which the gasoline contains MMT, manganese is also predominantly in the fine (PM 2.5) fraction (Pellizzari et al., 2001). Since combustion is associated with the production of ultrafines, more research on airborne ultrafine manganese particles in areas where MMT is present in the gasoline is warranted

The 2004 annual statewide emissions of manganese reported in the most recent California Toxics Inventory (CARB, 2005a) were estimated to be 1,055 tons. For 2002, the mean statewide ambient level was 31.5 ng/m^3.

4. Metabolism / Toxicokinetics

Environmental manganese can enter the body primarily by oral and inhalation routes. Dermal absorption of manganese is insignificant through intact skin; however, broken skin would obviously allow more access to manganese (e.g., potassium permanganate) and other poorly dermally absorbed compounds. Parenteral exposures have occurred through parenteral feeding and more recently i.v. drug abuse, leading to human disease. Manganese is an essential element normally absorbed from the intestinal tract as part of the diet. It is estimated that 2 to 5% of ingested manganese is retained in the adult body (Andersen et al., 1999). Retention can be up to 41% in breast-fed infants, and 20% in formula-fed infants (Dorner et al., 1989). Manganese absorption is increased (along with iron absorption) when there is a deficiency of iron in the diet (Davis et al., 1992). Ascorbic acid, calcium and phosphorus also affect manganese utilization (ibid).

As part of the normal manganese homeostatic mechanism, high levels of dietary manganese diminish absorption from the intestinal tract. Manganese appears to be absorbed from the gut largely in the divalent form, with approximately 80% of absorbed manganese subsequently bound in plasma to $ß_1$-globulin and albumin (Foradori et al., 1967). These manganese-protein complexes are efficiently removed from the blood by the liver and returned to the gut in bile for elimination, thus establishing an entero-hepatic circuit for manganese. In the blood, unbound manganese may be converted by ceruloplasmin to the trivalent cation which is then bound by transferrin. Transferrin-manganese complexes are much less efficiently removed by the liver and thus survive first pass elimination to circulate throughout the body (Gibbons et al., 1976). In the brain, transferrin receptors in the capillary beds may mediate uptake in regions with efferents to the nucleus accumbens and the caudate putamen. Other mechanisms also appear to contribute to brain uptake of manganese including a divalent metal transporter (DMT-1), and a less well-defined non-saturable mechanism. From these sites, manganese is thought to move by neuronal transport to the pallidum, thalamic nuclei, and substantia nigra, areas involved with motor control and movement (Aschner et al., 2005). While at normal plasma levels, manganese enters the brain mainly across the capillary epithelium, at elevated levels of manganese in the blood, transport across the choroid plexus becomes more prominent (Aschner, 2000).

The mechanisms mentioned above are thought to apply generally to the transport of manganese across the blood brain barrier of adults. However, in the fetus and neonate, the blood brain barrier is characterized as having greater permeability to many substances, including manganese, and a different distribution of molecular transporters (Erikson et al., 2007b). In mice following a single parenteral administration of $MnCl_2$ on postnatal days 7, 14, or 42, maximum retention of manganese in the brain occurred 24 hours after exposure and was 3.5%, 2.5%, and 0.3%, respectively, of the administered dose. For manganese administered on day 0, the maximum brain concentration (2.9%) occurred 43 days later, suggesting a lack of perinatal homeostatic control (Valois and Webster, 1989). The approximately ten-fold higher brain levels following dosing on days 0-14 compared with day 42 indicate a more rapid and extensive uptake of manganese from the blood in neonates compared with adults. The drop in maximum brain levels between days 14 and 42 is thought to reflect attainment of adult blood brain barrier function on day 21.

Manganese may be introduced directly into the blood during parenteral feeding or during injection of illicit designer drugs contaminated with permanganate. As with the inhalation route described below, parenteral administration of manganese avoids first pass clearance of manganese by the liver, and may result in high exposure of all organs to manganese.

Manganese exposure via the pulmonary route leads to more rapid absorption with higher efficiency, and with greater transfer to the brain compared with other routes (Drown et al., 1986; Roels et al., 1997). In experiments in 3-month old rats, Roels et al. (1997) used intratracheal instillation as a surrogate for inhalation for comparison with the oral route (gavage). Intratracheal instillation of $MnCl_2$ (1.22 mg/kg, once weekly for four weeks) raised the steady state manganese levels 68% in blood, 205% in the striatum, 48% in the cortex, and 27% in the cerebellum compared to controls. By gavage, a much higher dose of $MnCl_2$ (24.3 mg/kg) was required to achieve the same blood levels (68%). However, by this route, manganese levels in the striatum and cerebellum were not affected, and levels in the cortex were raised by only 22% (Table 4.1). In animals given a single intratracheal dose of $MnCl_2$ (1.22 mg/kg bw), blood manganese levels peaked within 30 min at 7,050 ng/100 ml. This was followed by a gradual decline but blood levels remained elevated over controls for at least 24 hours. By comparison, the single oral administration of 24.3 mg $MnCl_2$/kg bw resulted in a five-fold lower peak blood level of 1,660 ng/100 ml after one hour, followed by a return to control levels in 12 hours. Thus, compared to ingestion, inhalation of a relatively water soluble form of manganese leads to a rapid increase in blood levels that remain higher for longer, and results in higher brain manganese levels.

TABLE 4.1 INCREASE IN TISSUE MANGANESE BY ROUTE AND CHEMICAL FORM

Chemical Form and Route	Increase in Tissue Manganese (%)			
	Blood	Striatum	Cortex	Cerebellum
$MnCl_2$ Intratracheal (1.2 mg/kg)	68	205	48	27
$MnCl_2$ Gavage (24.3 mg/kg)	68	0	22	0
MnO_2 Intratracheal (1.2 mg/kg)	41	48	34	31
MnO_2 Gavage (24.3 mg/kg)	0	0	0	0

Using the same exposure protocol with the less soluble MnO_2, intratracheal instillation raised manganese levels 41% in blood, 48% in striatum, 31% in cerebellum, and 34% in cortex. By contrast, neither blood nor brain levels were increased following oral exposure (Table 4.1). As with $MnCl_2$, Mn blood levels following intratracheal MnO_2 reached a higher peak value (1,760 ng Mn/100 ml; 200% increase) than that achieved after gavage (900 ng/100 ml; 27% increase). Blood levels rose more slowly than with $MnCl_2$, starting at 48–72 hr after intratracheal instillation and peaking at 168 hr. By gavage, blood levels rose gradually to peak at 144 hr (Roels et al., 1997). In these studies, the solubility of the manganese complexes influenced the rate of absorption by either route, but in both cases inhalation resulted in substantially higher blood and brain levels.

In a further demonstration of the dependence of tissue distribution on oxidation state and route of exposure, Reaney et al. (2006) exposed 8-month old rats to 0, 2, or 6 mg/kg Mn(III)-pyrophosphate or $Mn(II)Cl_2$ intraperitoneally (i.p.) for five weeks. Significantly higher blood manganese levels were seen with Mn(III) vs equimolar Mn(II). A dose-dependent increase in brain manganese was observed, with Mn(III) producing levels that were 25% higher than following Mn(II). This may be related to the higher blood levels of manganese achieved with Mn(III) vs Mn(II) via the i.p. route. Examination of the striatum, globus pallidus, thalamus, and cerebral cortex by PIXE (particle induced x-ray emission; an x-ray fluorescence technique) revealed no differences in the distribution of manganese across these brain regions. There were, however, differences among regions in response to the concentration and oxidation state of the manganese. In the globus pallidus, the highest cumulative dose (90 mg/kg) of both forms of manganese increased GABA levels compared to controls (15-30%, $p = 0.037$). By contrast, dopamine levels in globus pallidus at this dose were increased by 60% with Mn(III), but decreased by 40% with Mn(II). The mechanism behind this differential effect is not clear but suggests that manganese oxidation states are important in manganese toxicity.

Drown and colleagues studied the distribution of soluble $^{54}MnCl_2$ and insoluble $^{54}Mn_3O_4$ after instillation into the adult rat lung (Drown et al., 1986). Initially the soluble form of manganese distributed more rapidly from the lung to the peripheral tissues than did the insoluble form. After two weeks the rates of distribution of the two forms became almost equal. Manganese (^{54}Mn) reached higher concentrations in the liver, kidney, and gastrointestinal tissues, but persisted longer in the heart, brain, and bone. The manganese was eliminated mainly in bile with very little elimination in urine.

The influence of solubility on tissue distribution was examined with aerodynamically similar aerosols of three manganese compounds of differing solubilities ($MnPO_4$, $MnSO_4$, and Mn_3O_4) in rats following inhalation (6 hr/day, 14 days) at 0, 0.03, 0.3, and 3.0 mg/m^3. At comparable dose levels, animals exposed to $MnSO_4$ had lower lung manganese levels than those exposed to either Mn_3O_4 (Dorman et al., 2001) or $MnPO_4$ (Vitarella et al., 2000), suggesting more rapid pulmonary clearance of the most soluble form. Consistent with this observation, after exposure to 3 mg/m^3, manganese levels in the olfactory bulb and striatum were highest with $MnSO_4$, followed by Mn_3O_4, then $MnPO_4$. As observed by Drown et al. (1986) and Roels et al. (1997) for intratracheal instillation, the more soluble forms of manganese accumulate in the brain more quickly following inhalation than do the less soluble compounds (Normandin et al., 2004).

For humans with occupational and/or environmental exposures, the main route of exposure is via inhalation. In both cases the manganese is usually in the form of particulates of various sizes. Manganese deposited in the lung can be absorbed directly into the blood stream, or can migrate (by mucociliary transport) into the upper respiratory tract and then be swallowed for possible absorption in the GI tract. In experimental animals, inhaled manganese may be transported via olfactory nerves directly to the brain following absorption from nasal passages (Brenneman et al., 2000; Dorman et al., 2002a; Elder et al., 2006; Dorman et al., 2006a). Neither pulmonary nor gastrointestinal absorption is required for this route of exposure, and the blood-brain barrier is bypassed. Evidence for absorption of particulate manganese oxide from the nose and transport to the brain was provided by Elder et al. (2006) in rats. Manganese concentrations in the olfactory bulb increased 3.5-fold following 12 days of intranasal instillation of ultrafine manganese oxide particles (3-8 nm) in both nares. With occlusion of the right nostril and instillation in the left naris, manganese accumulated almost exclusively in the left olfactory bulb. In this experimental paradigm, instillation of either the soluble manganese chloride or the insoluble manganese oxide particles (solubilization rate 1-1.5% per day) in the patent naris resulted in comparable levels of manganese in the ipsilateral side of the olfactory bulb. This, in conjunction with the observation that an increase in manganese in the olfactory bulb was detectable within 30 minutes of the instillation, suggests that particulate rather than dissolved manganese was the form transported to the brain. While instillation is not inhalation, this study does indicate absorption of manganese ultrafine particles occurs across the nasal epithelium with direct transport to the brain.

The deposition and uptake of manganese from the upper and lower airways is also influenced by particle size. Rats with nose-only exposure to MnO_2 aerosols of 1.3 and 18 µm mass median aerodynamic diameters (MMAD) showed higher levels of manganese in the lungs and olfactory bulbs following 15 days of inhalation exposure to the smaller (1.3 µm) versus larger (18 µm) particles (Fechter et al., 2002). Thus, while there was greater deposition of large particle manganese in the nasal passages compared with small particles, uptake from the nose was more efficient with the smaller particles. In addition, for the smaller particles, the lungs were a larger reservoir for more continuous systemic uptake of inhaled manganese. Thus the evaluations of potential toxicity from inhaled manganese must consider not only the chemical form of manganese, but also the particle size as important determinants of the toxicokinetics.

This may be particularly relevant to combustion products of MMT in which particle size is of 0.2-0.4 µm (Ter Haar et al., 1975). The inhalation toxicity of manganese-containing particles in this size range has received less attention than the larger fine and coarse particles.

More evidence for direct nose to brain transport in primates was provided by magnetic resonance imaging (MRI) studies in adult rhesus monkeys exposed by inhalation to manganese sulfate for 6 hours/day, 5 days/week for 13 weeks (Dorman et al., 2006a). Increases in signal intensity on T1-weighted images of various brain regions were well correlated with manganese levels measured upon necropsy. Increases in mean pallidal manganese concentrations of approximately 1.7-, 2.7-, and 6-fold over air-exposed controls were seen following exposure to $MnSO_4$ at 0.19, 0.97, and 4.55 mg/m^3, respectively. The particles at these three concentrations had MMAD of 1.73, 1.12, and 2.12 µm, respectively (1.04, 1.07, 1.12 µm geometric mean diameter (GMD), respectively). As expected, much higher increases in manganese concentrations were observed in olfactory epithelium, bulb, tract, and cortex. Lower but statistically significant ($p < 0.05$) increases were also observed in the putamen, white matter, and cerebellum. This study provided no evidence for translocation of manganese from the olfactory bulb to other brain regions, consistent with uptake from the blood as the source of manganese in the globus pallidus. However, the resolution of the MRI used in this study did not allow visualization of individual nerve tracts to rule out direct transfer of manganese between brain regions. Nevertheless, this study provides evidence for axonal transport from the nasal epithelium at least as far as the olfactory bulb in primates.

The major route of excretion of manganese is via bile, although a lesser amount is excreted via urine (Davis et al., 1993). That the liver maintains homeostasis of manganese can be seen by the fact that patients with cirrhosis of the liver accumulate abnormally high levels of manganese in their brains, especially in the globus pallidus (Rose et al., 1999). Similarly, rats that have a liver bypass also show high levels of manganese in the brain, especially in the globus pallidus (Rose et al., 1999).

Neonatal humans do not excrete manganese for the first two to three weeks of life. The intestinal barrier to manganese absorption is also immature in premature and neonatal infants (Cawte, 1985).

The toxicokinetics of manganese may also influence and be influenced by other metals. There is evidence that manganese uptake from the intestinal tract (Mena, 1974; Erikson et al., 2002), lungs (Brain et al., 2006), and nose (Thompson et al., 2007), is enhanced by iron deficiency. Rats rendered anemic by periodic bleeding absorbed significantly higher amounts of manganese (Brain et al., 2006). In each of these studies, brain levels of manganese were increased by iron deficiency. Based on data from NHANES III, the prevalence of iron deficiency among infants 1-2 years of age was 9%, and 9-11% among adolescent girls and women of child-bearing age. For comparison, the prevalence among teenage boys and men less than 50 years of age was 1%. Among older children and adults over 50 years of age, the prevalence of iron deficiency did not exceed 7% (Looker et al., 1997). Inasmuch as iron deficiency is a widespread condition

that disproportionately affects the young (Beard et al., 2001), children represent a more susceptible population.

Manganese may exist in eleven different valence states (-3 to +7) and may participate in a variety of oxidation-reduction reactions as a pro- or anti-oxidant. In biological systems, while the divalent (Mn^{2+}) and trivalent (Mn^{3+}) forms are most abundant, the trivalent form predominates in many tissues and appears to be responsible for manganese's pro-oxidant properties, possibly by its participation in Fenton-type reactions (HaMai et al., 2001). In vitro studies attempting to emulate conditions in the brain have shown that Mn^{3+}, but not Mn^{2+} (both as pyrophosphate), oxidizes dopamine, DOPA (a dopamine precursor), norepinephrine, and epinephrine to quinones and other products, with reduction of Mn^{3+} to $Mn(OH)_2$ (Archibald and Tyree, 1987). Polymerization of these catecholamine-derived quinones to form neuromelanin, from which the substantia nigra derives its name, is an O_2^--generating, auto-oxidative process that in turn enhances oxidation of Mn^{2+} to Mn^{3+}, thus increasing cellular oxidative stress.

The role of oxidative stress in manganese toxicity has been inferred in part from changes in cellular markers of oxidative stress upon exposure to high levels of manganese. As a result of participation in reactions with reactive oxygen species (ROS), levels of GSH in manganese-exposed cells decrease. This decrease may also reflect binding of GSH by manganese. Where metals are involved in the generation of ROS, metallothionein levels typically rise. Other markers, such as glutamine synthetase and tyrosine hydroxylase, are used due to their sensitivity to cellular oxidation states. In the hypothalamus of rats, subchronic inhalation exposure to $MnSO_4$ (0.03, 0.3, 3.0 mg/m^3) has been associated with a decrease in GSH and an increase in metallothionein mRNA, while the olfactory bulb experienced an increase in glutamine synthetase (Dobson et al., 2003). Similarly, subchronic inhalation of $MnSO_4$ (0.06, 0.3, 1.5 mg/m^3) by rhesus monkeys resulted in decreased tyrosine hydroxylase, glutamate transporter-1, glutamate/aspartate transporter, and glutamine synthetase (Erikson et al., 2007a). These changes reflect exposure to oxidative stress that impairs neurotransmitter synthesis, while increased metallothionein mRNA in all the brain regions examined (caudate, cerebellum, frontal cortex, globus pallidus, olfactory cortex, putamen) is a cellular response to ameliorate the effects of reactive oxygen species. Many of these effects were significantly different from controls starting at the lowest manganese concentration tested (0.06 mg/m^3). While these studies of manganese have focused on the role of metal-induced oxidative stress, the ability of manganese to bind to sulfhydryl groups, exemplified by GSH, suggests the possibility that manganese may also bind protein sulfhydryls. Indeed, the depletion of both protein- bound and non-protein sulfhydryls by manganese has been demonstrated in rat brains (Shukla and Chandra, 1977), and the possibility that such interactions alter the structure/function of key proteins has been theorized to represent an important mode of manganese toxicity (Martin, 1986).

The ability of manganese to readily bind thiol groups can enhance cellular susceptibility to oxidative stress by directly depleting GSH levels. However, manganese may also lower GSH levels indirectly by enhancing the autooxidation of cysteine, the rate limiting

precursor to glutathione (Wang and Cynader, 2001). In addition to making it unavailable for glutathione synthesis, the autooxidation of cysteine generates free radicals that are cytotoxic. Manganese III may oxidize cellular thiols, such as GSH and cysteine, to thiyl radicals (Wariishi et al., 1989). These may in turn participate in the oxidation of critical cellular components or signalling molecules as exemplified by the oxidation of dopamine by the cysteinyl thiyl radical (Shen and Dryhurst, 1998).

The effects of manganese on the markers of oxidative stress described above show an age and sex dependency. Juvenile (8 weeks) male and female rats, and senescent males (18 mo) breathed atmospheres containing $MnPO_4$ at 0.099 or $MnSO_4$ at 0.01, 0.098, or 0.478 mg Mn/m^3 (1.85, 1.92, 2.03 µm MMAD) for 6 hr/day, 5 day/wk for 13 weeks (Erikson et al., 2004). In young males, but not females or senescent males, there was an increase in glutamine synthetase levels in the hippocampus, but a decrease in the hypothalamus with both forms of manganese that was significant ($p < 0.05$) with exposure to $MnPO_4$. With exposure to the medium dose of $MnSO_4$, female and old, but not young, male rats showed significant decreases in glutamine synthetase levels in the hippocampus. Total GSH levels significantly decreased in the olfactory bulb of young males, but increased in females. In the striatum, GSH levels were significantly decreased in females and old males at all doses of $MnSO_4$, but were largely unchanged in young males. This is interesting in light of the observation by Dorman et al. (2004) that neither old age nor gender influenced delivery of manganese to the striatum. The decrease of GSH in the striatum in aged rats may be a result of the age-related loss of dopaminergic neurons, while the effect in females is suggested to be related to differences in levels of sex hormones between males and females. These data indicate that toxicokinetic and toxicodynamic characterizations of manganese must take age and gender into account.

That the chemical form and oxidation state of manganese is critical to its toxicokinetics is evident from the foregoing. No less critical to the toxicokinetics is the presence of manganese on or as nanoparticles versus free Mn_3O_4 in solution. The ability of manganese to cause oxidative stress in cultured human lung epithelial cells was assessed by measurement of reactive oxygen species (ROS) (Limbach et al., 2007). Nanoparticles (20-75 nm) of pure manganese, or silica doped with 0.5 and 1.6 wt % manganese, were suspended in culture medium at 30 ppm for comparison with the more soluble Mn_3O_4 at comparable concentrations. Compared with pure silica nanoparticles, particles doped with as little as 1.6 wt% manganese increased ROS in cultured cells by 2,500% while the free Mn_3O_4 increased ROS by only 400%. For comparison, in similar experiments Co_3O_4 particles were less than half as potent. In cell-free culture medium, ROS production was not different between the particles and the dissolved salt. This suggests that it is the dissolved metal, not the particles per se, that is responsible for the ROS generation, and that the nanoparticles function to facilitate manganese uptake by the cell.

5. Acute Toxicity of Manganese

Acute inhalation exposure to high levels of manganese as its oxides is associated with pulmonary edema and impaired function (Shiotsuka, 1984). The very small body of literature on acute toxicity includes two animal experiments involving acute exposures by inhalation. One is a two-hour exposure of 200 female CD-1 mice to manganese oxide (Mn_3O_4) aerosols (Adkins et al., 1980) that resulted in a NOAEL of 2.9 mg/m^3 based on respiratory effects (edema). The other is a 24 hr exposure of guinea pigs to 22 mg/m^3 MnO_2 (Bergstrom, 1977) that examined the effects of manganese exposure on pulmonary leukocytes, macrophages, and the clearance of bacteria from the lungs. However, since no dose response in lung wet:dry weight ratios was observed, no LOAEL was reported in the Adkins study, and the Bergstrom study employed a single exposure level. The accumulation of manganese in brain structures following acute inhalation exposure (Newland et al., 1987; Brenneman et al., 2000; Dorman et al., 2002a), and following intranasal instillation (Gianutsos et al., 1997) has been described; however, the toxicological consequences of these exposures were not reported. Neurobehavioral effects have been observed in mice following acute subcutaneous injections (Dodd et al., 2005), and in rats after a single oral administration of manganese (Shukakidze et al., 2003), but it is not clear how these routes of exposure compare to inhalation. No studies of acute manganese inhalation were located that demonstrated a dose-response or evaluated other toxicological endpoints.

6. Chronic Toxicity of Manganese

6.1 Chronic Toxicity to Adult Humans

Exposure of humans to manganese by inhalation leads to a suite of neurological effects called “manganism” (Lucchini et al., 1999). Frank manganism is a progressive disease that involves symptoms similar to those of Parkinson’s disease. Manganism is characterized by altered gait, fine tremor and occasionally psychiatric disturbances. The psychiatric disturbances are seldom seen in Parkinson’s disease, although dementia sometimes occurs late in this disease. Despite their similarities, the symptoms of manganism and Parkinson’s disease differ somewhat (Barbeau, 1984; Calne et al., 1994). Both manganism and Parkinson’s disease involve generalized bradykinesia and widespread rigidity. However, tremor is less frequent and dystonia more frequent in manganism. Manganism is also distinguished by a propensity to fall backward, failure to achieve a sustained therapeutic response to levodopa, and failure to detect a reduction in fluorodopa uptake by positron emission tomography (Calne et al., 1994). In Parkinsonism, the damage appears to be confined to the substantia nigra, whereas in manganism the damage is more widespread, involving other parts of the basal ganglia (Huang et al., 1998).

Manganese accumulates in certain brain structures, especially the extrapyramidal system. Structures rich in dopaminergic neurons show a heightened sensitivity to manganese toxicity. Within these tissues, manganese is found preferentially in mitochondria where it disrupts oxidative phosphorylation and mitochondrial function

(Gavin et al., 1999). Cytochrome c, released from damaged mitochondria, leads to apoptosis and loss of neurons (Malecki, 2001). Trivalent manganese can promote the formation of reactive oxygen species (HaMai et al., 2001) that can cause oxidative stress, which in turn has been shown to lead to apoptosis of neurons in the rat brain (Dobson et al., 2003). While individuals exposed to massive amounts of manganese show frank neurological symptoms as in the Groote Eylandt studies (Kilburn, 1987) and the industrial workers studies, individuals exposed to lesser amounts of manganese show more subtle neurological deficits in neurobehavioral tasks (Wennberg et al., 1992; Lucchini et al., 1999).

Adverse effects may occur at manganese exposure levels that are too low to cause frank manganism. Lucchini and his co-workers studied a group of 61 Italian ferroalloy workers who had been exposed to low levels of manganese dust by inhalation (Lucchini et al., 1999). These workers did not exhibit the frank signs of manganism, but they did exhibit subtler neurofunctional changes. The workers were exposed to a "current overall value" of 54 µg Mn per m^3 air at the time of the study, and an estimated average of 70.83 µg Mn dust/m^3 per year over an average 15.17 years of exposure. Earlier exposures were higher. In order to obtain a measure of cumulative exposure the investigators calculated a "cumulative exposure index" (CEI) for each worker based on their exposure history in the factory. For the purposes of analysis, workers were separated into three CEI groups of low CEI (< 500 µg/m^3 x yrs), mid CEI (500-1800 µg/m^3 x yrs), and high CEI (> 1800 µg/m^3 x yrs). The CEIs correlated positively with blood manganese levels. The workers were subjected to symptom questionnaires and neurobehavioral and neurophysiological testing for the purpose of finding whether neurological effects correlated with cumulative exposure. In multiple regression analyses, positive correlations were found between the log of the CEI and the following tests of the Swedish Performance Evaluations System: finger tapping in the dominant ($R = 0.32$, $p = 0.01$) and non-dominant ($R = 0.32$, $p = 0.01$) hands, Symbol Digit ($R = 0.33$, $p = 0.01$) and Digit Span ($R = 0.44$, $p = 0.004$). The moderate but significant correlation coefficients reported in this study suggest that manganese is an important contributor to these effects but likely not the only one. In addition, these results demonstrate that subtle neurological changes are taking place in workers exposed to relatively low levels of manganese in the absence of frank manganism. To identify safe exposure levels, the authors took the geometric mean of the mid CEI group (1113 µg/m^3 x yrs) and divided this by the geometric mean exposure time (11.51 yrs) to derive a value of 96.71 µg/m^3. When the low CEI group is used as the control group, this value represents the LOAEL for the observed neurobehavioral symptoms.

A battery of neurofunctional tests was also employed by Mergler et al. (1994) to document early nervous system dysfunction among workers with long-term (mean 16.7 yr) manganese exposure in a ferromanganese and silicomanganese alloy plant. Subjects (n = 115) were matched by age, educational level, and number of children to workers in the same geographical region but without exposure to metals or other neurotoxicants in the workplace. The test batteries assessed motor function (range, speed, stability, grip strength, manual dexterity, graphomotor) and sensory function (visual acuity, chromatic discrimination, contrast sensitivity, olfactory and vibrotactile threshold). A third battery assessed speech initiation and regulation, attention,

concentration and memory, cognitive flexibility, and affect. Environmental manganese levels were measured with personal monitors for total dust and manganese content (0.014 – 11.48 mg Mn/m^3), while stationary monitors measured manganese in respirable (0.001 – 1.273 mg/m^3) and nonrespirable dust. Manganese measured in blood was higher among manganese workers (1.03 vs 0.68 µg/100 ml, $p < 0.0001$), while urine levels were not significantly different.

On the tests of motor functions, the performance of manganese-exposed workers was significantly worse than controls ($p < 0.001$), with the greatest differences associated with tests requiring rapid, alternating, coordinated movements. While in the context of speech initiation and regulation there were no overall differences between groups, the manganese-exposed workers took significantly longer on the second trial of the digit naming test ($p = 0.05$) and made more errors ($p < 0.001$). Cognitive flexibility was also worse with manganese exposure ($p < 0.002$). Attention, concentration, and memory functions were similar between groups. In the comparison of mood states, manganese workers displayed significantly more tension ($p < 0.01$), anger ($p = 0.01$), fatigue ($p < 0.001$), and confusion ($p = 0.01$) than controls. The cross-sectional nature of this study precludes assigning symptoms of manganese toxicity to specific environmental levels of manganese since levels in the plant varied widely both spatially and likely historically. However, there was a strong association between blood levels of manganese and subtle neurobehavioral deficits.

Whether the neurobehavioral effects associated with occupational exposure to manganese are permanent or transitory has been the subject of several follow-up studies of occupational cohorts. Occupational exposure at the ferroalloy plant featured in the study above by Mergler et al. (1994) ceased with its closure in 1990. Fourteen years later, 69 of the original workers and 68 referents were re-examined with many of the same assessment tools used in the 1994 study (Bouchard et al., 2007a). After controlling for age, education, alcohol consumption, and smoking, manganese workers performed significantly worse on tests of motor function (Luria Motor Scale) than did referents in both the initial ($p < 0.001$) and follow-up ($p < 0.05$) evaluations, although the differences at follow-up were not as striking. The motor deficits that persisted between the initial and follow-up studies included slowing of simple and alternate movements, and poorer quality of form drawing. Deficits in hand steadiness observed in the initial study remained but were less pronounced at follow-up. These deficits were significantly associated with increasing levels of cumulative manganese exposure ($p < 0.05$). Although in the initial study, several tests of cognitive function showed significant deficits among the exposed workers, these differences were no longer evident at follow-up. In general, measures of mood states showed improvement over time. However, compared to referents, manganese workers tended to report more feelings of anger and hostility in both the initial and follow-up studies ($p < 0.1$). Feelings of confusion and bewilderment, while not different between groups in the initial study, were significantly more pronounced among manganese workers ($p < 0.05$) at follow-up and significantly associated with cumulative exposure ($p < 0.01$). In a neuropsychiatric profile, former manganese workers were significantly ($p < 0.05$) more likely to experience feelings of anger and depression than the referents (Bouchard et al., 2007b). In addition to the effects on the nervous system, in the present study former manganese workers had a

ten-fold increase in risk of respiratory problems. These two studies suggest that with cessation of manganese exposure, there is improvement in some neurological functions, but deficits in others remain.

While studies of the effects of manganese have tended to emphasize occupational exposures, a similar constellation of neurobehavioral effects has been found in a community study from which those with occupational exposures were excluded. Mergler et al. (1999) assessed nervous system functions in 273 individuals (151 women, 122 men) randomly selected from those living in proximity to a former manganese production plant in Southwest Quebec. A battery of tests similar to those of the occupational study above (Mergler et al., 1994) was used to profile nervous system function in relation to blood manganese levels. Motor skills and coordination, learning and recall, visual perception and speed, verbal naming, and cognitive flexibility were assessed. Blood manganese levels ranged from 2.5 to 15.9 µg/l, with results stratified by blood levels (low < 7.5 µg/l vs high >7.5 µg/l), age and sex. Elevated blood manganese (> 7.5 µg/l) was associated with poorer upper limb coordination ($p = 0.04$) and deficits in learning and recall, which was stronger in men ($p = 0.002$) than in women ($p = 0.04$). These deficits were more pronounced in older subjects with elevated blood manganese. The neurobehavioral effects reported here were observed at blood manganese levels lower than those of the occupational study above (0.75 µg/ 100 ml vs 1.03 µg/100 ml). The authors thus suggest that "manganese neurotoxicity can be viewed as a continuum of dysfunction, with early, subtle changes at lower exposure levels, progressing to more severe neurological disorders at the high exposure levels that have been observed in mining, industry and agriculture."

Male workers (n = 92, plus 101 matched controls) in an alkaline battery plant in Belgium exposed to manganese dioxide dust were the subjects of a cross-sectional epidemiological study (Roels et al., 1992). Total manganese concentrations and manganese dust were measured in the workers' breathing zones with personal samplers. Lifetime integrated respirable dust levels (LIRD) ranged from 0.04 to 4.43 mg Mn/m^3 * year, with a geometric mean of 0.793 mg Mn/m^3 * year. The average age of control and exposed groups was 30 years with a mean manganese exposure time of 5.3 years (0.2 to 17.7 years) for the latter group. In exposed workers, the geometric mean levels of blood and urine manganese (corrected for creatinine) were significantly higher ($p < 0.001$) than in controls. The subjects were also evaluated for neurobehavioral function, lung function, and hematological parameters. There were no significant differences in respiratory symptoms between those exposed and controls, and hematological parameters were in the normal range for both groups. In neurobehavioral tests, significant decrements in performance were found in exposed workers on tests for visual reaction time ($p < 0.001$), five measures of eye-hand coordination ($p < 0.005$), and in two of three tests of hand tremor ($p < 0.03$). The data for individuals in this study were used in a BMD analysis to calculate the 8-hr and chronic RELs.

In 1999, Roels et al. (1999) published a follow-up study of the cohort in the Roels et al. (1992) study described above. During the course of the present study, covering the years 1988-1995, the cohort dropped from 92 to 34 workers. Three neurobehavioral

assessments were made. Eye-hand coordination was tested yearly with an orthokinesimeter. Starting in 1991, yearly assessments were also made of visual reaction time, and hand steadiness with a hole tremormeter. Respirable manganese dust exposure was measured in a manner similar to that of the 1992 study using personal air monitors. Three levels of exposure (low, medium, and high), with average exposures from 1987-1992 of 400, 600, and 2,000 µg Mn/m^3, respectively, were compared with unexposed controls in a nearby chemical plant. After 1992, there was a substantial decline in manganese levels with the mean manganese levels dropping by the end of the study to 119, 181, and 744 $\mu g/m^3$ for the low, medium and high groups, respectively. In the low exposure group, the test of eye-hand coordination showed improvement with the decreasing manganese levels, and results were normal by the end of the study, while the effects in the higher exposure groups persisted. The time courses of the hand steadiness and visual reaction time tests showed no improvement and suggested irreversible impairment. Similarly, in neurobehavioral assessments of workers who had ceased manganese exposure, eye-hand coordination significantly improved, but deficits in hand steadiness and visual reaction time remained. These studies suggest that some of the neurological deficits improve when manganese exposure decreases, while others may be permanent.

Another follow-up among workers in the same plant covered by Roels et al., 1992 and 1999 was conducted by Crump and Rousseau (1999) for the years 1985-1996. This study covered 213 workers including 114 of the 140 originally tested by Roels. In this study the metric for manganese exposure was blood and urine levels, neither of which was associated with memory or eye-hand coordination tests. There were, however, marginally significant associations between manganese levels and poorer hand steadiness ($p = 0.05$). As in the Roels et al. (1999) follow-up, some neurobehavioral deficits improved with time and lower manganese levels; others appeared to be more permanent.

Welding in confined spaces represents a setting in which significant occupational inhalation exposure to manganese may occur. In an evaluation of 43 welders working on the San Francisco Bay Bridge, Bowler et al. (2007) documented decrements on neurological, neurophysiological, and pulmonary tests associated with exposure to a time-weighted average manganese dust level of 0.11-0.46 mg/m^3 for an average of 16.5 months. Manganese blood levels exceeded 10 µg/l in 43% of the workers. Multiple regression analyses against blood manganese and/or the individual's cumulative exposure index (CEI) revealed significant inverse dose-effect relationships with IQ ($p \leq 0.05$), executive function ($p \leq 0.03$), sustaining concentration and sequencing ($p \leq 0.04$), verbal learning ($p \leq 0.01$), working memory ($p \leq 0.04$), and immediate memory ($p \leq 0.02$) after adjustment for demographics and years of welding before working on the Bay Bridge. Spirometric measurements, taken at three time points, indicated declining lung function with manganese exposure. The first time point was after working on the bridge for an average of 1.5 months, the second after 10.8 months, and the third after 20.9 months. Between the first and third time points, measures of lung function decreased: 7% for FEV_1, 2% for FVC, and 21,2% for the FEV_1:FVC ratio ($p < 0.05$). In tests of mood and affect, the levels of clinical depression and anxiety among welders were greater than two standard deviations above the normative mean.

Neuropsychological tests of parameters characteristic of parkinsonism found that tremor was present 39-90% of the time on three different tests, postural sway was increased in about half of the welders, and motor dexterity and speed were impaired 52-95% of the time. Additional symptoms reported by the welders that showed significant negative correlations with the CEI included sexual function ($p < 0.05$), fatigue ($p < 0.05$), depression ($p < 0.01$), and headache ($p < 0.05$). Compared to test norms, olfaction was impaired in 88% of the welders. This study suffers from the absence of an unexposed control group for comparison. However, all welders were prescreened during the hiring process to ensure good health and fitness. Blood levels of copper, iron, and lead were also measured and considered to be in the normal range. This, coupled with the significant correlations between both blood and air manganese levels and the physiological and neurological decrements, strongly implicates manganese as a causative agent.

That an association between exposure to welding fumes and symptoms of neurotoxicity may be due to manganese was corroborated by magnetic resonance imaging (MRI) detection of characteristic bilateral hyperintense T1-weighted signals in the globus pallidus of eight welders referred for neurological assessment (Josephs et al., 2005). Among the six cases with multiple MRI follow-up scans, the intensity of the MRI signal among the four for whom manganese exposure was discontinued either remained the same (1 case) or faded (3 cases), indicating a loss of pallidal manganese. In the remaining two with continued exposure, the signal remained the same or increased in intensity. All cases presented multiple symptoms characteristic of manganism including postural tremors, reduced arm swing, ataxia, altered gait, multifocal myoclonus, and cognitive impairment. In addition, several cases reported irritability, memory loss, headaches, slurred speech, and reduced sexual drive. All cases had elevated or high normal serum manganese levels. This constellation of symptoms in association with manganese exposure and characteristic MRI images suggests a role for welding fumes in the development of manganism. Substantially similar symptomologies have been reported elsewhere in case studies of welders (Sadek et al., 2003). However, it is important to note that welding fumes are a mixture of metals, many of which are also neurotoxic and may contribute to the reported neurological symptoms.

The neurotoxic effects of exposure to welding fumes may be accompanied by pulmonary damage. Clara cells lining the airways normally secrete Clara cell protein (CC16) that has anti-inflammatory properties. Pulmonary damage that includes the Clara cells results in decreased recovery of CC16 in bronchoalveolar lavage fluid, as well as an increase in serum levels of CC16. The former effect is presumably due to reduced production by the affected Clara cells, while the latter is attributed to damage to the bronchoalveolar/blood barrier (Hermans et al., 1999). In ship welders, measures of serum CC16 levels, blood, urine and air manganese levels, pulmonary function (vital capacity), and subclinical neurological effects (EEG and visual evoked potential (VEP) were compared with unexposed controls (Halatek et al., 2005; 2008). During examinations that assessed both subjective and objective neurological status, 66% of the 59 workers reported subjective central nervous system symptoms, while 29% had abnormal VEP results and 41% had abnormal EEGs. Among welders showing neurological symptoms, blood manganese was significantly elevated (12.2 vs 6.1 µg/l, p

< 0.05) while vital capacity was significantly depressed (84.5%, p < 0.05) (Halatek et al., 2008). Multiple linear regression analysis revealed strong partial correlations between abnormal VEP and EEG, and both blood manganese (0.72, p = 0.03) and an index of cumulative manganese exposure (0.66, p = 0.01) (Halatek et al., 2005). Levels of CC16 were significantly correlated (0.82, p = 0.015) with abnormal VEP, EEG and CNS symptoms. The CC16 levels were significantly lower (9.6 µg/l, p < 0.05) among the younger welders who had fewer years of exposure (3 years) but higher blood manganese levels (13.7 µg/l), abnormal VEP and EEG results, and depressed vital capacity (83%). The authors suggest that the elevated CC16 levels indicate that welding fume exposure compromises pulmonary function, including that of the bronchoalveolar barrier. This in turn facilitates manganese access to the blood and brain, with the attendant subclinical neuropathological changes.

As mentioned in the study above, in addition to neurotoxicity, manganese inhalation may lead to symptoms of pulmonary toxicity. Indeed, the incidence of respiratory disease is higher among manganese-exposed workers than those not exposed (Boojar and Goodarzi, 2002). In a case report, Wittczak et al. (2008) present the study of a 42-year-old non-smoking welder with suspected occupational asthma. At admission, the patient presented with a recurrent nonproductive cough, and dyspnea with wheezing that usually occurred after 30-60 minutes of welding. Compared with non-work days, on the days the patient was exposed to welding fumes, he exhibited a greater than 20% variability in his peak expiratory flow rate (PEFR). Histamine challenge revealed significant bronchial hyperreactivity (PC_{20} = 0.5 mg/ml). In contrast to a placebo inhalation challenge (1% KCl solution), five minutes following a challenge with 0.1% MnCl solution, dyspnea occurred and forced expiratory volume (FEV1) dropped 45% . At one hour, FEV1 was 55% below resting levels, and only recovered to 35% below resting levels by 24 hours. At 4 and 24 hours post-exposure, changes in the proportions of eosinophils (8% and 10% resp.) and basophils (1% and 3%, resp.) were observed in induced sputum. None of these effects was observed in non-exposed controls after similar challenges. This constellation of symptoms and sensitivity to manganese challenge supports a role for manganese in occupational asthma.

Another occupational study of lower exposures was done in Sweden (Wennberg et al., 1992). In this study workers had been exposed for a year or more to manganese dust at mean concentrations of 0.18 mg/m^3 at one smelter, and 0.41 mg/m^3 at another. They were compared to workers at similar industrial plants without manganese exposure via a suite of neurological tests, including electroencephalogram, brainstem auditory evoked potential, event related auditory evoked potential, and diadochokinesometry (a test of the subject's ability to rotate a handle rapidly). Of these tests, the only one that produced significantly different results in the exposed subjects was the diadochokinesometry. The manganese-exposed workers were unable to rotate the handle as quickly as the control workers. This is interpreted as evidence of a "preclinical" effect of low-level manganese exposure.

A major study of non-industrial human exposures is the study of the natives of Groote Eylandt, a large island off the coast of Australia. The inhabitants of this island are Australian Aborigines. The island is so rich in manganese that the environment has

been described as a “manganese ecology” (Kilburn, 1987). The inhabitants are exposed by virtually all routes of exposure, but especially by ingestion of food and water high in manganese. Kilburn studied the natives of Groote Eylandt and compared them to a control group of Australian Aborigines living in another part of Australia. This paper does not quantitate the manganese exposures or body levels of manganese in the study population, and it would be difficult to quantitate exposures in this complex environmental situation. Kilburn reports certain congenital abnormalities, such as deformations of the foot (talipes equinovarus), closed anus (imperforate anus), and anorectal malformations, and neurobehavioral problems, including progressive muscle wasting (amyotrophy) and failure of muscle coordination (ataxia), that apparently occur with greater frequency in the islanders than in the control groups, but these could also be due to genetic factors present in this small population. Indeed all of the problems were seen in just two pedigrees. A likely interpretation would be that the adverse health effects observed reflect gene-environment interactions.

Exposure to excess manganese may occur via the parenteral route, especially in individuals receiving total parenteral nutrition (TPN). Unfortunately, patients receiving TPN are often those with liver damage and/or gastrointestinal disorders, both of which compromise the hepatobiliary circuit by which the body regulates retention of dietary manganese. Manganese intoxication in these cases typically manifests as confusion, dysarthria, rigidity, gait disturbances, and hypokinesia, and is generally confirmed by marked hyperintensity of the globus pallidus by magnetic resonance imaging (MRI) (Ono et al., 1995; Nagatomo et al., 1999). Symptomatic improvement and reversion to more normal T1-weighted MRI images following discontinuation of manganese supplementation support the diagnosis of manganism. While the parenteral route is thus involved in the increased risk of hypermanganesaemia during TPN, it is also involved in the recent rise in cases of manganism in adults associated with long-term intravenous use of illicit designer drugs. Sikk et al. (2007) described four cases of young adults presenting with symptoms of manganism (including impaired postural control, unsteady gait, manual dysfunction) in conjunction with long-term (7 months – 8 years) repeated use of the psychostimulant ephedrone. In two cases, drug use started as young as 17 and 19 years of age. The synthesis of ephedrone involved the oxidation of pseudoephedrine with potassium permanganate, which remained in the injected solution. Based on the drug injection history of two of the cases, and an analysis of the manganese content of a similarly synthesized ephedrone preparation, the authors estimate a total body burden of manganese corresponding to 900 and 500 mg/kg body weight compared to a normal body burden of 10-20 mg/kg (Schroeder et al., 1966). Cranial MRI of two individuals with exposures and symptoms similar to those described by Sikk et al. revealed hyperintense patterns in the globus pallidus indicating an abnormally high accumulation of manganese (Meral et al., 2007).

6.2 Chronic Toxicity to Infants and Children

Manganese is an essential nutrient, but it has toxic effects if exposure is excessive or prolonged, especially if exposure is by the inhalation route. A number of studies have reported correlations between early life exposure to excessive manganese and symptoms of impaired neurodevelopment as revealed on neurobehavioral tests and in

poorer academic performance. In a prospective study of the neurobehavioral effects of *in utero* exposure to manganese, Takser et al. (2003) reported an inverse correlation between cord blood manganese at birth and three subscales of psychomotor development (McCarthy scales of children's abilities) measured at three years of age (n = 126): attention (partial r = -0.33, $p < 0.01$), nonverbal memory (partial r = -0.28, $p < 0.01$), and hand skills (partial r = -0.22, $p < 0.05$). The adverse effects of manganese on neurodevelopment in these children persisted after adjustment for gender and maternal education, although the effects of manganese on hand skills were only observed in boys. Similarly, Collipp et al. (1983) used a battery of tests, including cognitive and projective tests, psycho-educational evaluation, speech, language and hearing evaluations, and social services evaluations, to identify 16 children who were hyperkinetic and exhibited learning disabilities. In comparison with 44 normal children of the same age, significantly elevated levels of hair manganese (0.434 µg/g; measured at 8 years of age) were reported in children with learning disabilities and hyperactivity compared with normal children (0.268 µg/g) ($p < 0.05$). An association between poorer performance in school and elevated hair manganese (1.242 µg/g) has also been observed among children in China compared with children with more normal manganese levels (Zhang et al., 1995).

Wasserman et al. (2006) reported adverse effects of manganese in 10-year old children (n = 142) in Bangladesh who had been exposed to manganese in their drinking water (< 200, 200-499, 500-999, > 1,000 µg/l). Comparing the lowest and highest dose groups (< 200 vs. > 1,000 µg/l), significant decrements in intellectual function at 9.5-10.5 years of age were revealed in scores on the Wechsler Intelligence Scale for Children-III with increasing daily intake of manganese (full scale, $p < 0.0001$; performance, $p < 0.0001$; verbal, $p < 0.02$). The scores of children with intermediate manganese exposures were also lower than those of the lowest dose group, but not significantly so. In this study, confounding by co-exposure to arsenic was limited by including only children whose drinking water contained < 10 µg As/l. Scores were adjusted for maternal education and intelligence, house type, television, child height and head circumference. Blood levels of manganese, arsenic and lead were also determined and added to the core model. In this case, only blood lead was correlated with decreased intellectual performance. However, in a simultaneous analysis of water manganese, water arsenic, and blood lead, the negative association between manganese water levels and intellectual function test scores remained (Full-Scale ß = -4.56, $p < 0.01$; Performance ß = -3.82, $p < 0.01$).

The uptake of metals into developing teeth provides a record of gestational exposure to manganese. In multiple regression analyses, after controlling for lead, high levels of manganese incorporated into teeth during the 20th week of gestation were positively correlated with behavioral disinhibition at 36 months of age (R = 0.48, $p < 0.01$) and, at 54 months, with impulsive errors on the Mirsky Continuous Performance Test (R = 0.48, $p < 0.01$) and the Children's Stroop Test (R = 0.38, $p < 0.01$). Positive correlations with manganese were also seen in ratings made by both parents and teachers of externalizing and attention problems on the Child Behavior Checklist in the 1st (R = 0.40 – 0.47, $p < 0.05$) and 3rd grades (R = 0.38 – 0.48, $p < 0.05$), and in the 3rd grade with the teachers' ratings on the Disruptive Behavior Disorders Scale (R = 0.44, $p < 0.05$),

ADHD (R = 0.48, p < 0.01), and hyperactivity – impulsivity (R = 0.55, p < 0.01). In contrast, manganese levels in tooth enamel formed in the 62-64th week of gestation (i.e., postnatally) were correlated only with teachers' reports of externalizing behaviors in the 1st (R= 0.40, p < 0.05) and 3rd grades (R = 0.57, p < 0.01). It thus appears that high prenatal manganese exposure may adversely affect behaviors expressed postnatally. There was, however, no correlation between tooth manganese and cognitive ability as measured on the Woodcock-Johnson Psycho-Educational Battery (Ericson et al., 2007).

Subtle neurobehavioral effects were seen in a case report of a 10-year old boy exposed for five years to elevated manganese in the family's drinking water (Woolf et al., 2002). The boy's hair manganese was high (3,091 ppb vs normal reference < 260 ppb), as was that of his 16 year-old brother (1,988 ppb). Neuropsychological tests on the 10 year-old revealed intact global cognitive skills but striking deficits in visual and verbal memory (< 20th percentile in the Wide Range Assessment of Visual-motor Abilities). No obvious neurobehavioral problems were noted for either the parents or the older sibling.

As with adults, children receiving long-term parenteral nutrition are at greater risk of hypermanganesaemia. This is especially problematic since it is often the premature infants that require TPN. Among infants receiving parenteral nutrition containing supplemental manganese, MRI scans revealed bilaterally symmetrical hyperintense signals in the globus pallidus associated with movement disorders (dystonia and abnormal posturing) (Fell et al., 1996), and in basal ganglia, brainstem, and cerebellum associated with seizures (Komaki et al., 1999). In one infant these effects developed within eight months (Fell et al., 1996). While an abnormally high T1-weighted MRI signal suggests high brain manganese levels, especially when removal of manganese results in gradually diminishing signal intensity, it should be noted that not all patients with elevated brain manganese develop overt neurological symptoms. Kafritsi et al. (1998) reported on siblings receiving parenteral nutrition for 63 and 23 months that resulted in elevated blood manganese levels of 323 nmol/l and 516 nmol/l, respectively (normal = 73-210 nmol/l) and hyperintense signals in the globus pallidi. The signal intensity reverted to normal following cessation of manganese supplementation with no evidence of abnormal neurological development at three years of follow up. Whether either child had subclinical effects or effects that will manifest only later in life is unknown.

6.3 Animal Studies of Chronic Toxicity

Animal studies of the toxic effects of chronic manganese exposure have focused on altered neurobehavior and the effects of manganese on the associated brain structures. These studies indicate that differences in age at exposure, route, and chemical form of the metal are critical to the distribution of manganese, and the type and extent of the adverse effects.

Early life exposure to air borne manganese may occur by multiple routes: in utero via the mother, and perinatally via milk ingestion and inhalation. To examine the effects of these exposures on tissue concentrations of manganese in adult and young rats, adult

male and female rats were exposed to $MnSO_4$ (0.05, 0.5, or 1 mg Mn/m^3; 1.05 µm GMD) or air 28 days prior to breeding, for up to 14 days during the mating period, during gestation days 0-19, and from one day post-partum through postnatal day (PND) 18 (Dorman et al., 2005a). Exposures were for 6 hr/day, 7 days/week. While these exposures did not affect maternal brain, lung, pancreas, or liver weights, the high dose (1 mg/m^3) was associated with decreased brain weights in pups on PND 14, female pups on PND 19, and male pups on PND 45. Measurements of manganese in the striatum, cerebellum, and olfactory bulb of neonatal rats on PND 19 showed statistically significant and dose-dependent increases relative to controls. On PND 18, maternal olfactory bulb, striatum, and cerebellum also had significantly ($p < 0.05$) elevated manganese from exposures to 0.5 mg/m^3 and above. Measurements made 27 days following exposure cessation on PND 45 showed that all tissue manganese levels had returned to control values. However, some pups on PND 45 still showed decreased brain weights suggesting that high early-life manganese exposure may result in prolonged alterations in brain size. By PND 63, all brain weights were at control values, but whether structural or functional deficits were present was not determined in this study.

Some consequences of early life exposure to manganese may not manifest until later in life. This appears to be the case for prenatal exposure to the manganese-containing fungicide Maneb (manganese ethylene-bis-dithiocarbamate), followed later in life by exposure to the pesticide paraquat and the development of symptoms of manganism. It has been reported previously (Thiruchelvam et al., 2000) that mice treated with Maneb twice a week for six weeks showed reduced motor activity immediately after treatment, with recovery of function in 24 hours. This effect was not seen with paraquat alone but was enhanced by co-exposure to paraquat. In these mice, co-exposure reduced tyrosine hydroxylase and dopamine transporter immunoreactivity in dorsal striatum. Similarly, only the combined Maneb/paraquat exposure decreased striatal tyrosine hydroxylase protein levels, caused reactive gliosis in dorsal-medial but not ventral striatum, and reduced tyrosine hydroxylase immunoreactivity and cell counts in the substantia nigra but not ventral tegmental area.

Barlow et al. (2004) extended these observations to early life susceptibility with the treatment of pregnant mice with Maneb, paraquat, or saline on gestation days 10-17. As adults, these mice received challenge exposures for eight days to either Maneb or paraquat on postnatal days 45-55. Prior to the challenge exposures, locomotor activity was evaluated but no significant differences among groups were found. On the eighth day of challenge exposures, locomotor activity was depressed in all animals exposed to Maneb as adults, but recovered to control levels within one week of the last challenge exposure, except for males prenatally exposed to Maneb and subsequently exposed to paraquat as adults. These males showed a 95% reduction in locomotor activity, while similarly exposed females showed no effects. In the context of dopaminergic neurochemistry, neither prenatal exposure to Maneb alone nor adult exposure to paraquat alone caused significant change in either gender. However, compared to male controls and paralleling the locomotor effects, males receiving Maneb prenatally and paraquat as adults had 50% lower striatal dopamine levels, 35% lower 3,4-dihydroxyphenylacetic acid (DOPAC, a dopamine metabolite) levels, and 40% greater

dopamine turnover. In the substantia nigra pars compacta, these males showed a loss of tyrosine hydroxylase-positive neurons of 30% compared with saline-treated males ($p < 0.001$), 30% compared with males receiving Maneb prenatally and saline as adults ($p < 0.001$), and 21% compared with males receiving paraquat as adults only ($p < 0.05$). The reduction in tyrosine hydroxylase positive neurons only occurred with Maneb followed by paraquat, not following Maneb alone. These results suggest that prenatal exposure to Maneb causes damage to the nigrostriatal region of the male brain that is only revealed in adulthood following another neurotoxic insult in the form of paraquat. While these experiments do not demonstrate that it is the manganese in Maneb that is responsible for the observed neurotoxicity, the types of toxicity described are similar to those observed for other manganese compounds. These experiments also do not address the potentially enhanced neurotoxicity associated with more continuous exposure to manganese as Maneb during prenatal to adult development. However, long-term exposure to Maneb among adult farm workers has been associated with the development of symptoms of Parkinson's Disease, characteristic of manganism (Ferraz et al., 1988; Meco et al., 1994). It should also be noted that while this experimental design emphasized the neurotoxicity of the sequential exposure to Maneb, then paraquat, it is possible that the deleterious effects of exposure to other neurotoxic substances during development or adulthood would also be enhanced by early life exposure to manganese-containing pesticides.

The relative sensitivity of neonatal and adult CD rats to manganese-induced neurotoxicity was studied by administering manganese dichloride orally to rats at doses of 0, 25, and 50 mg/kg per day (Dorman et al., 2000). Adults and pups were dosed for 21 consecutive days, and then were evaluated with behavioral tests such as pulse elicited startle response amplitude, and in terms of manganese levels in striatum, hippocampus, hindbrain, and cortex. Neonatal rats exposed at the highest level of manganese showed a statistically significant increase in amplitude of acoustic startle response. They also showed increases in brain levels of manganese. The results suggest that neonates may be at greater risk for manganese-induced neurotoxicity when compared to adults receiving high oral levels of manganese. The authors state that there are known pharmacokinetic processes that may relate to the increase in brain manganese concentration in neonatal rats including increased manganese absorption from the juvenile gastrointestinal tract, an incompletely formed blood-brain barrier, and a virtual absence of excretory mechanisms until weaning.

The effects of manganese inhalation on levels of the metal in various tissues has been explored in Rhesus monkeys. In a study by Dorman et al. (2006b), Rhesus monkeys, 20-24 months of age, inhaled manganese sulfate (60, 300 or 1,500 $\mu g/m^3$; 1.04, 1.07, 1.12 µm; GMD, respectively) 6 hours per day, 5 days per week for 13 weeks. At termination, tissue manganese levels were significantly ($p < 0.05$) elevated in all tissues examined, except testes, in animals exposed to the highest dose (1,500 $\mu g/m^3$). Even at the lowest dose (60 $\mu g/m^3$), manganese levels were significantly elevated in four of the eight brain regions examined, globus pallidus, putamen, white matter and cerebellum (Table 6.3.1). For comparison, the table includes manganese levels in these same brain regions reported below by Schneider et al. (2006) and Guilarte et al. (2006) for monkeys displaying neurobehavioral toxicity. To facilitate comparison with

human occupational studies, an annual dose is also presented showing the calculated air concentration had the dose levels been spread over a period of one year. In the study by Roels et al (1992), used for the development of the REL (Section 8), a similar measure of the annualized exposure was calculated as the lifetime integrated respirable dose (LIRD). In the Roels study, neurotoxicity was observed in individuals with LIRDs in the range of 60 to 3,715 µg*yr/m^3, a range that overlaps the concentrations used by Dorman that resulted in brain levels associated with neurotoxicity by Schneider and Guilarte. Although the brain levels of manganese were not measured in workers showing neurotoxicity in the Roels study, these studies in primates provide support that the air concentrations to which the workers were exposed was sufficient to result in brain manganese levels with which neurotoxicity is associated in primates.

TABLE 6.3.1 MANGANESE LEVELS IN PRIMATE BRAIN AFTER INHALATION OR IV EXPOSURE

	Dorman et al., 2006			Schneider et al., 2006/
	Inhalation level			Guilarte et al., 2006
	60 µg/m^3	**300 µg/m^3**	**1,500 µg /m^3**	**3.26-4.89 mg Mn/kg***
Caudate	0.47 µg/g	0.69 µg/g	1.72 µg/g	1.18 µg/g
Putamen	0.58	0.75	1.81	1.50
Globus pallidus	0.80	1.28	2.94	3.30
White matter	0.25	0.39	0.87	0.57
Annual dose**	**15 µg*yr/m^3**	**75 µg*yr/m^3**	**375 µg*yr/m^3**	

* Neurotoxicity reported in monkeys with the indicated brain Mn levels.
* Roels reported neurotoxicity at an overlapping range: LIRD = 60 - 3,715 µg*yr/m^3

Neurobehavioral effects may be preceded by changes in brain chemistry. Such changes were studied in four female rhesus monkeys exposed in an inhalation chamber to 30 mg/m^3 respirable manganese dust for five hours/day, five days/week (Bird et al., 1984). After two years the animals were sacrificed and compared to unexposed controls. The exposed monkeys showed decreased dopamine in the caudate and globus pallidus, as well as a 60 to 80 percent increase in manganese levels in the basal ganglia of the brain. However, the exposed monkeys did not exhibit any of the movement disorders that are characteristic of Parkinson's disease.

In another study of the effects of manganese inhalation on neurotransmitters in rhesus monkeys (20-24 months old), Struve et al. (2007) found that subchronic (13 wk) exposure to manganese sulfate resulted in statistically significant increases in mean manganese concentrations in the pallidus and putamen at 0.06, 0.3, and 1.5 mg/m^3 (MMAD 1.73, 1.89, 2.12 µm) , and in the caudate at ≥ 0.3 mg/m^3. Marginally statistically significant ($p < 0.1$) changes in neurotransmitter levels were seen only at the highest manganese concentration (1.5 mg/m^3) in the globus pallidus for GABA and 5-HIAA, and in the caudate for norepinephrine. This is consistent with the suggestion that manganese neurotoxicity derives in part from dis-regulation of GABA-ergic neurons (Fitsanakis et al., 2006), possibly related to the observed decreases in tyrosine hydroxylase and glutamine synthetase by manganese (Erikson et al., 2007a).

The distribution of manganese in primate brain, and its neurobehavioral and cognitive effects in 5-6 year old Cynomolgus macaques following weekly intravenous injection of $MgSO_4$ (10-15 $MgSO_4$ or 3.26-4.89 mg Mn/kg) for 39 weeks was investigated by Guilarte and associates. Neurobehavior, as rated on a modified Parkinsonian symptoms scale, activity levels measured with an activity monitor, and fine motor skills, assessed as the number of errors while trying to retrieve objects from wells of different sizes, all showed significant decrements ($p < 0.05$) at the end of the experiment compared with baseline (Guilarte et al., 2006a). Over this same period, stereotypical or compulsive-like behaviors, such as licking/biting fingers and grooming, significantly increased in frequency with manganese exposure ($p < 0.01$) (Schneider et al., 2006). The levels of manganese were significantly ($p < 0.05$) elevated in exposed monkeys compared to controls in the globus pallidus (3.3 µg/g tissue), caudate (1.18 µg/g), putamen (1.50 µg/g), and frontal white matter (0.57 µg/g) (Table 6.3.1). Imaging studies were performed at 128 days and 157 days after the start of manganese exposure, and included T-1 weighted magnetic resonance imaging (MRI), magnetic resonance spectroscopy (H-MRS), and positron emission tomography (PET). As assessed by PET, manganese decreased the ability of amphetamine to stimulate dopamine release in the striatum, apparently without the loss of dopaminergic terminals. The authors speculate that the inhibition of dopamine release may alter the excitability of nigrostriatal dopaminergic neurons and/or may alter dopamine compartmentalization. The former case may contribute to the behavioral symptoms while, in the latter case, the probability of dopamine oxidation and consequent neuronal damage may be increased (Guilarte et al., 2006a). Neuronal loss or dysfunction in these monkeys was suggested by a change in brain metabolites with chronic manganese exposure. Specifically, significant decreases in the N-acetylaspartate: creatinine ratio in parietal cortex ($p = 0.028$), and a near significant ($p = 0.055$) decrease in the white matter were observed.

Concern for the consequences of exposure to the combustion products of methylcyclopentadienyl manganese tricarbonyl (MMT) has fueled investigation of the bioaccumulation and neurobehavioral effects following subchronic exposure to manganese as the free metal, conjugates of sulfate and phosphate, and a mixture of the two conjugates. In a collection of related studies (Normandin et al., 2002; Salehi et al., 2003; Normandin et al., 2004; Tapin et al., 2005), young adult rats were exposed to aerosolized manganese or its conjugates for 6 hours/day, 5 days/week for 13 weeks at target levels of 30, 300, and 3,000 µg/m^3 (<1.55 – 6 µm MMAD). Following exposure, locomotor activity over a 36 hr period was recorded as resting time, distance traveled, and total ambulatory count. The animals were then sacrificed and the manganese levels in various tissues and brain regions measured. These studies consistently showed significant ($p < 0.05$) dose-dependent increases in manganese in the lungs for all forms of the metal. The highest dose of the manganese conjugates, separately or mixed, resulted in significantly ($p < 0.05$) elevated levels in all tissues except the liver, reflecting the liver's role in manganese homeostasis. The sulfate and phosphate conjugates were better assimilated into all extra-pulmonary tissues than was the un-conjugated metal (Normandin et al., 2004). Uptake of manganese into brain tissue was more efficient from the combined sulfate and phosphate exposure than from exposure to metallic manganese or the phosphate conjugate alone, presumably due to the higher solubility of the sulfate conjugate. This difference was reflected in the significantly ($p <$

0.05) lower ambulatory count for the animals exposed to the conjugate mixture compared to controls (Normandin et al., 2004). For rats exposed to $MnSO_4$ alone, the total distance traveled in the locomotor studies increased at all manganese concentrations concomitant with an increase in total resting time, suggesting shorter bursts of activity. These rats also showed a dose-dependent decrease in total ambulatory counts over 36 hours, as well as a dose-dependent loss of cells in the globus pallidus and caudate putamen (Tapin et al., 2005). Similarly, the highest exposure to the Mn sulfate/phosphate mixture produced a significant increase in motor activity and a significant decrease in total ambulatory counts (Saleh et al., 2003). In contrast, no behavioral changes were noted with exposure to the phosphate conjugate (Normandin et al., 2002). Collectively these studies suggest that behavioral neurotoxic effects are associated with inhalation of manganese conjugates and that the sulfate conjugate is more toxic than the phosphate or metallic forms, consistent with its greater solubility.

In addition to neurotoxicity, pulmonary dysfunction may be associated with inhalation of manganese. In a subchronic chamber study, young, male rhesus monkeys were exposed to manganese sulfate at 0.06, 0.3, or 1.5 mg Mn/m^3 for 6 hours/day, 5 days/week, for 65 exposure days (Dorman et al., 2005b). The MMADs of the particles in these aerosols were 1.73, 1.89, and 2.12, respectively (1.04, 1.07, 1.12 µm GMD, respectively). Another set of monkeys, exposed to 1.5 mg Mn/m^3 by this regimen, was held for 45 or 90 days prior to evaluation. A third set was exposed to 1.5 mg Mn/m^3 and evaluated after 15 or 30 days of exposure. The evaluations included histopathological assessments of the lungs, and measurements of the manganese content of lungs and olfactory epithelium. Manganese levels were significantly elevated ($p < 0.05$) in olfactory epithelium with all exposures, and in lungs at exposures of 0.3 mg/m^3 and above. In animals exposed to 1.5 mg/m^3 and evaluated after 15 or 33 days, significantly ($p < 0.05$) elevated manganese levels were found in both olfactory epithelium and lungs, however, these levels returned to control levels 45 and 90 days after exposure was discontinued. Significant bronchiolitis and alveolar duct inflammation was seen only in the animals exposed to 1.5 mg Mn/m^3, but these effects were apparently reversible as they were no longer present at 45 and 90 days post exposure. Increased bronchus-associated-lymphoid tissue was also observed only with the highest exposure. Thus the inflammatory changes in small airways and increased manganese lung concentrations were only associated with the highest exposure levels used (1.5 mg Mn/m^3), and were apparently reversible following cessation of exposure, suggesting that the lungs are a less sensitive target for manganese toxicity than is the central nervous system.

The pulmonary toxicity of manganese, as measured by induction of an inflammatory response, is relatively high compared with a number of the transition metals found in particulate pollution. Intratracheal instillation of the sulfates of copper, vanadium, nickel, iron, zinc, and manganese (0.1, 1.0 µmol/kg) was used to assess the relative inflammatory potential of these metals in rats. Bronchoalveolar lavage (BAL) at 4, 16 and 48 hours following exposure provided the medium in which markers of inflammation were measured (Rice et al., 2001). Lactate dehydrogenase activity and total protein levels in the lavage fluid, used as general indicators of toxicity, showed copper at 1

µmol/kg to be the most toxic at all time points, followed by nickel and manganese. Whereas with copper LDH activity peaked at 16 hours post-exposure, then declined by 48 hours, manganese-induced LDH activity was significantly ($p < 0.05$) elevated at all time points and continued to increase with time. Similarly, the numbers of leukocytes recovered from BAL fluid were highest for manganese compared with the other metals at 16 and 48 hours. At these same time points, neutrophilia was seen at the low dose only with copper, while at the higher dose, manganese was the most potent. Significant eosinophilia was observed for manganese, copper, iron, and nickel at 16 and 18 hours, but eosinophil numbers were the highest with manganese by two to three-fold. Lymphocyte levels were not elevated by metal treatment except with low-dose copper at 16 hours, and high dose manganese at 48 hours. Thus manganese and copper were found to be the most proinflammatory of the metals tested but presumably by different signaling pathways. The effects with copper tended to appear earlier and at lower exposure levels, while manganese was more effective at stimulating the appearance of immune cells at a higher dose and later time points.

6.4 Dietary Exposure to Manganese

Newborns and infants may be exposed to more manganese in their diets than are adults. Infant formulas based on cow's milk have about 16 times more manganese than human milk (Dorner et al., 1989). Soy based formulas have even higher levels of manganese – about 40 times the manganese of human milk (Tran et al., 2002a; Tran et al., 2002b). Formula usage can lead to significantly elevated body burdens of manganese. For example, the hair manganese in normal infants at birth was reported to be 0.19 µg/g hair and, in breast-fed infants, increased to 0.330 µg/g at four months of age. By comparison, hair manganese levels in infants on a formula diet reached 0.965 µg/g at six weeks of age, and 0.685 µg/g at four months (Collipp et al., 1983). In addition, infants can have a less varied diet than adults and may consume more of certain foods that are high in manganese (e.g., sweet potatoes, 2.6 mg/cup; spinach, 1.8 mg/cup; oatmeal, 1.4 mg/cup; (NWU, 2006)).

6.5 Nutritional Requirement

Manganese is an essential nutrient involved in the formation of bone, and in amino acid, cholesterol, and carbohydrate metabolism (FNB, 2004). It is required in a number of metalloenzymes, including arginase, glutamine synthetase, phosphoenolpyruvate decarboxylase, and superoxide dismutase (FNB, 2004). Levels of manganese in adult tissues are maintained at stable levels by homeostatic mechanisms that involve regulation of both uptake and excretion (Aschner and Aschner, 2005). Manganese homeostasis is not maintained in newborn infants, and it is not clear how long it takes for it to develop (FNB, 2004); homeostasis in mice takes 17 to 18 days to become effective (Fechter, 1999). Rat pups born to manganese-exposed mothers (dosed with 2000 ppm Mn in drinking water throughout pregnancy and for 11 days of lactation) have seven times the manganese (whole body) as controls (Kostial et al., 2005). By weaning (11 days after birth) the manganese concentration in both groups is virtually the same, indicating that in rat pups manganese homeostasis may begin shortly after birth and become effective by weaning (Kostial et al., 2005).

Adequate intakes (AI) of manganese have been established by the Food and Nutrition Board of the Institute of Medicine (FNB, 2004). They are given in Table 6.5.1 below. This table also contains tolerable upper intake levels (UL) for manganese consumption. It is of note that in many cases the UL is not very far above the AI level. For children one to three years of age the UL is less than twice the AI.

The AI for infants 0 to 6 months was set based on the amount of manganese in human milk and the average amount of milk consumed. There are no reports of nursing infants showing any symptoms of manganese deficiency (FNB, 2004). The AI for infants 7 to 12 months of age is based on the manganese content of a typical diet including human milk and other foods. This AI is much higher than the one for infants 0 to 6 months because the manganese content of other foods is generally much higher than the manganese content of human milk (FNB, 2004).

TABLE 6.5.1 ADEQUATE INTAKES AND TOLERABLE UPPER INTAKE LEVELS FOR MANGANESE FOR DIFFERENT AGE GROUPS

Group	Adequate Intake (AI) (mg/day)	Tolerable Upper Intake Level (UL) (mg/day)
Infants, 0-6 months	0.003	"not possible to establish"
Infants, 7-12 months	0.6	"not possible to establish"
Children, 1-3 years	1.2	2
Children, 4-8 years	1.5	3
Boys, 9-13 years	1.9	6
Boys, 14-18 years	2.2	9
Girls, 9-13 years	1.6	6
Girls, 14-18 years	1.6	9
Men, 19 to >70 years	2.3	11
Women, 19 to >70 years	1.8	11
Pregnant women, 14-18 yrs	2	9
Pregnant women, 19-50 yrs	2	11
Lactating mothers, 14-18 years	2.6	9
Lactating mothers, 19-50 years	2.6	11

6.6 Potential for Differential Effects in Children

Infants and children may be more susceptible than adults to manganese toxicity for the following toxicodynamic and toxicokinetic reasons:

1. As noted in the previous section, manganese exposures in childhood are associated with impaired neurodevelopment including decrements in intellectual function. Thus a major toxicodynamic factor that differs between adults and children, namely development of the central nervous system, presents hypersensitive targets for toxicity in the developing infant and child.
2. Early life manganese exposures may predispose to manifestations of neurological damage in adulthood following subsequent exposure to environmental toxicants (Barlow et al., 2004).
3. Newborns absorb and retain more manganese from the gastrointestinal tract than do adults (Dorner et al., 1989; Davis et al., 1993).
4. The liver of newborns has not yet developed the ability to maintain safe levels of manganese in the bloodstream and brain tissues by excreting excess manganese in the bile, i.e., homeostasis of manganese has not yet developed (Miller et al., 1975).
5. Some infant formulas and foods are high in manganese. Soy formula may contain 200-300 µg Mn/l compared with 6 µg Mn/l for breast milk (Tran et al., 2002a,b). High dietary intake, combined with inhalation exposure, may put infants at greater risk of manganese toxicity.
6. The newborn's brain is still developing, myelination is incomplete, and the blood-brain barrier is not fully formed (Chan et al., 1992). These conditions facilitate manganese uptake into the central nervous system and increase the risk of attaining toxic levels.
7. Modeling of the inhalation dosimetry of particles (0.001-10 µm), comparing infants (3 mo) and adults, in four regions of the respiratory tract (extra-thoracic, tracheo-upper bronchi, bronchiolar, pulmonary), suggests that differences in the dose per unit surface area between neonates and adults are dependent on particle size and respiratory tract region (Ginsberg et al., 2005). These differences are most pronounced in the pulmonary and bronchiolar regions for ultrafine particles in the 0.1 to 0.001 µm range where neonates experience a 2-4 fold higher particle dose. In addition, infants and young children experience overall higher deposition of particles than adults.
8. Manganese absorption from the nose (Thompson et al., 2007), lungs (Brain et al., 2006), and intestinal tract (Erikson et al., 2002) is enhanced by low iron levels, a condition more prevalent among children than adults. Uptake directly from the nose or from the lungs bypasses first pass through the liver.

7. Developmental and Reproductive Toxicity

While data are scarce on the developmental effects of perinatal manganese exposure in humans, rats exposed to supplemental manganese (50, 250, 500 µg/day) beginning at birth show decreased dopamine in the striatum and poorer performance on behavioral tests (Tran et al., 2002b). This is consistent with studies examining manganese levels in various brain regions following developmental exposure. Female rats were exposed to $MnCl_2$ in drinking water (10 mg/ml) from the time of mating through weaning. The female offspring were similarly treated until sacrifice at 5, 10, 22, or 120 days postpartum (Chan et al., 1992). These time points represented the early postnatal period (day 5), the period of active myelination (days 10- 22), and sexual maturation (days 22-120). As shown in Table 7.1, manganese levels in all regions of the 5-day-old brain, except the cerebellum, are significantly elevated relative to unexposed controls. During the period of myelination (days 10-22), the manganese concentrations decreased. However, compared with controls, the concentrations in the treated rats were 2-13-fold higher, with the greatest difference in the striatum, followed by the midbrain. The differences in levels between groups decreased through sexual maturation. These data suggest that manganese distribution in the developing brain is heterogeneous and age-dependent, with the striatum and midbrain as potentially more susceptible regions for metal accumulation with high exogenous exposure.

TABLE 7.1 BRAIN REGIONAL MN CONCENTRATIONS (µG/G WET WT.) FR. CHAN ET AL. (1992)

Brain Region		Postnatal Age (days) 5	10	22	120
Hypothalamus	Control	2.50 ± 0.33[c]	0.52 ± 0.05 [c]	0.42 ± 0.01[c]	0.30 ± 0.03
	Mn	4.52 ± 0.72 [c,,e]	0.99 ± 0.11 [c,e]	2.23 ± 0.20 [c,e]	1.11 ± 0.22 [e]
Cerebellum	Control	5.73 ± 0.28 [c]	3.97 ± 0.19 [c]	0.47 ± 0.16	0.38 ± 0.05
	Mn	4.95 ± 0.95 [c]	6.16 ± 0.11 [c,e]	1.32 ± 0.09[b,e]	0.94 ± 0.07 [e]
Pons & medulla	Control	9.56 ± 1.16 [c]	4.73 ± 0.50 [c]	0.42 ± 0.01[b]	0.35 ± 0.04
	Mn	13.86 ± 0.53 [c,e]	5.00 ± 0.28 [c]	1.46 ± 0.05 [b,e]	1.07 ± 0.23 [e]
Striatum	Control	12.05 ± 0.10 [c]	1.78 ± 0.10 [c]	0.12 ± 0.02 [c]	0.24 ± 0.03
	Mn	12.86 ± 0.54 [c,d]	3.72 ± 0.13 [c,e]	1.57 ± 0.24 [b,e]	1.13 ± 0.24 [e]
Midbrain	Control	1.96 ± 0.27 [c]	1.51 ± 0.08 [c]	0.19 ± 0.04[c]	0.38 ± 0.07
	Mn	6.43 ± 0.51 [c,e]	2.49 ± 0.03 [c,e]	2.15 ± 0.04 [b,e]	1.35 ± 0.32[e]
Cerebral cortex	Control	0.85 ± 0.20 [c]	1.15 ± 0.10 [c]	0.19 ± 0.04[b]	0.34 ± 0.07
	Mn	4.42 ± 0.21 [c,e]	2.56 ± 0.05 [c,e]	1.39 ± 0.16 [c,e]	0.62 ± 0.16[d]

[a] Values are the means ± SD of 6-10 female rats [b] P < 0.05 compared to day 120 by ANOVA
[c] P < 0.01 compared to day 120 by ANOVA [d] P < 0.01 compared to age-matched controls by t-test
[e] P < 0.001 compared to age-matched controls by t-test

In children on long-term parenteral nutrition resulting in blood manganese levels of 615-1840 nmol/l (vs reference range of 72-210 nmol/l), elevated manganese levels have been seen in globus pallidus and subthalamic nuclei (Fell et al., 1996), suggesting an enhanced potential for neurological damage. This is consistent with the decrements in

intellectual function in children exposed to manganese in drinking water reported by Wasserman et al. (2006).

The effects of manganese on reproduction in humans have been reported in epidemiological studies of workers with occupational exposure to manganese. The results have been mixed with Gennart et al. (1992) reporting no effect on fertility among workers exposed to a median manganese dust level of 0.71 mg/m^3, while those exposed to 0.07-8.61 mg/m^3 (geometric mean 0.94 mg/m^3) in a study by Lauwerys et al. (1985) sired a statistically significant lower number of children during the period of paternal exposure. However, workers in the Gennart et al. study were exposed to the relatively insoluble manganese oxide and had mean urine manganese levels of 0.82 µg/g creatinine. By comparison, the workers in the study by Lauwerys et al. were exposed to the more soluble manganese salts in addition to the oxide, and had mean urinary manganese levels of 4.37 µg/g creatinine. Thus the differences in the effects of manganese on reproduction reported in these two studies may be due to the significant differences in manganese exposures.

Adverse changes in reproductive parameters and behaviors have been seen in studies of rodents exposed to high levels of manganese. In immature female rats (23 days old), manganese (1-25 µg $MnCl_2$) introduced into the third ventricle of the brain significantly and dose-dependently stimulated the release of luteinizing hormone (LH). This effect was apparently at the level of the hypothalamus as pretreatment with the LH releasing hormone (LHRH) receptor antagonist, acyline, prior to manganese exposure blocked the release of LH (Pine et al., 2005). These authors further reported that serum LH, follicle stimulating hormone, and estradiol were all elevated by 29 days of age in rats that had received $MnCl_2$ by gavage starting on postnatal day 12. In these animals manganese altered the timing of reproductive events resulting in a significantly ($p < 0.001$) earlier onset of puberty as measured by vaginal opening.

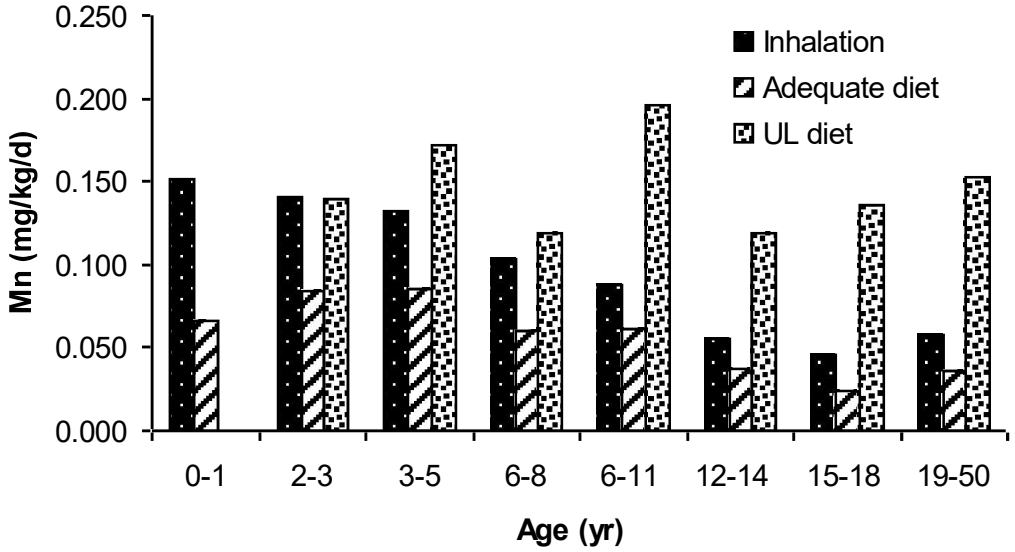
In adult male rats, exposure to 1,000 ppm manganese sulfate in drinking water for 12 weeks significantly suppressed sexual performance compared with controls as measured by prolonged ejaculatory latencies ($p < 0.001$), and increased post-ejaculatory intervals ($p < 0.05$). Displays of aggressive behaviors (lateralizations, boxing bouts, and fights with stud males) were also reduced ($p < 0.001$). The extent to which the altered behaviors represent neurological effects versus effects on testes and androgen production is not clear. However, among females mated to the manganese-treated males, the total number of resorptions was significantly increased ($p < 0.025$), suggesting a testicular effect. This is supported by a significant ($p < 0.001$) reduction in absolute and relative testes weights, and absolute seminal vesicle weights among manganese-exposed males (Bataineh et al., 1998). An effect of manganese on male reproductive organs was also investigated in mice following 43 days of oral manganese acetate (7.5 – 30 mg/kg/d) (Ponnapakkam et al., 2003). Unlike the study with rats above, there was no significant change in testicular weight or pathology with manganese exposure in the mice. Nor was there evidence of abnormal mating behavior. However, epididymal weights were significantly lower ($p < 0.05$) and there was a significant ($p < 0.001$) dose-dependent decrease in sperm number and motility.

The available data suggest that manganese is a reproductive toxicant in animals (both males and females) albeit at relatively high doses. Neurobehavioral toxicity manifests at levels encountered in the environment (Wasserman et al., 2006). Whether this decrement in intellectual function represents a true developmental effect with permanent consequences is not clear.

8. Derivation of Reference Exposure Levels

The determination of safe exposure levels to manganese is complicated by its status as an essential nutrient. However, as described above, inhalation of manganese results in a qualitatively and quantitatively different exposure compared to oral intake, with inhalation resulting in more rapid uptake and higher blood and brain levels. While dietary manganese levels moderate intestinal absorption of manganese, there appears to be no effect of dietary manganese on the pharmacokinetics of inhaled manganese (Dorman et al., 2002b). To provide perspective on potential manganese exposure from inhalation relative to the suggested upper limits for age-dependent dietary intake, we compared the potential manganese internal dose from inhalation with that from the recommended dietary levels for the various age groups indicated (Fig. 8.1). For this comparison, we used an air level of manganese of 0.215 mg Mn/m^3, the average level of respirable manganese dust to which workers were exposed in an occupational study of the effects of manganese exposure (Roels et al., 1992). It thus represents a high but real world exposure level associated with neurotoxicity. Adequate dietary intake and the recommended upper limit levels, above which toxic effects may be observed, are those set by the Food and Nutrition Board (FNB, 2004). The data for inhalation represent the amount of manganese taken up by the different groups, age-adjusted for average breathing rates per kilogram body mass per day (OEHHA, 2000; Arcus-Arth and Blaisdell, 2007). For this example, we assumed that uptake from the lungs is 100% of the inhaled manganese, and that absorption from dietary intake is 41% for 0-1 yrs, 10% for 2-3 yrs, and 5% for all other ages. The inhaled manganese becomes the age-specific breathing rate multiplied by the air concentration. We compared the inhaled dose to the internal dose of manganese expected from an adequate diet, and from intake at the upper limit. This analysis suggests that among neonates and children through age 8, the manganese uptake from inhalation of this high level of manganese would substantially exceed the adequate dietary amount and may approach or exceed the levels beyond which toxicity may be expected. Therefore, compared with adults at the same exposure level, a child's manganese inhalation is a larger proportion of the maximum recommended levels. This is due to the higher breathing rates, lower body mass, and greater absorption of manganese by children. Thus, for comparable air exposures, children are more at risk for exceeding safe levels than are adults.

FIGURE 8.5 INTERNAL MANGANESE DOSE FROM INHALATION AND DIET BY AGE



Age- and breathing rate-adjusted internal manganese dose following chronic inhalation of 0.215 mg/m^3 manganese (Inhalation), consumption of recommended minimum daily intake (Adequate diet), or upper limit level beyond which toxic effects may be observed (UL diet). Data expressed as mg Mn/kg body weight/day.

8.1 Manganese Acute Reference Exposure Level

Acute Reference Exposure Levels (RELs) are levels at which intermittent one-hour exposures are not expected to result in adverse health effects (see Section 5 of the Technical Support Document (TSD)). Pulmonary damage and inflammation are the principal endpoints associated with acute inhalation exposure to manganese. However, at present the database is insufficient to allow the development of an acute REL for manganese based on inhalation studies. No studies were located that reported dose-response data for acute inhalation exposures, nor was it possible to determine both LOAELs and NOAELs from the available data.

8.2 Manganese 8-Hour Reference Exposure Level

Study	Roels et al., 1992
Study population	92 workers in a battery plant
Exposure method	Inhalation of workplace air
Exposure continuity	
Exposure duration	8 hr/day, 0.2-17.7 yr (mean 5.3 yr)
Critical effects	Impaired neurobehavior: visual reaction time, eye-hand coordination, hand steadiness
NOAEL	not observed
Benchmark concentration	72 µg/m^3
Time-adjusted exposure	51 µg/m^3 (72*5/7)
LOAEL uncertainty factor (UF_L)	Not applicable
Subchronic uncertainty factor (UFs)	√10 (default 8-12% of lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default: human study)
Toxicodynamic (UF_{A-d})	1 (default: human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	10 (greater absorption and lung deposition in children)
Toxicodynamic (UF_{H-d})	10 (greater susceptibility of children to neurotoxicity)
Cumulative uncertainty factor	300
Reference Exposure Level	**0.17 µg/m^3**

The 8-hour Reference Exposure Level is a concentration at or below which adverse noncancer health effects would not be anticipated for repeated 8-hour exposures (see Section 6 in the TSD).

The proposed 8-hr REL for manganese is 0.17 µg/m^3 based on impairment of neurobehavioral function in humans in the occupational study of Roels et al. (1992) described in Section 6.1. Data on the lifetime integrated exposure to respirable dust (LIRD) for each of the 92 workers and whether or not their response scores were abnormal on each of the three tests (visual reaction time, eye-hand coordination, and hand steadiness), were originally compiled by Dr. Roels, and were provided to OEHHA by Dr. J. Michael Davis of the US EPA. Abnormal scores were defined as those values that exceeded the 95th percentile value of the parameter as estimated from the cumulative frequency curves of the control group as in Roels et al. (1982). The LIRD was estimated for each worker based on the current airborne manganese concentration characteristic of each job multiplied by the number of years the worker had spent in that job. The result for each job held by an individual worker was then summed to obtain the LIRD for the individual. In our analysis, using US EPA's BMDS version 1.4.1b software, the LIRD (in µg/m^3 x yr), divided by the total years of manganese exposure for each individual, was compared with his performance on each of the three tests (scored as 0 if the test was normal and 1 if abnormal). In this treatment, the group size is 1. Eye-hand

coordination (EHC) and hand steadiness (HST) are the two most critical endpoints; the incidence of changes in the visual reaction time in the study population was consistently lower. For both these endpoints, the best fitting models were the Probit and Logistic models; the quality of fit was not distinguishable on statistical grounds. The lower 95% confidence bound benchmark confidence level ($BMCL_{05}$) for the Probit fit to the EHC data was selected as the most health protective value among these relatively closely spaced results.

Eye Hand Coordination (EHC)					
Model	BMC_{05}	$BMCL_{05}$	BMC/BMCL	P for fit	AIC
Probit	97	**72**	1.4	0.3797	93.9124
Logistic	105	78	1.4	0.3874	93.8307
Hand Steadiness (HST)					
Model	BMC_{05}	$BMCL_{05}$	BMC/BMCL	P for fit	AIC
Probit	162	115	1.4	0.2201	68.2214
Logistic	175	125	1.4	0.2389	67.9531

This analysis yielded a $BMCL_{05}$ of 72 µg Mn/m^3. A time correction was applied since the workers in the study were only exposed 5 days per week, whereas the 8-hour REL is designed to protect against daily exposures, as noted in the TSD. A cumulative UF of 300 was applied, comprising a $\sqrt{10}$ for subchronic to chronic conversion (average exposure duration = 5.3 yr; Section 4.4.6 of the TSD), and 10 each for intraspecies toxicokinetic (UF_{H-k}) and toxicodynamic (UF_{H-d}) uncertainty, resulting in an 8-hour REL of 0.17 µg Mn/m^3. This REL is based on healthy adult male workers with adjustments for the potentially greater susceptibility of children. The intraspecies UF_{H-k} of 10 was chosen in part to reflect the 3-4-fold greater deposition of inhaled particulates in the 1-10 µm size range in the lungs of neonates relative to adults exposed to similar particulate levels in ambient air (Ginsberg et al., 2005). In addition, neonates and infants more efficiently absorb and retain manganese than do adults (Dorner et al., 1989).

A UF_{H-d} of 10 is used to address the expectation that the still-developing brain of newborn and infant children is more sensitive to the effects of manganese and that injuries to the nervous system during development are anticipated to have lasting effects.

The development of these RELs is based on a benchmark concentration analysis of data from an occupational study as described above. An alternative approach involves the use of physiologically-based pharmacokinetic (PBPK) models, the development of which in rats has been described in a recent series of papers by workers at the Chemical Industry Institute of Toxicology , now the Hamner Institutes for Health Sciences (Teeguarden et al., 2007a; Teeguarden et al., 2007b; Teeguarden et al., 2007c); (Nong et al., 2008). While these papers represent significant progress in the modeling of manganese pharmacokinetics, they have yet to be extended to and validated in humans or non-human primates. For this reason, they were not used for the estimation of these REL values.

8.3 Manganese Chronic Reference Exposure Level

Study	Roels et al., 1992
Study population	92 workers in a battery plant
Exposure method	Inhalation of workplace air
Exposure continuity	
Exposure duration	8 hr/day, 0.2-17.7 yr (mean 5.3 yr)
Critical effects	Impaired neurobehavior: visual reaction time, eye-hand coordination, hand steadiness
NOAEL	not observed
Benchmark concentration	72 µg/m^3
Time-adjusted exposure	26 µg/m^3 (72 µg/m^3 x 10/20 x 5/7)
LOAEL uncertainty factor (UF_L)	Not applicable
Subchronic uncertainty factor (UFs)	√10 (default 8-12% of lifetime)
Interspecies uncertainty factor	
Toxicokinetic (UF_{A-k})	1 (default: human study)
Toxicodynamic (UF_{A-d})	1 (default: human study)
Intraspecies uncertainty factor	
Toxicokinetic (UF_{H-k})	10 (greater absorption and lung deposition in children)
Toxicodynamic (UF_{H-d})	10 (greater susceptibility of children to neurotoxicity)
Cumulative uncertainty factor	300
Reference Exposure Level	**0.09 µg/m^3**

The chronic Reference Exposure Level is a concentration at which adverse noncancer health effects would not be expected from continuous lifetime exposures (see Section 7 in the Technical Support Document).

The proposed chronic REL for manganese of 0.09 µg/m^3 is based on impairment of neurobehavioral function in humans in the occupational study of Roels et al. (1992). The benchmark dose approach was used, as described above for the 8-hour REL, to derive a $BMCL_{05}$ of 72 µg/m^3. This corresponded to a time-adjusted concentration of 26 µg/m^3 (based on an 8 hour TWA occupational exposure to 10 m^3 manganese-contaminated air per day out of 20 m^3 total air inhaled per day over 5 days/week).

A cumulative UF of 300 was used, comprising a √10 for subchronic to chronic conversion (average exposure duration = 5.3 yr; Section 4.4.6 of the TSD), and 10 each for intraspecies toxicokinetic (UF_{H-k}) and toxicodynamic (UF_{H-d}) uncertainty. This REL is based on healthy adult male workers with adjustments for the potentially greater susceptibility of children. The intraspecies UF_{H-k} of 10 was chosen in part to reflect the 3-4-fold greater deposition of inhaled particulates in the 1-10 µm range in the lungs of neonates relative to adults exposed to similar particulate levels in ambient air (Ginsberg et al., 2005). In addition, neonates and infants more efficiently absorb and retain manganese than do adults (Dorner et al., 1989). It should also be noted that the effects

reported in the Roels study were to a relatively insoluble form of manganese, MnO_2. As shown in Table 4.1 above, exposures to similar levels of the more soluble $MnCl_2$ by the same route result in higher manganese brain levels.

A UF_{H-d} of 10 is used to address the expectation that the still-developing brain of newborn and infant children is more sensitive to the effects of manganese and that injuries to the nervous system during development are anticipated to have lasting effects. This REL was developed with specific consideration of the potentially greater susceptibility of children to manganese neurotoxicity. For comparison, the RfC for chronic manganese inhalation developed by the US EPA is 0.05 $\mu g/m^3$ (U.S.EPA, 1993) and is also based on Roels et al. (1992).

As described in Section 6.3 above, the studies by Dorman et al. (2006), Guilarte et al. (2006) and Schneider et al. (2006) report comparable post-controlled exposure manganese levels in the same regions of the brains of Rhesus monkeys, albeit using different experimental protocols. Based on the inhalation data from Dorman et al., it is possible to extrapolate an air manganese concentration at which the neurotoxicity reported by Guilarte and Schneider would have been expected. After adjustment for the differences in exposure duration, the projected air manganese levels from Dorman corresponding to the toxicity-associated region-specific brain levels reported by Guilarte are 75 $\mu g/m^3$ inhaled concentration for the caudate, 98 $\mu g/m^3$ for putamen, 150 $\mu g/m^3$ for globus pallidus, and 73 $\mu g/m^3$ for white matter. While the differences in the exposure regimens among these studies precludes using them to derive a REL, it is relevant and supportive that this range of exposure subsumes the LOAEL for neurotoxic effects in humans reported by Lucchini et al. (1999) of 97 $\mu g\ Mn/m^3$, and the point of departure for the REL based on the Roels et al. study of 72 $\mu g\ Mn/m^3$. Thus, these studies of non-human primates support the effect level upon which the REL is based.

8.4 Manganese as a Toxic Air Contaminant

In view of the potential for higher exposure in children than adults coupled with a lower ability to regulate manganese, and enhanced neurodevelopmental susceptibility leading to differential impacts in infants and children identified in Section 6.2.1, OEHHA recommends that manganese be identified as a toxic air contaminant which may disproportionately impact children pursuant to Health and Safety Code, Section 39669.5(c).

9. References

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Mercury Reference Exposure Levels

(Hg^0 Elemental; Quicksilver)

CAS 7439-97-6

1. Summary

Elemental mercury exposures adversely affect several organ systems. The effects of acute, high level inhalation exposures first appear in the lungs as pulmonary dysfunction, possibly followed by respiratory failure leading to death. At lower levels of exposure, the kidneys and brain, especially the developing brain, are more sensitive targets. Short term maternal exposure to mercury vapor during pregnancy may result in long lasting neurobehavioral effects in the offspring, an effect upon which the acute REL is based. Chronic, low level exposures also adversely affect the central nervous system and manifest as motor deficits (tremors, unsteady gait, performance decrements), mood changes (irritability, nervousness), poor concentration, short-term memory deficits, tremulous speech, blurred vision, paresthesia, and decreased nerve conduction. Renal and cardiovascular functions are also impaired with long term exposure. This REL focuses on inhalation exposures. There is a large body of literature on methylmercury poisoning as well as the toxicology of ingested mercury. Much of the latter is reviewed in OEHHA's documentation of the Public Health Goal for drinking water (OEHHA, 1999)

1.1 Mercury Acute REL

Reference Exposure Level	**0.6 µg Hg/m³ (0.07 ppb Hg^0)**
Critical effect(s)	CNS disturbances in offspring
Hazard Index target(s)	Nervous system

1.2 Mercury 8-Hour REL

Reference Exposure Level	**0.06 µg Hg/m³ (0.007 ppb Hg^0)**
Critical effect(s)	Impairment of neurobehavioral functions in humans
Hazard Index target(s)	Nervous system

1.3 Mercury Chronic REL

Reference Exposure Level	**0.03 µg Hg/m³ (0.004 ppb Hg^0)**
Critical effect(s)	Impairment of neurobehavioral functions in humans
Hazard Index target(s)	Nervous system

2. Physical & Chemical Properties - Elemental Mercury

Description	Silver-white, heavy, mobile, odorless, liquid metal
Molecular formula	Hg^0
Molecular weight	200.59 g/mol
Density	13.53 g/cm^3 @ 25° C
Boiling point	356.73° C
Melting point	-38.7° C
Vapor pressure	2 x 10^{-3} mm Hg @ 25° C
Solubility	soluble in nitric acid, to some extent in lipids, and up to 0.28 µmol in water @ 25° C
Odor threshold	odorless
Conversion factor	1 ppm in air = 8.34 mg/m^3 @ 25° C

3. Occurrence and Major Uses

Mercury and mercury-containing compounds are widely used in diverse applications. Thermometers, barometers and thermostats take advantage of mercury's uniform temperature-dependent volume expansion over a broad temperature range. It is used in mercury arc and fluorescent lamps, as a catalyst in oxidation of organic compounds, in the extraction of gold and silver from ores, and as a cathode in electrolysis. It is also used in pulp and paper manufacturing, as a component of batteries, in dental amalgams, and in the manufacture of switching devices such as oscillators, the manufacture of chlorine and caustic soda, as a lubricant, and as a laboratory reagent. To a lesser extent mercury has been used as a grain fumigant, in pharmaceuticals, agricultural chemicals, and as a preservative (ACGIH, 1986).

The annual statewide emissions of mercury from mobile, stationary and natural sources reported in the California Toxics Inventory for 2004 were estimated to be 18 tons (CARB, 2005a). Statewide ambient levels of mercury in 2002 were 1.7 ng/m^3 (CARB, 2005b). Mercury emitted in the metallic form is slowly oxidized in the atmosphere to the ionic mercurous and mercuric (+1 and +2) forms, which are much more soluble in water. These forms dissolve in raindrops and are deposited onto land and water. Much of this precipitation enters sediment of streams or other water bodies, where it is converted to methylmercury and can be accumulated by fish. Thus human exposure to air-borne mercury may be direct, via inhalation, and indirect, through a diet containing contaminated fish. For the purposes of evaluating a Reference Exposure Level, however, we focus on studies of inhalation exposure to mercury.

4. Metabolism / Toxicokinetics

Inhalation exposure to mercury is usually to vapors of the elemental form. However, combustion processes may also emit mercury salts (chlorides and oxides). Thus inhalation exposure to these forms also occurs. Exposure to the inorganic forms of mercury, the mercurous and mercuric salts, also occurs via the oral route. However,

absorption from the intestinal tract is much less efficient (2-38%) than from the lungs (70-80%) (ATSDR, 1999). To protect against oral exposure to inorganic mercury via drinking water, OEHHA (1999) has developed a public health goal (PHG) of 0.0012 mg/L (1.2 ppb) as a level of exposure expected to pose no significant health risk to individuals consuming the water on a daily basis. The difference between the PHG and the REL values reported in this document in part reflects differences in the toxicokinetics by the different routes of exposure. For inhalation exposure to mercury vapor, modeling based on human and experimental animal studies suggests that approximately 80% of inhaled mercury is deposited in the respiratory tract, of which about 70% is rapidly absorbed into the blood with a half-time of around 1 min. The remainder is absorbed more slowly with half-times of 8 hr to 5 days (Leggett et al., 2001). Absorption is markedly decreased if the breathing is done only through the mouth (Teisinger and Fiserova-Bergerova, 1965). It is not clear whether this difference is related to the direct uptake of mercury from nasal passages but mercury is known to be transported via olfactory nerves directly to the brain (Tjalve and Henriksson, 1999). In the blood, elemental mercury (Hg^0) may be oxidized by catalase and peroxidase to the more toxic inorganic forms. Cellular membranes and the blood-brain barrier are readily permeable to Hg^0, but much less so to the inorganic forms. Residual Hg^0 in the blood may enter target cells and be oxidized to the mercuric form intracellularly, effectively trapping it in the cells. The biological half-life of mercury in the human head is reported to be 21 days, and 64 days in the kidney (Hursh et al., 1976). Mercury is eliminated in urine, feces and exhaled air.

Mercury exerts its toxicity through several mechanisms mainly related to the high affinity of the mercuric ion for sulfhydryl groups. By binding to non-protein sulfhydryls such as glutathione and N-acetyl cysteine, mercury alters intracellular thiol status, thus promoting oxidative stress and lipid peroxidation. Mercury interacts with the mitochondrial electron transport chain resulting in increased H_2O_2. There is a concomitant depletion of mitochondrial glutathione, depolarization of the inner mitochondrial membrane, and increased susceptibility of the mitochondrial membrane to peroxidation. Mitochondrial function is thus impaired and oxidative stress increased (Lund et al., 1993). In addition to mercury's pro-oxidant effects, the binding of mercury by sulfhydryl-containing proteins disrupts a broad range of critical cellular functions such as microtubule polymerization (Yole et al., 2007), DNA transcription (Rodgers et al., 2001), glutamine synthesis (Allen et al., 2001), and calcium homeostasis (Yole et al., 2007). These effects may lead to cell dysfunction and death, an effect that is exacerbated by mercury's ability to promote auto-immune responses (Rowley and Monestier, 2005). Indeed, among genetically susceptible individuals, much of the renal pathology associated with mercury exposure has been attributed to auto-antibodies to renal proteins (Hua et al., 1993). Disruption of cellular processes during development can have severe and long-lasting effects. This is especially true during the growth and organization of the central nervous system as it is critically dependent on cell division and neuronal migration. These processes in turn depend on microtubule polymerization which is powerfully inhibited by both the mercuric ion and methylmercury.

5. Acute Toxicity of Mercury

5.1 Acute Toxicity to Adult Humans

The respiratory tract is the first organ system affected in cases of acute inhalation poisoning (Levin et al., 1988). Acute exposure to Hg^0 can lead to shortness of breath within 24 hours and a rapidly deteriorating course leading to death due to respiratory failure (Kanluen and Gottlieb, 1991; Asano et al., 2000). In a case report, Kanluen and Gottlieb (1991) observed four individuals from a private home where silver was being smelted from dental amalgam containing an unknown amount of Hg^0. All individuals died 9-23 days post-exposure from respiratory distress despite treatment with dimercaprol, a mercury chelator. Autopsy revealed acute lung injury characterized by necrotizing bronchiolitis with edema, emphysema, and obliteration of alveolar spaces with extensive interstitial fibrosis. The concentrations of mercury to which the individuals were exposed and the duration of exposure are not known.

Central nervous system (CNS) effects such as tremors or increased excitability are sometimes seen in cases of acute accidental exposures (Netterstrom et al., 1996). Long-term effects from a single exposure to Hg^0 were reported in 6 male workers exposed to an estimated concentration of 44 mg Hg/m³ for a period of several hours (McFarland and Reigel, 1978). Long-term CNS effects included nervousness, irritability, lack of ambition, and loss of sexual drive for several years. Shortness of breath also persisted for years in all cases. Acute inhalation exposure to Hg^0 vapors from broken thermometers resulted in generalized skin eruptions in 15 individuals (Nakayama et al., 1983). The doses and durations of exposure were not estimated.

A similar symptomatology was reported by Sexton et al. (1978) following the spillage of 100-300 ml of elemental mercury in two mobile homes that exposed 11 people to mercury vapor for one to two months. Following one to two weeks of exposure, the most intensely exposed residents, three teenage girls, reported the onset of anorexia, painful mouth, abdominal cramps, mild diarrhea, bleeding gingiva, irritated eyes, insomnia, difficulty concentrating and general restlessness. Prior to the girls' hospitalization, changes in academic performance, handwriting and personality were noted by the girls' teachers. A similar constellation of symptoms including intention tremor was subsequently observed in the other eight exposed residents. Skin rashes of varying severity were also seen among five of the residents. Blood mercury levels ranged from 183 to 620 ng/ml (normal is < 5 ng/ml). The highest air mercury level measured in one of the vacated and sealed trailers was 1.0 mg/m^3 five months after the initial spill. Neurological exams at two to four months following termination of exposure were normal for eight of the residents. However, at four months, two of the intensely exposed girls still showed neurological abnormalities as manifested in difficulties copying simple diagrams, and abnormal electroencephalograms.

The acute effects of inhalation exposure to mercury may be compounded by simultaneous dietary intake of methylmercury. The use of mercury amalgamation in the recovery of gold in the Amazon Basin has resulted in locally elevated mercury levels both in indoor air in gold shops (250-40,600 ng/m^3), and in ambient urban air (20-5,800

ng/m^3) (Hacon et al., 1995), thus increasing the opportunities for both acute and long-term exposures. At the same time, gold extraction activities have caused mercury contamination of waterways resulting in a concomitant increase in methylmercury in the diet from the consumption of contaminated fish (Cordier et al., 1998). Adverse neurological and otological effects have been associated with elevated blood mercury levels in both adults and children in this environment (Counter et al., 1998).

Predisposing Conditions for Mercury Toxicity

Medical: Persons with preexisting nervous system disorders or kidney diseases might be at increased risk of mercury toxicity. Also at higher risk are persons previously sensitized to mercury (Lerch and Bircher, 2004), and those with genetic susceptibililty to mercury-induced hypersensitivity (Warfvinge et al., 1995). Developing organisms (fetuses and infants) are especially susceptible to the neurotoxicity of mercury (USEPA, 1997).

Other: People who consume significant amounts of fish from areas with advisories for daily fish intake due to mercury contamination may be more susceptible to the chronic toxicity of airborne mercury due to existing body burden.

5.2 Acute Toxicity to Infants and Children

The data regarding the toxic effects of acute exposure of children to Hg^0 are largely limited to case reports with little or no information on actual exposure levels. In children who inhale high levels of toxic Hg^0 vapors, pulmonary dysfunction is the primary cause of mortality. For example, autopsy of a 4-month-old child who died following acute exposure to Hg^0 vapors revealed pulmonary and general edema, nephrotic degeneration, ventricular dilation, and a greyish, necrotic appearance in the digestive mucosa (Campbell, 1948). In another case study, severe interstitial pneumonitis, erosion of the bronchial epithelium, membrane lesions of the alveoli and alveolar ducts, and significantly elevated Hg in the kidneys and liver were documented by Matthes et al. (1958) following the deaths of three children aged 4, 20, and 30 months from acute Hg^0 vapor exposure in the home. Cases of CNS disturbances, including irritability, insomnia, malaise, anorexia, fatigue, ataxia, and headache have been reported in children exposed to vapor from spilled elemental mercury in their homes (Florentine and Sanfilippo, 1991).

5.3 Acute Toxicity to Experimental Animals

As reported for humans, acute inhalation exposure of experimental animals to high levels of mercury is associated with pulmonary toxicity. However, the effects of mercury inhalation following short term exposure have also been examined in the context of neurotoxicity, notably neurobehavioral effects, and mercury deposition and distribution in the nervous system, as well as pathological changes in various organs.

Pathological changes in lung tissues similar to those reported in humans (edema, fibrosis, and necrosis of alveolar epithelium and hyaline membranes) were observed by Livardjani et al. (1991) in rats exposed to 26 mg (3.1 ppm) Hg/m³ for 1 hour, or 27 mg