BEFORE THE POLLUTION CONTROL BOARD
OF THE STATE OF ILLINOIS

KB SULLIVAN INC.,	)	
Petitioner,	)	
	)	
v.	)	PCB 2021-078
	)	(LUST Appeal)
ILLINOIS ENVIRONMENTAL	)	
PROTECTION AGENCY,	)	
Respondent.	)	

NOTICE

Don Brown, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph, Suite 11-500
Chicago, IL 60601
don.brown@illinois.gov

Carol Webb, Hearing Officer
Illinois Pollution Control Board
1021 North Grand Avenue East
P.O. Box 19274
Springfield, IL 62794-9274
carol.webb@illinois.gov

Patrick D. Shaw
Law Office of Patrick D. Shaw
80 Bellerive Road
Springfield, IL 62704
pdshaw1law@gmail.com

PLEASE TAKE NOTICE that I have today filed with the office of the Clerk of the Pollution Control Board an **APPEARANCE,** the **ADMINISTRATIVE RECORD** and a **CERTIFICATE OF RECORD ON APPEAL,** copies of which are herewith served upon you.

Respectfully submitted,

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY,
Respondent

Melanie A. Jarvis

Melanie A. Jarvis
Assistant Counsel
Division of Legal Counsel
1021 North Grand Avenue, East
P.O. Box 19276
Springfield, Illinois 62794-9276
217/782-5544
866/273-5488 (TDD)
Dated: March 18, 2022

**BEFORE THE POLLUTION CONTROL BOARD
OF THE STATE OF ILLINOIS**

KB SULLIVAN INC.,	)	
Petitioner,	)	
	)	
v.	)	PCB 2021-078
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ILLINOIS ENVIRONMENTAL	)	
PROTECTION AGENCY,	)	
Respondent.	)	

APPEARANCE

The undersigned, as one of its attorneys, hereby enters her Appearance on behalf of the Respondent, the Illinois Environmental Protection Agency.

Respectfully submitted,

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY,
Respondent

Melanie A. Jarvis

Melanie A. Jarvis
Assistant Counsel
Special Assistant Attorney General
Division of Legal Counsel
1021 North Grand Avenue, East
P.O. Box 19276
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PROTECTION AGENCY,	)	
Respondent.	)	

CERTIFICATE OF RECORD ON APPEAL

Pursuant to 35 Ill. Adm. Code 105.116(b) and 105.410, the following constitutes an index of documents comprising the record:

PAGES	DOCUMENT(S)	DATE
R0001–R0140	Corrective Action Plan and Budget	February 17, 2012
R0141–R0221	TACO Calculations	April 6, 2012
R0222–R0263	Revised TACO Calculations	April 27, 2012
R0264–R0266	IEPA Reviewer Notes	May 9, 2012
R0267–R0271	IEPA Decision Letter	May 16, 2012
R0272–R0289	CWM Letter to IEPA	June 12, 2012
R0290–R0293	IEPA Claim Reviewer Notes	November 19, 2020
R0294–R0342	Reimbursement Claim	October 20, 2020
R0343–R0346	IEPA Decision Letter	February 5, 2021

I, Brian Bauer, certify on information and belief that the entire record of the Respondent's decision, as defined in 35 Ill. Adm. Code 105.410(b), is hereby enclosed.

By: ______________________
Brian Bauer
Leaking Underground Storage Tank Section
Illinois Environmental Protection Agency

Date: March 18, 2022

This filing submitted on recycled paper.

CERTIFICATE OF SERVICE

I, the undersigned attorney at law, hereby certify that on **March 18, 2022**, I served true and correct copies of an **APPEARANCE,** the **ADMINISTRATIVE RECORD** and a **CERTIFICATE OF RECORD ON APPEAL,** via the Board's COOL system and email, upon the following named persons:

Don Brown, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph, Suite 11-500
Chicago, IL 60601
don.brown@illinois.gov

Carol Webb, Hearing Officer
Illinois Pollution Control Board
1021 North Grand Avenue East
P.O. Box 19274
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carol.webb@illinois.gov

Patrick D. Shaw
Law Office of Patrick D. Shaw
80 Bellerive Road
Springfield, IL 62704
pdshaw1law@gmail.com

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY,
Respondent

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Assistant Counsel
Division of Legal Counsel
1021 North Grand Avenue, East
P.O. Box 19276
Springfield, Illinois 62794-9276
217/782-5544
866/273-5488 (TDD)

CW³M Company
Environmental Consulting Services

701 W. South Grand Avenue
Springfield, IL 62704

Phone: (217) 522-8001
Fax: (217) 522-8009

February 17, 2012

Mr. Brad Dilbaitis, Project Manager
LUST Section, Bureau of Land
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, Illinois 62794-9276

RE: **LPC #1390305014—Moultrie County**
KB Food & Gas/Sullivan
111 West Jackson Street (Rt. 121 & 32)
Incident Number: 90-0146/2004-0969
LUST Technical Reports—Corrective Action Plan and Budget

Dear Mr. Dilbaitis:

On behalf of Mr. Kamlesh Patel, owner of KB Food & Gas in Sullivan, Illinois, we are submitting the attached Corrective Action Plan and Budget for the above referenced site.

If you have any questions or require additional information, please contact Mr. Vince Smith or me at (217) 522-8001.

RECEIVED
FEB 17 2012
IEPA/BOL

Sincerely,

Carol L. Rowe, P.G.
Senior Environmental Geologist

xc: Mr. Kamlesh Patel, *KB Food & Gas*
Mr. William T. Sinnott, *CW³M Company, Inc.*

IEPA - DIVISION OF RECORDS MANAGEMENT
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CORRECTIVE ACTION PLAN AND BUDGET

KB FOOD & GAS

Sullivan, Illinois
LPC#1390305014– Moultrie County
Incident Numbers 90-0146/2004-0969

Submitted to:
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
Leaking Underground Storage Tank Section, Bureau Of Land
1021 North Grand Avenue East
Springfield, Illinois 62794-9276

Prepared by:
CW³M COMPANY, INC.

701 South Grand Avenue West
Springfield, Illinois
(217) 522-8001

400 West Jackson, Suite C
Marion, Illinois
(618) 997-2238

FEBRUARY 2012

TABLE OF CONTENTS

APPENDICES

TABLES

ACRONYMS AND ABBREVIATIONS

ADLs	Acceptable Detection Limits
BETX	Benzene, ethylbenzene, toluene, total xylenes
CAP	Corrective Action Plan
CACR	Corrective Action Completion Report
CES	Consolidated Environmental Services
ELUC	Environmental Land Use Control
HAAs	Highway Authority Agreements
IDOT	Illinois Department of Transportation
Ill. Adm. Code	Illinois Administrative Code
IEMA	Illinois Emergency Management Agency
IEPA	Illinois Environmental Protection Agency
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey
LUST	Leaking Underground Storage Tank
MTBE	Methyl tert-butyl ether
OSFM	Illinois Office of the State Fire Marshal
PNAs	Polynuclear aromatic hydrocarbons
PVC	Polyvinyl chloride
ROWs	Right of Ways
SICR	Site Investigation Completion Report
TACO	Tiered Approach to Corrective Action Objectives
USTs	Underground Storage Tank

1. SITE HISTORY/EXECUTIVE SUMMARY

1.1 GENERAL

Mr. Kamlesh Patel, owner of the underground storage tanks (USTs) at KB Food & Gas, purchased the subject site located at 111 West Jackson Street in Sullivan, Illinois, from Convenience and Petroleum Marketing, LLC, on August 2, 2007 (CES, 2007). With the purchase, Mr. Patel acquired responsibility for leaking UST Incident Numbers 2004-0969 and 90-0146. Incident Number 2004-0969 was assigned on July 9, 2004, by the Illinois Emergency Management Agency (IEMA) after a removal of the UST's was requested by the Illinois Department of Transportation (IDOT) and presided over by the Illinois Office of the State Fire Marshal (OSFM). Based on soil staining and visual signs of contamination, the OSFM required that a confirmed release be reported to the IEMA. Site investigation and remedial proceedings were originally performed by Consolidated Environmental Services (CES). Based on the investigation by CES, Incident #2004-0969 was a commingling release with the former release Incident #90-0146. Once the purchase of the property was finalized, Mr. Patel then requested CW^3M Company, Inc. to proceed with the reporting and site investigation requirements in accordance with the requirements of 35 Illinois Administrative Code (Ill Adm. Code) 734. An Election to proceed as owner was filed by Mr. Patel on February 18, 2010, and approved by the Agency on March 4, 2010.

The 20-Day Certification was submitted to the Illinois Environmental Protection Agency (IEPA) on July 23, 2004 (CES, 2004). The 45-Day Report was submitted November 9, 2004 (CES, 2004a). A Site Classification Work Plan and Budget was submitted on November 9, 2004 (CES, 2004b) and was denied by the Agency on February 15, 2005 (IEPA, 2005). On September 8, 2004, the Agency approved the 45-Day Report (IEPA, 2004). A Stage 2 Site Investigation Plan (SIP) and Budget was submitted on October 14, 2005 (CES, 2005) and was approved, with modifications to the budget, by the IEPA on January 20, 2006 (IEPA, 2006). A Stage 2 SIP Budget was submitted on July, 1, 2010 (CW^3M, 2010) and was approved with modifications on August 26, 2010 (IEPA, 2010). A Stage 3 SIP and Budget was submitted to the IEPA on August 20, 2010 (CW^3M, 2010a) and was approved by IEPA on October 13, 2010 (IEPA, 2010a). An amended Stage 3 SIP and Budget was submitted on September 6, 2011 (CW^3M, 2011) and was denied in a letter by the IEPA on October 4, 2011 (IEPA, 2011). The Agency has made the determination that soil and groundwater has been defined to Tier 1 residential clean up objectives and no further investigation is needed. A Site Investigation Completion Report (SICR) was submitted on November 10, 2011 (CW^3M, 2011a) and was approved, with modifications to the Stage 3 Site Investigation Actual Costs, by the IEPA on January 11, 2012 (IEPA, 2012).

This Corrective Action Plan (CAP) and Budget has been prepared in accordance with the requirements of Ill. Adm. Code 734. The CAP Certification form, which has been prescribed and provided by the IEPA has been included in Appendix A. This report is certified by an Illinois Licensed Professional Engineer.

1.2 SITE LOCATION

KB Food & Gas is located at 111 West Jackson Street, Sullivan, Moultrie County, Illinois. The site is located in the NE ¼ of the NW ¼ of the SE ¼ of Section 2, Township 13 North of the Centralia Baseline and Range 5 East of the Third Principle Meridian.

1.3 UNDERGROUND STORAGE TANK INFORMATION

CES personnel were on site July 15th and 16th, 2004, to oversee tank removal activities and collect soil samples. The tanks were ventilated and the tanks, product piping and the vent risers removed. A narrative of the tank removals and other early action activities was provided in the 45-Day Report (CES, 2004a).

Table 1-1. Underground Storage Tank Summary

Tank Number	Tank Volume (gallons)	Tank Contents	Incident Number	Release Information	Current Status
1	10,000	Gasoline	90-0146 2004-0969	Spills & Overfills	Removed 7/8/2004
2	8,000	Gasoline	2004-0969	Spills & Overfills	Removed 7/8/2004
3	8,000	Gasoline	2004-0969	Spills & Overfills	Removed 7/8/2004
4	5,000	Diesel	2004-0969	Spills & Overfills	Removed 7/8/2004
5	5,000	Gasoline	2004-0969	Spills & Overfills	Removed 7/8/2004
6	2,000	Kerosene	2004-0969	Spills & Overfills	Removed 7/8/2004
7	10,000	Gasoline	None	None	Installed 8/5/2004
8	10,000	Gasoline	None	None	Installed 8/5/2004
9	8,000	Diesel	None	None	Installed 8/5/2004
10	5,000	Kerosene	None	None	Installed 8/5/2004
11	5,000	Gasoline	None	None	Installed 8/5/2004

1.4 EARLY ACTION SUMMARY

During and following completion of the tank removal activities, transportation and disposal of contaminated backfill materials was initiated. CES collected six soil samples from the product dispenser islands, as well as a groundwater sample collected from standing water in the UST removal area. Additionally, groundwater samples were collected from the old monitoring wells installed by Shaffer, Kramer, Silver & Associates, in response to Incident #90-0146. CES personnel returned to the site on July 30, 2004, and again on August 16th and 17th, 2004, to oversee additional soil removal from the UST excavation.

Approximately 1,698.37 tons (1,132.24 cubic yards) of contaminated backfill material was removed from the UST excavation site and disposed of at Environmental Recycling Centers

Coles County Landfill in Charleston, Illinois. Upon completion of the backfill removal, 8 samples were collected along the walls of the excavation, and 7 samples were collected from the excavation floor.

The indicator contaminants for gasoline are benzene, ethylbenzene, toluene, and total xylenes (BETX) and methyl tert-butyl ether (MTBE), while the indicator contaminants for diesel fuel and kerosene are BETX, MTBE, and polynuclear aromatic hydrocarbons (PNAs). Soil samples were collected and analyzed for BETX, MTBE, and PNAs due to diesel fuel and kerosene involved in the release. The clean-up objectives were set, and the results were submitted to the IEPA in the 45-Day Report (CES, 2004a). The Stage 2 SIP proposed that BETX and MTBE remain the only indicator contaminants that should be tested for because PNA contamination was not found, and it was approved by the IEPA on January 20, 2006 (IEPA, 2006). Acceptable Detection Limits (ADLs) were in accordance with SW 8260B analysis methods.

The analytical results for the USTs excavation were submitted in the Stage 2 Site Investigation Plan (CES, 2005).

Maps showing the former tank locations, early action excavation area, and early action sample locations have been incorporated into our maps as accurately as possible.

1.5 SITE INVESTIGATION SUMMARY

Based upon the results of the initial on-site sampling, it was determined that off-site access was going to be required on the six surrounding properties. All but one property (News Progress, south of the subject property) has denied access or access has been considered denied. Off-site access correspondence was included in the SICR (CW^{3}M, 2011a) and will be provided again in the Corrective Action Completion Report (CACR). In addition, all soil and groundwater analytical results were provided in the SICR (CW^{3}M, 2011a).
Soil analytical results indicate that the Tiered Approach to Corrective Action Objectives (TACO) Tier 1 Residential Clean-up Objectives have been exceeded at the northern, northwestern, western, southern, and southeastern property boundaries with the majority of the release emanating from the pump islands. Indicator contaminants that have exceeded the objectives include BETX and MTBE. Based on on-site and off-site investigations from the limited amount of off-site access granted, the soil plume has been defined.

Groundwater analytical results indicate that the groundwater quality has exceeded the Class I Groundwater Objectives at all of the property boundaries. Indicator contaminants that have exceeded the objectives include BETX and MTBE. Based on on-site and off-site investigations from the limited amount of off-site access granted, the groundwater plume has been defined. An Amended Stage 3 Plan and Budget was submitted to further investigate off-site, but the Agency determined that the contamination found at MW-13 was likely not part of the KB Food & Gas release, and denied the additional investigation.

1.6 CORRECTIVE ACTION SUMMARY

The results from the site investigation activities indicate that soil contamination above Tier 1 Clean-up Objectives is present on-site. Upon the determination of TACO Tier 2 Clean-up Objectives, it is apparent that levels of contamination defined from site investigations activities have met Tier 2 Clean-up Objectives. The establishment of the TACO Tier 2 Clean-up Objectives will allow all soil on-site to meet industrial/commercial and construction worker land use clean-up objectives.

Soil analytical results indicate that TACO Tier 1 Residential Clean-up Objectives have been exceeded on-site at the property boundary bordering News Progress, located south of the subject property. Due to the limited area, close proximity to utility lines, and News Progress's building foundation, the removal of potential off-site contaminated soil is not a viable option. CW^{3}M proposes to use an Environmental Land Use Control (ELUC) restricting the News Progress property to industrial/commercial usage by accepting the Tier 2 Clean-up Objectives for the KB Food & Gas site. If the property owner is objectionable to entering into an ELUC for the property, a Corrective Action Plan and Budget Amendment will be submitted to address off-site contamination at the News Progress property.

Soil analytical results indicate that the TACO Tier 1 Residential Clean-up Objectives have been exceeded at KB Food & Gas property boundary lines bordering Hamilton Street (Illinois Route 32), Jackson Street (Illinois Route 121), and Van Buren Street. Highway Authority Agreements (HAAs) with the City of Sullivan and IDOT will be required to address potential soil contamination under these Right of Ways (ROWs).

Groundwater modeling indicates that the extent of groundwater contamination exceeding the most stringent Tier 1 remediation objectives reaches off-site properties. Therefore, it will be proposed that the City of Sullivan adopt either a citywide or limited groundwater ordinance effectively prohibiting the installation of potable water supply wells within a specified area of Sullivan, Illinois.

2. REMEDIATION OBJECTIVES

2.1 DETERMINATION OF CLEAN-UP OBJECTIVES

In accordance with 35 Ill. Adm. Code 734.410, remediation objectives for the site have been determined in accordance with 35 Ill. Adm. Code 742. Therefore during site investigation activities, the following site-specific parameters were determined:

> *Hydraulic Conductivity (K):* 1.38 x 10^{-5} cm/sec
> *Soil bulk density* (ρ_b)*:* 1.846 g/cm^3
> *Soil particle density* (ρ_s): 2.652 g/cm^3
> *Moisture content (w):* 0.142
> *Organic carbon content* (f_{oc}): 0.721

In order to determine the hydraulic conductivity, a slug test was performed during Stage 1 site investigation activities. The test was performed by lowering a "slug" constructed of polyvinyl chloride (PVC) into a monitoring well. When the slug is lowered into the well, the groundwater is displaced by the volume of the slug. As the water within the well equilibrates, water depth changes are recorded in relation to the time interval that has passed since the test was initiated.

The hydraulic conductivity calculations are based on the total well depth, screen length and radius, initial water depth and the water depth change over time. The depth-to-water changes over time have been plotted on a semi-logarithmic graph and the curve has been evaluated. The slope of the straight-line portion of the curve, along with the other slug test data, was used to calculate the hydraulic conductivity.

Velocity was calculated using the hydraulic conductivity results determined at the site, as well as the hydraulic gradient. The hydraulic gradient was found by calculating the change in gradient between the most up-gradient well (MW-12, 95.33 feet) and the down-gradient well in the direction of flow (MW-8, 94.13 feet), then dividing this answer by the distance in feet between the two wells (116 feet). Formula R24, ($U_{gw} = K \bullet i$) of 35 Ill. Adm. Code § 742 Appendix C, Table C. The resulting velocity is 1.42 x 10^{-7} cm/sec.

The remaining four parameters were determined by laboratory analysis of a soil sample, which was collected during drilling activities. Samples were collected in accordance with 35 Ill. Adm. Code 742.

Using these site-specific parameters, equation S1 through S10 was used to calculate the Tier 2 objectives for soil at the site. All variables utilized were provided by TACO objectives. Refer to Appendix D for TACO input variables and equations used.

2.2 SOIL AND GROUNDWATER OBJECTIVES

The soil and groundwater objectives are listed for the site below in tabular format. Tier 2 values are listed with a groundwater usage restriction and an industrial/commercial property use restriction for the property itself. Additionally, the groundwater at this site continues to be considered Class 1 unless demonstrated otherwise pursuant to 35 Ill. Adm. Code 620.210.

Table 2-1 Remediation Objectives

Parameter	TACO Industrial/Commercial Tier 2 Soil Clean-up Objective (mg/kg)	TACO Class 1 Groundwater Clean-up Objective (mg/L)
Benzene	55.1	0.005
Ethylbenzene	400	0.7
Toluene	650	1.0
Total Xylenes	320	10.0
MTBE	3,694	0.07

Tables comparing all soil samples to the most stringent Tier 1 Clean-up Objectives and all groundwater samples to TACO Class 1 Groundwater Clean-up Objectives have been included in Appendix E. Tables comparing all soil samples to the TACO Industrial/Commercial Tier 2 Clean-up Objectives have also been included in Appendix E. No sample locations exceed the TACO Tier 2 objectives.

3. CORRECTIVE ACTION PLAN

The goal of remediation is to bring the contaminant levels of the soil and groundwater at KB Food & Gas in Sullivan below clean-up objectives and reduce the chance of exposure to contaminated groundwater. A number of remediation technologies are available for Leaking Underground Storage Tank (LUST) sites. The selection of a clean-up technology involves a choice of the option best suited to meet the clean-up objectives for the site within a reasonable timeframe in a cost conscious manner. This decision has been made for KB Food & Gas by the process of identifying possible technology options, screening the options according to threshold requirements, and then selecting the best of the remaining options.

The following CAP and Budget has been prepared by CW^{3}M Company, Inc., as their recommendation for the most appropriate approach to the remediation of the contamination for the KB Food & Gas property in Sullivan, Illinois. CW^{3}M proposes to use an industrial/commercial land use restriction on-site and at the News Progress property. This plan proposes no soil remediation, since there is no contamination on-site above TACO Tier 2 Industrial/Commercial Clean-up Objectives. However, soil analytical results indicate that TACO Tier 1 Residential Clean-up Objectives have been exceeded at the property boundary bordering News Progress, located south of the subject property. Due to the limited area, close proximity to utilities, and News Progress's building foundation, the removal of potential contaminated soil off-site is not a viable option. CW^{3}M proposes to use an ELUC restricting the News Progress property to industrial/commercial uses by accepting the Tier 2 Clean-up Objectives for the KB Food & Gas site. If the property owner does not wish to obtain an industrial land use restriction for the property, a Corrective Action Plan and Budget Amendment will be submitted to address off-site contamination at the News Progress property.

In addition, soil analytical results indicate that the TACO Tier 1 Residential Clean-up Objectives have been exceeded at the KB Food & Gas property boundary lines bordering Hamilton Street (Illinois Route 32), Jackson Street (Illinois Route 121), and Van Buren Street. CW^{3}M proposes to use HAAs with the City of Sullivan and IDOT to address potential soil contamination under these ROWs to limit the exposure to any potential contamination above Tier 1 Clean-up Objectives.

Groundwater analytical results indicate that the groundwater quality has exceeded the Class 1 Groundwater Clean-up Objectives at all of the property boundaries. Indicator contaminants that have exceeded the objectives include BETX and MTBE. Based on on-site and off-site investigations from the limited amount of off-site access granted, the groundwater plume has been defined. Groundwater modeling indicates that the extent of groundwater contamination exceeding the most stringent Tier 1 remediation objectives reaches off-site properties. Groundwater flow is in the general northeast direction. Modeling of the soil and groundwater contamination below Tier 1 Clean-up Objectives indicates contaminant migration to the north and northeast moving off-site to the Yoder House and the northeast residence. Therefore, it will be proposed that the City of Sullivan adopt a citywide or limited groundwater ordinance effectively prohibiting the installation of potable water supply wells within a specified area of Sullivan, Illinois. The adoption of a groundwater ordinance by the City of Sullivan will be used to reduce any chance of exposure to contaminated groundwater caused by the incident. Lastly, after all institutional controls and agreements are approved and in place, all wells on- and off-site will be properly abandoned.

3.1 CURRENT AND PROJECTED USES OF THE SITE

The site is currently an active gas station and will continue to remain as so. The site is surrounded by residential and commercial properties.

3.2 INSTITUTIONAL CONTROLS PROPOSED

This CAP proposes an industrial/commercial land use restriction on site and at the News Progress property south of the subject site. CW³M proposes to use an ELUC restricting the News Progress property to industrial/commercial uses by accepting the Tier 2 Clean-up Objectives for the KB Food & Gas site. HAAs will be used limit access to potential soil contamination under the ROWs of Hamilton Street (Illinois Route 32), Jackson Street (Illinois Route 121), and Van Buren Street that are contaminated above TACO Tier 1 Clean-up Objectives. Finally, the adoption of a citywide or limited groundwater ordinance by the City of Sullivan will be used to reduce any chance of exposure to contaminated groundwater caused by the incident.

3.3 WATER SUPPLY WELL SURVEY

A survey of water supply wells for the purpose of identifying and locating all community water supply wells within 2,500 feet of the UST systems and all potable water supply wells within 200 feet of the UST systems has been completed. The Illinois State Water Survey (ISWS), the Illinois State Geological Survey (ISGS) and the IEPA Division of Public Water Supplies were contacted via Source Water Assessment Program online.

The ISGS, ISWS, and IEPA Division of Public Water Supplies were accessed online on June 7, 2010 (EPA.STATE.IL.US, 2010). The response indicated that one well was located within 2,500 feet of the site and no wells are within the designated set back zone.

Also, the response stated that there are no community water supply wells located within 2,500 feet of the site or groundwater ordinance in place for the City of Sullivan.

Table 3-1. Water Supply Well Information

Well ID	Type	Depth of Well *(feet)*	Distance From USTs *(feet)*	Setback Zone *(feet)*
20790	ISGS	150	2,270	200

3.4 CLOSURE

Analytical results indicate that TACO Tier 2 Industrial/Commercial Clean-up Objectives have been met for the site. Once the HAAs, Groundwater Ordinance, and off-site industrial/commercial land use controls are approved and in place, a CACR will be submitted to the IEPA requesting a No Further Remediation letter. The closure report will be accompanied by a certification from an Illinois Registered Professional Engineer.

4. REFERENCES

CES, 2004. Consolidated Environmental Services, Inc., *20-Day Certification*, CPM Store No. 108, Sullivan, Illinois, July 23, 2004.

CES, 2004a. Consolidated Environmental Services, Inc., *45-Day Report*, CPM Store No. 108, Sullivan, Illinois, November 9, 2004.

CES, 2004b. Consolidated Environmental Services, Inc., *Site Classification Work Plan and Budget*, CPM Store No. 108, Sullivan, Illinois, November 9, 2004.

CES, 2005. Consolidated Environmental Services, Inc., *Stage 2 Site Investigation Plan and Budget*, CPM Store No. 108, Sullivan, Illinois, October 14, 2005.

CES, 2007. Consolidated Environmental Services, Inc., *Subject Site Ownership Correspondence*, KB Food & Gas, Sullivan, Illinois, August 2, 2007.

EPA.STATE.IL.US, 2010. Source Water Assessment Program, *Water Well Survey Map* www.maps.epa.state.il.us, accessed June 7, 2010.

IEPA, 2004. Illinois Environmental Protection Agency, *45-Day Report Correspondence*, CPM Store No. 108, Sullivan, Illinois, September 8, 2004.

IEPA, 2005. Illinois Environmental Protection Agency, *Site Classification Work Plan and Budget Correspondence*, CPM Store No. 108, Sullivan, Illinois, February 15, 2005.

IEPA, 2006. Illinois Environmental Protection Agency, *Stage 2 Site Investigation Plan and Budget Correspondence*, CPM Store No. 108, Sullivan, Illinois, January 20, 2006.

IEPA, 2010. Illinois Environmental Protection Agency, *Stage 2 Site Investigation Plan Budget Correspondence*, KB Food & Gas, Sullivan, Illinois, August 26, 2010.

IEPA, 2010a. Illinois Environmental Protection Agency, *Stage 3 Site Investigation Plan and Budge Correspondence*, KB Food & Gas, Sullivan, Illinois, October 13, 2010.

IEPA, 2011. Illinois Environmental Protection Agency, *Amended Stage 3 Site Investigation Plan and Budget Correspondence*, KB Food & Gas, Sullivan, Illinois, October 4, 2011.

IEPA, 2012. Illinois Environmental Protection Agency, *Site Investigation Completion Report Correspondence*, KB Food & Gas, Sullivan, Illinois, January 11, 2012.

CW³M, 2010. CW³M Company, Inc., *Stage 2 Site Investigation Plan Budget*, KB Food & Gas, Sullivan, Illinois, July 1, 2010.

CW³M, 2010a. CW³M Company, Inc., *Stage 3 Site Investigation Plan and Budget*, KB Food & Gas, Sullivan, Illinois, August 20, 2010.

CW³M, 2011. CW³M Company, Inc., *Amended Stage 3 Site Investigation Plan and Budget*, KB Food & Gas, Sullivan, Illinois, September 6, 2011.

CW³M, 2011a. CW³M Company, Inc., *Site Investigation Completion Report*, KB Food & Gas, Sullivan, Illinois, November 10, 2011.

APPENDIX A

CORRECTIVE ACTION PLAN FORM

KB FOOD & GAS
SULLIVAN, ILLINOIS

Illinois Environmental Protection Agency

Bureau of Land • 1021 N. Grand Avenue E. • P.O. Box 19276 • Springfield • Illinois • 62794-9276

Leaking Underground Storage Tank Program
Corrective Action Plan

A. Site Identification

IEMA Incident # (6- or 8-digit): 04-0969 IEPA LPC# (10-digit): 1390305014

Site Name: KB Food & Gas

Site Address (Not a P.O. Box): 111 West Jackson Street / Routes 121 & 132

City: Sullivan County: Moultrie ZIP Code: 61951

B. Site Information

1. Will the owner or operator seek reimbursement from the Underground Storage Tank Fund? ☑ Yes ☐ No
2. If yes, is the budget attached? ☑ Yes ☐ No
3. Is this an amended plan? ☐ Yes ☑ No
4. Identify the material(s) released: Gasoline, Diesel, Kerosene
5. This Corrective Action Plan is submitted pursuant to:
   a. 35 Ill. Adm. Code 731.166 ☐

      The material released was:

      -petroleum ☐

      -hazardous substance (see Environmental Protection Act Section 3.215) ☐
   b. 35 Ill. Adm. Code 732.404 ☐
   c. 35 Ill. Adm. Code 734.335 ☑

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C. Proposed Methods of Remediation

1. Soil Tier 2 Industrial/Commercial Clean-up Objectives, ELUC, Highway Authority Agreements
2. Groundwater Groundwater Ordinance

D. Soil and Groundwater Investigation Results

(for incidents subject to 35 Ill. Adm. Code 731 only or 732 that were classified using Method One or Two, if not previously provided)

Provide the following:

1. Description of investigation activities performed to define the extents of soil and/or groundwater contamination;
2. Analytical results, chain-of-custody forms, and laboratory certifications;
3. Tables comparing analytical results to applicable remediation objectives;

4. Boring logs;
5. Monitoring well logs; and
6. Site maps meeting the requirements of 35 Ill. Adm. Code 732.110(a) or 734.440 and showing:
    a. Soil sample locations;
    b. Monitoring well locations; and
    c. Plumes of soil and groundwater contamination.

E. Technical Information - Corrective Action Plan

Provide the following:

1. Executive summary identifying the objectives of the corrective action plan and the technical approach to be utilized to meet such objectives;
    a. The major components (e.g., treatment, containment, removal) of the corrective action plan;
    b. The scope of the problems to be addressed by the proposed corrective action; and
    c. A schedule for implementation and completion of the plan;
2. Identification of the remediation objectives proposed for the site;
3. A description of the remedial technologies selected:
    a. The feasibility of implementing the remedial technologies;
    b. Whether the remedial technologies will perform satisfactorily and reliably until the remediation objectives are achieved; and
    c. A schedule of when the technologies are expected to achieve the applicable remediation objectives;
4. A confirmation sampling plan that describes how the effectiveness of the corrective action activities will be monitored during their implementation and after their completion;
5. A description of the current and projected future uses of the site;
6. A description of engineered barriers or institutional controls that will be relied upon to achieve remediation objectives:
    a. an assessment of their long-term reliability;
    b. operating and maintenance plans; and
    c. maps showing area covered by barriers and institutional controls;
7. The water supply well survey:
    a. Map(s) showing locations of community water supply wells and other potable wells and the setback zone for each well;
    b. Map(s) showing regulated recharge areas and wellhead protection areas;
    c. Map(s) showing the current extent of groundwater contamination exceeding the most stringent Tier 1 remediation objectives;
    d. Map(s) showing the modeled extent of groundwater contamination exceeding the most stringent Tier 1 remediation objectives;
    e. Tables listing the setback zone for each community water supply well and other potable water supply wells;
    f. A narrative identifying each entity contacted to identify potable water supply wells, the name and title of each person contacted, and any field observations associated with any wells identified; and
    g. A certification from a Licensed Professional Engineer or Licensed Professional Geologist that the survey was conducted in accordance with the requirements and that documentation submitted includes information obtained as a result of the survey (certification of this plan satisfies this requirement);

8. Appendices:
    a. References and data sources report that are organized; and
    b. Field logs, well logs, and reports of laboratory analyses;
9. Site map(s) meeting the requirements of 35 Ill. Adm. Code 732.110(a) or 734.440;
10. Engineering design specifications, diagrams, schematics, calculations, manufacturer's specifications, etc.;
11. A description of bench/pilot studies;
12. Cost comparison between proposed method of remediation and other methods of remediation;
13. For the proposed Tier 2 or 3 remediation objectives, provide the following:
    a. The equations used;
    b. A discussion of how input variables were determined;
    c. Map(s) depicting distances used in equations; and
    d. Calculations; and
14. Provide documentation to demonstrate the following for alternative technologies:
    a. The proposed alternative technology has a substantial likelihood of successfully achieving compliance with all applicable regulations and remediation objectives;
    b. The proposed alternative technology will not adversely affect human health and safety or the environment;
    c. The owner or operator will obtain all Illinois EPA permits necessary to legally authorize use of the alternative technology;
    d. The owner or operator will implement a program to monitor whether the requirements of subsection (14)(a) have been met;
    e. Within one year from the date of Illinois EPA approval, the owner or operator will provide to the Illinois EPA monitoring program results establishing whether the proposed alternative technology will successfully achieve compliance with the requirements of subsection (14)(a); and
    f. Demonstration that the cost of alternative technology will not exceed the cost of conventional technology and is not substantially higher than at least two other alternative technologies, if available and technically feasible.

F. Exposure Pathway Exclusion

Provide the following:

1. A description of the tests to be performed in determining whether the following requirements will be met:
    a. Attenuation capacity of the soil will not be exceeded for any of the organic contaminants;
    b. Soil saturation limit will not be exceeded for any of the organic contaminants;
    c. Contaminated soils do not exhibit any of the reactivity characteristics of hazardous waste per 35 Ill. Adm. Code 721.123;
    d. Contaminated soils do not exhibit a pH ≤ 2.0 or ≥ 12.5; and
    e. Contaminated soils which contain arsenic, barium, cadmium, chromium, lead, mercury, or selenium (or their associated salts) do not exhibit any of the toxicity characteristics of hazardous waste per 35 Ill. Adm. Code 721.124.
2. A discussion of how any exposure pathways are to be excluded.

G. Signatures

All plans, budgets, and reports must be signed by the owner or operator and list the owner's or operator's full name, address, and telephone number.

UST Owner or Operator

Name KB Sullivan, Inc.
Contact Kamlesh Patel
Address 140 Hearthstone
City Bartlett
State Illinois
Zip Code 60103
Phone (630) 730 - 4450
Signature KBPatel
Date 2/12/12

Consultant

Company CW M Company, Inc.
Contact Carol Rowe
Address 701 South Grand Avenue West
City Springfield
State Illinois
Zip Code 62704
Phone (217) 522 - 8001
Signature
Date 2/16/2012

I certify under penalty of law that all activities that are the subject of this plan were conducted under my supervision or were conducted under the supervision of another Licensed Professional Engineer or Licensed Professional Geologist and reviewed by me; that this plan and all attachments were prepared under my supervision; that, to the best of my knowledge and belief, the work described in this plan has been completed in accordance with the Environmental Protection Act [415 ILCS 5], 35 Ill. Adm. Code 731, 732 or 734, and generally accepted standards and practices of my profession; and that the information presented is accurate and complete. I am aware there are significant penalties for submitting false statements or representations to the Illinois EPA, including but not limited to fines, imprisonment, or both as provided in Sections 44 and 57.17 of the Environmental Protection Act [415 ILCS 5/44 and 57.17].

Licensed Professional Engineer or Geologist

Name Vince E. Smith
Company CW M Company, Inc.
Address 701 South Grand Avenue West
City Springfield
State Illinois
Zip Code 62704
Phone (217) 522 - 8001
Ill. Registration No. 62-46118
License Expiration Date 11/30/13
Signature V E Smith
Date 2/16/12

L.P.E. or L.P.G. Seal

RECEIVED
FEB 17 2012
IEPA/BOL

VINCE E. SMITH
46118
REGISTERED
PROFESSIONAL
ENGINEER
OF
ILLINOIS

APPENDIX B

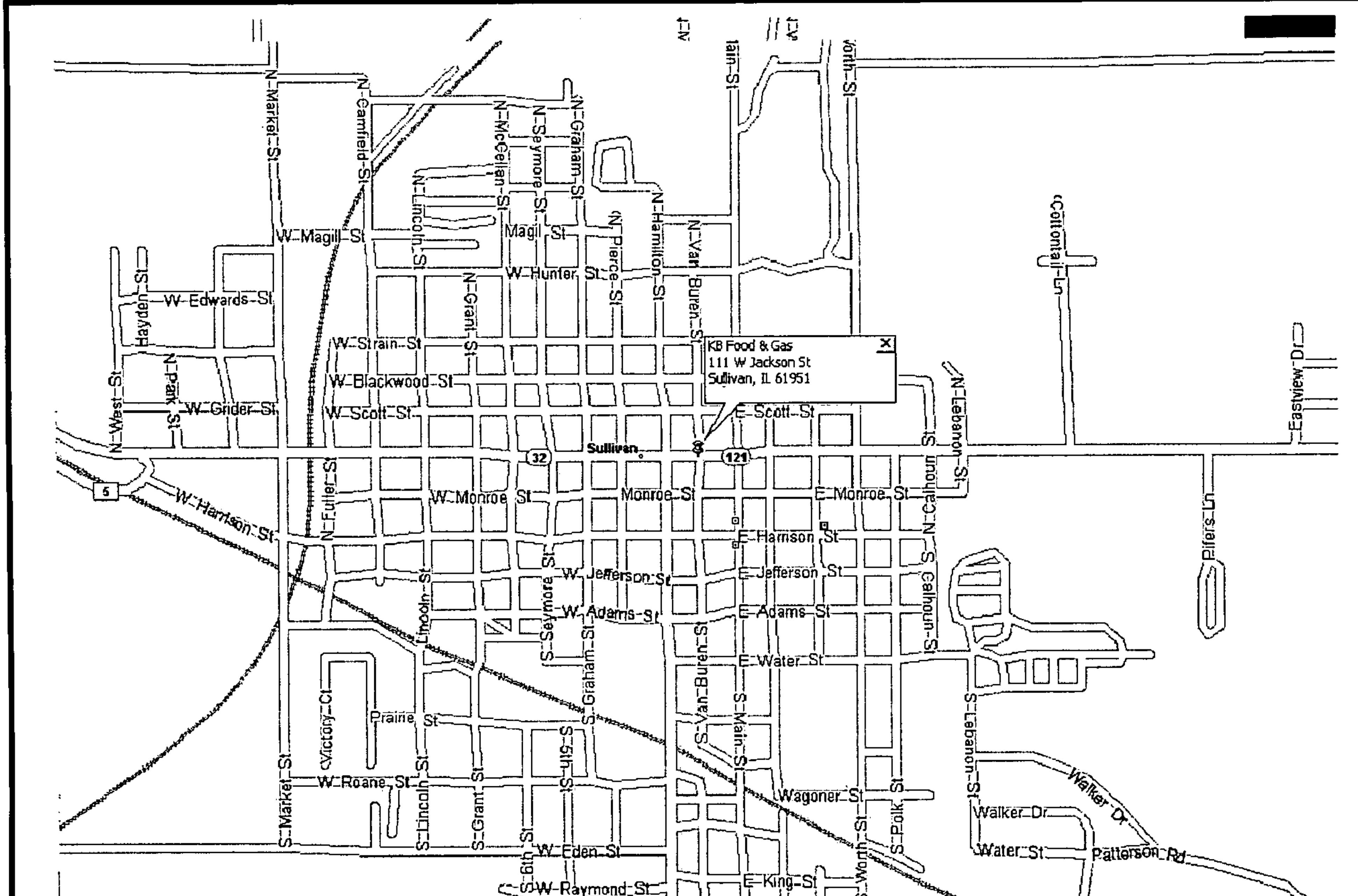
SITE MAPS AND ILLUSTRATIONS

KB FOOD & GAS
SULLIVAN, ILLINOIS

INDEX OF DRAWINGS

Drawing Number	Description	File Name
0001A	Site Location Map	SiteMap.doc
0001B	Facility Location Map (Topographic)	TopoMap.doc
0002	Site Map	Site1.dwg
0003	Soil Boring Location Map	sbloc1.dwg
0004	Monitoring Well Location Map	mwloc1.dwg
0005	Monitoring Well Elevation Map	mwelev1.dwg
0008	Groundwater Elevation Map (March 2010)	gwelev.dwg
0008A	Groundwater Elevation Map (May 2010)	gw0510.dwg
0008B	Groundwater Elevation Map (October 2010)	gw1010.dwg
0009A	Soil Contamination Values Map (0-5 feet)	sval0-5A.dwg
0009B	Soil Contamination Values Map (5-10 feet)	sval5-10A.dwg
0010	Groundwater Contamination Values Map	gwvalA.dwg
0011A	Tier 1 Soil Contamination Plume Map (0-5 feet)	splumeA.dwg
0011B	Tier 1 Soil Contamination Plume Map (5-10 feet)	splumeB.dwg
0012	Groundwater Contamination Plume Map	gwplumeA.dwg
0013	Groundwater Contaminant Transport Modeling Map	Modeling2.dwg
0014	Highway Authority Agreement Location Map	HAA.dwg
0015	TACO Information Map	TACO.dwg

[redacted]



0024

CW^{3}M Company, Inc.
701 South Grand Avenue West
Springfield, IL 62704
(217)-522-8001

Site Location Map
KB Food & Gas
111 West Jackson Street
Sullivan, Illinois

Drawn By: RCW
Reviewed By: CLR
Drawing.0001A
SiteMap.doc

The appearance of some of the images

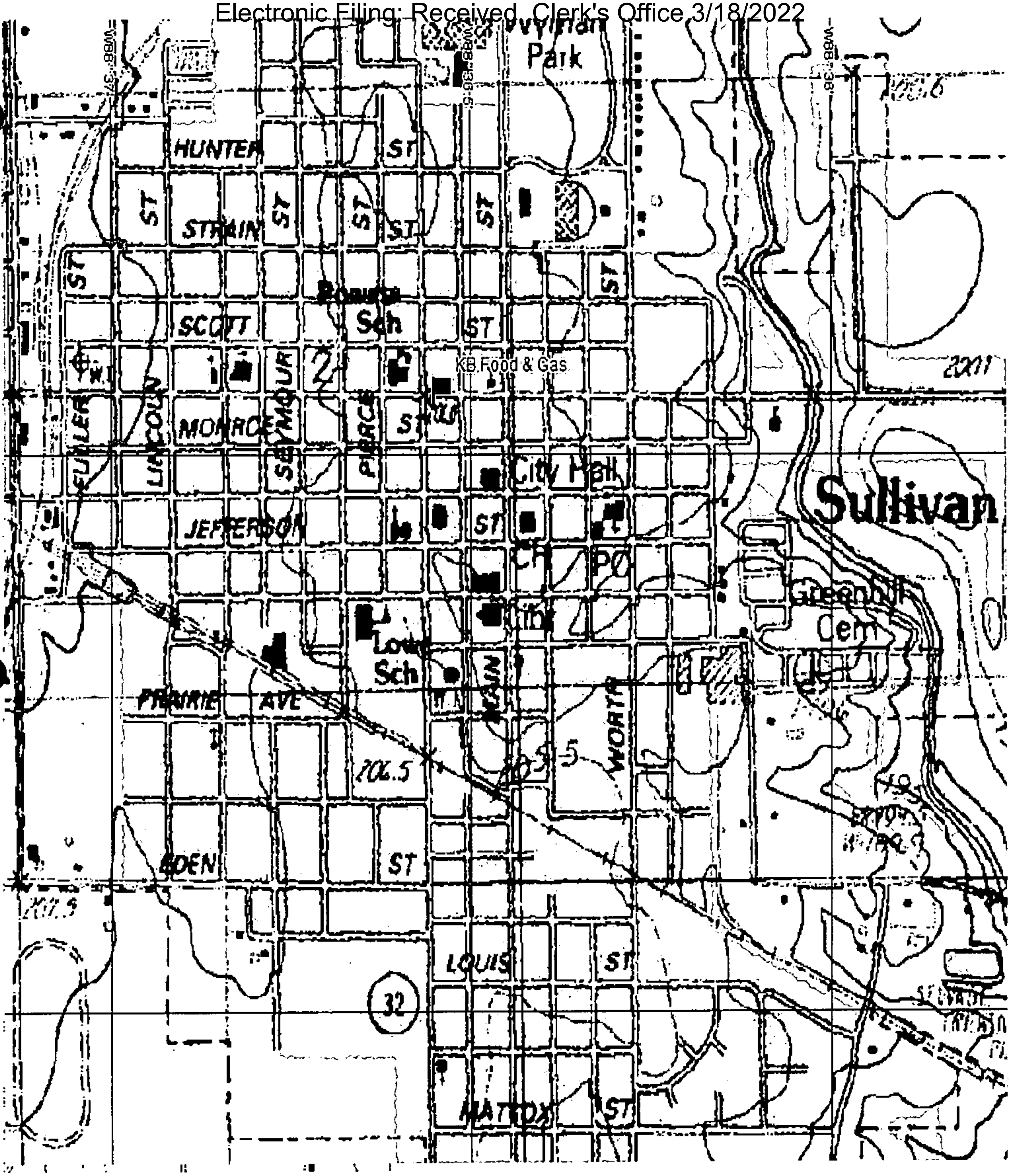
following this page is due to

Poor Quality Original Documents

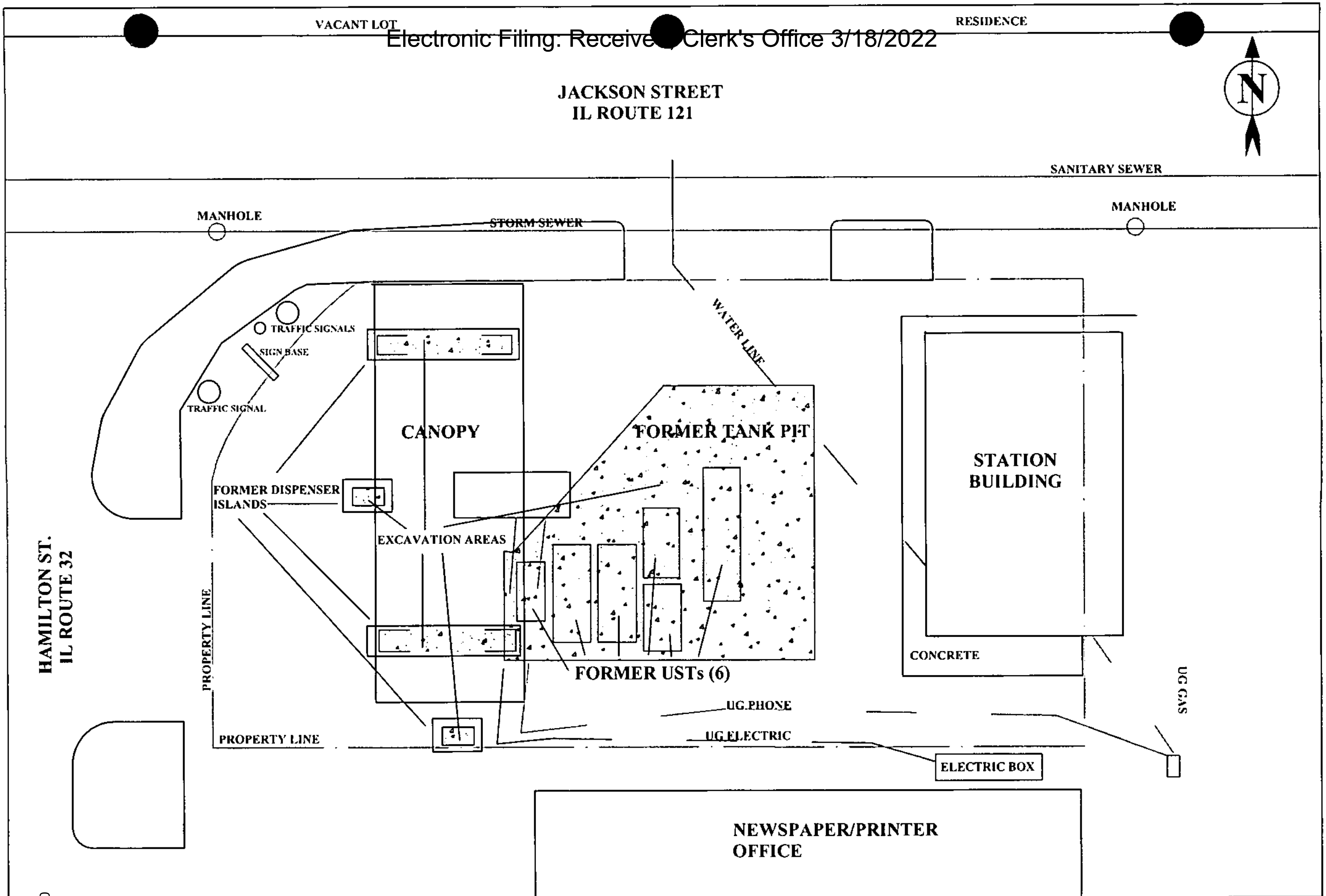
and not the scanning or filming processes.

Com Microfilm Company
(217) 525-5860

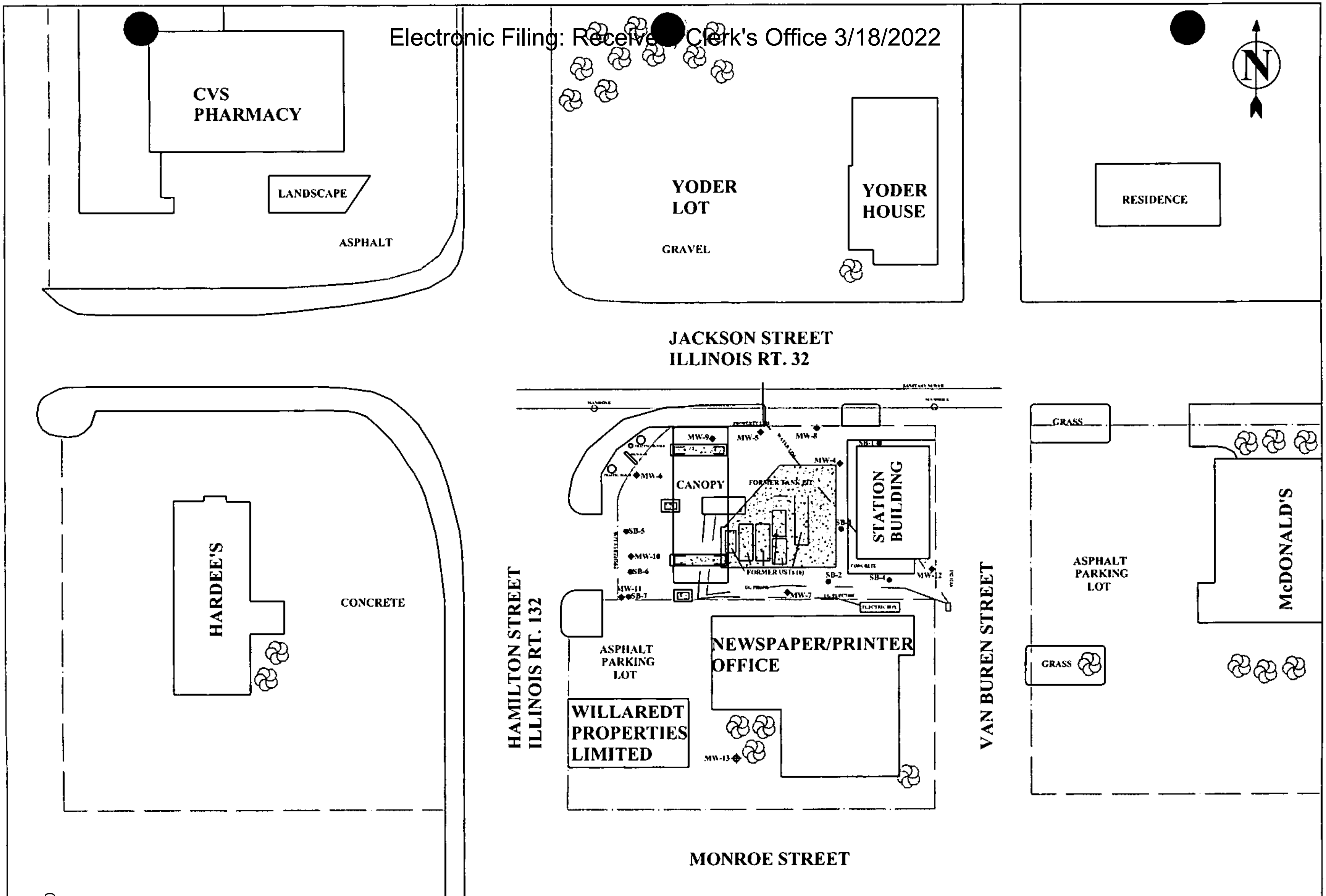
J:\toolbox\poorDocs.doc



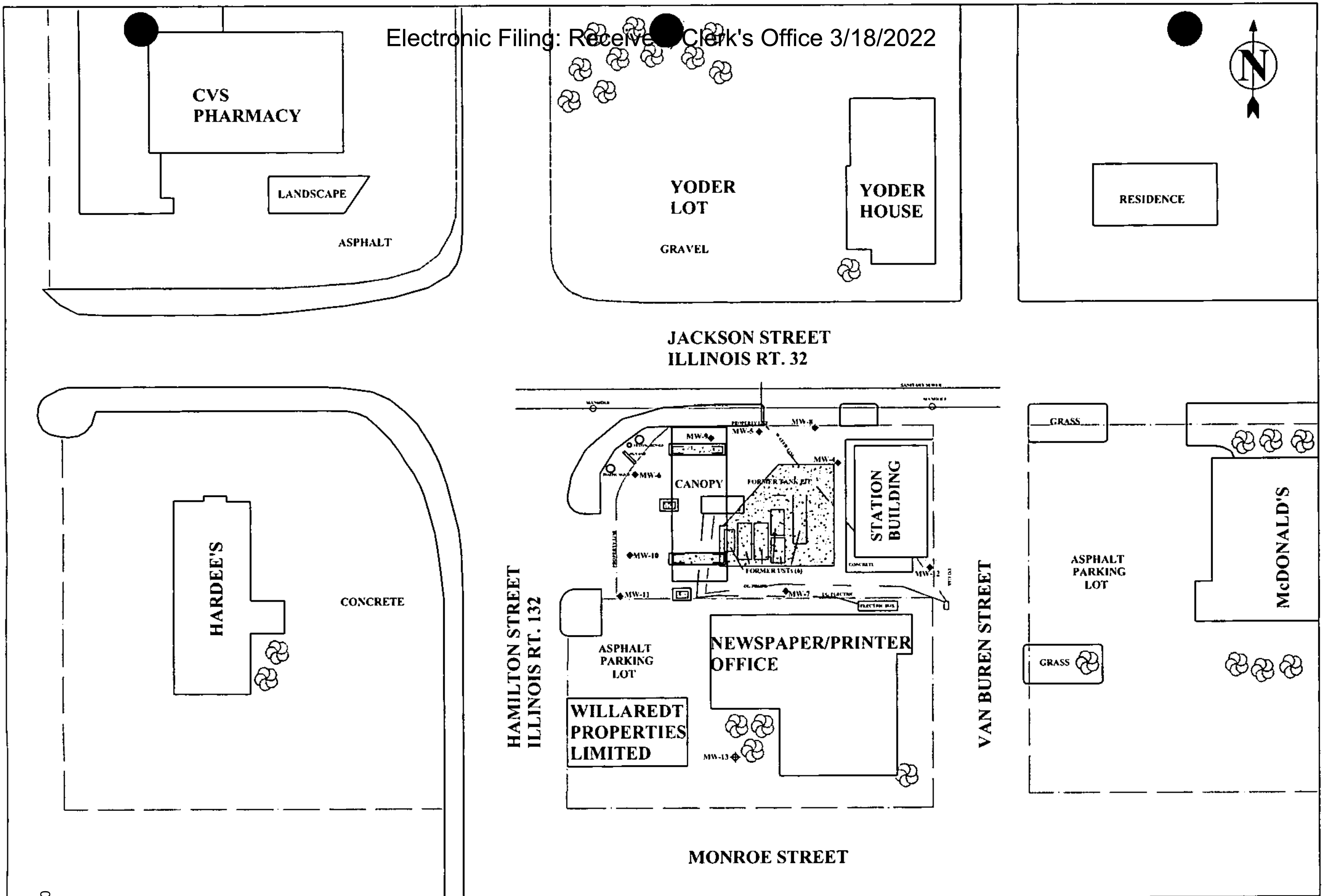
CW³M Company, Inc. 701 W. South Grand Ave. Springfield, IL 62704 (217) 522-8001	**Facility Location Map** 111 WEST JACKSON STREET SULLIVAN, ILLINOIS	Drawn By: KMC Reviewed By: Drawing 0001B TopoMap.doc



CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT # 2004-0969 MOULTRIE COUNTY	SITE MAP	SCALE: 1"=30' DATE: 4/20/10 REVISED DATE: 6/6/11 DRAWING: 0002	DRAWN BY: KMC REVISED BY: KMC REVIEWED BY: CLR SITE1.DWG

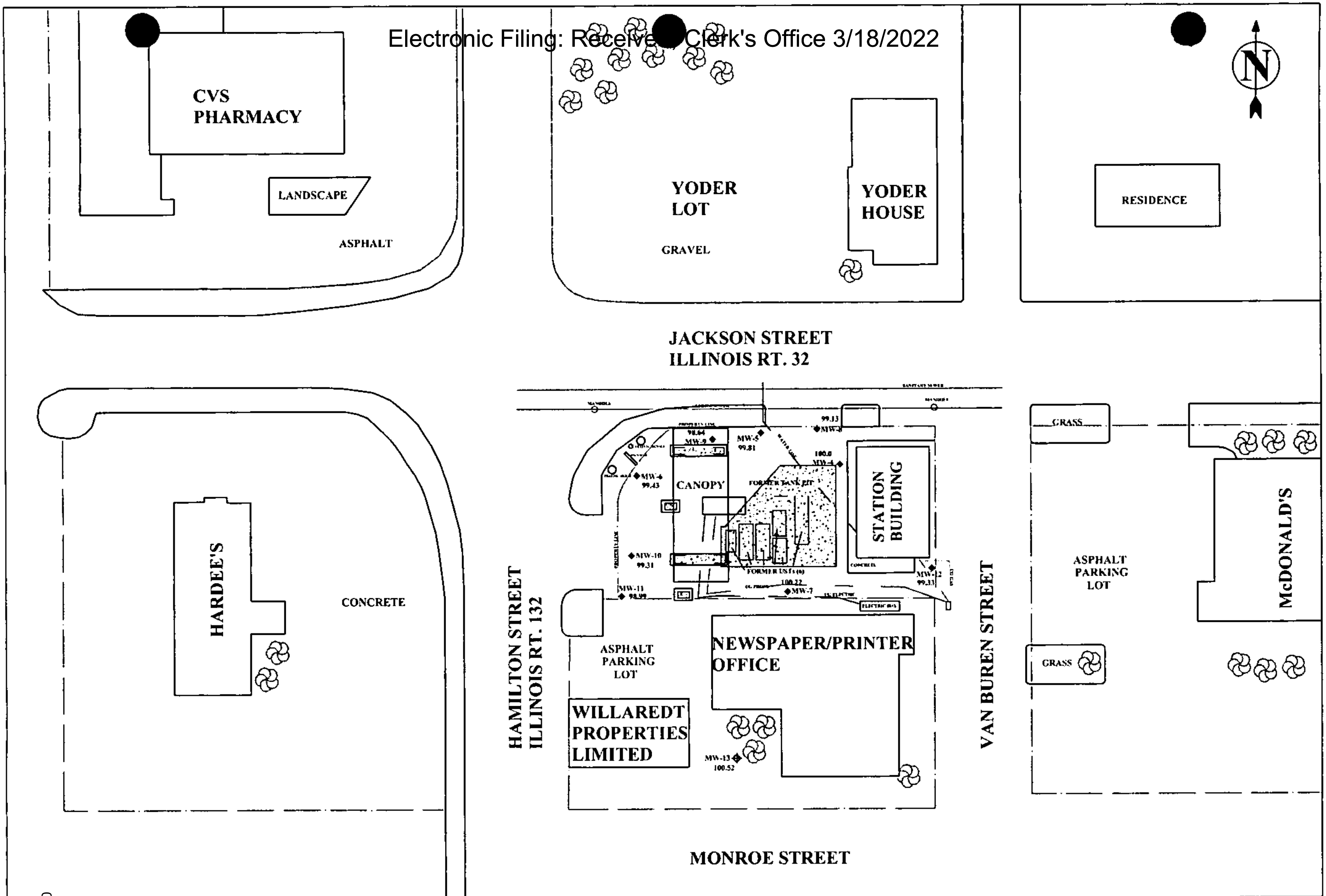


CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	SOIL BORING LOCATION MAP	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 6/2/11 DRAWING: 0003	DRAWN BY: KMC REVISED BY: KMC REVIEWED BY: CLR SBLOC1.DWG



0029

CW^{3}M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	MONITORING WELL LOCATION MAP	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 6/2/11 DRAWING: 0004	DRAWN BY: KMC REVISED BY: KMC REVIEWED BY: CLR MWLOC1.DWG



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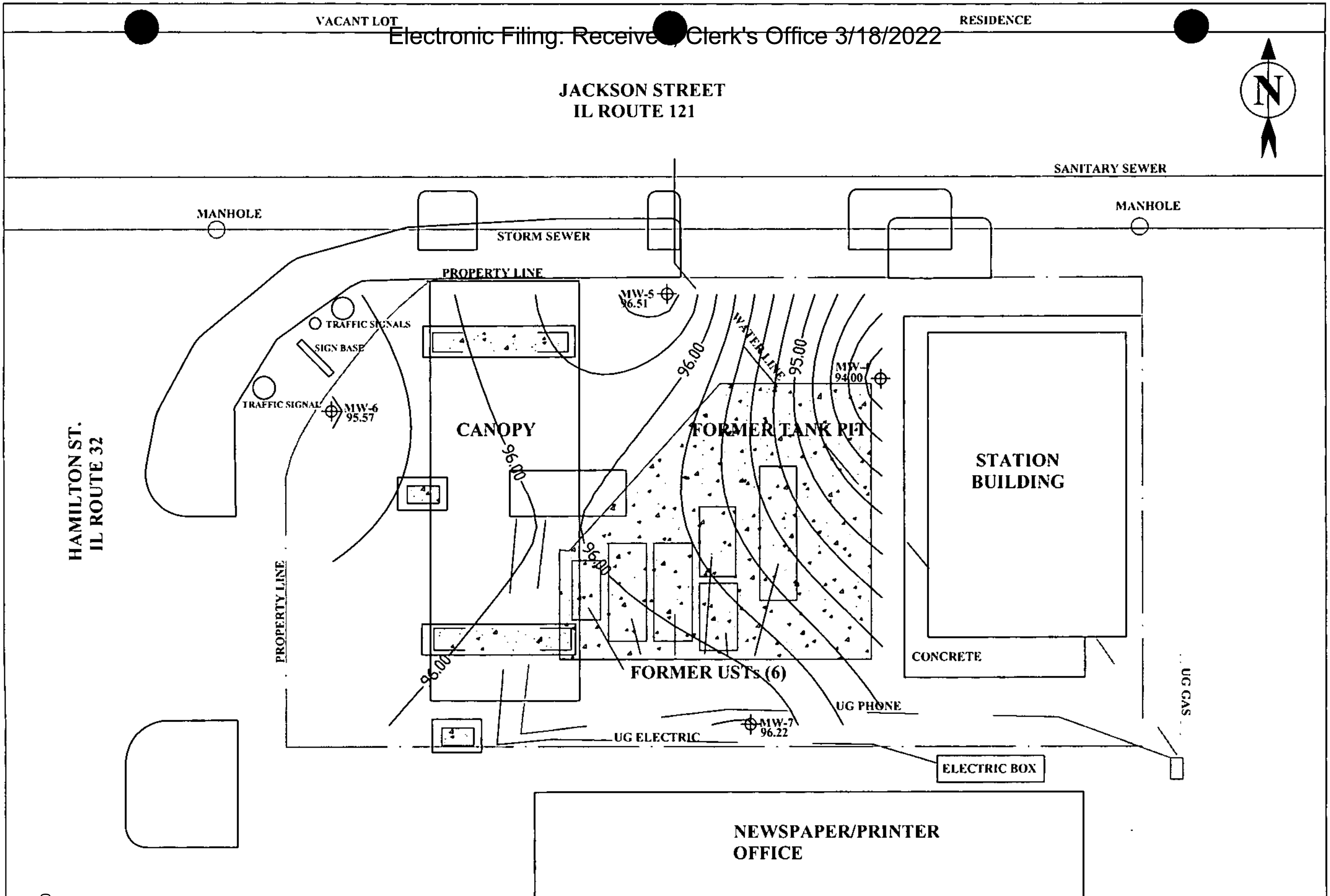
CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	MONITORING WELL ELEVATION MAP	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 11/1/10 DRAWING: 0005	DRAWN BY: MAB REVISED BY: KMC REVIEWED BY: CLR MWELEV1.DWG



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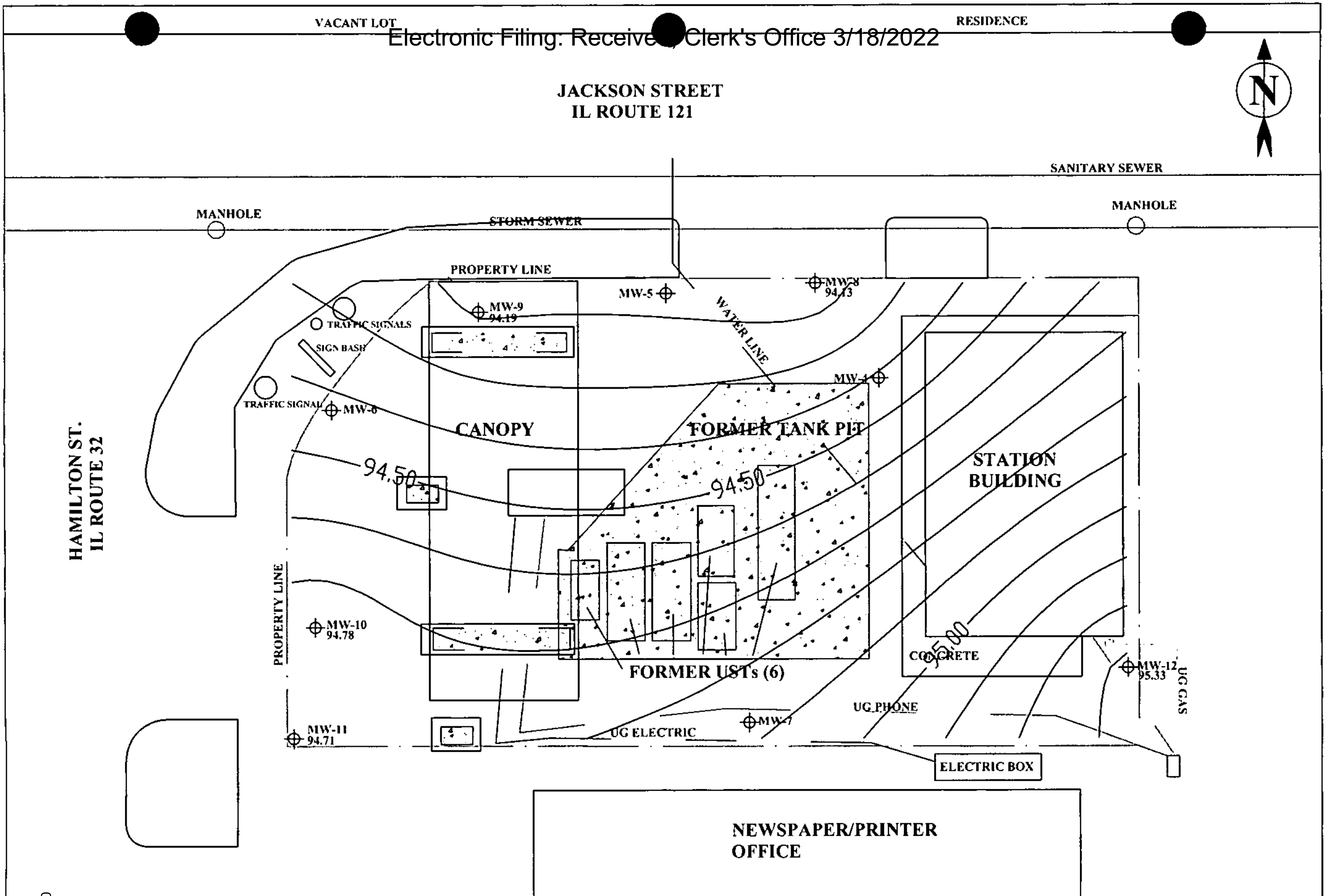

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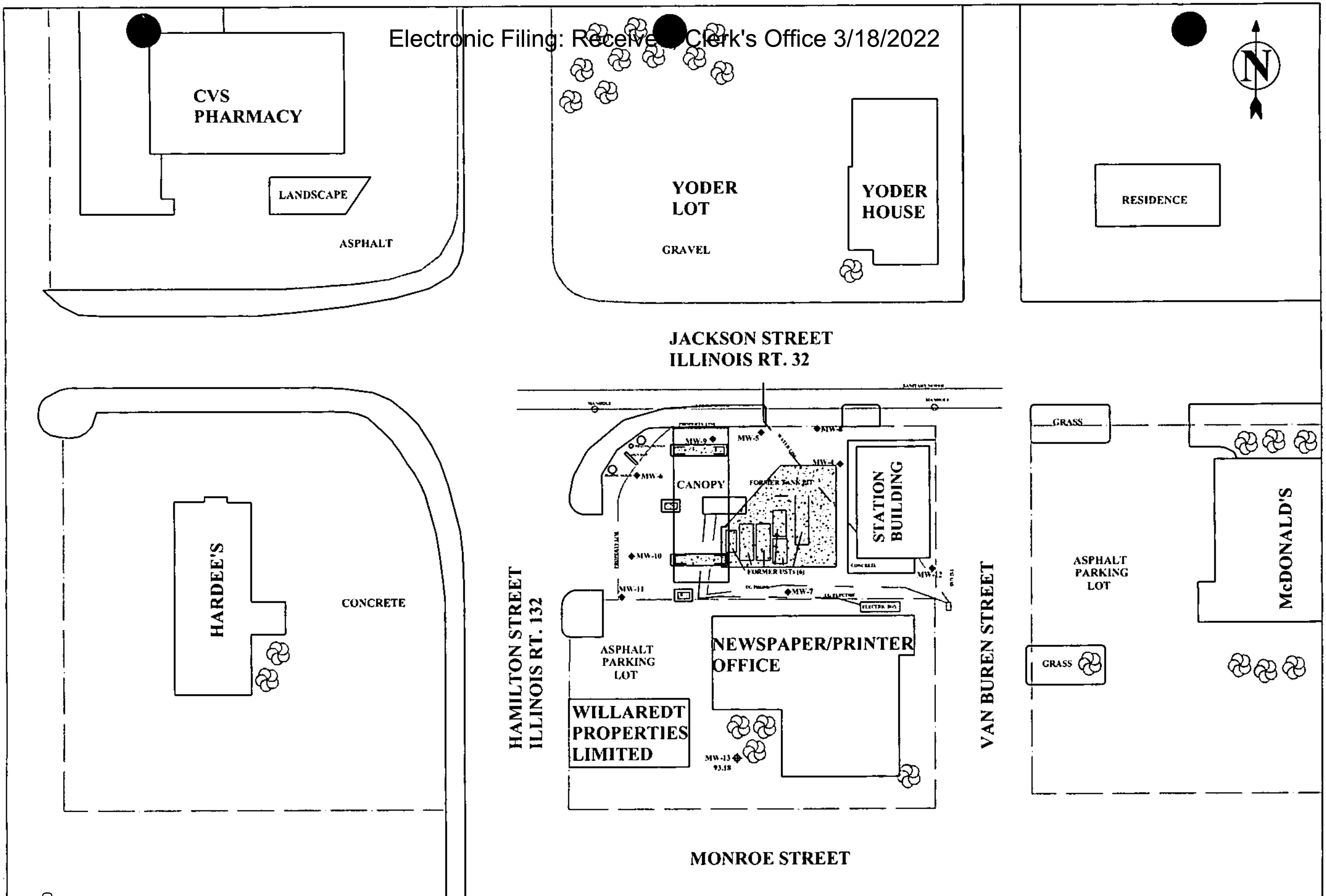

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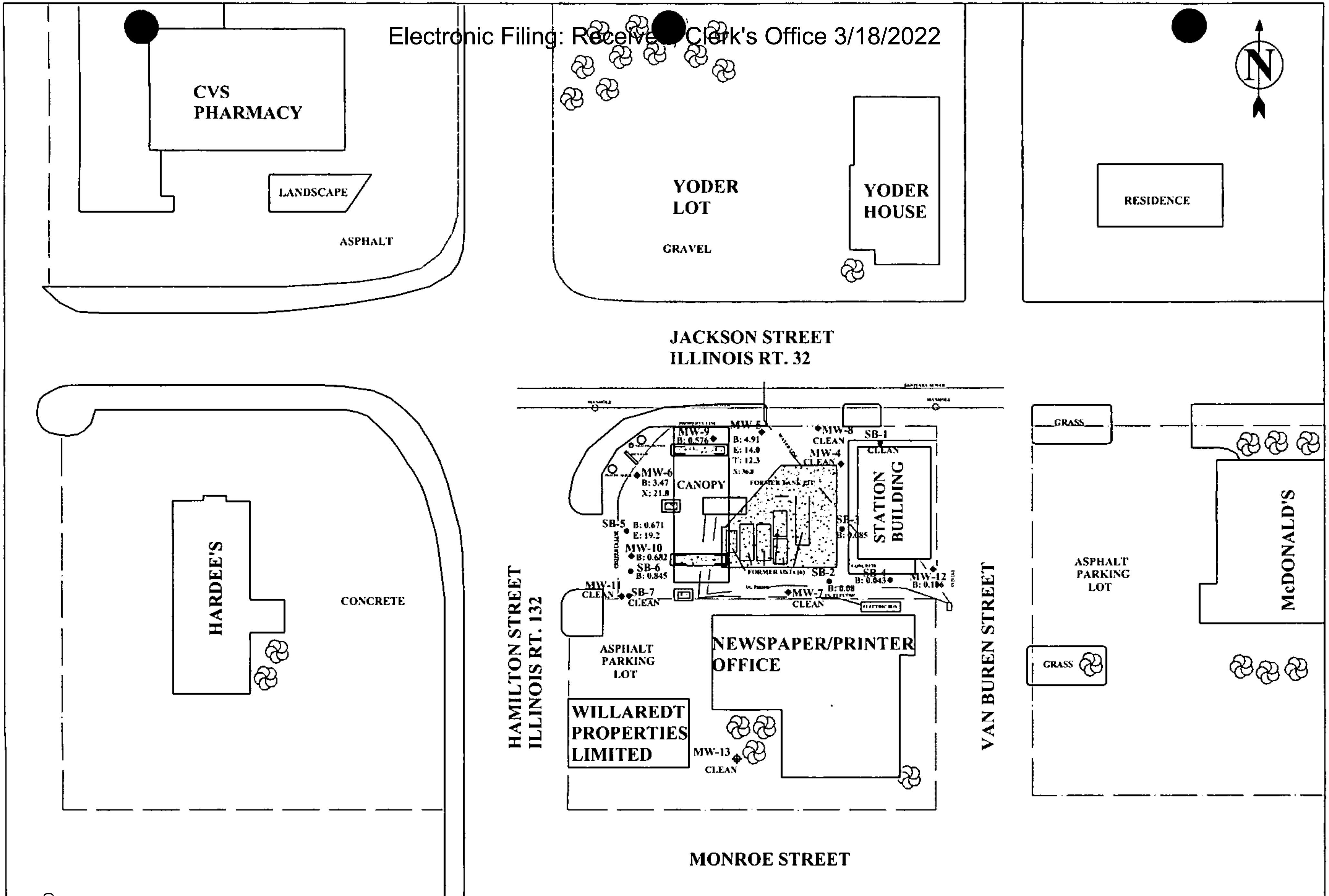

CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	SOIL CONTAMINATION VALUES MAP (0-5 FEET)	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 10/26/11 DRAWING: 0009A	DRAWN BY: MAB REVISED BY: JKT REVIEWED BY: SVAL0-5A.DWG

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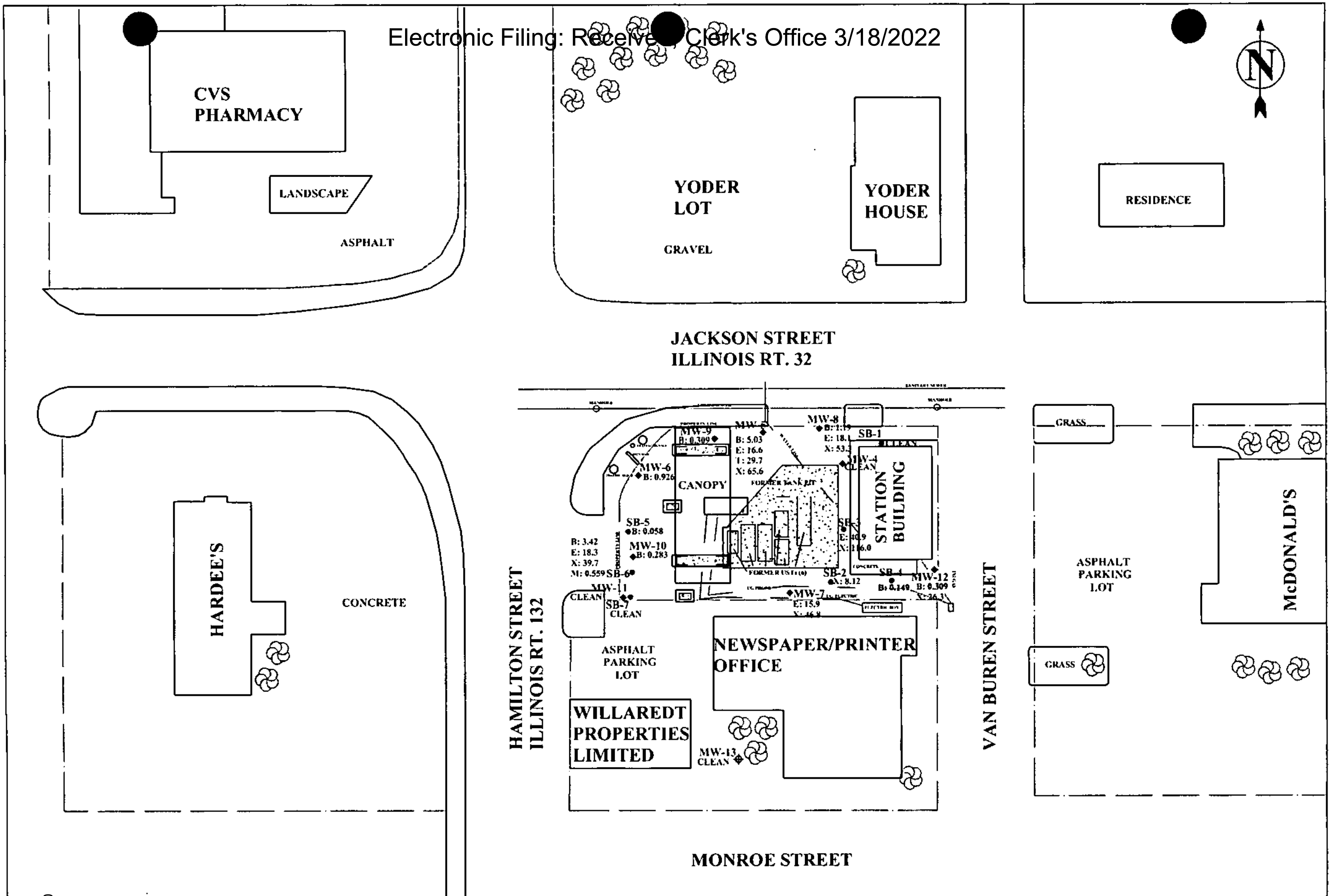

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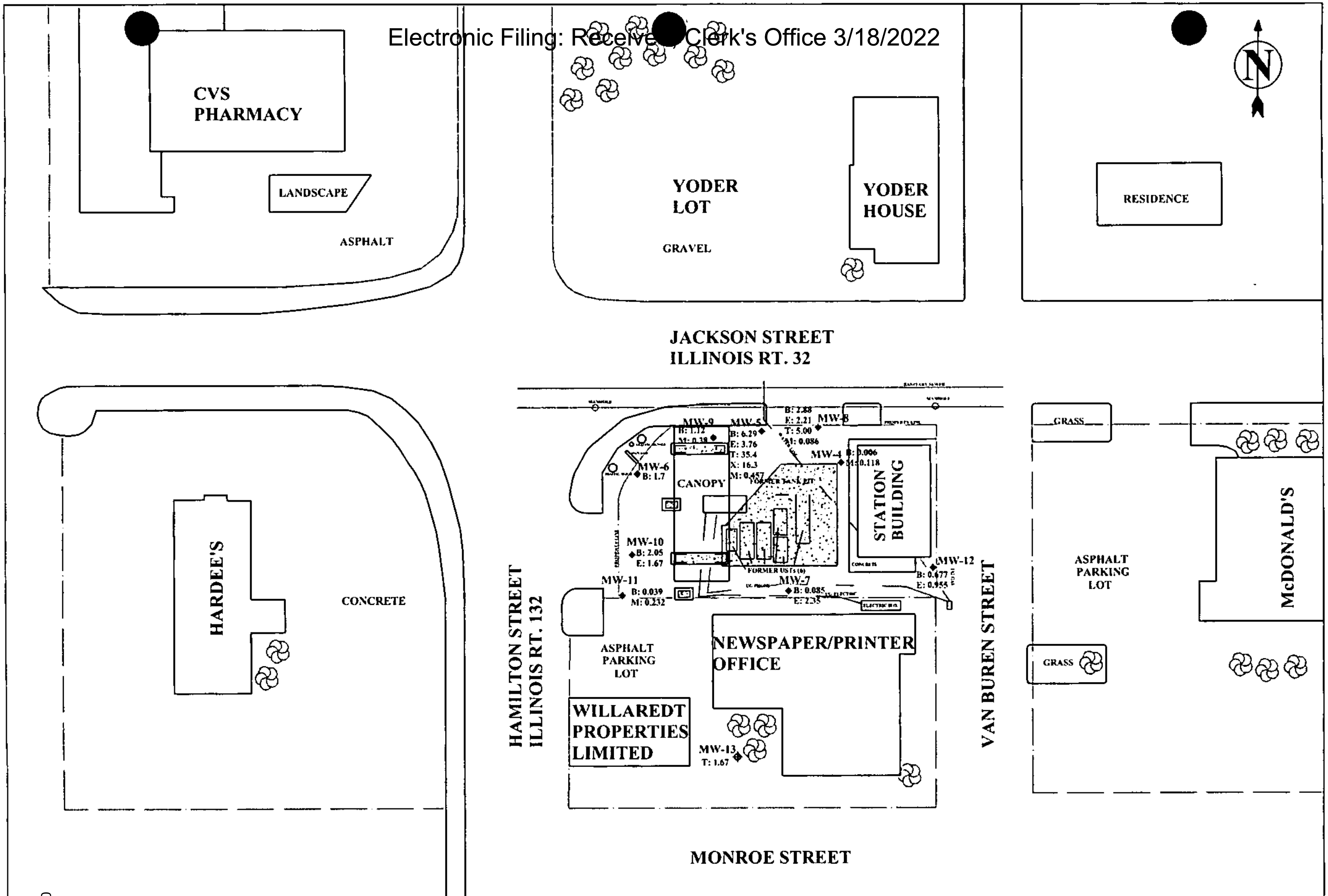
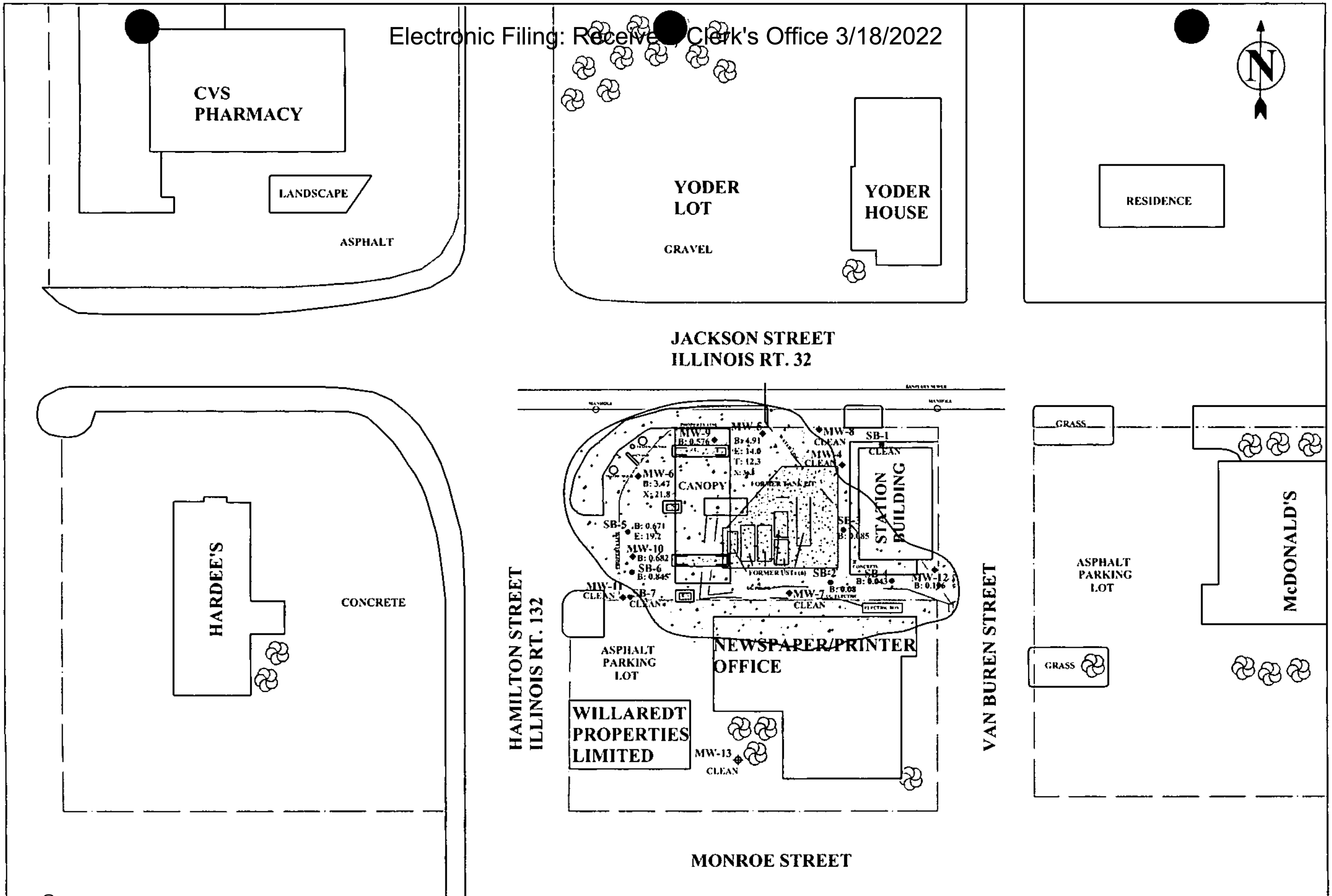
CW²M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	SOIL CONTAMINATION VALUES MAP (5-10 FEET)	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 10/26/11 DRAWING: 0009B	DRAWN BY: MAB REVISED BY: JKT REVIEWED BY: SVAL5-10A.DWG

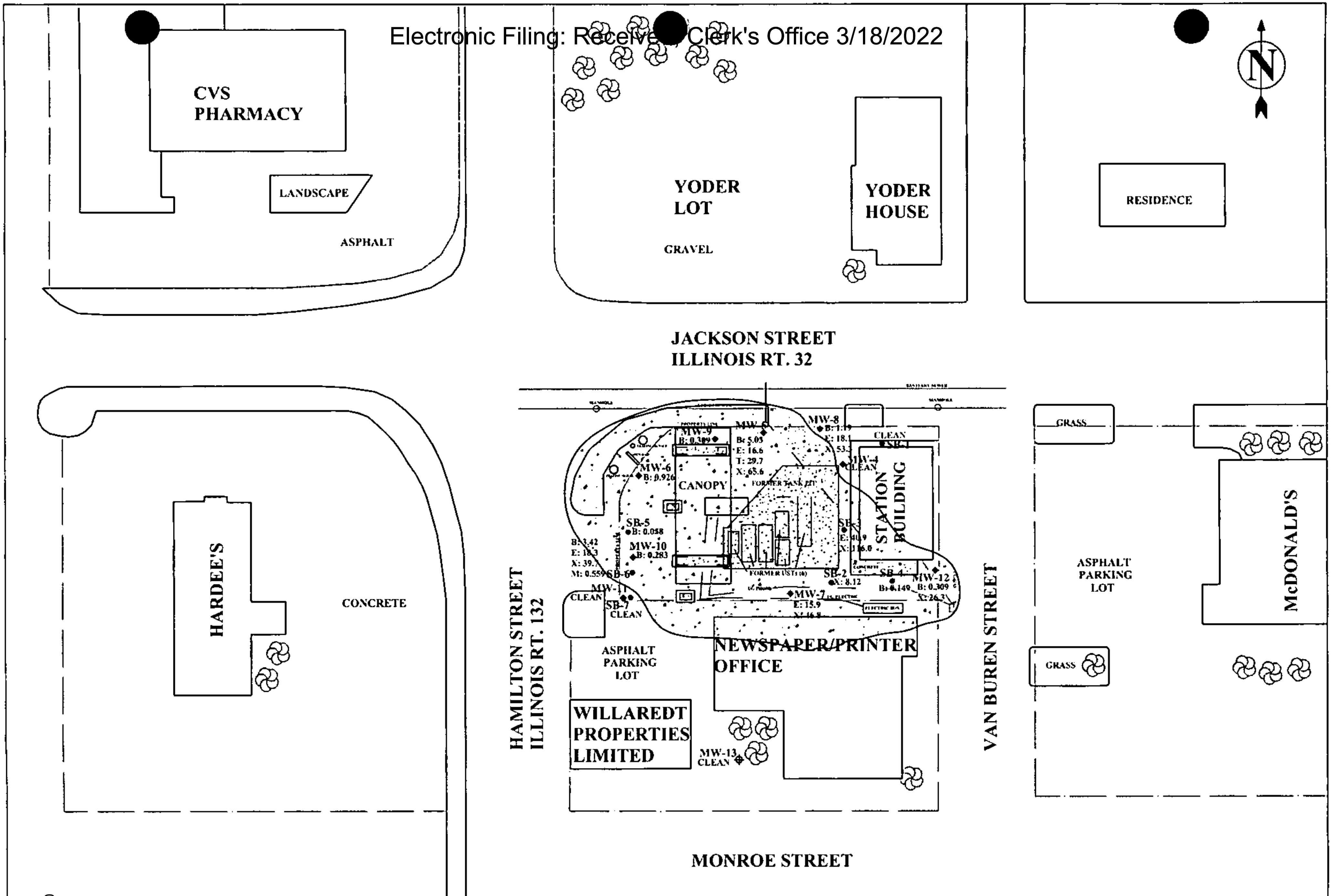


CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	GROUNDWATER CONTAMINATION VALUES MAP	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 10/26/11 DRAWING: 0010	DRAWN BY: MAB REVISED BY: JKT REVIEWED BY: GWVALA.DWG



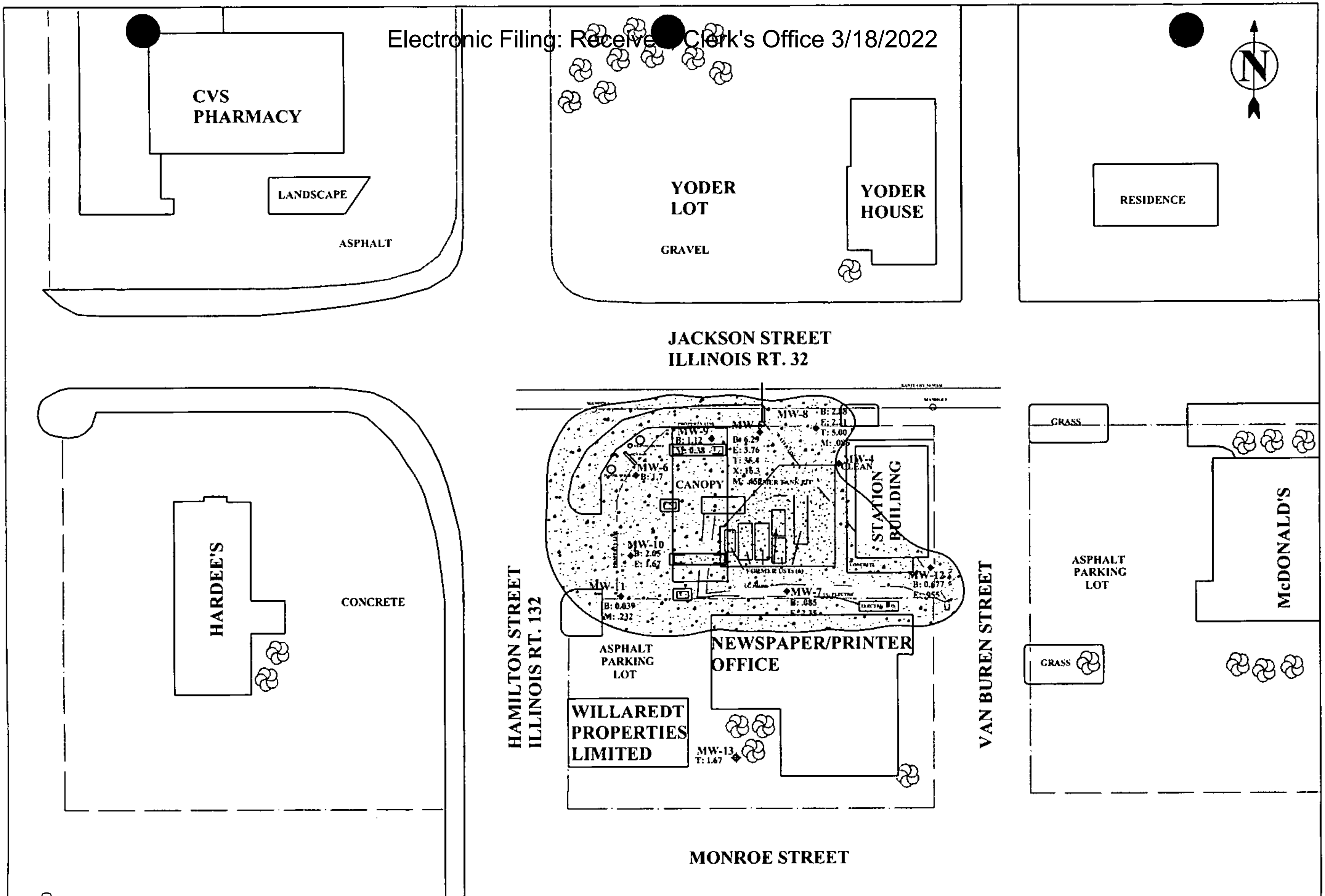
0037

CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	TIER 1 SOIL CONTAMINATION PLUME MAP (0-5 FEET)	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 10/27/11 DRAWING: 0011A	DRAWN BY: MAB REVISED BY: JKT REVIEWED BY: SPLUMEA.DWG



0038

CW^{3}M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	TIER 1 SOIL CONTAMINATION PLUME MAP (5-10 FEET)	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 10/27/11 DRAWING: 0011B	DRAWN BY: MAB REVISED BY: JKT REVIEWED BY: SPLUMEB.DWG



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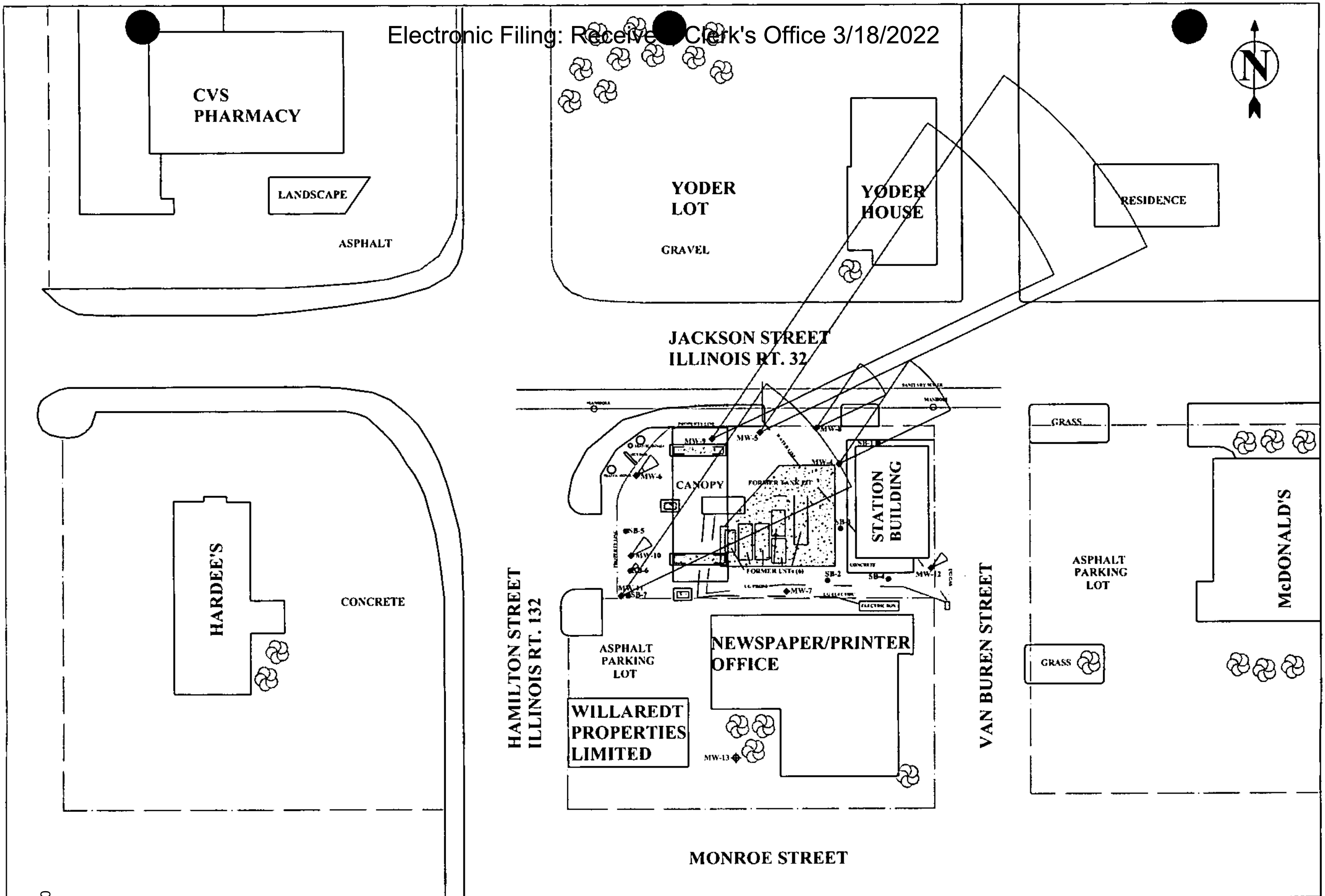
CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	GROUNDWATER CONTAMINATION PLUME MAP	SCALE: 1"=80' DATE: 7/6/10 REVISED DATE: 10/27/11 DRAWING: 0012	DRAWN BY: MAB REVISED BY: JKT REVIEWED BY: GWPLUMEA.DWG



CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	GROUNDWATER CONTAMINANT TRANSPORT MODELING MAP	SCALE: 1"=80' DATE: 1/31/12 REVISED DATE: 1/31/12 DRAWING: 0013	DRAWN BY: RCW REVISED BY: RCW REVIEWED BY: CLR Modeling2.DWG

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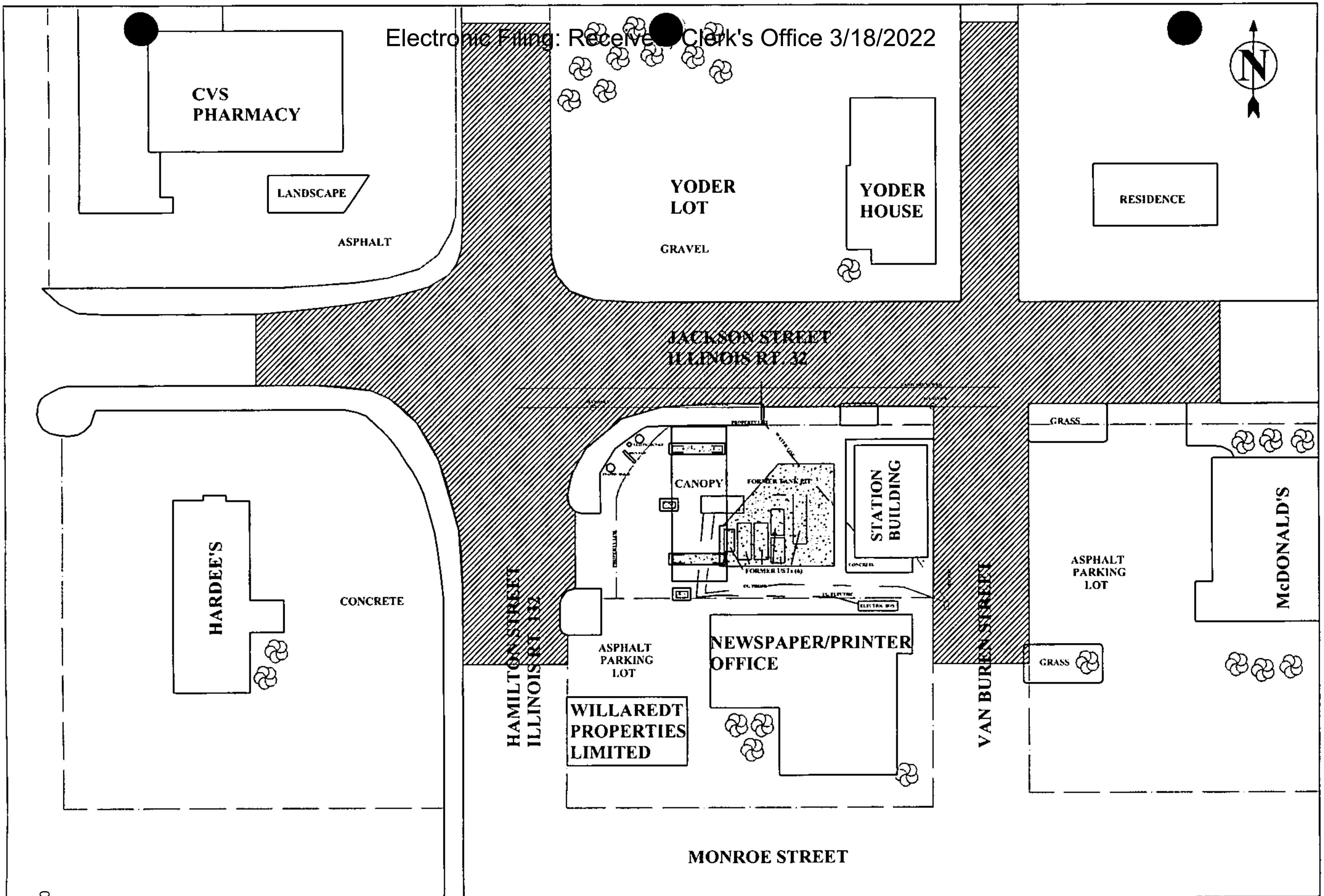
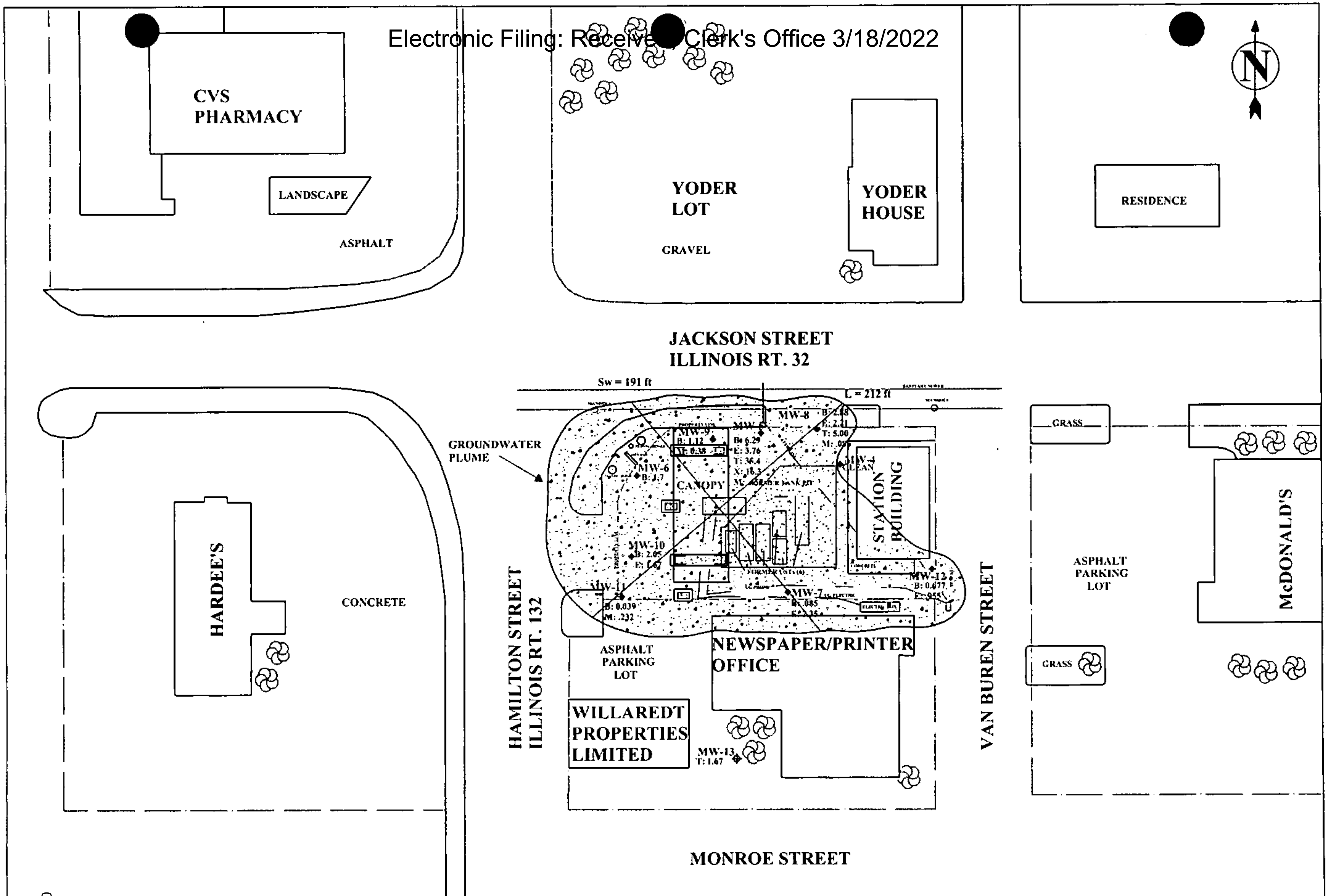


0041

CW³M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	HIGHWAY AUTHORITY AGREEMENT LOCATION MAP	SCALE: 1"=80' DATE: 2/1/12 REVISED DATE: DRAWING: 0014	DRAWN BY: RCW REVISED BY: REVIEWED BY: CLR HAA.DWG



CW3M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	KB SULLIVAN SULLIVAN, IL INCIDENT #: 2004-0969 MOULTRIE COUNTY	TACO INFORMATION MAP	SCALE: 1"=80' DATE: 1/27/12 REVISED DATE: 2/1/12 DRAWING: 0015	DRAWN BY: MAB REVISED BY: RCW REVIEWED BY: CLR TACO.DWG

0042

APPENDIX C

OSFM ELIGIBILITY DETERMINATION

KB FOOD & GAS
SULLIVAN, ILLINOIS

Office of the Illinois
State Fire Marshal
"Partnering With the Fire Service to Protect Illinois"

CERTIFIED MAIL - RECEIPT REQUESTED #7011 0110 0001 4649 3316

October 17, 2011

KB Sullivan, Inc.
c/o CW3M Company
P.O. Box 571
Carlinville, IL 62626

In Re: Facility No. 4-013187
IEMA Incident No. 90-0146
KB Sullivan, Inc.
105 West Jackson
Sullivan, Moultrie Co., IL

Dear Applicant:

The Reimbursement Eligibility and Deductible Application received on August 26, 2011 for the above referenced occurrence has been reviewed. The following determinations have been made based upon this review.

You have filed an "Election to Proceed as Owner" and have received acceptance from the Illinois Environmental Protection Agency. It has been determined, therefore, that you are eligible to seek payment of costs in excess of **$10,000**. The costs must be in response to the occurrence referenced above and associated with the following tanks:

Eligible Tanks

Tank 1 10,000 gallon Gasoline

You must contact the Illinois Environmental Protection Agency to receive a packet of Agency billing forms for submitting your request for payment.

An owner or operator is eligible to access the Underground Storage Tank Fund if the eligibility requirements are satisfied:

1. Neither the owner nor the operator is the United States Government,

2. The tank does not contain fuel which is exempt from the Motor Fuel Tax Law,

3. The costs were incurred as a result of a confirmed release of any of the following substances:

   "Fuel", as defined in Section 1.19 of the Motor Fuel Tax Law

   Aviation fuel

   Heating oil

Kerosene

Used oil, which has been refined from crude oil used in a motor vehicle, as defined in Section 1.3 of the Motor Fuel Tax Law.

4. The owner or operator registered the tank and paid all fees in accordance with the statutory and regulatory requirements of the Gasoline Storage Act.

5. The owner or operator notified the Illinois Emergency Management Agency of a confirmed release, the costs were incurred after the notification and the costs were a result of a release of a substance listed in this Section. Costs of corrective action or indemnification incurred before providing that notification shall not be eligible for payment.

6. The costs have not already been paid to the owner or operator under a private insurance policy, other written agreement, or court order.

7. The costs were associated with "corrective action".

This constitutes the final decision as it relates to your eligibility and deductibility. We reserve the right to change the deductible determination should additional information that would change the determination become available. An underground storage tank owner or operator may appeal the decision to the Illinois Pollution Control Board (Board), pursuant to Section 57.9 (c) (2). An owner or operator who seeks to appeal the decision shall file a petition for a hearing before the Board within 35 days of the date of mailing of the final decision, (35 Illinois Administrative Code 105.504(b)).

For information regarding the filing of an appeal, please contact:

Clerk
Illinois Pollution Control Board
State of Illinois Center
100 West Randolph, Suite 11-500
Chicago, Illinois 60601
(312) 814-3620

The following tanks are also listed for this site:

Tank 2 8,000 gallon Gasoline
Tank 3 8,000 gallon Gasoline
Tank 4 5,000 gallon Diesel Fuel
Tank 5 5,000 gallon Gasoline
Tank 6 2,000 gallon Kerosene
Tank 7 10,000 gallon Gasoline
Tank 8 10,000 gallon Gasoline
Tank 9 8,000 gallon Diesel Fuel
Tank 10 5,000 gallon Kerosene
Tank 11 5,000 gallon Gasoline

Your application indicates that there has not been a release from these tanks under this incident number. You may be eligible to seek payment of corrective action costs associated with these tanks if it is determined that there has been a release from one or more of these tanks. Once it is determined that there has been a release from one or more of these tanks you may submit a separate application for an eligibility determination to seek corrective action costs associated with this/these tanks.

If you have any questions, please contact our office at (217) 785-5878.

Sincerely,

Deanne Lock

Deanne Lock
Administrative Assistant
Division of Petroleum and Chemical Safety

cc: IEPA
Facility File

APPENDIX D

TACO VARIABLES AND EQUATIONS

KB FOOD & GAS
SULLIVAN, ILLINOIS

KB Food & Gas
IEMA Incident #90-0146/2004-0969
Land use: Industrial/ Commercial & Construction worker
Site-Specific Parameters

As Determined in Field (Needed for All Uses)				
Name	**Symbol**	**Value**	**Units**	**Site Sp. / Default**
Hydraulic Conductivity	K	1.38E-05	cm/s	Site Specific
Soil Particle Density	ρ_s	2.65	g/cm^3	Site Specific
Moisture Content	w	0.142		Site Specific
Soil Bulk Density	ρ_b	1.846	g/cm^3	Site Specific
Fractional Organic C	f_{oc}	0.721		Site Specific
USDA Soil Classification	[redacted]			
MW-12 GW Elevation		95.33	ft st	Site Specific
MW-8 GW Elevation		94.13	ft st	Site Specific
Distance	x	116	feet	Site Specific

SSL Equations (Soil)			
Name	**Symb.**	**Value**	**Units / EQ.**
Porosity	η	0.30	**S24**
For Soil to Groundwater Ingestion Route - S17/S28			
Hydraulic Cond.	K	4.35E+00	m/yr
Hydraulic Gradient	i	0.01034483	
Dilution Factor	DF	20.00	**S22**
Mixing Zone Depth	d	16.84	**S25**
Source Length	L	212	ft
Aquifer Thickness	d_a	10	m
For Mass Limit Equations - S26, S27, S28			
Thickness of Soil	d_s	10	ft
For Inhalation Eq. -- Only with USCS Classification			
Sat Hyd. Cond.	K_s	60	(m/yr)
Exponential	1/(2b+3)	0.073	
For Inhalation Eq. -- Use Default if Prev Section N/A			
Water Filled Por.	θ_w	0.21	**S20**
Air Filled Porosity	θ_a	0.10	**S21**

RBCA Equations (GW Modeling)			
Name	**Symb.**	**Value**	**Units / EQ.**
Hydraulic Gradient	i	0.0103	
Plume Width (Horz)	S_w	191	ft
Plume Width (Vert)	S_d	6.56	ft
Hydraulic Cond.	K	1.19E+00	cm/d
For Soil to Groundwater Modeling - R14			
Hydraulic Cond.	K	4.35E+02	cm/yr
Total Porosity	θ_T	0.30	
Water Filled Por.	θ_{ws}	0.26	**R22**
Air Filled Porosity	θ_{as}	0.04	**R21**
Plume Width (Par)	W	212	ft
GW Darcy Velocity	U_{gw}	4.50	ft

KB Food & Gas				
IEMA Incident #90-0146/2004-0969				
GROUNDWATER CLEAN-UP OBJECTIVES				
(mg/L)				
	Most Stringent	**Class I**	**Class II**	**ADLs**
Parameter	**CUO**	**GW**	**GW**	**(U)**
Benzene	**0.005**	**0.005**	0.025	<0.002
Ethylbenzene	**0.7**	**0.7**	1	<0.002
MTBE	**0.07**	**0.07**	**0.07**	<0.005
Toluene	**1.0**	**1.0**	2.5	<0.002
Total Xylenes	**10.0**	**10.0**	**10.0**	<0.005
Acenaphthene	**0.42**	**0.42**	2.1	<0.018
Acenaphthylene^	**0.21**	**0.21**	1.05	<0.010
Anthracene	**2.1**	**2.1**	10.5	<0.0066
Benzo(a)anthracene	**0.00013**	**0.00013**	0.00065	<0.00013
Benzo(a)pyrene	**0.0002**	**0.0002**	0.002	<0.0002
Benzo(b)fluoranthene	**0.00018**	**0.00018**	0.0009	<0.00018
Benzo(g,h,i)perylene^	**0.21**	**0.21**	1.05	<0.00076
Benzo(k)fluoranthene	**0.00017**	**0.00017**	0.00085	<0.00017
Chrysene	**0.0015**	**0.0015**	0.0075	<0.0015
Dibenz(a,h)anthracene	**0.0003**	**0.0003**	0.0015	<0.0003
Fluoranthene	**0.28**	**0.28**	1.4	<0.0021
Fluorene	**0.28**	**0.28**	1.4	<0.0021
Indeno(1,2,3-cd)pyrene	**0.00043**	**0.00043**	0.00215	<0.00043
Naphthalene	**0.14**	**0.14**	0.22	<0.010
Phenanthrene^	**0.21**	**0.21**	1.05	<0.0064
Pyrene	**0.21**	**0.21**	1.05	<0.0027
^Temporary Objectives from additional tables -- 10/1/04				
Updated 12/20/04				

KB Food & Gas							
SOIL CLEAN-UP OBJECTIVES							
(mg/kg)							
	Most Stringent	I/C	I/C	I/C	I/C	C_{sat}	ADLs
Parameter	CUO	I/C Ing	I/C Inh.	CW Ing.	CW Inh.		(U)
Benzene	55.1	104.1	55.1	2300	77.5	870	<0.002
Ethylbenzene	400	204,400	346,849	20,405	2,244	400	<0.002
MTBE	3694	40,880	571,019	20,405	3,694	8800	<0.005
Toluene	650	410,000	1,242,434	410,000	8,038	650	<0.002
Total Xylenes	320	1,000,000	34,017	410,000	880.2	320	<0.005
Acenaphthene	120000	120000		120000			<1.200
Acenaphthylene^	61000	61000		61000			<0.660
Anthracene	610000	610000		610000			<0.660
Benzo(a)anthracene	8.0	8		170			<0.009
Benzo(a)pyrene	0.80	0.8		17			<0.015
Benzo(b)fluoranthene	8.0	8		170			<0.011
Benzo(g,h,i)perylene^	61000.0	61000		61000			<0.051
Benzo(k)fluoranthene	78.4	78.4		17000			<0.011
Chrysene	784.0	784		17014			<0.100
Dibenz(a,h)anthracene	0.80	0.8		17			<0.020
Fluoranthene	82000	82000		82000			<0.660
Fluorene	82000	82000		82000			<0.140
Indeno(1,2,3-cd)pyrene	8.0	8		170			<0.029
Naphthalene	6.0	41000	270	40,809	6.0		<0.660
Phenanthrene^	61000	61000		61000			<0.660
Pyrene	61000	61000		61000			<0.180

0050

KB Food & Gas					
IEMA Incident #90-0146/2004-0969					
Tier 1 -- SOIL CLEAN-UP OBJECTIVES					
(mg/kg)					
	I/C	I/C	I/C	I/C	Csat
Parameter	I/C Ing	I/C Inh.	CW Ing.	CW Inh.	
Benzene	100	1.6	2300	2.2	870
Ethylbenzene	200000	400	20000	58	400
MTBE	20000	8800	2000	140	8800
Toluene	410000	650	410000	42	650
Total Xylenes	1000000	320	410000	5.6	320
Acenaphthene	120000		120000		
Acenaphthylene^	61000		61000		
Anthracene	610000		610000		
Benzo(a)anthracene	8		170		
Benzo(a)pyrene	0.8		17		
Benzo(b)fluoranthene	8		170		
Benzo(g,h,i)perylene^	61000		61000		
Benzo(k)fluoranthene	78		17000		
Chrysene	780		17000		
Dibenz(a,h)anthracene	0.8		17		
Fluoranthene	82000		82000		
Fluorene	82000		82000		
Indeno(1,2,3-cd)pyrene	8		170		
Naphthalene	41000	270	4100	1.8	
Phenanthrene^	61000		61000		
Pyrene	61000		61000		

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KB Food & Gas				
IEMA Incident #90-0146/2004-0969				
Tier 2 -- SOIL CLEAN-UP OBJECTIVES				
(mg/kg)				
	I/C	I/C	I/C	I/C
Parameter	**I/C Ing**	**I/C Inh.**	**CW Ing.**	**CW Inh.**
Benzene	104.1	55.1	2258.2	77.5
Ethylbenzene	204,400	346,849	20,405	2,244
MTBE	40,880	571,019	20,405	3,694
Toluene	163,520	1,242,434	163,236	8,038
Total Xylenes	408,800	34,017	204,045	880
Acenaphthene				
Acenaphthylene^				
Anthracene				
Benzo(a)anthracene	7.84		170.14	
Benzo(a)pyrene	0.78		17.01	
Benzo(b)fluoranthene	7.84		170.14	
Benzo(g,h,i)perylene^				
Benzo(k)fluoranthene	78.40		1701.39	
Chrysene	784.00		17013.89	
Dibenz(a,h)anthracene	0.78		17.01	
Fluoranthene				
Fluorene				
Indeno(1,2,3-cd)pyrene	7.84		170.14	
Naphthalene	40,880	63	40,809	6.0
Phenanthrene^				
Pyrene				
^Temporary Objectives from additional tables -- 10/1/04				
Updated 12/20/04				

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KB Food & Gas		
RBCA - LF Equations		
Parameter	**LF_w**	**k_s**
(Default)		
Equation	**R13**	**R20**
Benzene	0.023	42.467
Ethylbenzene	0.004	261.723
MTBE	0.118	8.292
Toluene	0.008	131.222
Total Xylenes	0.005	187.460
Acenaphthene	0.000	5104.680
Acenaphthylene	7.010	0.000
Anthracene	0.000	21269.500
Benzo(a)anthracene	0.000	286958.000
Benzo(a)pyrene	0.000	735420.000
Benzo(b)fluoranthene	0.000	886830.000
Benzo(g,h,i)perylene	7.010	0.000
Benzo(k)fluoranthene	0.000	886830.000
Chrysene	0.000	286958.000
Dibenz(a,h)anthracene	0.000	2739800.000
Fluoranthene	0.000	77147.000
Fluorene	0.000	9949.800
Indeno(1,2,3-cd)pyrene	0.000	2501870.000
Naphthalene	0.001	1442.000
Phenanthrene	7.010	0.000
Pyrene	0.000	75705.000

KB Food & Gas

SSL Equations

Parameter	Res Ingestion	M L Res. Inhal.	Res. GW C I	Res. GW C II	I/C I/C Ing	I/C I/C Inh.	I/C CW Ing.	I/C CW Inh.
Equation	S1 / S2	S4 / S6	S17	S17	S1 / S3	S4 / S6	S1 / S3	S5 / S7
Benzene	11.64	3.605	4.259	21.295	104.06	55.121	2258.21	77.5
Ethylbenzene	7,821	60,260	3665.923	5237.033	204,400	346,849	20,405	2,244
MTBE	1,564	180,781	11.766	11.766	40,880	571,019	20,405	3,694
Toluene	6,257	301,302	2626.959	6567.399	163,520	1,242,434	163,236	8,038
Total Xylenes	15,643	6,026	37516.963	37516.963	408,800	34,017	204,045	880
Acenaphthene	4,693		42880.253	214401.263	122,640		122,427	
Acenaphthylene^			0.469	2.344				
Anthracene	23,464		893323.695	4466618.473	613,200		612,135	
Benzo(a)anthracene	0.88		746.091	3730.455	7.84		170.139	
Benzo(a)pyrene	0.09		2941.680	29416.804	0.78		17.014	
Benzo(b)fluoranthene	0.88		3192.588	15962.942	7.84		170.139	
Benzo(g,h,i)perylene^			0.469	2.344				
Benzo(k)fluoranthene	8.77		3015.222	15076.112	78.40		1701.389	
Chrysene	87.72		8608.743	43043.717	784.00		17013.889	
Dibenz(a,h)anthracene	0.09		16438.801	82194.003	0.78		17.014	
Fluoranthene	3,129		432023.825	2160119.127	81,760		81,618	
Fluorene	3,129		55719.506	278597.530	81,760		81,618	
Indeno(1,2,3-cd)pyrene	0.88		21516.083	107580.415	7.84		170.139	
Naphthalene	1,564	181	4037.916	6345.296	40,880	63	40,809	6.05
Phenanthrene^			0.469	2.344				
Pyrene	2,346		317961.469	1589807.345	61,320		61,214	

Parameter	I/C GW C I	I/C GW C II	VF I/C	VF CW	VF' CW	D_A	K_d	ML GW C I	ML GW C II
Equation	S17	S17	S8	S8	S9	S10	S19	S28	S28
Benzene	4.259	21.295	1.05E+05	7.10E+03	7.10E+02	1.191E-06	42.467	0.224	1.120
Ethylbenzene	3665.923	5237.033	2.38E+05	1.60E+04	1.60E+03	2.335E-07	261.723	31.351	44.787
MTBE	11.766	11.766	1.30E+05	8.80E+03	8.80E+02	7.754E-07	8.292	3.135	3.135
Toluene	2626.959	6567.399	1.70E+05	1.15E+04	1.15E+03	4.55E-07	131.222	44.787	111.968
Total Xylenes	37516.963	37516.963	2.33E+05	1.57E+04	1.57E+03	2.428E-07	187.460	447.872	447.872
Acenaphthene	42880.253	214401.263	8.61E+06	5.81E+05	5.81E+04	1.779E-10	5104.680	18.811	94.053
Acenaphthylene^	0.469	2.344						9.405	47.027
Anthracene	893323.695	4466618.473	2.48E+07	1.68E+06	1.68E+05	2.136E-11	21269.500	94.053	470.266
Benzo(a)anthracene	746.091	3730.455	1.14E+08	7.67E+06	7.67E+05	1.02E-12	286958.000	0.006	0.029
Benzo(a)pyrene	2941.680	29416.804	1.86E+08	1.26E+07	1.26E+06	3.811E-13	735420.000	0.009	0.090
Benzo(b)fluoranthene	3192.588	15962.942	1.65E+08	1.11E+07	1.11E+06	4.833E-13	886830.000	0.008	0.040
Benzo(g,h,i)perylene^	0.469	2.344						9.405	47.027
Benzo(k)fluoranthene	3015.222	15076.112	2.61E+08	1.76E+07	1.76E+06	1.939E-13	886830.000	0.008	0.038
Chrysene	8608.743	43043.717	9.36E+07	6.32E+06	6.32E+05	1.505E-12	286958.000	0.067	0.336
Dibenz(a,h)anthracene	16438.801	82194.003	4.77E+08	3.22E+07	3.22E+06	5.783E-14	2739800.000	0.013	0.067
Fluoranthene	432023.825	2160119.127	6.45E+07	4.35E+06	4.35E+05	3.167E-12	77147.000	12.540	62.702
Fluorene	55719.506	278597.530	1.65E+07	1.12E+06	1.12E+05	4.816E-11	9949.800	12.540	62.702
Indeno(1,2,3-cd)pyrene	21516.083	107580.415	4.33E+08	2.92E+07	2.92E+06	7.044E-14	2501870.000	0.019	0.096
Naphthalene	4037.916	6345.296	2.45E+06	1.65E+05	1.65E+04	2.196E-09	1442.000	6.270	9.853
Phenanthrene^	0.469	2.344						9.405	47.027
Pyrene	317961.469	1589807.345	6.29E+07	4.25E+06	4.25E+05	3.332E-12	75705.000	9.405	47.027

		Carc./Gen	Res	I/C	C/W
SSL Standard Inputs	AT Ing		6	25	0.115
	AT Inh		30	25	0.115
	ATc	70			
	BW	70	15	70	70
	ED	30	6	25	1
	ED m-I	70			
	EF		350	250	30
	F(x)	0.194			
	I	0.3			
	I m-I	0.18			
	IF s-adj	114			
	IR soil		200	50	480
	IRw		2	1	
	PEF		1320000000	1240000000	1.24E+08
	Q/C VF		68.81	85.81	85.81
	Q/C PEF		90.8	85.81	85.81
	T		950000000	790000000	3.60E+06
	T m-I	30			
	THQ	1			
	TR	1.0E-06			
	Um	4.69			
	V	0.5			
	rho w	1			
S26	VF m-I		11556.7763	14411.9601	14411.96

KB Food & Gas												
SOIL CLEAN-UP OBJECTIVES												
	S	D_i	D_w	H'	K_{oc}	λ	SF_o	URF	RfC	RfCs	RfD	RfDs
Parameter	(mg/L)	(cm^2/s)	(cm^2/s)	(25°C)	(L/kg)	(d^{-1})	$(mg/kg\text{-}d)^{-1}$	$(ug/m^3)^{-1}$	(mg/m^3)	(mg/m^3)	(mg/kg-d)	(mg/kg-d)
Benzene	1750	0.088	9.80E-06	0.228	58.9	0.0009	0.055	7.8E-06	0.03	0.08	0.004	0.012
Ethylbenzene	169	0.075	7.80E-06	0.323	363	0.003			1	1	0.1	0.1
MTBE	51000	0.102	1.10E-05	0.0241	11.5	0			3	3	0.02	0.1
Toluene	526	0.087	8.60E-06	0.272	182	0.011			5	5	0.08	0.8
Total Xylenes	186	0.072	9.34E-06	0.25	260	0.0019			0.1	0.4	0.2	1
Acenaphthene	4.24	0.0421	7.69E-06	0.00636	7080	0.0034					0.06	0.6
Acenaphthylene^												
Anthracene	0.0434	0.0324	7.74E-06	0.00267	29500	0.00075					0.3	3
Benzo(a)anthracene	0.0094	0.051	9.00E-06	0.000137	398000	0.00051	0.73	1.1E-04				
Benzo(a)pyrene	0.00162	0.043	9.00E-06	0.0000463	1020000	0.00065	7.3	1.1E-03				
Benzo(b)fluoranthene	0.0015	0.0226	5.56E-06	0.00455	1230000	0.00057	0.73	1.1E-04				
Benzo(g,h,i)perylene^												
Benzo(k)fluoranthene	0.0008	0.0226	5.56E-06	0.000034	1230000	0.00016	0.073	1.1E-04				
Chrysene	0.0016	0.0248	6.21E-06	0.00388	398000	0.00035	0.0073	1.1E-05				
Dibenz(a,h)anthracene	0.00249	0.0202	5.18E-06	0.000000603	3800000	0.00037	7.3	1.2E-03				
Fluoranthene	0.206	0.0302	6.35E-06	0.00066	107000	0.00019					0.04	0.4
Fluorene	1.98	0.0363	7.88E-06	0.00261	13800	0.000691					0.04	0.4
Indeno(1,2,3-cd)pyrene	0.000022	0.019	5.66E-06	0.0000656	3470000	0.00047	0.73	1.1E-04				
Naphthalene	31	0.059	7.50E-06	0.0198	2000	0.0027			0.003	0.003	0.02	0.2
Phenanthrene^												
Pyrene	0.135	0.0272	7.24E-06	0.000451	105000	0.00018					0.03	0.3

APPENDIX C TABLE K		
Soil Texture	**Sat. Hyd. Cond., K_s**	**1/(2b+3)**
Sand	1830	0.090
Loamy Sand	540	0.085
Sandy Loam	230	0.080
Silt Loam	120	0.074
Loam	60	0.073
Sandy Clay Loam	40	0.058
Silt Clay Loam	13	0.054
Clay Loam	20	0.050
Sandy Clay	10	0.042
Silt Clay	8	0.042
Clay	5	0.039

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TACO R26 EQUATION
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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
$C_{(source)}$	mg/l		Concentration at source (benzene)
X	cm	2,438	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	243.84	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	81.28	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	12.192	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 80 ft

$C_{(x)}$ =	**0.00000**	mg/L	=	0.0000	ug/l = ppb	Benzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Xylene (total)
	0.06936	mg/L	=	69.3582	ug/l = ppb	MTBE

INPUTS

Contaminant	Concentration (mg/L)	λ
Benzene	**0.006**	0.0009
Ethylbenzene	**0.047**	0.003
Toluene	**0.097**	0.011
Xylene (total)	**0.206**	0.0019
MTBE	**0.118**	0

Source of Analytical Data: **3/15/2010**

Distance =	**80**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

Note: λ values come from Appendix C, Table E.

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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	8,443	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	844.296	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	281.432	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	42.2148	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 277 ft

$C_{(x)}$ =	**0.00000**	mg/L	=	0.0000	ug/l = ppb	Benzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Xylene (total)
	0.06994	mg/L	=	69.9355	ug/l = ppb	MTBE

INPUTS

Contaminant	Concentration (mg/L)	λ
Benzene	6.29	0.0009
Ethylbenzene	3.76	0.003
Toluene	35.4	0.011
Xylene (total)	16.3	0.0019
MTBE	0.457	0

Source of Analytical Data: **3/15/2010**

Distance =	**277**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

Note: λ values come from Appendix C, Table E.

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TACO R26 EQUATION
Groundwater Modeling
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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	427	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	42.672	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	14.224	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	2.1336	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 14 ft

$C_{(x)}$ =	**0.00452**	mg/L	=	4.5190	ug/l = ppb	Benzene
	0.00000	mg/L	=	0.0010	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00011	mg/L	=	0.1083	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	Concentration (mg/L)	λ
Benzene	**1.7**	0.0009
Ethylbenzene	**0.654**	0.003
Toluene	**0.256**	0.011
Xylene (total)	**2.340**	0.0019
MTBE	-	0

Source of Analytical Data: **3/15/2010**

Distance =	**14**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

Note: λ values come from Appendix C, Table E.

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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	30	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	3.048	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	1.016	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.1524	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 1 ft

$C_{(x)}$ =	**0.04507**	mg/L	=	45.0669	ug/l = ppb	Benzene
	0.35450	mg/L	=	354.5035	ug/l = ppb	Ethylbenzene
	0.00112	mg/L	=	1.1159	ug/l = ppb	Toluene
	1.91156	mg/L	=	1,911.5560	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration (mg/L)**	λ
Benzene	**0.085**	0.0009
Ethylbenzene	**2.35**	0.003
Toluene	**0.239**	0.011
Xylene (total)	**6.77**	0.0019
MTBE	-	0

Source of Analytical Data: **3/15/2010**

Distance =	**1**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

Note: λ values come from Appendix C, Table E.

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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	1,524	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	152.4	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	50.8	Transverse Dispersitivity = α_x/3 (Equation R17)
α_z	cm	7.62	Vertical Dispersitivity = α_x/20 (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 50 ft

$C_{(x)}$ =	**0.00000**	mg/L	=	0.0019	ug/l = ppb	Benzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Xylene (total)
	0.06970	mg/L	=	69.7013	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration (mg/L)**	λ
Benzene	**2.88**	0.0009
Ethylbenzene	**2.21**	0.003
Toluene	**5.00**	0.011
Xylene (total)	**7.98**	0.0019
MTBE	**0.086**	0

Source of Analytical Data: **5/27/2010**

Distance =	**50**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

Note: λ values come from Appendix C, Table E.

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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	7,468	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	746.76	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	248.92	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	37.338	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

INPUTS

Contaminant	**Concentration (mg/L)**	λ
Benzene	**1.12**	0.0009
Ethylbenzene	**0.437**	0.003
Toluene	**0.024**	0.011
Xylene (total)	-	0.0019
MTBE	**0.38**	0

Source of Analytical Data: **5/27/2010**

Distance =	**245**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

Note: λ values come from Appendix C, Table E.

At a distance of 245 ft

$C_{(x)}$ =	**0.00000**	mg/L	=	0.0000	ug/l = ppb	Benzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	-	mg/L	=	-	ug/l = ppb	Xylene (total)
	0.06965	mg/L	=	69.6494	ug/l = ppb	MTBE

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TACO R26 EQUATION
Groundwater Modeling
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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	457	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	45.72	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	15.24	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	2.286	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 15 ft

$C_{(x)}$ =	**0.00402**	mg/L	=	4.0191	ug/l = ppb	Benzene
	0.00000	mg/L	=	0.0013	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	-	mg/L	=	-	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	Concentration (mg/L)	λ
Benzene	**2.05**	0.0009
Ethylbenzene	**1.67**	0.003
Toluene	**0.035**	0.011
Xylene (total)	-	0.0019
MTBE	-	0

Source of Analytical Data: **5/27/2010**

Distance =	**15**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

Note: λ values come from Appendix C, Table E.

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TACO R26 EQUATION
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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	5,029	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	502.92	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	167.64	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	25.146	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

INPUTS

Contaminant	**Concentration (mg/L)**	λ
Benzene	**0.039**	0.0009
Ethylbenzene	**0.004**	0.003
Toluene	-	0.011
Xylene (total)	-	0.0019
MTBE	**0.232**	0

Source of Analytical Data: **5/27/2010**

Distance =	**165**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

Note: λ values come from Appendix C, Table E.

At a distance of 165 ft

$C_{(x)}$ =	**0.00000**	mg/L	=	0.0000	ug/l = ppb	Benzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Ethylbenzene
	-	mg/L	=	-	ug/l = ppb	Toluene
	-	mg/L	=	-	ug/l = ppb	Xylene (total)
	0.06989	mg/L	=	69.8916	ug/l = ppb	MTBE

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TACO R26 EQUATION
Groundwater Modeling
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$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	335	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	33.528	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	11.176	Transverse Dispersitivity = αx/3 (Equation R17)
α_z	cm	1.6764	Vertical Dispersitivity = αx/20 (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 11 ft

$C_{(x)}$ =	**0.00474**	mg/L	=	4.7424	ug/l = ppb	Benzene
	0.00001	mg/L	=	0.0096	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00083	mg/L	=	0.8266	ug/l = ppb	Xylene (total)
	0.01500	mg/L	=	15.0000	ug/l = ppb	MTBE

INPUTS

Contaminant	Concentration (mg/L)	λ
Benzene	0.677	0.0009
Ethylbenzene	0.955	0.003
Toluene	0.17	0.011
Xylene (total)	3.980	0.0019
MTBE	0.015	0

Source of Analytical Data: **5/27/2010**

Distance =	11	ft
K =	1.38E-05	cm/sec
i =	0.010	ft/ft
S_w =	191	ft
S_d =	6.56	ft
θ_t =	0.303	

Note: λ values come from Appendix C, Table E.

0065

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-5 2.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	213	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	21.336	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	7.112	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	1.0668	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 7 ft

$C_{(x)}$ =	**0.00347**	mg/L	=	3.4666	ug/l = ppb	Benzene
	0.00001	mg/L	=	0.0107	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00041	mg/L	=	0.4093	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	4.91	0.11	0.0009
Ethylbenzene	14	0.05	0.003
Toluene	12.3	0.09	0.011
Xylene (total)	36.8	0.20	0.0019
MTBE	-	-	0

Source of Analytical Data: **2/24/2010**

Distance =	**7**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0066

2/1/2012

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-5 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	213	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	21.336	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	7.112	Transverse Dispersitivity = $\alpha_x/3$ (Equation R17)
α_z	cm	1.0668	Vertical Dispersitivity = $\alpha_x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 7 **ft**

$C_{(x)}$ =	**0.00355**	mg/L	=	3.5514	ug/l = ppb	Benzene
	0.00001	mg/L	=	0.0127	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00073	mg/L	=	0.7296	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	**5.03**	**0.12**	0.0009
Ethylbenzene	**16.6**	**0.06**	0.003
Toluene	**29.7**	**0.23**	0.011
Xylene (total)	**65.6**	**0.35**	0.0019
MTBE	**-**	**-**	0

Source of Analytical Data: **2/24/2010**

Distance =	**7**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0067

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-6 2.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	183	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	18.288	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	6.096	Transverse Dispersitivity = α_x/3 (Equation R17)
α_z	cm	0.9144	Vertical Dispersitivity = α_x/20 (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 6 ft

$C_{(x)}$ =	**0.00368**	mg/L	=	3.6794	ug/l = ppb	Benzene
	0.00002	mg/L	=	0.0189	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00047	mg/L	=	0.4678	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	3.47	0.08	0.0009
Ethylbenzene	10.4	0.04	0.003
Toluene	0.42	0.00	0.011
Xylene (total)	21.8	0.12	0.0019
MTBE	-	-	0

Source of Analytical Data: 2/24/2010

Distance =	6	ft
K =	1.38E-05	cm/sec
i =	0.010	ft/ft
S_w =	191	ft
S_d =	6.56	ft
θ_t =	0.303	

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2/1/2012

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-6 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	91	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	9.144	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	3.048	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.4572	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 3 ft

$C_{(x)}$ =	**0.00385**	mg/L	=	3.8488	ug/l = ppb	Benzene
	0.00003	mg/L	=	0.0317	ug/l = ppb	Ethylbenzene
	-	mg/L	=	-	ug/l = ppb	Toluene
	-	mg/L	=	-	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	0.926	0.02	0.0009
Ethylbenzene	0.844	0.00	0.003
Toluene	-	-	0.011
Xylene (total)	-	-	0.0019
MTBE	-	-	0

Source of Analytical Data: 2/24/2010

Distance =	3	ft
K =	1.38E-05	cm/sec
i =	0.010	ft/ft
S_w =	191	ft
S_d =	6.56	ft
θ_t =	0.303	

0069

2/1/2012

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-7 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
$C_{(source)}$	mg/l		Concentration at source (benzene)
X	cm	30	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	3.048	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	1.016	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.1524	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 1 ft

$C_{(x)}$ =	-	mg/L	=	-	ug/l = ppb	Benzene
	0.00912	mg/L	=	9.1169	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0035	ug/l = ppb	Toluene
	0.07011	mg/L	=	70.1102	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration (mg/kg)**	**(mg/L)**	λ
Benzene	-	-	0.0009
Ethylbenzene	15.90	0.06	0.003
Toluene	0.099	0.00	0.011
Xylene (total)	46.8	0.25	0.0019
MTBE	-	-	0

Source of Analytical Data: **2/24/2010**

Distance =	**1**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0070

2/1/2012

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil SB-3 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	30	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	3.048	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	1.016	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.1524	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 1 ft

$C_{(x)}$ =	-	mg/L	=	-	ug/l = ppb	Benzene
	0.02345	mg/L	=	23.4517	ug/l = ppb	Ethylbenzene
	-	mg/L	=	-	ug/l = ppb	Toluene
	0.17378	mg/L	=	173.7774	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	-	-	0.0009
Ethylbenzene	40.9	0.16	0.003
Toluene	-	-	0.011
Xylene (total)	116	0.62	0.0019
MTBE	-	-	0

Source of Analytical Data: **2/24/2010**

Distance =	**1**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0071

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil SB-5 2.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	61	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	6.096	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	2.032	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.3048	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 2 ft

$C_{(x)}$ =	**0.00470**	mg/L	=	4.6997	ug/l = ppb	Benzene
	0.00252	mg/L	=	2.5207	ug/l = ppb	Ethylbenzene
	-	mg/L	=	-	ug/l = ppb	Toluene
	0.00035	mg/L	=	0.3479	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	0.671	0.016	0.0009
Ethylbenzene	19.2	0.07	0.003
Toluene	-	-	0.011
Xylene (total)	0.663	0.00	0.0019
MTBE	-	-	0

Source of Analytical Data: 2/24/2010

Distance =	2	ft
K =	1.38E-05	cm/sec
i =	0.010	ft/ft
S_w =	191	ft
S_d =	6.56	ft
θ_t =	0.303	

0072

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil SB-6 2.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	91	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	9.144	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	3.048	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.4572	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 3 ft

$C_{(x)}$ =	**0.00351**	mg/L	=	3.5122	ug/l = ppb	Benzene
	0.00004	mg/L	=	0.0380	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00042	mg/L	=	0.4218	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	**0.845**	**0.020**	0.0009
Ethylbenzene	**1.01**	**0.00**	0.003
Toluene	**0.015**	**0.00**	0.011
Xylene (total)	**2.01**	**0.01**	0.0019
MTBE	-	-	0

Source of Analytical Data: **2/24/2010**

Distance =	**3**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0073

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil SB-6 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	30	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	3.048	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	1.016	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.1524	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 1 ft

$C_{(x)}$ =	**0.04235**	mg/L	=	42.3545	ug/l = ppb	Benzene
	0.01049	mg/L	=	10.4931	ug/l = ppb	Ethylbenzene
	-	mg/L	=	-	ug/l = ppb	Toluene
	0.05947	mg/L	=	59.4738	ug/l = ppb	Xylene (total)
	0.06597	mg/L	=	65.9726	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	3.42	0.080	0.0009
Ethylbenzene	18.3	0.07	0.003
Toluene	-	-	0.011
Xylene (total)	39.7	0.21	0.0019
MTBE	0.559	0.066	0

Source of Analytical Data: **2/24/2010**

Distance =	**1**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0074

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-8 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	91	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	9.144	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	3.048	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.4572	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 3 **ft**

$C_{(x)}$ =	**0.00495**	mg/L	=	4.9461	ug/l = ppb	Benzene
	0.00068	mg/L	=	0.6803	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.01119	mg/L	=	11.1850	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	1.19	0.028	0.0009
Ethylbenzene	18.1	0.07	0.003
Toluene	0.313	0.00	0.011
Xylene (total)	53.3	0.28	0.0019
MTBE	-	-	0

Source of Analytical Data: **5/19/2010**

Distance =	3	ft
K =	1.38E-05	cm/sec
i =	0.010	ft/ft
S_w =	191	ft
S_d =	6.56	ft
θ_t =	0.303	

0075

2/1/2012

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-9 2.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
$C_{(source)}$	mg/l		Concentration at source (benzene)
X	cm	61	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	6.096	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	2.032	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.3048	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 2 ft

$C_{(x)}$ =	**0.00403**	mg/L	=	4.0343	ug/l = ppb	Benzene
	0.00059	mg/L	=	0.5921	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00058	mg/L	=	0.5824	ug/l = ppb	Xylene (total)
	0.00720	mg/L	=	7.1992	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	**0.576**	**0.013**	0.0009
Ethylbenzene	**4.51**	**0.02**	0.003
Toluene	**0.018**	**0.00**	0.011
Xylene (total)	**1.11**	**0.01**	0.0019
MTBE	**0.06**	**0.01**	0

Source of Analytical Data: **5/19/2010**

Distance =	**2**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0076

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-9 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	30	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	3.048	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	1.016	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.1524	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 1 ft

$C_{(x)}$ =	**0.00383**	mg/L	=	3.8268	ug/l = ppb	Benzene
	0.00217	mg/L	=	2.1732	ug/l = ppb	Ethylbenzene
	-	mg/L	=	-	ug/l = ppb	Toluene
	0.00289	mg/L	=	2.8913	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	**0.309**	**0.007**	0.0009
Ethylbenzene	**3.79**	**0.01**	0.003
Toluene	-	-	0.011
Xylene (total)	**1.93**	**0.01**	0.0019
MTBE	-	-	0

Source of Analytical Data: **5/19/2010**

Distance =	**1**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0077

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-10 2.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1-\sqrt{1+\frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	61	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	6.096	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	2.032	Transverse Dispersitivity = $\alpha_x/3$ (Equation R17)
α_z	cm	0.3048	Vertical Dispersitivity = $\alpha_x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = $(K * i) / \theta_t$ (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 2 ft

$C_{(x)}$ =	**0.00478**	mg/L	=	4.7767	ug/l = ppb	Benzene
	0.00032	mg/L	=	0.3216	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0000	ug/l = ppb	Toluene
	0.00012	mg/L	=	0.1207	ug/l = ppb	Xylene (total)
	0.01157	mg/L	=	11.5659	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	**0.682**	**0.016**	0.0009
Ethylbenzene	**2.45**	**0.01**	0.003
Toluene	**0.015**	**0.00**	0.011
Xylene (total)	**0.23**	**0.00**	0.0019
MTBE	**0.098**	**0.01**	0

Source of Analytical Data: **5/19/2010**

Distance =	**2**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0078

2/1/2012

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-10 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
C (source)	mg/l		Concentration at source (benzene)
X	cm	30	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	3.048	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	1.016	Transverse Dispersitivity = $\alpha x/3$ (Equation R17)
α_z	cm	0.1524	Vertical Dispersitivity = $\alpha x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of 1 **ft**

$C_{(x)}$ =	**0.00350**	mg/L	=	3.5048	ug/l = ppb	Benzene
	0.00028	mg/L	=	0.2833	ug/l = ppb	Ethylbenzene
	0.00000	mg/L	=	0.0004	ug/l = ppb	Toluene
	0.00035	mg/L	=	0.3491	ug/l = ppb	Xylene (total)
	0.00814	mg/L	=	8.1433	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	0.283	0.007	0.0009
Ethylbenzene	0.494	0.00	0.003
Toluene	0.01	0.00	0.011
Xylene (total)	0.233	0.00	0.0019
MTBE	0.069	0.01	0

Source of Analytical Data: 5/19/2010

Distance =	1	ft
K =	1.38E-05	cm/sec
i =	0.010	ft/ft
S_w =	191	ft
S_d =	6.56	ft
θ_t =	0.303	

0079

TACO R26 EQUATION
Soil to Groundwater Modeling
Soil MW-12 7.5ft

$$C(x) = C_{(source)} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right)\bullet\left(1-\sqrt{1+\frac{4\lambda\bullet\alpha_x}{U}}\right)\right]\bullet erf\left[\frac{S_w}{4\bullet\sqrt{\alpha_y\bullet X}}\right]\bullet erf\left[\frac{S_d}{2\bullet\sqrt{\alpha_z\bullet X}}\right]$$

$C_{(x)}$ =	mg/l		Concentration at distance X from source
$C_{(source)}$	mg/l		Concentration at source (benzene)
X	cm	30	Distance along x-axis of GW plume, direction of GW flow
α_x	cm	3.048	Longitudinal Dispersitivity = X * .10 (Equation R16)
α_y	cm	1.016	Transverse Dispersitivity = $\alpha_x/3$ (Equation R17)
α_z	cm	0.1524	Vertical Dispersitivity = $\alpha_x/20$ (Equation R18)
λ	/day		First Order Degradation Constant (App C, Table E) for each contaminant
U	cm/day	0.040654	Specific discharge = (K * i) / θ_t (Equation R19)
K	cm/day	1.19232	Hydraulic conductivity (field measurement)
i	cm/cm	0.010345	Hydraulic gradient (field measurement)
θ_t		0.30	Total Porosity
S_w	cm	5,812	source width along horizontal axis of plume at source
S_d	cm	200	source width along vertical axis of plume at source (App C, Table D)

At a distance of **1 ft**

$C_{(x)}$ =	**0.00383**	mg/L	=	3.8268	ug/l = ppb	Benzene
	0.00543	mg/L	=	5.4300	ug/l = ppb	Ethylbenzene
	0.00001	mg/L	=	0.0099	ug/l = ppb	Toluene
	0.03940	mg/L	=	39.3995	ug/l = ppb	Xylene (total)
	-	mg/L	=	-	ug/l = ppb	MTBE

INPUTS

Contaminant	**Concentration** (mg/kg)	(mg/L)	λ
Benzene	**0.309**	**0.007**	0.0009
Ethylbenzene	**9.47**	**0.04**	0.003
Toluene	**0.279**	**0.00**	0.011
Xylene (total)	**26.3**	**0.14**	0.0019
MTBE	**-**	**-**	0

Source of Analytical Data: **5/19/2010**

Distance =	**1**	ft
K =	**1.38E-05**	cm/sec
i =	**0.010**	ft/ft
S_w =	**191**	ft
S_d =	**6.56**	ft
θ_t =	**0.303**	

0800

2/1/2012

APPENDIX E

ANALYTICAL RESULTS

KB FOOD & GAS
SULLIVAN, ILLINOIS

COMPARISON TO TIER 1 OBJECTIVES

KB SULLIVAN
Site Assessment Data

SOIL 2-24-10

	Location	MW-4	MW-4	MW-5	MW-5	MW-6	MW-6	MW-7	MW-7	SB-1	SB-1
	DEPTH	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'
Parameter	Class I CUO										
Benzene	0.03	<0.002	<0.002	4.91	5.03	3.47	0.926	<0.002	<0.002	<0.002	<0.002
Ethylbenzene	13.0	<0.002	<0.002	14.	16.6	10.4	0.844	1.44	15.9	<0.002	<0.002
Toluene	12.0	0.003	<0.002	12.3	29.7	0.42	<0.002	<0.002	0.099	<0.002	<0.002
Total Xylenes	5.6	<0.005	<0.005	36.8	65.6	21.8	<0.005	0.992	46.8	<0.005	<0.005
MTBE	0.32	0.03	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

KB SULLIVAN
Site Assessment Data

SOIL 2-24-10

	Location	SB-2	SB-2	SB-3
	DEPTH	2.5'	7.5'	2.5'
Parameter	Class I CUO			
Benzene	**0.03**	**0.08**	<0.002	**0.085**
Ethylbenzene	**13.0**	1.91	4.65	1.09
Toluene	**12.0**	<0.002	<0.002	<0.002
Total Xylenes	**5.6**	0.503	**8.12**	0.055
MTBE	**0.32**	<0.005	<0.005	<0.005

0084

KB SULLIVAN
Site Assessment Data

SOIL 2-24-10

	Location	SB-3	SB-4	SB-4	SB-5	SB-5	SB-6	SB-6
	DEPTH	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'
Parameter	Class I CUO							
Benzene	0.03	<0.002	0.043	0.149	0.671	0.058	0.845	3.42
Ethylbenzene	13.0	40.9	0.069	0.052	19.2	0.027	1.01	18.3
Toluene	12.0	<0.002	<0.002	0.006	<0.002	<0.002	0.015	<0.002
Total Xylenes	5.6	116.	0.027	0.022	0.663	<0.005	2.01	39.7
MTBE	0.32	<0.005	<0.005	<0.005	<0.005	0.041	<0.005	0.559

KB SULLIVAN
Site Assessment Data

SOIL 5-19-10

	Location	MW-8	MW-8	MW-9	MW-9	MW-10	MW-10	MW-11	MW-11	MW-12	MW-12
	DEPTH	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'
Parameter	Class I CUO										
Benzene	**0.03**	0.003	**1.19**	**0.576**	**0.309**	**0.682**	**0.283**	0.004	0.023	**0.106**	**0.309**
Ethylbenzene	**13.0**	0.008	**18.1**	4.51	3.79	2.45	0.494	0.004	0.002	0.091	9.47
Toluene	**12.0**	0.002	0.313	0.018	<0.002	0.015	0.01	0.007	0.005	0.004	0.279
Total Xylenes	**5.6**	0.034	**53.3**	1.11	1.93	0.23	0.233	<0.005	<0.005	0.076	**26.3**
MTBE	**0.32**	0.028	<0.005	0.061	<0.005	0.098	0.069	<0.005	0.069	<0.005	<0.005

KB SULLIVAN
Site Assessment Data

SOIL 9-22-10

	Location	MW-13	MW-13
	DEPTH	2.5'	7.5'
Parameter	Class I CUO		
Benzene	0.03	<0.002	<0.002
Ethylbenzene	13.0	<0.002	<0.002
Toluene	12.0	<0.002	0.005
Total Xylenes	5.6	<0.005	<0.005
MTBE	0.32	<0.005	<0.005

KB Sullivan

Site Assessment Data

GW 3-15-10

	Location	**MW-4**	**MW-5**	**MW-6**	**MW-7**
Parameter	**Class I CUO**				
Benzene	**0.005**	**0.006**	**6.29**	**1.7**	**0.085**
Ethylbenzene	**0.7**	0.047	**3.76**	0.654	**2.35**
Toluene	**1.0**	0.097	**35.4**	0.256	0.239
Total Xylenes	**10.0**	0.206	**16.3**	2.34	6.77
MTBE	**0.07**	**0.118**	**0.457**	<0.005	<0.005

8800

KB Sullivan

Site Assessment Data

GW 5-27-10

	Location	MW-8	MW-9	MW-10	MW-11	MW-12
Parameter	**Class I CUO**					
Benzene	**0.005**	**2.88**	**1.12**	**2.05**	**0.039**	**0.677**
Ethylbenzene	**0.7**	**2.21**	0.437	**1.67**	0.004	**0.955**
Toluene	**1.0**	**5.**	0.024	0.035	<0.002	0.17
Total Xylenes	**10.0**	7.98	<0.005	<0.005	<0.005	3.98
MTBE	**0.07**	**0.086**	**0.38**	<0.005	**0.232**	0.015

6800

KB Sullivan

Site Assessment Data

GW 10-1-10

	Location	MW-13
Parameter	**Class I CUO**	
Benzene	**0.005**	<0.002
Ethylbenzene	**0.7**	0.041
Toluene	**1.0**	**1.67**
Total Xylenes	**10.0**	0.285
MTBE	**0.07**	<0.005

0600

COMPARISON TO TIER 2 OBJECTIVES

KB SULLIVAN

Site Assessment Data

SOIL 2-24-10

	Location	MW-4	MW-4	MW-5	MW-5	MW-6	MW-6	MW-7	MW-7	SB-1	SB-1
	DEPTH	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'
Parameter	Tier 2 CUO										
Benzene	55.1	<0.002	<0.002	4.91	5.03	3.47	0.926	<0.002	<0.002	<0.002	<0.002
Ethylbenzene	400	<0.002	<0.002	14.	16.6	10.4	0.844	1.44	15.9	<0.002	<0.002
Toluene	650	0.003	<0.002	12.3	29.7	0.42	<0.002	<0.002	0.099	<0.002	<0.002
Total Xylenes	320	<0.005	<0.005	36.8	65.6	21.8	<0.005	0.992	46.8	<0.005	<0.005
MTBE	3694	0.03	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

0092

KB SULLIVAN

Site Assessment Data

SOIL 2-24-10

	Location	SB-2	SB-2	SB-3
	DEPTH	2.5'	7.5'	2.5'
Parameter	Tier 2 CUO			
Benzene	**55.1**	0.08	<0.002	0.085
Ethylbenzene	**400**	1.91	4.65	1.09
Toluene	**650**	<0.002	<0.002	<0.002
Total Xylenes	**320**	0.503	8.12	0.055
MTBE	**3694**	<0.005	<0.005	<0.005

KB SULLIVAN

Site Assessment Data

SOIL 2-24-10

	Location	SB-3	SB-4	SB-4	SB-5	SB-5	SB-6	SB-6
	DEPTH	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'
Parameter	Tier 2 CUO							
Benzene	**55.1**	<0.002	0.043	0.149	0.671	0.058	0.845	3.42
Ethylbenzene	**400**	40.9	0.069	0.052	19.2	0.027	1.01	18.3
Toluene	**650**	<0.002	<0.002	0.006	<0.002	<0.002	0.015	<0.002
Total Xylenes	**320**	116.	0.027	0.022	0.663	<0.005	2.01	39.7
MTBE	**3694**	<0.005	<0.005	<0.005	<0.005	0.041	<0.005	0.559

0094

KB SULLIVAN

Site Assessment Data

SOIL 5-19-10

	Location	MW-8	MW-8	MW-9	MW-9	MW-10	MW-10	MW-11	MW-11	MW-12	MW-12
	DEPTH	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'	2.5'	7.5'
Parameter	Tier 2 CUO										
Benzene	**55.1**	0.003	1.19	0.576	0.309	0.682	0.283	0.004	0.023	0.106	0.309
Ethylbenzene	**400**	0.008	18.1	4.51	3.79	2.45	0.494	0.004	0.002	0.091	9.47
Toluene	**650**	0.002	0.313	0.018	<0.002	0.015	0.01	0.007	0.005	0.004	0.279
Total Xylenes	**320**	0.034	53.3	1.11	1.93	0.23	0.233	<0.005	<0.005	0.076	26.3
MTBE	**3694**	0.028	<0.005	0.061	<0.005	0.098	0.069	<0.005	0.069	<0.005	<0.005

KB SULLIVAN
Site Assessment Data

SOIL 9-22-10

	Location	MW-13	MW-13
	DEPTH	2.5'	7.5'
Parameter	Tier 2 CUO		
Benzene	55.1	<0.002	<0.002
Ethylbenzene	400	<0.002	<0.002
Toluene	650	<0.002	0.005
Total Xylenes	320	<0.005	<0.005
MTBE	3694	<0.005	<0.005

9600

APPENDIX F

BORING LOGS & WELL COMPLETION REPORTS

KB FOOD & GAS
SULLIVAN, ILLINOIS

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 2004-0969	**BOREHOLE NUMBER:** SB-1
SITE NAME: KB Sullivan	**BORING LOCATION:** 1' N & 5' E of NW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 9:30 AM	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 9:50 AM	**BACKFILL:** Grout

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0.5	Concrete/gravel subbase						No odor or discoloration throughout
2	Black silt loam	OM	85%				
3	Grey/brown silty clay, very stiff some sand	CL		0.0	Grab	SB-1-2.5'	BETX, MTBE
6	trace gravel						
8			100%	0.0	Grab	SB-1-7.5'	BETX, MTBE
12.5	Brown medium to coarse sand	SW	100%				Too wet to PID
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at center of each 5 foot section per regulations

Manway / Surface Elevation:

Groundwater Depth While Drilling: ~10-11' **Auger Depth:** 15' **Driller:** CW³M

Groundwater Depth After Drilling: **Rotary Depth:** **Geologist:** CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 2004-0969	**BOREHOLE NUMBER:** SB-2
SITE NAME: KB Sullivan	**BORING LOCATION:** 21' W & 10' S of SW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 2:10 PM	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 2:25 PM	**BACKFILL:** Grout

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–2	Concrete/gravel subbase						Strong odor & discoloration
2	Black silt loam	ML					
3	Grey/brown clayey silt, soft some sand	ML	90%	9.8	Grab	SB-2-2.5'	BETX, MTBE
5–6							very strong odor
6	trace gravel						
8	stiffens slightly, more clay larger gravel		100%	13.1	Grab	SB-2-7.5'	BETX, MTBE
10	End of boring						
11–15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at center of each 5 foot section per regulations

Manway / Surface Elevation:

Groundwater Depth While Drilling: N/A	**Auger Depth:**	10'	**Driller:**	CW³M
Groundwater Depth After Drilling:	**Rotary Depth:**		**Geologist:**	CLR/KMC

Illinois Environmental Protection Agency

CW3M COMPANY, INC.
DRILLING BOREHOLE LOG

Page 1 of 1

LUST INCIDENT #: 2004-0969	BOREHOLE NUMBER: SB-3
SITE NAME: KB Sullivan	BORING LOCATION: 13' W & 21' N of SW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	RIG TYPE: Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 2:25 PM	DRILLING/SAMPLE METHOD: Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 2:45 PM	BACKFILL: Grout

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–2	Concrete/gravel subbase						
2	Black silt loam	OM					
3	Grey/brown clayey silt some sand	ML	90%	0.8	Grab	SB-3-2.5'	BETX, MTBE
5.5	Trace gravel						strong odor
8	Stiffens slightly, more clay content Larger gravel		100%	47.3	Grab	SB-3-7.5'	BETX, MTBE
10	End of boring						
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:

▼ Groundwater Depth While Drilling:	N/A	Auger Depth:	10'	Driller:	CW3M
▽ Groundwater Depth After Drilling:		Rotary Depth:		Geologist:	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 2004-0969	**BOREHOLE NUMBER:** SB-4
SITE NAME: KB Sullivan	**BORING LOCATION:** 10' S & 18' E of SW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 2:45 PM	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 3:05 PM	**BACKFILL:** Grout

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
1	Concrete/gravel subbase						Slight odor & discoloration throughout
2	Black silt loam	OM					
3	Grey/brown clayey silt some sand	ML	85%	0.1	Grab	SB-4-2.5'	BETX, MTBE
4							
5							
6	trace gravel						
7							
8	stiffens slightly		100%	0.0	Grab	SB-4-7.5'	BETX, MTBE
9							
10	larger gravel						
11	End of boring						
12							
13							
14							
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:

Groundwater Depth While Drilling: N/A	**Auger Depth:** 10'	**Driller:**	CW³M
Groundwater Depth After Drilling:	**Rotary Depth:**	**Geologist:**	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 2004-0969	**BOREHOLE NUMBER:** SB-5
SITE NAME: KB Sullivan	**BORING LOCATION:** 134' W & 20' N of SW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 3:05 PM	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 3:25 PM	**BACKFILL:** Grout

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
1	Concrete/gravel subbase						Strong odor Discoloration decreases w/ depth
2	Black silt loam	OM					Strongest Odor
3	Grey/brown clayey silt, stiff some sand/backfill sand	ML	90%	47.3	Grab	SB-5-2.5'	BETX, MTBE
4							
5							
6	trace gravel						
7	Backfill sand	SW					
8			100%	2.4	Grab	SB-5-7.5'	BETX, MTBE
9	Fine sand/silt stiffens	SW					
10							
11	End of boring						
12							
13							
14							
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:

▼ **Groundwater Depth While Drilling:**	N/A	**Auger Depth:** 10'		**Driller:**	CW³M
▽ **Groundwater Depth After Drilling:**		**Rotary Depth:**		**Geologist:**	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 2004-0969	**BOREHOLE NUMBER:** SB-6
SITE NAME: KB Sullivan	**BORING LOCATION:** 124' W & 3' S of SW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 3:25 PM	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 3:50 PM	**BACKFILL:** Grout

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–2	Concrete/gravel subbase						Slight discoloration
2	Black silt loam	OM					
3	Grey/brown clayey silt, stiff some sand	ML	90%	0.0	Grab	SB-6-2.5'	BETX, MTBE
5							Very strong odor & discoloration
6	trace gravel						
7–10	Brown medium & coarse sand with gravel	SW	100%	28.7	Grab	SB-6-7.5'	BETX, MTBE
10							wet
10	End of boring						
11							
12							
13							
14							
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:

▼ **Groundwater Depth While Drilling:**	~9'	**Auger Depth:**	10'	**Driller:**	CW³M
▽ **Groundwater Depth After Drilling:**		**Rotary Depth:**		**Geologist:**	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 2004-0969	**BOREHOLE NUMBER:** SB-7
SITE NAME: KB Sullivan	**BORING LOCATION:** 150' W and 24' S of SW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 5/19/10 12:30 PM	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 5/19/10 12:55 PM	**BACKFILL:** Grout

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0.5–2	Asphalt/ gravel subbase						No odor or discoloration throughout
2–3	Balck silt loam	OM	80%				
3–7.5	Grey brown silty clay, stiff, some sand	CL					
5.5	trace of gravel			0.0			
6.5					TACO	SB-7 6-8'	Tier 2 parameters
7.5–8.5	Brown fine to medium sand and some silt	SW	100%				
8.5–9.5	Brown silt	ML					
9.5–10	Brown clayey silt with sand moist	ML					
10	End of boring						

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Adjacent to MW-11. Appeared to be clean location for Tier 2 parameter sample collection.

Manway / Surface Elevation:

Groundwater Depth While Drilling:	~9-10	**Auger Depth:**	10'	**Driller:**	CW³M
Groundwater Depth After Drilling:		**Rotary Depth:**		**Geologist:**	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 04-0969	BOREHOLE NUMBER: MW-4
SITE NAME: KB Sullivan	BORING LOCATION: 11' S & 11' W of NW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	RIG TYPE: Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 9:50 AM	DRILLING/SAMPLE METHOD: Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 11:15 AM	BACKFILL: N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
1	Concrete/gravel subbase						
2	Black silt loam some gravel	OM					Slight odor & discoloration
3	Grey/brown silty clay, very stiff some sand	CL	90%	0.0	Grab	MW4-2.5'	BETX, MTBE
4							
5							
6	traces of gravel						
7							
8			100%	0.0	Grab	MW4-7.5'	BETX, MTBE
9							
10							
11							Slight odor & discoloration
12	Brown medium to coarse gravel very wet	SW					Too wet to PID
13			100%				
14							
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:	100'				
Groundwater Depth While Drilling:	~10-11'	Auger Depth:	15'	Driller:	CW³M
Groundwater Depth After Drilling:		Rotary Depth:		Geologist:	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 04-0969	**BOREHOLE NUMBER:** MW-5
SITE NAME: KB Sullivan	**BORING LOCATION:** 62' W & 9' N of NW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 11:15 AM	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 12:00 PM	**BACKFILL:** N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–2	Concrete/gravel subbase						Odor throughout
2	Black silt loam	OM					
3	Grey/brown silty clay, very stiff some sand	CL	90%	38.4	Grab	MW5-2.5'	BETX, MTBE
6	traces of gravel						
8			100%	48.2	Grab	MW5-7.5'	BETX, MTBE
12.5	Brown medium to coarse gravel very wet, soft	SW	95%				Too wet to PID
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at center of each 5 foot section per regulations

Manway / Surface Elevation: 99.81'

Groundwater Depth While Drilling: ~10-11' **Auger Depth:** 15' **Driller:** CW³M

Groundwater Depth After Drilling: **Rotary Depth:** **Geologist:** CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

ST INCIDENT #: 04-0969	BOREHOLE NUMBER: MW-6
SITE NAME: KB Sullivan	BORING LOCATION: 142' W & 18' S of NW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	RIG TYPE: Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 12:00 PM	DRILLING/SAMPLE METHOD: Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 1:15 PM	BACKFILL: N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–2	Concrete/gravel subbase						Strong odor & discoloration throughout
2	Black silt loam	OM					
2.5	Grey/brown silty clay, very stiff some sand	CL	80%	61.6	Grab	MW6-2.5'	BETX, MTBE
6	traces of gravel						
8			100%	28.8	Grab	MW6-7.5'	BETX, MTBE
12.5	Brown medium to coarse sand	SW	100%				Too wet to PID
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation: 99.43'

Groundwater Depth While Drilling: ~10-11' Auger Depth: 15' Driller: CW³M

Groundwater Depth After Drilling: Rotary Depth: Geologist: CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

ST INCIDENT #: 04-0969	BOREHOLE NUMBER: MW-7
SITE NAME: KB Sullivan	BORING LOCATION: 45' W & 91' S of NW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	RIG TYPE: Longyear Truck-Mount
DATE/TIME STARTED: 2/24/10 1:15 PM	DRILLING/SAMPLE METHOD: Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 2/24/10 2:10 PM	BACKFILL: N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0.5	Concrete/gravel subbase						Strong odor & discoloration throughout
2	Black silt loam	OM					
3	Grey/brown silty clay, very stiff some sand	CL	85%	7.9	Grab	MW7-2.5'	BETX, MTBE
6	traces of gravel						
8			90%	64.4	Grab	MW-7-7.5'	BETX, MTBE
12.5	Brown medium to coarse sand	SW	100%				
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:	100.22'				
Groundwater Depth While Drilling:	~10-11'	Auger Depth:	15'	Driller:	CW³M
Groundwater Depth After Drilling:		Rotary Depth:		Geologist:	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 04-0969	BOREHOLE NUMBER: MW-8
SITE NAME: KB Sullivan	BORING LOCATION: 26' W and 12' N of NW corner of station building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	RIG TYPE: Longyear Truck-Mount
DATE/TIME STARTED: 5/19/10 8:30 AM	DRILLING/SAMPLE METHOD: Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 5/19/10 9:20 AM	BACKFILL: N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0.5	Concrete / gravel subbase						Slight discoloration
2	Black silt loam	OM					
2.5			85%	0.1	Grab	MW8-2.5'	BETX, MTBE
3	Grey/ brown silty clay, very stiff, some sand	CL					
6	trace gravel						Odor begins
7.5			100%	46.3	Grab	MW8-7.5'	BETX, MTBE
10.5	wet/ moist						
12.5	Brown medium to coarse sand	SW	100%				
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Determine Eastern extent of Contamination beyond MW-5
Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:	99.13'				
Groundwater Depth While Drilling:	~10'	Auger Depth:	15'	Driller:	CW³M
Groundwater Depth After Drilling:		Rotary Depth:		Geologist:	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 04-0969	BOREHOLE NUMBER: MW-9
SITE NAME: KB Sullivan	BORING LOCATION: 107' W and 5' N of NW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	RIG TYPE: Longyear Truck-Mount
DATE/TIME STARTED: 5/19/10 9:20 AM	DRILLING/SAMPLE METHOD: Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 5/19/10 10:00 AM	BACKFILL: N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–1.5	Concrete / gravel subbase						Strong odor and discoloration throughout
1.5–2.5	Black silt loam	OM	90%	5.6	Grab	MW9-2.5'	BETX, MTBE
2.5–12.5	Grey/ brown silty clay, very stiff, some sand	CL					
6	Trace gravel		100%	36.4	Grab	MW9-7.5'	BETX, MTBE
12.5–15	Brown medium to coarse sand	SW	100%				
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Determine contamination levels at proporty line between MW-6 and MW-5
Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:	98.64'				
▼ Groundwater Depth While Drilling:	~9-10'	Auger Depth:	15'	Driller:	CW³M
▽ Groundwater Depth After Drilling:		Rotary Depth:		Geologist:	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 04-0969	BOREHOLE NUMBER: MW-10
SITE NAME: KB Sullivan	BORING LOCATION: 146' W and 1' N of SW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	RIG TYPE: Longyear Truck-Mount
DATE/TIME STARTED: 5/19/10 10:00 AM	DRILLING/SAMPLE METHOD: Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 5/19/10 10:50 AM	BACKFILL: N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–1.5	Concrete / gravel subbase						Strong odor and discoloration throughout
1.5–2.5	Black silt loam	OM	90%	1.7	Grab	MW10-2.5'	BETX, MTBE
2.5–7	Grey/ brown silty clay, very stiff, some sand; trace gravel	CL					
7–8	Brown fine to medium poorly sorted sand	SW	100%	7.0	Grab	MW10-7.5'	BETX, MTBE
8–9	Brown silt	ML					
9–12.5	Brown clayey silt with sand moist; wet	ML					
12.5–15	Brown medium to coarse sand	SW	100%				

. Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Determine extent of contamination along west property boundary
Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation: 99.31'

Groundwater Depth While Drilling: ~9-10' **Auger Depth:** 15' **Driller:** CW³M

Groundwater Depth After Drilling: **Rotary Depth:** **Geologist:** CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.

DRILLING BOREHOLE LOG

LUST INCIDENT #: 04-0969	**BOREHOLE NUMBER:** MW-11
SITE NAME: KB Sullivan	**BORING LOCATION:** 151' W and 24' N of SW corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 5/19/10 10:50 AM	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 5/19/10 11:40 AM	**BACKFILL:** N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
1	Asphalt / gravel subbase						No odor and discoloration throughout
2	Black silt loam	OM	75%	0.0	Grab	MW11-2.5'	BETX, MTBE
3	Grey/ brown silty clay, very stiff, some sand	CL					
4							
5							
6	trace gravel						
7	Brown fine to medium poorly sorted sand	SW	100%	0.0	Grab	MW11-7.5'	BETX, MTBE
8	Brown silt	ML					
9	Brown Clayey silt with sand moist	ML					
10							
11	wet						
12			100%				
13	Brown medium to coarse sand	SW					
14							
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Determine contamination levels at west property line
Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation: 98.99'

Groundwater Depth While Drilling: ~9-10'	**Auger Depth:** 15'	**Driller:** CW³M
Groundwater Depth After Drilling:	**Rotary Depth:**	**Geologist:** CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 04-0969	BOREHOLE NUMBER: MW-12
SITE NAME: KB Sullivan	BORING LOCATION: 1' E and 7'S of SE corner of building
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	RIG TYPE: Longyear Truck-Mount
DATE/TIME STARTED: 5/19/10 11:40 AM	DRILLING/SAMPLE METHOD: Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 5/19/10 12:30 PM	BACKFILL: N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–2	Concrete / gravel subbase						
2	Black silt loam	OM					
2.5			95%	0.9	Grab	MW12-2.5'	BETX, MTBE
3	Grey/ brown silty clay, very stiff, some sand	CL					
6	trace gravel						
7.5			100%	36.2	Grab	MW12-7.5'	BETX, MTBE
11.5	moist						
12.5			100%				
13	Brown medium to coarse sand	SW					
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation:	99.33'				
▼ Groundwater Depth While Drilling:	~9-10'	Auger Depth:	15'	Driller:	CW³M
▽ Groundwater Depth After Drilling:		Rotary Depth:		Geologist:	CLR/KMC

Illinois Environmental Protection Agency

CW³M COMPANY, INC.
DRILLING BOREHOLE LOG

LUST INCIDENT #: 04-0969	**BOREHOLE NUMBER:** MW-13
SITE NAME: KB Sullivan	**BORING LOCATION:** 101' S & 4' W of MW-7.
SITE ADDRESS: 111 West Jackson St. Sullivan, IL	**RIG TYPE:** Longyear Truck-Mount
DATE/TIME STARTED: 9/22/10 2:15 pm	**DRILLING/SAMPLE METHOD:** Hollow Stem Augers/5' Cont. Sampler
DATE/TIME FINISHED: 9/22/10 2:50 pm	**BACKFILL:** N/A Set well

DEPTH (FEET)	SOIL AND ROCK DESCRIPTION	USCS CLASS	Sample Recovery	PID (ppm)	Sample Type	SAMPLE NUMBER	REMARKS: (Odor, Color, Moisture, Penetrometer, etc.)
0							
0–2	Grass/topsoil						Slight odor throughout
2	Black silt loam	OM					
2.5			95%	0.9	Grab	MW13-2.5'	BETX, MTBE
3	Brown silty clay, very stiff	CL					
5	Brown mottled grey silty clay w/trace pebbles	CL					
7.5			100%	36.2	Grab	MW13-7.5'	BETX, MTBE
10	moist						
12.5			100%				
13	Brown medium to coarse sand	SW					
15							

Stratification lines are approximate, in-situ transition between soil types may be gradual.

NOTES: Sampled at the center of each 5 foot section per regulations

Manway / Surface Elevation: 100.52'

Groundwater Depth While Drilling: ~9-10' **Auger Depth:** 15' **Driller:** CW³M

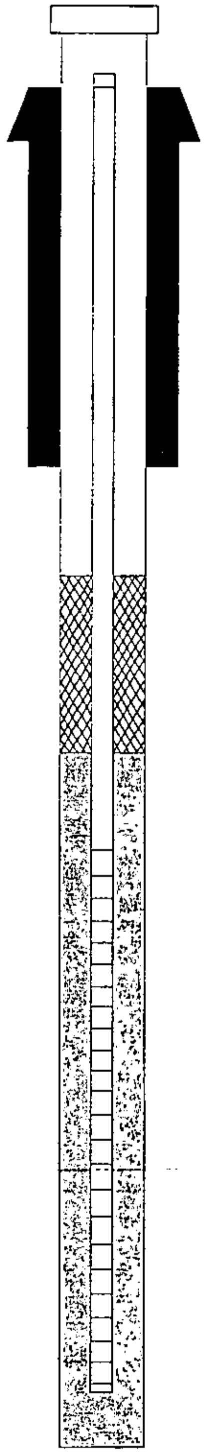
Groundwater Depth After Drilling: **Rotary Depth:** **Geologist:** MAB/MKC

Illinois Environmental Protection Agency **LUST Well Completion Report**

Incident No.	90-0146 & 2004-0969	**Well No.**	MW-4
Site Name	KB Sullivan	**Date Drilled**	2/24/2010
Drilling Contractor	CW^3M	**Date Completed**	2/24/2010
Driller	CW^3M	**Geologist**	CLR/KMC
Drilling Method	Hollow Stem Auger	**Drilling Fluids**	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



100.00 ft.	Top of Protective Casing
99.75 ft.	Top of riser pipe
100.00 ft.	Ground surface
99.50 ft.	Top of Annular Sealant
N/A	Casing Stickup
99.50 ft.	Top of Seal
3.00 ft.	Total Seal interval
96.50 ft.	Top of Sand
95.50 ft.	Top of Screen
10.0 ft.	Total Screen Interval
85.50 ft.	Bottom of Screen
85.00 ft.	Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~10-11 ft. while drilling
Depth to Water	94.00 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

Completed by: KMC

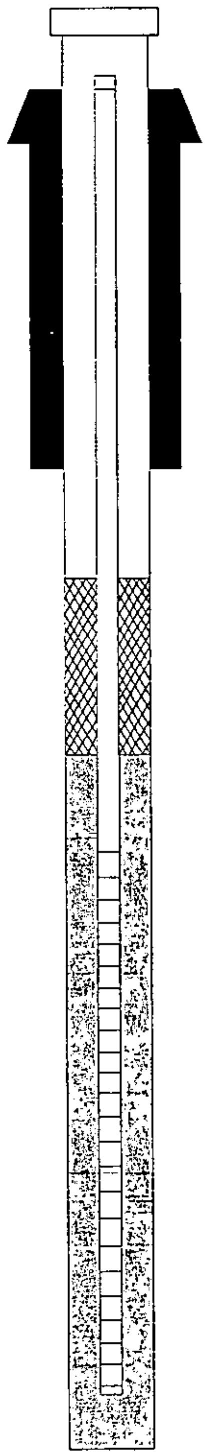
Illinois Environmental Protection Agency

LUST Well Completion Report

Incident No.	90-0146 & 2004-0969	Well No.	MW-5
Site Name	KB Sullivan	Date Drilled	2/24/2010
Drilling Contractor	CW^{3}M	Date Completed	2/24/2010
Driller	CW^{3}M	Geologist	CLR/KMC
Drilling Method	Hollow Stem Auger	Drilling Fluids	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



99.81 ft.	Top of Protective Casing
99.56 ft.	Top of riser pipe
99.81 ft.	Ground surface
99.31 ft.	Top of Annular Sealant
N/A	Casing Stickup
99.31 ft.	Top of Seal
3.00 ft.	Total Seal interval
96.31 ft.	Top of Sand
95.31 ft.	Top of Screen
10.0 ft.	Total Screen Interval
85.31 ft.	Bottom of Screen
84.81 ft.	Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~10-11 ft. while drilling
Depth to Water	96.51 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

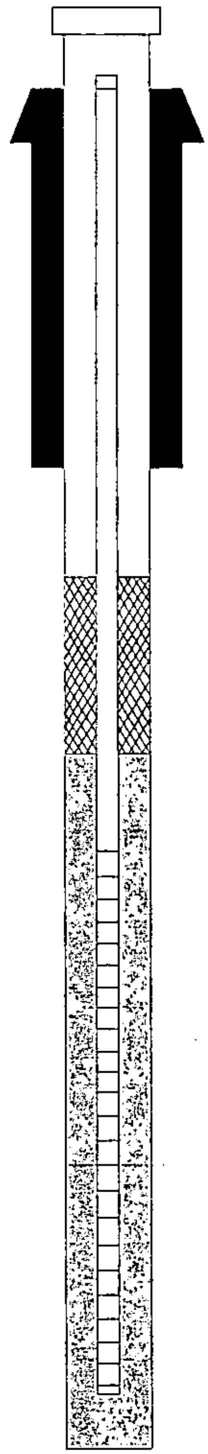
Completed by: KMC

Illinois Environmental Protection Agency **LUST Well Completion Report**

Incident No.	90-0146 & 2004-0969	**Well No.**	MW-6
Site Name	KB Sullivan	**Date Drilled**	2/24/2010
Drilling Contractor	CW^{3}M	**Date Completed**	2/24/2010
Driller	CW^{3}M	**Geologist**	CLR/KMC
Drilling Method	Hollow Stem Auger	**Drilling Fluids**	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



99.43 ft. Top of Protective Casing
99.18 ft. Top of riser pipe
99.43 ft. Ground surface
98.93 ft. Top of Annular Sealant
N/A Casing Stickup
98.93 ft. Top of Seal
3.00 ft. Total Seal interval
95.93 ft. Top of Sand
94.93 ft. Top of Screen
10.0 ft. Total Screen Interval
84.93 ft. Bottom of Screen
84.43 ft. Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~10-11 ft. while drilling
Depth to Water	95.57 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

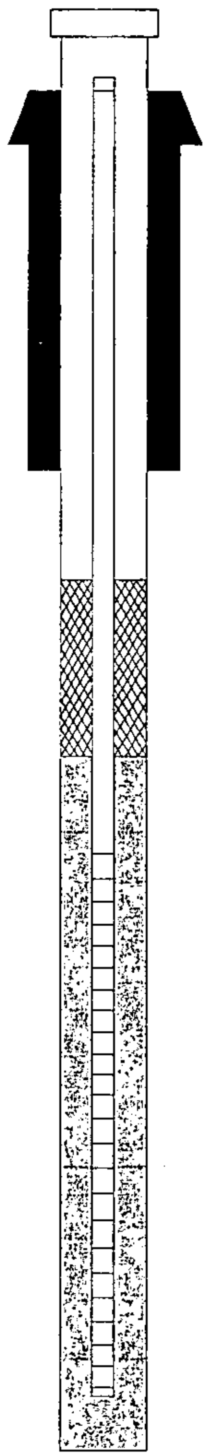
Completed by: KMC

Illinois Environmental Protection Agency **LUST Well Completion Report**

Incident No.	90-0146 & 2004-0969	**Well No.**	MW-7
Site Name	KB Sullivan	**Date Drilled**	2/24/2010
Drilling Contractor	CW^3M	**Date Completed**	2/24/2010
Driller	CW^3M	**Geologist**	CLR/KMC
Drilling Method	Hollow Stem Auger	**Drilling Fluids**	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



100.22 ft.	Top of Protective Casing
99.97 ft.	Top of riser pipe
100.22 ft.	Ground surface
99.72 ft.	Top of Annular Sealant
N/A	Casing Stickup
99.72 ft.	Top of Seal
3.00 ft.	Total Seal interval
96.72 ft.	Top of Sand
95.72 ft.	Top of Screen
10.0 ft.	Total Screen Interval
85.72 ft.	Bottom of Screen
85.22 ft.	Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~10-11 ft. while drilling
Depth to Water	96.22 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

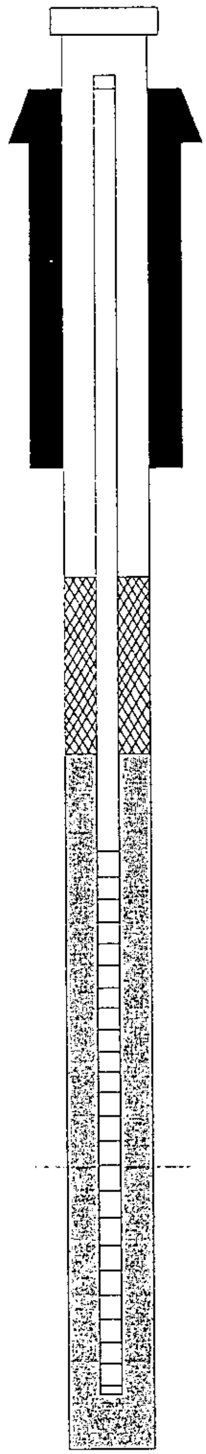
Completed by: KMC

Illinois Environmental Protection Agency | **LUST Well Completion Report**

Incident No.	90-0146 & 2004-0969	**Well No.**	MW-8
Site Name	KB Sullivan	**Date Drilled**	5/19/2010
Drilling Contractor	CW^{3}M	**Date Completed**	5/19/2010
Driller	CW^{3}M	**Geologist**	CLR/KMC
Drilling Method	Hollow Stem Auger	**Drilling Fluids**	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



- 99.13 ft. Top of Protective Casing
- 98.88 ft. Top of riser pipe
- 99.13 ft. Ground surface
- 98.63 ft. Top of Annular Sealant
- N/A Casing Stickup
- 98.63 ft. Top of Seal
- 3.00 ft. Total Seal interval
- 95.63 ft. Top of Sand
- 94.63 ft. Top of Screen
- 10.0 ft. Total Screen Interval
- 84.63 ft. Bottom of Screen
- 84.13 ft. Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~10 ft. while drilling
Depth to Water	94.13 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

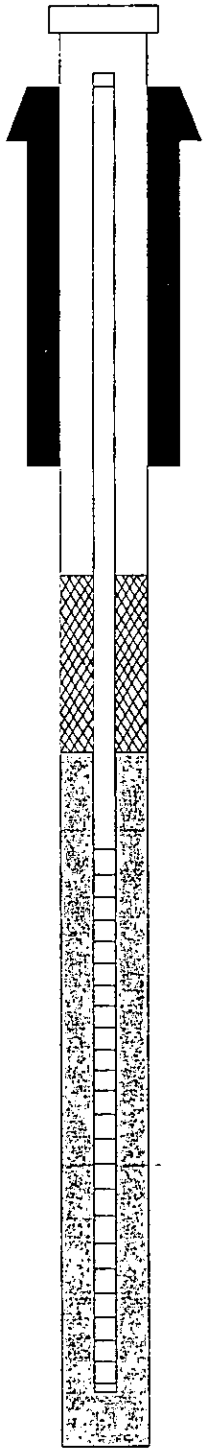
Completed by: KMC

Illinois Environmental Protection Agency **LUST Well Completion Report**

Incident No.	90-0146 & 2004-0969	**Well No.**	MW-9
Site Name	KB Sullivan	**Date Drilled**	5/19/2010
Drilling Contractor	CW^3M	**Date Completed**	5/19/2010
Driller	CW^3M	**Geologist**	CLR/KMC
Drilling Method	Hollow Stem Auger	**Drilling Fluids**	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



98.64 ft.	Top of Protective Casing
98.39 ft.	Top of riser pipe
98.64 ft.	Ground surface
98.14 ft.	Top of Annular Sealant
N/A	Casing Stickup
98.14 ft.	Top of Seal
3.00 ft.	Total Seal interval
95.14 ft.	Top of Sand
94.14 ft.	Top of Screen
10.0 ft.	Total Screen Interval
84.14 ft.	Bottom of Screen
83.64 ft.	Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~9-10 ft. while drilling
Depth to Water	94.19 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

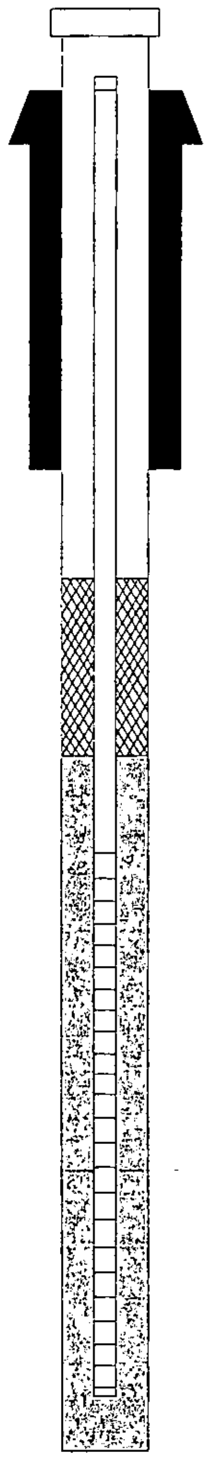
Completed by: KMC

Illinois Environmental Protection Agency | **LUST Well Completion Report**

Incident No.	90-0146 & 2004-0969	**Well No.**	MW-10
Site Name	KB Sullivan	**Date Drilled**	5/19/2010
Drilling Contractor	CW^{3}M	**Date Completed**	5/19/2010
Driller	CW^{3}M	**Geologist**	CLR/KMC
Drilling Method	Hollow Stem Auger	**Drilling Fluids**	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



99.31 ft.	Top of Protective Casing
99.06 ft.	Top of riser pipe
99.31 ft.	Ground surface
98.81 ft.	Top of Annular Sealant
N/A	Casing Stickup
98.81 ft.	Top of Seal
3.00 ft.	Total Seal interval
95.81 ft.	Top of Sand
94.81 ft.	Top of Screen
10.0 ft.	Total Screen Interval
84.81 ft.	Bottom of Screen
84.31 ft.	Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~9-10 ft. while drilling
Depth to Water	94.78 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

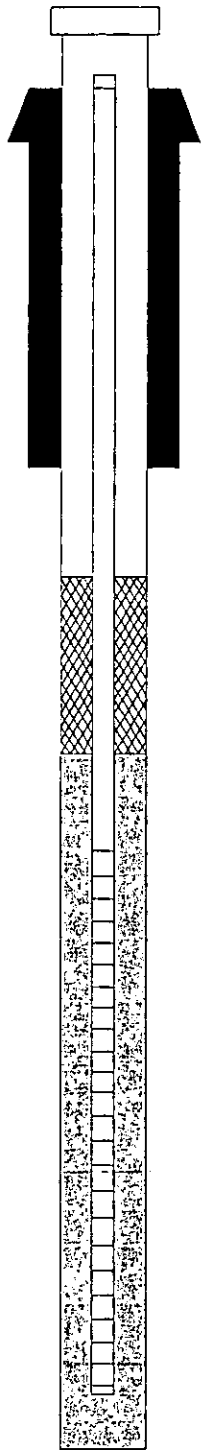
Completed by: KMC

Illinois Environmental Protection Agency — **LUST Well Completion Report**

Incident No.	90-0146 & 2004-0969	**Well No.**	MW-11
Site Name	KB Sullivan	**Date Drilled**	5/19/2010
Drilling Contractor	CW^3M	**Date Completed**	5/19/2010
Driller	CW^3M	**Geologist**	CLR/KMC
Drilling Method	Hollow Stem Auger	**Drilling Fluids**	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



98.99 ft.	Top of Protective Casing
98.74 ft.	Top of riser pipe
98.99 ft.	Ground surface
98.49 ft.	Top of Annular Sealant
N/A	Casing Stickup
98.49 ft.	Top of Seal
3.00 ft.	Total Seal interval
95.49 ft.	Top of Sand
94.49 ft.	Top of Screen
10.0 ft.	Total Screen Interval
84.49 ft.	Bottom of Screen
83.99 ft.	Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~9-10 ft. while drilling
Depth to Water	94.71 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

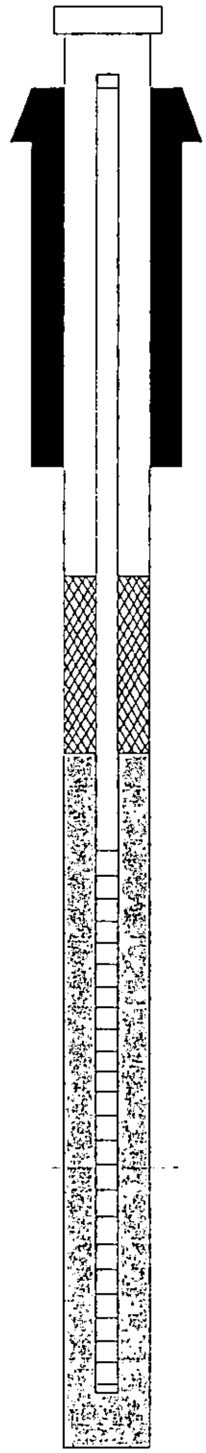
Completed by: KMC

Illinois Environmental Protection Agency | LUST Well Completion Report

Incident No.	90-0146 & 2004-0969	Well No.	MW-12
Site Name	KB Sullivan	Date Drilled	5/19/2010
Drilling Contractor	CW^{3}M	Date Completed	5/19/2010
Driller	CW^{3}M	Geologist	CLR/KMC
Drilling Method	Hollow Stem Auger	Drilling Fluids	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



99.33	ft.	Top of Protective Casing
99.08	ft.	Top of riser pipe
99.33	ft.	Ground surface
98.83	ft.	Top of Annular Sealant
N/A		Casing Stickup
98.83	ft.	Top of Seal
3.00	ft.	Total Seal interval
95.83	ft.	Top of Sand
94.83	ft.	Top of Screen
10.0	ft.	Total Screen Interval
84.83	ft.	Bottom of Screen
84.33	ft.	Bottom of Borehole

Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~9-10 ft. while drilling
Depth to Water	95.33 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

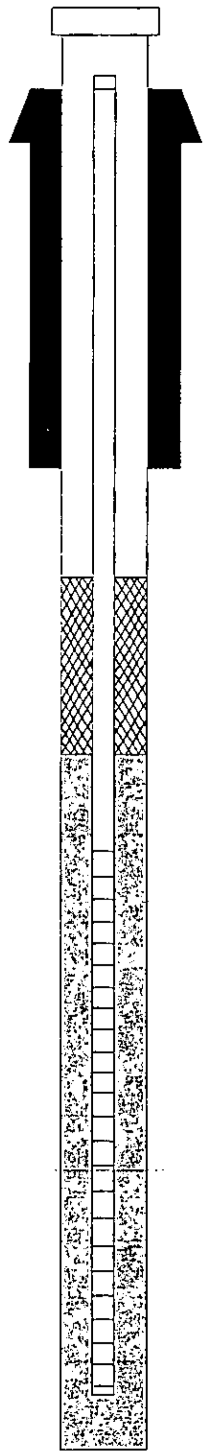
Completed by: KMC

Illinois Environmental Protection Agency — **LUST Well Completion Report**

Incident No.	90-0146 & 2004-0969	**Well No.**	MW-13
Site Name	KB Food & Gas, Inc.	**Date Drilled**	9/22/2010
Drilling Contractor	CW^{3}M	**Date Completed**	9/22/2010
Driller	CW^{3}M	**Geologist**	MAB/MKC
Drilling Method	Hollow Stem Auger	**Drilling Fluids**	N/A

Annular Space Details

Type of Surface Seal	Concrete
Type of Annular Sealant	Bentonite
Type of Bentonite	High-Yield
Type of Sand Pack	Coarse 20-20



Well Construction Materials

	Stainless Steel Type	PVC Specify Type	Other Specify Type
Riser Coupling Joint			
Riser Pipe Above w.t.		Sched.-40	
Riser Pipe Below w.t.			
Screen		Sched.-40	
Coupling Joint Screen to Riser		Sched.-40	
Protective Casing			Steel

Measurements

Riser Pipe Length	4.25 ft.
Screen Length	10.0 ft.
Screen Slot Size	10-slot
Protective Casing Length	N/A
Depth to Water	~9-10 ft. while drilling
Depth to Water	93.18 ft. static
Free Product Thickness	N/A
Gallons removed (develop)	Approximately 3 gallons
Gallons removed (purge)	Approximately 3 gallons
Other	

Completed by: MAB

APPENDIX G

CORRECTIVE ACTION PLAN BUDGET

KB FOOD & GAS
SULLIVAN, ILLINOIS

Owner/Operator and Licensed Professional Engineer/Geologist Budget Certification Form

I hereby certify that I intend to seek payment from the UST Fund for costs incurred while performing corrective action activities for Leaking UST incident 90-0146/2004-0969. I further certify that the costs set forth in this budget are for necessary activities and are reasonable and accurate to the best of my knowledge and belief. I also certify that the costs included in this budget are not for corrective action in excess of the minimum requirements of 415 ILCS 5/57, no costs are included in this budget that are not described in the corrective action plan, and no costs exceed Subpart H: Maximum Payment Amounts, Appendix D Sample Handling and Analysis amounts, and Appendix E Personnel Titles and Rates of 35 Ill. Adm. Code 732 or 734. I further certify that costs ineligible for payment from the Fund pursuant to 35 Ill. Adm. Code 732.606 or 734.630 are not included in the budget proposal or amendment. Such ineligible costs include but are not limited to:

Costs associated with ineligible tanks.
Costs associated with site restoration (e.g., pump islands, canopies).
Costs associated with utility replacement (e.g., sewers, electrical, telephone, etc.).
Costs incurred prior to IEMA notification.
Costs associated with planned tank pulls.
Legal fees or costs.
Costs incurred prior to July 28, 1989.
Costs associated with installation of new USTs or the repair of existing USTs.

RECEIVED
FEB 17 2012
IEPA/BOL

Owner/Operator: KB Sullivan, Inc

Authorized Representative: Kamlesh Patel   Title: Owner

Signature: K.B. Patel   Date: 2/12/12

Subscribed and sworn to before me the 12th day of February, 2012.

OFFICIAL SEAL
CAROL E. ROWE
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 2-26-2013
Seal

(Notary Public)

In addition, I certify under penalty of law that all activities that are the subject of this plan, budget, or report were conducted under my supervision or were conducted under the supervision of another Licensed Professional Engineer or Licensed Professional Geologist and reviewed by me; that this plan, budget, or report and all attachments were prepared under my supervision; that, to the best of my knowledge and belief, the work described in the plan, budget, or report has been completed in accordance with the Environmental Protection Act [415 ILCS 5], 35 Ill. Adm. Code 732 or 734, and generally accepted standards and practices of my profession; and that the information presented is accurate and complete. I am aware there are significant penalties for submitting false statements or representations to the Illinois EPA, including but not limited to fines, imprisonment, or both as provided in Sections 44 and 57.17 of the Environmental Protection Act [415 ILCS 5/44 and 57.17].

L.P.E./L.P.G.: Vince E. Smith   L.P.E./L.P.G. Seal:

VINCE E. SMITH
43119
REGISTERED PROFESSIONAL ENGINEER
OF
ILLINOIS

L.P.E./L.P.G. Signature: V. E. Smith   Date: 2/16/12

Subscribed and sworn to before me the 16th day of February, 2012.

OFFICIAL SEAL
CAROL E. ROWE
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 2-26-2013
Seal

(Notary Public)

The Illinois EPA is authorized to require this information under 415 ILCS 5/1. Disclosure of this information is required. Failure to do so may result in the delay or denial of any budget or payment requested hereunder.

General Information for the Budget and Billing Forms

LPC #: 1390305014 County: Moultrie

City: Sullivan Site Name: KB Food & Gas

Site Address: 111 West Jackson Street / Routes 121 & 32

IEMA Incident No.: 90-0146 2004-0969

IEMA Notification Date.: Jan 17, 1990 Jul 9, 2004

Date this form was prepared: Feb 1, 2012

This form is being submitted as a (check one):

- [x] Budget Proposal
- [ ] Budget Amendment (Budget amendments must include only the costs over the previous budget.)
- [ ] Billing Package

RECEIVED
FEB 17 2012
IEPA/BOL

Please provide the name(s) and date(s) of report(s) documenting the costs requested:

Name(s):

Date(s):

This package is being submitted for the site activities indicated below :

35 Ill. Adm. Code 734:

- [ ] Early Action
- [ ] Free Product Removal after Early Action
- [ ] Site Investigation Stage 1: [ ] Stage 2: [ ] Stage 3: [ ]
- [x] Corrective Action

35 Ill. Adm. Code 732:

- [ ] Early Action
- [ ] Free Product Removal after Early Action
- [ ] Site Classification
- [ ] Low Priority Corrective Action
- [ ] High Priority Corrective Action

35 Ill. Adm. Code 731:

- [ ] Site Investigation
- [ ] Corrective Action

IL 532 -2825
LPC 630 Rev. 1/ 2007

General Information for the Budget and Billing Forms

The following address will be used as the mailing address for checks and any final determination letters regarding payment from the Fund.

Pay to the order of: KB Food & Gas

Send in care of: CWM Company, Inc.

Address: P.O. Box 571

City: Carlinville State: IL Zip: 62626

The payee is the: Owner ☒ Operator ☐ (Check one or both.)

K. B. Patel

Signature of the owner or operator of the UST(s) (required)

If you have a change of address, click here to print off a W-9 Form.

Number of petroleum USTs in Illinois presently owned or operated by the owner or operator; any subsidiary, parent or joint stock company of the owner or operator; and any company owned by any parent, subsidiary or joint stock company of the owner or operator:

Fewer than 101: ☒ 101 or more: ☐

Number of USTs at the site: 11 (Number of USTs includes USTs presently at the site and USTs that have been removed.)

Number of incidents reported to IEMA for this site: 2

Incident Numbers assigned to the site due to releases from USTs: 90-01416 2004-0969

Please list all tanks that have ever been located at the site and tanks that are presently located at the site.

Product Stored in UST	Size (gallons)	Did UST have a release?	Incident No.	Type of Release Tank Leak / Overfill / Piping Leak
Gasoline	10,000	Yes ☒ No ☐	90-0146 2004-0969	Spills & Overfills
Gasoline	8,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Gasoline	8,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Diesel	5,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Gasoline	5,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Kerosene	2,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Gasoline	10,000	Yes ☐ No ☒	None	None
Gasoline	10,000	Yes ☐ No ☒	None	None
Diesel	8,000	Yes ☐ No ☒	None	None

Product Stored in UST	Size (gallons)	Did UST have a release?	Incident No.	Type of Release Tank Leak / Overfill / Piping Leak
Kerosene	5,000	Yes ☐ No ☒	None	None
Gasoline	5,000	Yes ☐ No ☒	None	None
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		

Add More Rows   Undo Last Add

Budget Summary

Choose the applicable regulation: (•) 734 ( ) 732

734	Free Product	Stage 1 Site Investigation	Stage 2 Site Investigation	Stage 3 Site Investigation	Corrective Action
					Proposed
Drilling and Monitoring Well Costs Form	$	$	$	$	$
Analytical Costs Form	$	$	$	$	$
Remediation and Disposal Costs Form	$	$	$	$	$
UST Removal and Abandonment Costs Form	$	$	$	$	$
Paving, Demolition, and Well Abandonment Costs Form	$	$	$	$	$ 1,719.00
Consulting Personnel Costs Form	$	$	$	$	$ 31,443.23
Consultant's Materials Costs Form	$	$	$	$	$ 734.30
Handling Charges Form	Handling charges will be determined at the time a billing package is submitted to the Illinois EPA. The amount of allowable handling charges will be determined in accordance with the Handling Charges Form.				
Total	$	$	$	$	$ 33,896.53

Paving, Demolition, and Well Abandonment Costs Form

A. Concrete and Asphalt Placement/Replacement

Number of Square Feet	Asphalt or Concrete	Thickness (inches)	Cost ($) per Square Foot	Replacement or Placement for an Engineered Barrier	Total Cost

Total Concrete and Asphalt Placement/Replacement Costs:	

B. Building Destruction or Dismantling and Canopy Removal

Item to Be Destroyed, Dismantled, or Removed	Unit Cost ($)	Total Cost ($)

Total Building Destruction or Dismantling and Canopy Removal Costs:	

Paving, Demolition, and Well Abandonment Costs Form

C. Well Abandonment

Monitoring Well ID #	Type of Well (HSA / PUSH / Recovery)	Depth of Well (feet)	Cost ($) per Foot	Total Cost
MW-4	HSA	15.00	11.46	$171.90
MW-5	HSA	15.00	11.46	$171.90
MW-6	HSA	15.00	11.46	$171.90
MW-7	HSA	15.00	11.46	$171.90
MW-8	HSA	15.00	11.46	$171.90
MW-9	HSA	15.00	11.46	$171.90
MW-10	HSA	15.00	11.46	$171.90
MW-11	HSA	15.00	11.46	$171.90
MW-12	HSA	15.00	11.46	$171.90
MW-13	HSA	15.00	11.46	$171.90

Total Monitoring Well Abandonment Costs:	**$1,719.00**

Total Paving, Demolition, and Well Abandonment Costs:	**$1,719.00**

Consulting Personnel Costs Form

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	Task			
	Senior Project Manager	4.00	114.59	$458.36
CCAP-Budget	Budget Complaince / Techinical Oversight			
	Engineer I	16.00	85.94	$1,375.04
CCAP-Budget	Budget Calculations / Inputs			
	Senior Prof. Engineer	3.00	148.97	$446.91
CCAP-Budget	Budget Review & Certification			
	Senior Admin. Assistant	2.00	51.57	$103.14
CCAP-Budget	Budget Compilation, Assembly, and Distribution			
	Senior Draftperson/CAD	12.00	68.75	$825.00
CCA-Field	Plume / Analytical / Modeling Map Development			
	Engineer I	12.00	85.94	$1,031.28
TACO 2 or 3	TACO Calculations / Clean-up Objectives Development			
	Senior Prof. Engineer	2.00	148.97	$297.94
TACO 2 or 3	TACO Calculations / Clean-up Objectives Oversight and Review			
	Engineer III	12.00	114.59	$1,375.08
CCA-Field	Groundwater Contaminant Transport Modeling			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	Task			
	Senior Project Manager	6.00	114.59	$687.54
CCAP	Report Coordination / Technical Oversight / Compliance			
	Senior Prof. Engineer	3.00	148.97	$446.91
CCAP	Report Review and Certification			
	Engineer I	30.00	85.94	$2,578.20
CCAP	Corrective Action Design / Report Preparation			
	Draftperson/CAD I	8.00	45.84	$366.72
CCAP	Drafting and Editing Maps for the Report			
	Senior Admin. Assistant	2.00	51.57	$103.14
CCAP	Report Compilation, Assembly, and Distribution			
	Senior Project Manager	4.00	114.59	$458.36
CCA-Field	Office Preparation, Scheduling, Arrangements for Well Abandonment Activities			
	Senior Project Manager	2.00	114.59	$229.18
CCA-Field	CA Documentation / Compliance for Well Abondonment / Property Owner Correspondence			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
	Senior Project Manager	6.00	114.59	$687.54
HAA	HAA IDOT Oversight / Technical Compliance			
	Engineer III	20.00	114.59	$2,291.80
HAA	HAA IDOT Development / Correspondence			
	Senior Admin. Assistant	2.00	51.57	$103.14
HAA	HAA IDOT Compilation, Assembly, and Distribution			
	Engineer I	18.00	85.94	$1,546.92
ELUC	City Groundwater Ordinance Preparation			
	Senior Project Manager	4.00	114.59	$458.36
ELUC	City Groundwater Ordinance Review			
	Senior Prof. Engineer	12.00	148.97	$1,787.64
ELUC	City Groundwater Ordinance Preparation / Design and Correspondence with City Officials			
	Senior Draftperson/CAD	6.00	68.75	$412.50
ELUC	Drafting of Maps for City Groundwater Ordinance			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	Task			
	Senior Project Manager	8.00	114.59	$916.72
ELUC	Off-Site I/C Land Use Restriction Coordination / Oversight / Negotiation with Property Owner			
	Senior Prof. Engineer	2.00	148.97	$297.94
ELUC	Off-Site I/C Land Use Restriction Technical Compliance / Correspondence			
	Engineer I	12.00	85.94	$1,031.28
ELUC	Development and Coordination of Off-Site I/C Land Use Restriction / Recording			
	Senior Project Manager	3.00	114.59	$343.77
CACR	NFR Recording / IEPA Correspondence / Submittal			
	Senior Admin. Assistant	2.00	51.57	$103.14
CACR	NFR Recording / County Deed Processing			
	Senior Project Manager	6.00	114.59	$687.54
CACR	Report Coordination / Technical Oversight / Compliance			
	Senior Prof. Engineer	3.00	148.97	$446.91
CACR	Report Review and Certification			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
	Engineer III	30.00	114.59	$3,437.70
CACR	Report Preparation / Development			
	Draftperson/CAD IV	10.00	63.02	$630.20
CACR	Drafting / Updating and Completion of Maps			
	Senior Admin. Assistant	2.00	51.57	$103.14
CACR	Report Compilation, Assembly, and Distribution			
	Senior Project Manager	3.00	114.59	$343.77
CACR	Deed Restriction for Groundwater Ordinance			
	Senior Project Manager	16.00	114.59	$1,833.44
CA-Pay	Reimbursement Complaince / Technical Oversight / Documentation			
	Senior Prof. Engineer	6.00	148.97	$893.82
CA-Pay	Reimbursement Review and Certification			
	Senior Acct. Technician	30.00	63.02	$1,890.60
CA-Pay	Reimbursement Preparation			
	Senior Admin. Assistant	8.00	51.57	$412.56
CA-Pay	Reimbursement Compilation, Assembly, and Distribution			

*Refer to the applicable Maximum Payment Amounts document.

Total of Consulting Personnel Costs	**$31,443.23**

Consultant's Materials Costs Form

Materials, Equipment, or Field Purchase	Time or Amount Used	Rate ($)	Unit	Total Cost
Remediation Category	**Description/Justification**			
Copies	600.00	.10	/each	$60.00
CCAP	Copies of Plan and Report			
Postage	3.00	5.00	/each	$15.00
CCAP	Report Distribution			
Copies	300.00	.10	/each	$30.00
CCAP-Budget	Copies of Budget			
Postage	3.00	5.00	/each	$15.00
CCAP-Budget	Budget Distribution			
Copies	1,000.00	.10	/each	$100.00
CACR	Copies of Completion Report and Attachments			
Postage	3.00	5.00	/each	$15.00
CACR	Completion Report Distribution			
Copies	1,000.00	.10	/each	$100.00
CA-Pay	Copies of Reimbursement Claim			
Postage	3.00	5.00	/each	$15.00
CA-Pay	Reimbursement Distribution			
NFR Recording	1.00	68.00	/each	$68.00
CACR	NFR Recording Fees			

Materials, Equipment, or Field Purchase	Time or Amount Used	Rate ($)	Unit	Total Cost
Remediation Category	**Description/Justification**			
Postage	5.00	5.00	/each	$25.00
CACR	NFR Recording / Correspondence			
Copies	100.00	.10	.each	$10.00
CACR	NFR / Recording / Submittal			
Copies	200.00	.10	/each	$20.00
ELUC	Ordinance Development and Notification / Correspondence			
Postage	6.00	5.00	/each	$30.00
ELUC	Ordinance Development and Notification / Correspondence			
Copies	300.00	.10	/copy	$30.00
HAA	Copies of HAA			
Postage	4.00	5.00	/each	$20.00
HAA	Postage for HAA and HAA Correspondence w/ IDOT and City of Sullivan			
Copies	200.00	.10	/each	$20.00
ELUC	Copies of off-site ELUC / Correspondence			
Postage	4.00	5.00	/each	$20.00
ELUC	Postage for ELUC and ELUC Correspondence			
Mileage	166.00	.55	/mile	$91.30
CACR	2 RT from Springfield (1-ELUC/GWO City Meeting, 1-Off-site Property Owner Meeting)			

Materials, Equipment, or Field Purchase		Time or Amount Used	Rate ($)	Unit	Total Cost
Remediation Category	**Description/Justification**				
Recording Fees		1.00	50.00	/each	$50.00
ELUC	Recording of ELUC				

Total of Consultant Materials Costs	**$734.30**

CW³M Company
Environmental Consulting Services
701 W. South Grand Avenue
Springfield, IL 62704
Phone: (217) 522-8001
Fax: (217) 522-8009

April 6, 2012

Mr. Brad Dilbaitis, Project Manager
LUST Section, Bureau of Land
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, Illinois 62794-9276

RE: **LPC #1390305014—Moultrie County**
KB Food & Gas/Sullivan
111 West Jackson Street (Rt. 121 & 32)
Incident Number: 90-0146/2004-0969
LUST Technical Reports—Corrective Action Plan and Budget - Revised TACO Calculations

Dear Mr. Dilbaitis:

In response to your inquiry to us about the TACO Calculations contained within the February 17, 2012, Corrective Action Plan (CAP) and Budget for the above referenced site, we have re-done the calculations, and attached them. As outlined in our email to you on March 2, 2012, the calculations that were included in the CAP were done using a spreadsheet that has errors in the calculations. The attached calculations are a complete replacement for Appendix D of the document under review. Just to be thorough, we have included pages of calculations that we do not normally publish in a report, in case you have any additional questions as to how the numbers were arrived at.

These revised calculations will change Table 2-1 on page 7 of the CAP to:

Table 2-1 Remediation Objectives

Parameter	TACO Industrial/Commercial Tier 2 Soil Clean-up Objective (mg/kg)	TACO Class 1 Groundwater Clean-up Objective (mg/L)
Benzene	16.3	0.005
Ethylbenzene	204,045	0.7
Toluene	163,236	1.0
Total Xylenes	879.12	10.0
MTBE	3,691	0.07

While each of the Clean-up Objectives has changed, there is no substantive impact on the overall CAP. There is still no soil contamination above the Tier 2 Objectives. While some of the benzene modeling distances have been reduced slightly, the MTBE modeling, which controlled the overall required area requiring remediation, is unchanged.

We apologize for the error in the calculations, and have taken steps to try to prevent that from happening again on other projects. If you have any questions or require additional information, please contact Mr. Vince Smith or me at (217) 522-8001.

Sincerely,

Carol L. Rowe, P.G.
Senior Environmental Geologist

xc: Mr. Kamlesh Patel, *KB Food & Gas*
Mr. William T. Sinnott, *CW³M Company, Inc.*

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Summary of Tier 2 Calculations
KB Food & Gas/Sullivan
90-0146 & 2004-0969
04/03/12

Table 3

Tier 1 Objectives

		Benzene		Toluene		Ethylbenzene		Total Xylenes		Naphthalene		MTBE	
Residential	Ingestion	12	mg/kg	16,000	mg/kg	7,800	mg/kg	16,000	mg/kg	1,600	mg/kg	780	mg/kg
	Inhalation	0.8	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	170	mg/kg	8,800	mg/kg
	Migration Class 1	0.03	mg/kg	12	mg/kg	13	mg/kg	150	mg/kg	12	mg/kg	0.32	mg/kg
	Migration Class 2	0.17	mg/kg	29	mg/kg	19	mg/kg	150	mg/kg	18	mg/kg	0.32	mg/kg
Industrial/Commercial	Ingestion	100	mg/kg	410,000	mg/kg	200,000	mg/kg	410,000	mg/kg	41,000	mg/kg	20,000	mg/kg
	Inhalation	1.60	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	270	mg/kg	8,800	mg/kg
Construction Worker	Ingestion	2,300	mg/kg	410,000	mg/kg	20,000	mg/kg	41,000	mg/kg	4,100	mg/kg	2,000	mg/kg
	Inhalation	2.20	mg/kg	42	mg/kg	58	mg/kg	5.6	mg/kg	1.80	mg/kg	140	mg/kg
Soil Saturation		870	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	44,705.49	mg/kg	8,800	mg/kg

Tier 2 SSL Objectives

		Benzene	Equation	Toluene	Equation	Ethylbenzene	Equation	Total Xylenes	Equation	Naphthalene	Equation	MTBE	
Residential	Ingestion	11.64	S-2	1,251	S-1	1,564	S-1	3,129	S-1	313	S-1	156.4	S-1
	Inhalation	28.81	S-6	[illegible]	S-4	[illegible]	S-4	21,338.74	S-4	6,736.83	S-4	358,399.91	S-4
	Migration Mass-Limit Class 1	0.22	S-28	44.79	S-28	31.35	S-28	447.87	S-28	8.27	S-28	3.14	S-28
	Migration Class 1	4.259	S-17	2626.96	S-17	3,665.92	S-17	[illegible]	S-17	4,037.92	S-17	11.77	S-17
Industrial-Commercial	Ingestion	16.30	S-2	1,635,200	S-1	204,400	S-1	408,800	S-1	40,880	S-1	20,440	S-1
	Inhalation	55.05	S-6	[illegible]	S-4	[illegible]	S-4	33,973.08	S-4	10,725.60	S-4	[illegible]	S-4
	Migration Mass-Limit Class 1	0.22	S-28	44.79	S-28	31.35	S-28	447.87	S-28	8.27	S-28	3.14	S-28
	Migration Class 1	4.259	S-17	2,626.96	S-17	3,665.92	S-17	[illegible]	S-17	4,037.92	S-17	11.77	S-17
Construction Worker	Ingestion	2,258.21	S-3	163,236	S-1	204,045	S-1	204,045	S-1	40,809	S-1	20,405	S-1
	Inhalation	77.42	S-7	8,027.18	S-5	2,240.93	S-5	879.12	S-5	89.39	S-5	3,691.38	S-5
Soil Saturation		74,533.54	S-29	69,089.07	S-29	44,252.94	S-29	34,890.78	S-29	44,705.49	S-29	428,622.97	S-29

all values are in mg/kg

\\\\\\\\\\\\\\\\ Site Specific Value cannot exceed Soil Saturation Limit, otherwise Tier 2 Inhalation or Tier 2 Migration objectives are the Soil Saturation objective

Groundwater Contaminate Concentration Exceedances at Surface Water or Set Back Zone (mg/L)

	Benzene	Equation	Toluene	Equation	Ethylbenzene	Equation	Total Xylenes	Equation	Naphthalene	Equation	MTBE	
Result	#DIV/0!	R-26	#DIV/0!	R-26	#DIV/0!	R-26	#DIV/0!	R-26			#DIV/0!	R-26
Surface Water Objective	0.86		0.6		0.014		0.36					

Version: 6/27/2008

R-26 Input/Summary Sheet

Version: 6/27/2008

IEMA Incident # (6 or 8 digit)	**90-0146 & 2004-0969**	
IEPA LPC # (10 digit)	1390305014	
Site Name:	**KB Food & Gas/Sullivan**	
Site Address:	111 West Jackson Street	
City:	Sullivan	
County:	Moultrie	
Zip Code:	61951	
SSL Equations Used:	S5,6,7,8,9,10,17,18,19,20,21,22,24	
RBCA Equations Used:	Example R-1, R-2, R3	
Contact Information for Individual who Performed Calcula	CWM Company, Inc., Bob Woodruff	
Land Use:	Ind./Com. & Construction Worker	
Objective from S17 used in R26:	No	
Groundwater:	Class 1	
Standard or Mass Limit Equations:	Standard Equations	If Mass Limit, then Specifiy Acres:
Square Feet of Plume for Mass Limit Eq.:	0.00	< use this # above
Date Data is Entered:	**April 3, 2012**	

Entry	Description		
	Holcomb Bulk Density (pcf), or	Shelby Tube Location:	
1.846	Dry Soil Bulk Density (g/cm^3 or kg/L): 1.5, or Gravel =2.0, Sand = 1.8, Silt = 1.6, Clay = 1.7, or site specific		
2.652	ρs - Soil Particle Density	Reference	
0.304	Total Soil Porosity	0.304	0.304
0.206	Water Filled Porosity	0.206	0.206
0.098	Air Filled Porosity	0.098	0.098
0.430	θ_T - Total Soil Porosity (RBCA)	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36	
0.142	w - Average Soil Moisture Content	0.1, or; Subsurface Soil (top 1m) = 0.1; Subsurface Soil (below 1 m) =0.2; or Site Specific	
Loam	USDA Soil Classification (Pick from List)		Entry
0.72100	Fractional Organic Carbon (foc) in g/g	Organic Matter (%):	
		Organic Matter (mg/kg):	
		Total Organic Carbon (g/g):	0.721

Entry	Description	
1.38E-05	Average Hydraulic Conductivity (cm/sec) Well Name	
1.38E-05	Falling Hydraulic Conductivity (cm/sec) MW-4	
	Rising Hydraulic Conductivity (cm/sec)	
0.01030	Hydraulic Gradient (0.02 for sites with no groundwater)	**Meters**
10	d_a - Aquifer Thickness (ft)	3.048 m
10	d_s - Depth of Source (ft) (Vertical Thickness of Contamination)	3.048 m
	X - Distance along the centerline of the groundwater plume emanating to setback zone or surface water from the source in the direction of groundwater flow (ft) (RBCA)	0 cm
212	L - Source Length Parallel to Groundwater Flow (ft)	64.59053376 m
191	Sw: Source Width -horizontal plane (ft) (RBCA)	5821.68 cm

Surface Water

$C_{(x)}$ - Concentration of Contaminant in groundwater at distance X from the source (mg/L)		
	Benzene	MTBE
	Toluene	
	Ethylbenzene	
	Total Xylenes	

Chemicals of Concern		
Benzene		
Toluene		Chrysene
Ethylbenzene		Benzo(k)fluoranthene
Total Xylenes		Indeno(1,2,3-cd)pyrene
MTBE		

☐ Mass Limit Equations

SSL Equations Needed

☑ Inhalation Equations

☑ Groundwater Ingestion Equations

☑ Csat Equations

☐ Fugitive Dust Equations

☑ Ingestion Equations

Text discussion for "i", L, d_a, d_s, S_w, S_d	
Hydraulic Gradient	elevations were determined and the depth to groundwater was noted in each well. This data was used to generate a potentiometric flow map with contour lines which show potentiometric head. A corresponding flow line, perpendicular to the contour lines, was determined between two known points of groundwater elevation (MW-2 = 89.64 feet and MW-7 = 95.56 feet). The length of this flow line was then determined to be 214 feet. The hydraulic gradient was determined by the difference in elevation divided by the length of flow between the points: (95.56-89.64) / 214 = 0.02766 ft/ft or 0.02766 m/m or 0.02766 cm/cm.

Source Length

The **Source Length Parallel to Groundwater Flow (L)** was determined from the site map and analytical results. A value of 45.1104 m was used to encompass the length of contamination parallel to groundwater flow. This value is the distance between soil borings BH-1 and BH-2.

Aquifer Thickness

The **Aquifer Thickness (d_a)** is a site specific value determined by the length of the monitoring well screen. The Aquifer Thickness value used in the modeling equations was 3.048 meters.

Depth of Source

The **Depth of Source (d_s)** was determined from the analytical results and soil boring logs. A value of 3.048 m was used to encompass the vertical thickness of contamination based upon a clean soil sample at BH-1A, "hot" samples at BH-2B and BH-2C, and a clean soil sample at BH-2D. Thus the vertical thickness of soil contamination has been determined to be 3.048 m.

Source Width

The source width perpendicular to groundwater flow direction in the Horizontal Plane (S_w) was determined from the site map and analytical results. A value of 3566.16 cm was used to encompass the width of contamination in the horizontal plane. This value is the distance between clean wells MW-4 and and MW-6.

Source Depth

The source width perpendicular to groundwater flow direction in the Vertical Plane (S_d) was determined from the soil boring logs and analytical results. A value of 304.8 cm was used to encompass the width of contamination in the vertical plane based on the depths of contamination present and the PID readings from the bore logs.

Distance (X)

BENZENE								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
MW-5	5.03	1	0.006	0.0024	MW-4	0.006	1	0.0025
MW-6	0.926		0.001		MW-5	6.290	13	0.0045
MW-8	1.19		0.001		MW-6	1.700	10	0.0042
					MW-7	0.085	4	0.0044
					MW-8	2.880	11	0.0046
					MW-9	1.120	9	0.0043
					MW-10	2.050	11	0.0033
					MW-11	0.039	3	0.0038
					MW-12	0.677	8	0.0042

Toluene	
Soil Exceedances	Groundwater Exceedances

Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
MW-5	29.7		0.0113		MW-5	35.400	1	0.0345
					MW-8	5.000	1	0.0049
					MW-13	1.670	1	0.0016

Ethylbenzene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
MW-5	16.6		0.00316973		MW-5	3.760	1	0.2933
MW-7	15.9		0.003		MW-7	2.350	1	0.1833
SB-5	19.2		0.004		MW-8	2.210	1	0.1724
SB-6	18.3		0.003		MW-10	1.670	1	0.1303
MW-8	18.1		0.003		MW-12	0.955	1	0.0745

Total Xylenes								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
MW-5	65.6		0.017485419		MW-5	16.300	1	2.8931
MW-7	46.8		0.012					

MTBE								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
					MW-4	0.118	80	0.0694
					MW-5	0.457	278	0.0696
					MW-8	0.086	50	0.0697
					MW-9	0.380	245	0.0697
					MW-11	0.232	165	0.0699

KB Food & Gas/Sullivan
Site-Specific Parameters

As Determined in Field (Needed for All Uses)				
Name	**Symbol**	**Value**	**Units**	**Site Sp. / Default**
Hydraulic Conductivity	K	1.38E-05	cm/s	Site Specific
Soil Particle Density	ρ_s	2.65	g/cm^3	Site Specific
Moisture Content	w	0.142		Site Specific
Soil Bulk Density	ρ_b	1.846	g/cm^3	Site Specific
Fractional Organic C	f_{oc}	0.721		Site Specific
MW-12 GW Elevation		95.33	ft st	Site Specific
MW-8 GW Elevation		94.13	ft st	Site Specific
Distance	x	116	feet	Site Specific

SSL Equations (Soil)			
Name	**Symb.**	**Value**	**Units / EQ.**
Porosity	η	0.30	**S24**
For Soil to Groundwater Ingestion Route - S17/S28			
Hydraulic Cond.	K	4.35E+00	m/yr
Hydraulic Gradient	i	0.01034483	
Dilution Factor	DF	20.00	**S22**
Mixing Zone Depth	d	16.84	**S25**
Source Length	L	212	ft
Aquifer Thickness	d_a	10	m
For Mass Limit Equations - S26, S27, S28			
Thickness of Soil	d_s	10	ft
For Inhalation Eq. -- Only with USCS Classification			
Sat Hyd. Cond.	K_s	60	(m/yr)
Exponential	l/(2b+3	0.073	
For Inhalation Eq. -- Use Default if Prev Section N/A			
Water Filled Por.	θ_w	0.21	**S20**
Air Filled Porosity	θ_a	0.10	**S21**

RBCA Equations (GW Modeling)			
Name	**Symb.**	**Value**	**Units / EQ.**
Hydraulic Gradient	i	0.0103	
Plume Width (Horz)	S_w	191	ft
Plume Width (Vert)	S_d	6.56	ft
Hydraulic Cond.	K	1.19E+00	cm/d
For Soil to Groundwater Modeling - R14			
Hydraulic Cond.	K	4.35E+02	cm/yr
Total Porosity	θ_T	0.30	
Water Filled Por.	θ_{ws}	0.21	**R22**
Air Filled Porosity	θ_{as}	0.10	**R21**
Plume Width (Par)	W	212	ft
GW Darcy Velocity	U_{gw}	4.50	ft

Summary of Tier 2 Calculations
KB Food & Gas/Sullivan
90-0146 & 2004-0969
04/03/12

Table 3

Tier 1 Objectives

		Benzene		Toluene		Ethylbenzene		Total Xylenes		Naphthalene		MTBE	
Residential	Ingestion	12	mg/kg	16,000	mg/kg	7,800	mg/kg	16,000	mg/kg	1,600	mg/kg	780	mg/kg
	Inhalation	0.8	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	170	mg/kg	8,800	mg/kg
	Migration Class 1	0.03	mg/kg	12	mg/kg	13	mg/kg	150	mg/kg	12	mg/kg	0.32	mg/kg
	Migration Class 2	0.17	mg/kg	29	mg/kg	19	mg/kg	150	mg/kg	18	mg/kg	0.32	mg/kg
Industrial/Commercial	Ingestion	100	mg/kg	410,000	mg/kg	200,000	mg/kg	410,000	mg/kg	41,000	mg/kg	20,000	mg/kg
	Inhalation	1.60	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	270	mg/kg	8,800	mg/kg
Construction Worker	Ingestion	2,300	mg/kg	410,000	mg/kg	20,000	mg/kg	41,000	mg/kg	4,100	mg/kg	2,000	mg/kg
	Inhalation	2.20	mg/kg	42	mg/kg	58	mg/kg	5.6	mg/kg	1.80	mg/kg	140	mg/kg
Soil Saturation		870	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	44,705.49	mg/kg	8,800	mg/kg

Tier 2 SSL Objectives

		Benzene	Equation	Toluene	Equation	Ethylbenzene	Equation	Total Xylenes	Equation	Naphthalene	Equation	MTBE	
Residential	Ingestion	11.64	S-2	1,251	S-1	1,564	S-1	3,129	S-1	313	S-1	156.4	S-1
	Inhalation	26.81	S-6	[illegible]	S-4	[illegible]	S-4	21,338.74	S-4	6,736.83	S-4	358,399.91	S-4
	Migration Mass-Limit Class 1	0.22	S-28	44.79	S-28	31.35	S-28	447.87	S-28	6.27	S-28	3.14	S-28
	Migration Class 1	4.259	S-17	2626.96	S-17	3,665.92	S-17	[illegible]	S-17	4,037.92	S-17	11.77	S-17
Industrial-Commercial	Ingestion	16.30	S-2	1,635,200	S-1	204,400	S-1	408,600	S-1	40,880	S-1	20,440	S-1
	Inhalation	55.05	S-6	[illegible]	S-4	[illegible]	S-4	33,973.08	S-4	10,725.60	S-4	[illegible]	S-4
	Migration Mass-Limit Class 1	0.22	S-28	44.79	S-28	31.35	S-28	447.87	S-28	6.27	S-28	3.14	S-28
	Migration Class 1	4.259	S-17	2,626.96	S-17	3,665.92	S-17	[illegible]	S-17	4,037.92	S-17	11.77	S-17
Construction Worker	Ingestion	2,258.21	S-3	163,236	S-1	204,045	S-1	204,045	S-1	40,809	S-1	20,405	S-1
	Inhalation	77.42	S-7	8,027.18	S-5	2,240.93	S-5	879.12	S-5	69.39	S-5	3,691.38	S-5
Soil Saturation		74,533.54	S-29	69,089.07	S-29	44,252.94	S-29	34,890.78	S-29	44,705.49	S-29	428,622.97	S-29

all values are in mg/kg

Site Specific Value cannot exceed Soil Saturation Limit, otherwise Tier 2 Inhalation or Tier 2 Migration objectives are the Soil Saturation objective

Groundwater Contaminate Concentration Exceedances at Surface Water or Set Back Zone (mg/L)

	Benzene	Equation	Toluene	Equation	Ethylbenzene	Equation	Total Xylenes	Equation	Naphthalene	Equation	MTBE	
Result	#DIV/0!	R-26	#DIV/0!	R-26	#DIV/0!	R-26	#DIV/0!	R-26			#DIV/0!	R-26
Surface Water Objective	0.86		0.6		0.014		0.36					

Version: 6/27/2008

KB Food & Gas/Sullivan *90-0146 & 2004-0969*

Math for R-26 Calculations
BENZENE MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_s = (soil contamination at modeling point) / (Equation S-17)	$GW_{obj} = C_w / DF$	Conversion 1 foot = 30.48 cm: X (ft)	X (cm)	R-16 $\alpha_x = 0.10 \cdot X$	R-17 $\alpha_y = \alpha_x / 3$	R-18 $\alpha_z = \alpha_x / 20$	"Term 1" = $(X / (2 \cdot \alpha_x))$	"Term 2" = $(1 - SQRT[1 + (4 \cdot \lambda \cdot \alpha_x) / (U)])$
MW-5	5.03 / 42.591 = 0.118	0.118 / 20.000 = 0.00591	1	30.48	0.1 x 30.48 = 3.048	3.048 / 3 = 1.016	3.048 / 20 = 0.1524	30.48 / 2 x 3.048 = 5	1 - SQRT[1 + (4 x 0.0009 x 3.048)/ 0.02856]= -0.1798
MW-8	0.926 / 42.591 = 0.022	0.022 / 20.000 = 0.00109							
MW-8	1.19 / 42.591 = 0.028	0.028 / 20.000 = 0.00140							

Sample Location	$\beta_1 = S_w / (4 \cdot SQRT(\alpha_y \cdot X))$	$\beta_2 = S_d / (2 \cdot SQRT(\alpha_z \cdot X))$	ERF(β_1)	ERF(β_2)	C_{source}	$C_{(x)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$
	S_w /(4 x SQRT (α_y x X))= β_1	S_d /(2 x SQRT (α_z x X))= β_2	Section 742 APPENDIX C: Table G			x e (Term 1 x Term 2) x ERF(β_1) x ERF(β_2) = mg/L
MW-5	5821.66 /(4 x SQRT (1.016 x 30.48))= 261.53792	200 /(2 x SQRT (0.1524 x 30.48))= 46.39808	1.000000	1.000000	0.00591	x e (5 x -0.1798) x 1.000000 x 1.000000 = 0.00244
MW-8					0.00109	
MW-8					0.00140	

KB Food & Gas/Sullivan *90-0146 & 2004-0969*

R-26 Calculations
BENZENE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm X (ft)	X (cm)	R-16: $\alpha_x = 0.10 * X$ 0.1	x	X (cm)	=	α_x (cm)	R-17: $\alpha_y = \alpha_x / 3$ α_x (cm)	/	3	=	α_y (cm)	R-18: $\alpha_z = \alpha_x / 20$ α_x (cm)	/	20	=	α_z (cm)
MW-4	0.006	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-5	6.29	13	396.24	0.1	x	396.24	=	39.624	39.624	/	3	=	13.208	39.624	/	20	=	1.9812
MW-6	1.7	10	304.8	0.1	x	304.8	=	30.48	30.48	/	3	=	10.16	30.48	/	20	=	1.524
MW-7	0.085	4	121.92	0.1	x	121.92	=	12.192	12.192	/	3	=	4.064	12.192	/	20	=	0.6096
MW-8	2.88	11	335.28	0.1	x	335.28	=	33.528	33.528	/	3	=	11.176	33.528	/	20	=	1.6764
MW-9	1.12	9	274.32	0.1	x	274.32	=	27.432	27.432	/	3	=	9.144	27.432	/	20	=	1.3716
MW-10	2.05	11	335.28	0.1	x	335.28	=	33.528	33.528	/	3	=	11.176	33.528	/	20	=	1.6764
MW-11	0.039	3	91.44	0.1	x	91.44	=	9.144	9.144	/	3	=	3.048	9.144	/	20	=	0.4572
MW-12	0.677	8	243.84	0.1	x	243.84	=	24.384	24.384	/	3	=	8.128	24.384	/	20	=	1.2192

Sample Location	"Term 1" = [X / (2 * α_x)] X	/	2	x	α_x	=	"Term 1"	"Term 2" = (1 - SQRT[1 + (4 * λ * α_x) / (U)]) 1	-	SQRT[	1	+(	4	x	λ	x	α_x	)/	U	]=	"Term 2"
MW-4	30.48	/	2	x	3.048	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	3.048	)/	0.02856	]=	-0.1786
MW-5	396.24	/	2	x	39.624	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	39.624	)/	0.02856	]=	-1.4484
MW-6	304.8	/	2	x	30.48	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	30.48	)/	0.02856	]=	-1.2006
MW-7	121.92	/	2	x	12.192	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	12.192	)/	0.02856	]=	-0.5927
MW-8	335.28	/	2	x	33.528	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	33.528	)/	0.02856	]=	-1.2861
MW-9	274.32	/	2	x	27.432	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	27.432	)/	0.02856	]=	-1.1113
MW-10	335.28	/	2	x	33.528	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	33.528	)/	0.02856	]=	-1.2861
MW-11	91.44	/	2	x	9.144	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	9.144	)/	0.02856	]=	-0.4872
MW-12	243.84	/	2	x	24.384	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	24.384	)/	0.02856	]=	-1.0163

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$ S_w	/(	4	x	SQRT	(	α_y	x	X	))=	β_1	$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$ S_d	/(	2	x SQRT	(	α_z	x	X	))=	β_2
MW-4	5621.88	/(	4	x	SQRT	(	1.016	x	30.48	))=	201.83762	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.38806
MW-5	5621.88	/(	4	x	SQRT	(	13.208	x	396.24	))=	20.11927	200	/(	2	x SQRT	(	1.9812	x	396.24	))=	3.56908
MW-6	5621.88	/(	4	x	SQRT	(	10.16	x	304.8	))=	26.16375	200	/(	2	x SQRT	(	1.524	x	304.8	))=	4.63961
MW-7	5621.88	/(	4	x	SQRT	(	4.064	x	121.92	))=	66.38438	200	/(	2	x SQRT	(	0.6096	x	121.92	))=	11.59967
MW-8	5621.88	/(	4	x	SQRT	(	11.176	x	335.28	))=	23.77814	200	/(	2	x SQRT	(	1.6764	x	335.28	))=	4.21801
MW-9	5621.88	/(	4	x	SQRT	(	9.144	x	274.32	))=	29.86972	200	/(	2	x SQRT	(	1.3716	x	274.32	))=	5.15534
MW-10	5621.88	/(	4	x	SQRT	(	11.176	x	335.28	))=	23.77814	200	/(	2	x SQRT	(	1.6764	x	335.28	))=	4.21801
MW-11	5621.88	/(	4	x	SQRT	(	3.048	x	91.44	))=	87.17917	200	/(	2	x SQRT	(	0.4572	x	91.44	))=	15.46603
MW-12	5621.88	/(	4	x	SQRT	(	8.128	x	243.84	))=	32.69219	200	/(	2	x SQRT	(	1.2192	x	243.84	))=	5.79976

Sample Location	ERF(β_1) Section 742 APPENDIX C: Table G	ERF(β_2)	$C_{gw} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$ C_{source}	x e	("Term 1"	+	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	=	mg/L
MW-4	1.000000	1.000000	0.00600	x e	5	+	-0.1786	x	1.000000	x	1.000000	=	0.00248
MW-5	1.000000	1.000000	6.29000	x e	5	+	-1.4484	x	1.000000	x	1.000000	=	0.00486
MW-6	1.000000	1.000000	1.70000	x e	5	+	-1.2006	x	1.000000	x	1.000000	=	0.00429
MW-7	1.000000	1.000000	0.08500	x e	5	+	-0.5927	x	1.000000	x	1.000000	=	0.00439
MW-8	1.000000	1.000000	2.88000	x e	5	+	-1.2861	x	1.000000	x	1.000000	=	0.00464
MW-9	1.000000	1.000000	1.12000	x e	5	+	-1.1113	x	1.000000	x	1.000000	=	0.00432
MW-10	1.000000	1.000000	2.05000	x e	5	+	-1.2861	x	1.000000	x	1.000000	=	0.00330
MW-11	1.000000	1.000000	0.03900	x e	5	+	-0.4872	x	1.000000	x	1.000000	=	0.00377
MW-12	1.000000	1.000000	0.67700	x e	5	+	-1.0163	x	1.000000	x	1.000000	=	0.00416

KB Food & Gas/Sullivan ***90-0146 & 2004-0969***

Math for R-26 Calculations

TOLUENE MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_w = (soil contamination at modeling point) / (Equation S-17)	$GW_{obj} = C_w / DF$	Conversion: 1 foot = 30.48 cm	R-16: $\alpha_x = 0.10 * X$	R-17: $\alpha_y = \alpha_x / 3$	R-18: $\alpha_z = \alpha_x / 20$	"Term 1" = $[X / (2 * \alpha_x)]$	"Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$
	/ = C_w	C_w / DF = GW_{obj} (mg/L)	X (ft) X (cm)	0.1 x X (cm) = α_x (cm)	α_x (cm) / 3 = α_y (cm)	α_x (cm) / 20 = α_z (cm)	X / 2 x α_x = "Term 1"	1 - SQRT [1 + (4 x λ x α_x) / U] = "Term 2"
MW-6	29.7 / 131.348 = 0.226	0.226 / 20.000 = 0.01131						

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$	$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$	ERF(β_1)	ERF(β_2)	$C_{(X)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$
	S_w / (4 x SQRT (α_y x X)) = β_1	S_d / (2 x SQRT (α_z x X)) = β_2	Section 742 APPENDIX C: Table G		C_{source} x e ^("Term 1" x "Term 2") x ERF(β_1) x ERF(β_2) = mg/L
MW-6					0.01131

KB Food & Gas/Sullivan *90-0146 & 2004-0969*

R-26 Calculations
TOLUENE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion 1 foot = 30.48 cm		R-16 $\alpha_x = 0.10 * X$					R-17 $\alpha_y = \alpha_x / 3$					R-18 $\alpha_z = \alpha_x / 20$				
		X (ft)	X (cm)	0.1	x	X (cm)	=	α_x (cm)	α_x (cm)	/	3	=	α_y (cm)	α_x (cm)	/	20	=	α_z (cm)
MW-5	35.4	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-8	5	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-13	1.87	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524

Sample Location	"Term 1" = $[X / (2 * \alpha_x)]$							"Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$													
	X	/	2	x	α_x	=	"Term 1"	1	-	SQRT [	1	+ (	4	x	λ	x	α_x	) /	U	] =	"Term 2"
MW-5	30.48	/	2	x	3.048	=	8	1	-	SQRT [	1	+ (	4	x	0.011	x	3.048	) /	0.02856	] =	-1.3864
MW-8	30.48	/	2	x	3.048	=	8	1	-	SQRT [	1	+ (	4	x	0.011	x	3.048	) /	0.02856	] =	-1.3866
MW-13	30.48	/	2	x	3.048	=	8	1	-	SQRT [	1	+ (	4	x	0.011	x	3.048	) /	0.02856	] =	-1.3866

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$											$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$									
	S_w	/ (	4	x	SQRT	(	α_y	x	X	)) =	β_1	S_d	/ (	2	x SQRT	(	α_z	x	X	)) =	β_2
MW-5	5421.68	/ (	4	x	SQRT	(	1.016	x	30.48	)) =	261.53792	200	/ (	2	x SQRT	(	0.1524	x	30.48	)) =	46.39806
MW-8	5421.68	/ (	4	x	SQRT	(	1.016	x	30.48	)) =	261.53792	200	/ (	2	x SQRT	(	0.1524	x	30.48	)) =	46.39806
MW-13	5421.68	/ (	4	x	SQRT	(	1.016	x	30.48	)) =	261.53792	200	/ (	2	x SQRT	(	0.1524	x	30.48	)) =	46.39806

Sample Location	ERF(β_1)	ERF(β_2)	$C_{gw} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$									
	Section 742 APPENDIX C: Table G		C_{source}	x e	("Term 1"	x	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	= mg/L
MW-5	1.000000	1.000000	35.40000	x e	8	x	-1.3866	x	1.000000	x	1.000000	= 0.03452
MW-8	1.000000	1.000000	5.00000	x e	8	x	-1.3866	x	1.000000	x	1.000000	= 0.00488
MW-13	1.000000	1.000000	1.87000	x e	8	x	-1.3866	x	1.000000	x	1.000000	= 0.00163

KB Food & Gas/Sullivan ***90-0146 & 2004-0969***

Math for R-26 Calculations

ETHYLBENZENE MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_u = (soil contamination at modeling point) / (Equation S-17)				C_u	$GW_{obj} = C_u / DF$					Conversion 1 foot = 30.48 cm	
					C_u	C_u	/	DF	=	GW_{obj} (mg/L)	X (ft)	X (cm)
MW-6	15.6	/	201.852	=	0.063	0.063	/	20.000	=	0.00317		
MW-7	15.8	/	201.852	=	0.061	0.061	/	20.000	=	0.00304		
SB-5	18.2	/	201.852	=	0.073	0.073	/	20.000	=	0.00367		
SB-6	16.3	/	201.852	=	0.070	0.070	/	20.000	=	0.00349		
MW-8	16.1	/	201.852	=	0.069	0.069	/	20.000	=	0.00344		

Sample Location	R-16: $\alpha_x = 0.10 * X$				R-17: $\alpha_y = \alpha_x / 3$					R-18: $\alpha_z = \alpha_x / 20$					"Term 1" = $[X / (2 * \alpha_x)]$						"Term 2" = $(1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)])$													
	0.1	x	X (cm)	α_x (cm)	α_x (cm)	/	3	=	α_y (cm)	α_x (cm)	/	20	=	α_z (cm)	X	/	2	x	α_x	= "Term 1"	1	-	SQRT[	1	+ (	4	x	λ	x	α_x	)/	U	] =	"Term 2"
MW-6																																		
MW-7																																		
SB-5																																		
SB-6																																		
MW-8																																		

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$										$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$										ERF(β_1)	ERF(β_2)	$C_{gw} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$							
	S_w	/(	4	x	SQRT	(	α_y	x	X	))=	β_1	S_d	/(	2	x	SQRT	(	α_z	x	X	))=	β_2	Section 742 APPENDIX C: Table G		C_{source}	x e	("Term 1" x "Term 2")	x ERF(β_1)	x ERF(β_2)	= mg/L
MW-6																								0.00317					
MW-7																								0.00304					
SB-5																								0.00367					
SB-6																								0.00349					
MW-8																								0.00346					

KB Food & Gas/Sullivan **90-0146 & 2004-0969**

R-25 Calculations

ETHYLBENZENE MATH FOR R-36 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion 1 foot = 30.48 cm		R-16: $\alpha_x = 0.10 * X$					R-17: $\alpha_y = \alpha_x / 3$					R-18: $\alpha_z = \alpha_x / 20$					"Term 1" = $(X / (2 * \alpha_x))$							"Term 2" = (1 - SQRT[1 + (4 * λ * α_x) / (U)])													
		X (ft)	X (cm)	0.1	x	X (cm)		α_x (cm)	α_x (cm)	/	3	=	α_y (cm)	α_x (cm)	/	20	=	α_z (cm)	X	/	2	x	α_x	=	"Term 1"	1	-	SQRT[	1	+(	4	x	λ	x	α_x	)/	U	]= "Term 2"
MW-6	3.76	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524	30.48	/	2	x	3.048	=	5	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02856	]= -0.5102
MW-7	2.35	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524	30.48	/	2	x	3.048	=	5	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02856	]= -0.5102
MW-8	2.21	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524	30.48	/	2	x	3.048	=	5	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02856	]= -0.5102
MW-10	1.67	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524	30.48	/	2	x	3.048	=	5	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02856	]= -0.5102
MW-12	0.955	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524	30.48	/	2	x	3.048	=	5	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02856	]= -0.5102

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$											$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$										ERF(β_1)	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$									
	S_w	/(	4	x	SQRT	(	α_y	x	X	))=	β_1	S_d	/(	2	x SQRT	(	α_z	x	X	))=	β_2	Section 742 APPENDIX C: Table G		C_{source}	x e	("Term 1"	x	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	= mg/L
MW-6	5421.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63762	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39808	1.000000	1.000000	3.76000	x e	5	x	-0.5102	x	1.000000	x	1.000000	= 0.29531
MW-7	5421.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63762	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39808	1.000000	1.000000	2.35000	x e	5	x	-0.5102	x	1.000000	x	1.000000	= 0.18532
MW-8	5421.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63762	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39808	1.000000	1.000000	2.21000	x e	5	x	-0.5102	x	1.000000	x	1.000000	= 0.17248
MW-10	5421.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63762	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39808	1.000000	1.000000	1.67000	x e	5	x	-0.5102	x	1.000000	x	1.000000	= 0.13028
MW-12	5421.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63762	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39808	1.000000	1.000000	0.95500	x e	5	x	-0.5102	x	1.000000	x	1.000000	= 0.07490

KB Food & Gas/Sullivan **90-0146 & 2004-0969**

Math for R-26 Calculations

TOTAL XYLENES MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_x = (soil contamination at modeling point) / (Equation S-17)					$GW_{obj} = C_x / DF$					Conversion: 1 foot = 30.48 cm		R-15: $\alpha_x = 0.10 * X$				R-17: $\alpha_y = \alpha_x / 3$				R-18: $\alpha_z = \alpha_x / 20$				"Term 1" = [X / (2 * α_x)]						"Term 2" = (1 - SQRT[1 + (4 * λ * α_x) / (U)])													
					C_x	C_x	/	DF	=	GW_{obj} (mg/L)	X (ft)	X (cm)	0.1	x	X (cm)	α_x (cm)	α_x (cm)	/	3	= α_y (cm)	α_x (cm)	/	20	= α_z (cm)	X	/	2	x	α_x	= "Term 1"	)	-	SQRT[	1	+(	4	x	λ	x	α_x	)/	U	]=	"Term 2"
MW-5	85.6	/	187,585	=	0.360	0.350	/	20,000	=	0.01749																																		
MW-7	46.8	/	187,585	=	0.349	0.249	/	20,000	=	0.01247																																		

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$										$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$										ERF(β_1)	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$								
	S_w	/(	4	x	SQRT	(	α_y	x	X	))=	β_1	S_d	/(	2	x	SQRT	(	α_z	x	X	))=	β_2	Section 742 APPENDIX C: Table G		C_{source}	x e	("Term 1" x "Term 2")	x ERF(β_1)	x ERF(β_2)	=	mg/L
MW-5																									0.01749						
MW-7																									0.01247						

KB Food & Gas/Sullivan — *90-0146 & 2004-0969*

R-26 Calculations

Total Xylenes MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm X (ft)	X (cm)	R-16: $\alpha_x = 0.10 * X$ 0.1	x	X (cm)	=	α_x (cm)	R-17: $\alpha_y = \alpha_x / 3$ α_x (cm)	/	3	=	α_y (cm)	R-18: $\alpha_z = \alpha_x / 20$ α_x (cm)	/	20	=	α_z (cm)	"Term 1" = [X / (2 * α_x)] X	/	2	x	α_x	=	"Term 1"	"Term 2" = [1 - SQRT[1 + (4 * λ * α_x) / (U)]] 1	-	SQRT [	1	+ (	4	x	λ	x	α_x	) /	U	] =	"Term 2"
MW-5	16.3	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524	30.48	/	2	x	3.048	=	5	1	-	SQRT [	1	+ (	4	x	0.0019	x	3.048	) /	0.02856	] =	-0.3468

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$ S_w	/ (	4	x	SQRT	(	α_y	x	X	)) =	β_1	$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$ S_d	/ (	2	x SQRT	(	α_z	x	X	)) =	β_2	ERF(β_1) Section 742 APPENDIX C: Table G	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$ C_{source}	x e	("Term 1"	+	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	=	mg/L
MW-5	5821.68	/ (	4	x	SQRT	(	1.016	x	30.48	)) =	261.83782	200	/ (	2	x SQRT	(	0.1524	x	30.48	)) =	46.39808	1.000000	1.000000	16.30000	x e	5	+	-0.3468	x	1.000000	x	1.000000	=	2.89312

KB Food & Gas/Sullivan *90-0146 & 2004-0969*

Math for R-26 Calculations

MTBE MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_w = (soil contamination at modeling point) / (Equation S-17)	$GW_{obj} = C_y / DF$			Conversion: 1 foot = 30.48 cm		R-16: $\alpha_x = 0.10 * X$			R-17: $\alpha_y = \alpha_x / 3$				R-18: $\alpha_z = \alpha_x / 20$				"Term 1" = $(X / (2 * \alpha_x))$					"Term 2" = $(1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)])$										
	C_y	C_y	/ DF	= GW_{obj} (mg/L)	X (ft)	X (cm)	0.1 x	X (cm)	α_x (cm)	α_x (cm)	/	3	= α_y (cm)	α_x (cm)	/	20	= α_z (cm)	X	/	2	x	α_x = "Term 1"	1 -	SQRT[	1	+(	4	x	λ	x α_x	)/ U]= "Term 2"

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$									$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$									ERF(β_1)	ERF(β_2)	$C_{gw} = C_{source} \times e^{(Term\ 1 + Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$							
	S_w	/(	4	x	SQRT	(	α_y	x	X))= β_1	S_d	/(	2	x	SQRT	(	α_z	x	X))= β_2	Section 742 APPENDIX C: Table G		C_{source}	x e	("Term 1"	+ "Term 2")	x ERF(β_1)	x ERF(β_2)	=	mg/L

KB Food & Gas/Sullivan — *90-0146 & 2004-0969*

R-26 Calculations

MTBE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	X (ft) (Conversion: 1 foot = 30.48 cm)	X (cm)	R-16 $\alpha_x = 0.10 \cdot X$: 0.1 × X (cm)	= α_x (cm)	R-17 $\alpha_y = \alpha_x / 3$: α_x (cm) / 3	= α_y (cm)	R-18 $\alpha_z = \alpha_x / 20$: α_x (cm) / 20	= α_z (cm)
MW-4	0.118	80	2438.4	0.1 × 2438.4	243.84	243.84 / 3	81.28	243.84 / 20	12.192
MW-5	0.457	278	8473.44	0.1 × 8473.44	847.344	847.344 / 3	282.448	847.344 / 20	42.3672
MW-6	0.088	50	1524	0.1 × 1524	152.4	152.4 / 3	50.8	152.4 / 20	7.62
MW-8	0.38	245	7467.6	0.1 × 7467.6	746.76	746.76 / 3	248.92	746.76 / 20	37.338
MW-11	0.232	165	5029.2	0.1 × 5029.2	502.92	502.92 / 3	167.64	502.92 / 20	25.146

Sample Location	"Term 1" = [X / (2 × α_x)]: X / 2 × α_x	= "Term 1"	"Term 2" = {1 - SQRT[1 + (4 × λ × α_x) / (U)]}: 1 - SQRT[1 + (4 × λ × α_x) / U]	= "Term 2"
MW-4	2438.4 / 2 × 243.84	5	1 - SQRT[1 + (4 × 0 × 243.84) / 0.02856]	0.0000
MW-5	8473.44 / 2 × 847.344	5	1 - SQRT[1 + (4 × 0 × 847.344) / 0.02856]	0.0000
MW-6	1524 / 2 × 152.4	5	1 - SQRT[1 + (4 × 0 × 152.4) / 0.02856]	0.0000
MW-8	7467.6 / 2 × 746.76	5	1 - SQRT[1 + (4 × 0 × 746.76) / 0.02856]	0.0000
MW-11	5029.2 / 2 × 502.92	5	1 - SQRT[1 + (4 × 0 × 502.92) / 0.02856]	0.0000

Sample Location	$\beta_1 = S_y / (4 \cdot SQRT[\alpha_y \cdot X])$: S_y / (4 × SQRT (α_y × X))	= β_1	$\beta_2 = S_z / (2 \cdot SQRT[\alpha_z \cdot X])$: S_z / (2 × SQRT (α_z × X))	= β_2	ERF(β_1) (Section 742 APPENDIX C, Table G)	ERF(β_2) (Section 742 APPENDIX C, Table G)
MW-4	5621.68 / (4 × SQRT (81.28 × 2438.4))	3.74922	200 / (2 × SQRT (12.192 × 2438.4))	0.87998	0.999998	0.587904
MW-5	5621.68 / (4 × SQRT (282.448 × 8473.44))	0.94078	200 / (2 × SQRT (42.3672 × 8473.44))	0.16690	0.610636	0.186542
MW-6	5621.68 / (4 × SQRT (50.8 × 1524))	5.23075	200 / (2 × SQRT (7.62 × 1524))	0.92796	1.000000	0.610583
MW-8	5621.68 / (4 × SQRT (248.92 × 7467.6))	1.06790	200 / (2 × SQRT (37.338 × 7467.6))	0.18938	0.866873	0.211165
MW-11	5621.68 / (4 × SQRT (167.64 × 5029.2))	1.68606	200 / (2 × SQRT (25.146 × 5029.2))	0.28120	0.975015	0.308132

Sample Location	$C_{gw} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$: C_{source}	× e ("Term 1" × "Term 2")	× ERF(β_1)	× ERF(β_2)	= mg/L
MW-4	0.11800	× e (5 × [illegible])	0.999996	0.587904	0.06937
MW-5	0.45700	× e (5 × [illegible])	0.610636	0.186542	0.06964
MW-6	0.08800	× e (5 × [illegible])	1.000000	0.610583	0.06971
MW-8	0.38000	× e (5 × [illegible])	0.866873	0.211165	0.06972
MW-11	0.23200	× e (5 × [illegible])	0.975015	0.308132	0.06983

Illinois Enviromental Protection Agency
Leaking Underground Storage Tank Program
SSL Input Parameters for Use with Tier 2 Calculations

A. Site Identification

IEMA Incident # (6- or 8-digit): 90-0146 & 2004-0969 IEPA LPC # (10-digit): 1390305014

Site Name: KB Food & Gas/Sullivan

Site Address (not a P.O. Box): 111 West Jackson Street

City: Sullivan County: Moultrie Zip Code: 61951

Leaking UST Technical File

B. Tier 2 Calculation Information

Equation(s) Used (ex: S12,S17,S28): S5,6,7,8,9,10,17,18,19,20,21,22,24

Contact Information for Individual Who Performed Calculations:

CWM Company, Inc., Bob Woodruff

Land Use: Industrial/Commercial Soil Type: Loam

Groundwater: [X] Class I [ ] Class II

Mass Limit: [ ] Yes [X] No If Yes, then Specify Acreage: ______

- Mass Limit Acreage other than defaults must always be rounded up.
- Failure to use site-specific parameters where allowed could affect payment from the UST Fund
- Maps depicting source width, plume dimensions, distance, etc. must also be submitted.
- Inputs must be submitted in the designated unit.

AT (ingestion)	=	Ind/Com = 25	yr
		Con. Worker = 0.115	yr
AT (inhalation)	=	Ind/Com = 25	yr
		Con. Worker = 0.115	yr
AT_c	=	70	yr
BW	=	Ind/Com = 70	kg
			kg
		Con. Worker = 70	kg
C_{sat}	=	Benzene = 74533.544	mg/kg
		Toluene = 69089.065	mg/kg
		Ethylbenzene = 44252.944	mg/kg
		Total Xylenes = 34890.784	mg/kg
		MTBE = 428622.974	mg/kg
			mg/kg
			mg/kg
			mg/kg
			mg/kg
			mg/kg

d_a	=	3.048	m
d_s	=	3.048	m
DA	=	Benzene = 1.21455755751624E-06	cm^2/s
		Toluene = 4.63807479969942E-07	cm^2/s
		Ethylbenzene = 2.38050310577377E-07	cm^2/s
		Xylenes = 2.47482814038283E-07	cm^2/s
		MTBE = 7.89567667967154E-07	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s

Incident # 90-0146 & 2004-0969

C_w	=	Benzene = 0.1	mg/L
		Toluene = 20	mg/L
		Ethylbenzene = 3665.924	mg/L
		Total Xylenes = 37516.972	mg/L
		MTBE = 11.766	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
			mg/L
d	=	9.883	m
ED (inhalation of carcinogens)	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
ED (ingestion of noncarcinogens)	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
ED (inhalation of noncarcinogens)	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
ED (ingestion of groundwater)	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
ED_{M-L}	=	70	yr
EF	=	Ind/Com = 250	d/yr
		Con. Worker = 30	d/yr
F(x)	=	0.194	unitless
f_{oc}	=	0.721	g/g
GW_{obj}	=	Benzene = 0.005	mg/L
		Toluene = 1	mg/L
		Ethylbenzene = 0.7	mg/L
		Total Xylenes = 10	mg/L
		MTBE = 0.07	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
			mg/L
H'	=	Benzene = 0.228	unitless
		Toluene = 0.272	unitless
		Ethylbenzene = 0.323	unitless
		Total Xylenes = 0.25	unitless
		MTBE = 0.0241	unitless
			unitless
			unitless
			unitless
			unitless
			unitless
i	=	0.0103	m/m
I	=	0.3	m/yr
I_{M-L}	=	0.18	m/yr
$IF_{soil-adj}$	=	114	(mg-yr)/(kg-d)
IR_{soil}	=	Ind/Com = 50	mg/d

D_i	=	Benzene = 0.088	cm^2/s
		Toluene = 0.087	cm^2/s
		Ethylbenzene = 0.075	cm^2/s
		Total Xylenes = 0.072	cm^2/s
		MTBE = 0.102	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
D_w	=	Benzene = 0.0000098	cm^2/s
		Toluene = 0.0000086	cm^2/s
		Ethylbenzene = 0.0000078	cm^2/s
		Total Xylenes = 0.00000934	cm^2/s
		MTBE = 0.000011	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
DF	=	1.022863821	unitless
ED (ingestion of carcinogens	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
K_{oc}	=	Benzene = 58.9	cm^3/g or L/kg
		Toluene = 182	cm^3/g or L/kg
		Ethylbenzene = 363	cm^3/g or L/kg
		Total Xylenes = 260	cm^3/g or L/kg
		MTBE = 11.5	cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
K_s	=	60	m/yr
L	=	64.59053376	m
PEF	=		m^3/kg
PEF'	=		m^3/kg
Q/C (VF equations)	=	Ind/Com = 85.81	$(g/m^2\text{-}s)/(kg/m^3)$
		Con. Worker = 85.81	$(g/m^2\text{-}s)/(kg/m^3)$
Q/C (PEF equations)	=		$(g/m^2\text{-}s)/(kg/m^3)$
RfC (mg/m^3)		**Chronic**	**Subchronic**
Benzene	=	0.03	0.08
Toluene	=	5	5
Ethylbenzene	=	1	1
Total Xylenes	=	0.1	0.4
MTBE	=	3	3
	=	0.003	0.003
	=		NA
	=		NA

	Con. Worker = 480	mg/d	

=		NA
=		NA

Incident # 90-0146 & 2004-0969

IR_w	=	Ind/Com = 1	L/d
K	=	4.351968	m/yr
K_d(non-ionizing organcis)	=	Benzene = 42.4669	cm^3/g or L/kg
		Toluene = 131.222	cm^3/g or L/kg
		Ethylbenzene = 261.723	cm^3/g or L/kg
		Total Xylenes = 187.46	cm^3/g or L/kg
		MTBE = 8.2915	cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
K_d (ionizing organics)	=		cm^3/g or L/kg
K_d (inorganics)	=		cm^3/g or L/kg
VF'	=	Benzene = 7090.604	m^3/kg
		Toluene = 11474.226	m^3/kg
		Ethylbenzene = 16016.141	m^3/kg
		Total Xylenes = 15707.959	m^3/kg
		MTBE = 8794.225	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
VM_{M-L}	=	#VALUE!	m^3/kg
		Toluene = 0	m^3/kg
		#VALUE!	m^3/kg
		Total Xylenes = 0	m^3/kg
		#VALUE!	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
VF'_{M-L}	=	#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
η	=	0.304	L_{pore}/L_{soil}
θ_a	=	0.098	L_{air}/L_{soil}

RfD_o mg/(kg-d)		Chronic	Subchronic
Benzene	=	0.004	0.012
Toluene	=	0.08	0.8
Ethylbenzene	=	0.1	1
Total Xylenes	=	0.2	1
MTBE	=	0.01	0.1
	=	0.02	0.2
	=		0.6
	=		NA
	=		NA
	=		NA

S	=	Benzene = 1750	mg/L
		Toluene = 526	mg/L
		Ethylbenzene = 169	mg/L
		Total Xylenes = 186	mg/L
		MTBE = 51000	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
			mg/L
SF_o	=	Benzene = 0.055	$(mg/kg\text{-}d)^{-1}$
		Toluene = NA	$(mg/kg\text{-}d)^{-1}$
		Ethylbenzene = NA	$(mg/kg\text{-}d)^{-1}$
		Total Xylenes = NA	$(mg/kg\text{-}d)^{-1}$
		MTBE = NA	$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
T	=	Ind/Com = 7.9E08	s
		Con. Worker = 3.6×10^6	s
T_{M-L}	=	30	yr
THQ	=	1	unitless
TR	=	1.00E-06	unitless
U_m	=	4.69	m/s
URF	=	Benzene = 7.8×10^{-6}	$(\mu g/m^3)^{-1}$
U_t	=	11.32	m/s
V	=	0.5	unitless
VF	=	Benzene = 105037.778	m^3/kg
		Toluene = 169975.256	m^3/kg
		Ethylbenzene = 237257.638	m^3/kg
		Total Xylenes = 232692.323	m^3/kg
		MTBE = 130274.645	m^3/kg
			m^3/kg
			m^3/kg

m^3/kg
m^3/kg
m^3/kg

Incident # 90-0146 & 2004-0969

θ_w	=	0.206	L_{water}/L_{soil}
ρ_b	=	1.846	kg/l or g/cm^3
ρ_s	=	2.652	g/cm^3
ρ_w	=	1	g/cm^3
1/(2b+3)	=	0.073	unitless

Illinois Enviromental Protection Agency
Leaking Underground Storage Tank Program
RBCA Input Parameters for Use with Tier 2 Calculations

A. Site Identification

IEMA Incident # (6- or 8-digit): 90-0146 & 2004-0969 IEPA LPC # (10-digit): 1390305014

Site Name: KB Food & Gas/Sullivan

Site Address (not a P.O. Box): 111 West Jackson Street

City: Sullivan County: Moultrie Zip Code: 61951

Leaking UST Technical File

B. Tier 2 Calculation Information

Equation(s) Used (ex: R12,R14,R26): R16, R17, R18,R19, R21, R22, R23, R24,R26

Contact Information for Individual Who Performed Calculations:

CWM Company, Inc., Bob Woodruff

Land Use: Industrial/Commercial Soil Type: Loam

Groundwater: [X] Class I [ ] Class II

Mass Limit: [ ] Yes [X] No If Yes, then Specify Acreage: ______

Objective from S17 used in R26? [ ] Yes [X] No

If Yes, then Specify C_{source} from S17 See Attached mg/L.

- Mass Limit Acreage other than defaults must always be rounded up.
- Failure to use site-specific parameters where allowed could affect payment from the UST Fund
- Maps depicting source width, plume dimensions, distance, etc. must also be submitted.
- Inputs must be submitted in the designated unit.

AT_c	=	70	yr
AT_n	=	Ind/Com = 25 Con. Worker = 0.115	yr yr
BW	=	70	yr
C_{source}	=	See Attached	mg/L
$C_{(x)}$	=	See Attached	mg/L
d	=	100	cm

D^{air}	=	See Attached	cm^2/s
D^{water}	=	See Attached	cm^2/s
D_s^{eff}	=	See Attached	cm^2/s
ED	=	Ind/Com = 25 Con. Worker = 1	yr yr
EF	=	Ind/Com = 250 Con. Worker = 30	d/yr d/yr

erf	=	See Attached	unitless
f_{oc}	=	0.721	g/g
GW_{comp}	=	See Attached	mg/L
GW_{source}	=	See Attached	mg/L
H'	=	See Attached	$cm3_{water}/cm^3_{air}$
i	=	0.0103	cm/cm
I	=	30	cm/yr
IR_{air}	=	20	m^3/d
IR_{soil}	=	Ind/Com = 50 Con. Worker = 480	mg/d mg/d

RAF_d (PNAs)	=	0.05	unitless
RAF_d (inorganics)	=	0	unitless
RAF_o	=	1	unitless
$RBSL_{air}$ (carcinoginic)	=	See Attached	$\mu g/m^3$
$RBSL_{air}$ (noncarcinoginic)	=	See Attached	$\mu g/m^3$
RfD_i	=	See Attached	mg/kg-d
SA	=	3,160	cm^2/d
S_d	=	200.0	cm
S_w	=	5,821.7	cm
SF_i	=	See Attached	$(mg/kg\text{-}d)^{-1}$

IR_w	=	Ind/Com = 1	L/d
K	=	1.192 435.197	cm/d cm/yr
K_{oc}	=	See Attached	cm^3/g or L/kg
k_s (non-ionizing organics)	=	See Attached	cm^3_{water}/g_{soil}
k_s (ionizing organics)	=	Not Applicable	cm^3_{water}/g_{soil}
k_s (inorganics)	=	Not Applicable	cm^3_{water}/g_{soil}
L_s	=	100	cm
LF_{sw}	=	See Attached	$(mg/L_{water})/(mg/kg_{soil})$
M	=	0.5	mg/cm^2
Pe	=	$6.9 \cdot 10^{-14}$	g/cm^2-s
RAF_d	=	0.5	unitless
α_x	=	See Attached	cm
α_y	=	See Attached	cm
α_z	=	See Attached	cm
λ	=	See Attached	d^{-1}
π	=	3.1416	
τ	=	$9.46 \cdot 10^8$	s

SF_o	=	See Attached	$(mg/kg\text{-}d)^{-1}$
THQ	=	1	unitless
TR	=	1.00E-06	unitless
U	=	0.0285	cm/d
U_{air}	=	225	cm/s
U_{gw}	=	435.207	cm/y
VF_p	=	3.97133E-12	kg/m^3
VF_{samb}	=	See Attached	$(mg/m^3_{air})/(mg/kg_{soil})$ or kg/m^3
VF_{ss}	=	See Attached	kg/m3
W	=		cm
w	=	0.142	g_{water}/g_{soil}
δ_{air}	=	200	cm
δ_{gw}	=	200	cm
θ_{as}	=	0.167868	cm^3_{air}/cm^3_{soil}
θ_{ws}	=	0.262132	cm^3_{water}/cm^3_{soil}
θ_T	=	0.43	cm^3/cm^3_{soil}
ρ_b	=	1.846	g/cm^3
ρ_w	=	1	g/cm^3

	H'	λ	Koc
Benzene	0.228	0.0009	58.9
Toluene	0.272	0.011	182
Ethylbenzene	0.323	0.003	363
Total Xylenes	0.25	0.0019	260
MTBE	0.0241	0	11.5

Benzene R26 Modeled Groundwater from Vertical Modeled Soils

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
MW-5	0.006	0.002	30.48	3.048	1.016	0.1524	1	1
MW-6	0.001							
MW-8	0.001							

Benzene R26 Modeled Groundwater

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
MW-4	0.006	30.48	3.048	1.016	0.1524	1	1
MW-5	6.290	396.24	39.624	13.208	1.9812	1	0.99999955
MW-6	1.700	304.8	30.48	10.16	1.524	1	1
MW-7	0.085	121.92	12.192	4.064	0.6096	1	1
MW-8	2.880	335.28	33.528	11.176	1.6764	1	1
MW-9	1.120	274.32	27.432	9.144	1.3716	1	1
MW-10	2.050	335.28	33.528	11.176	1.6764	1	1
MW-11	0.039	91.44	9.144	3.048	0.4572	1	1
MW-12	0.677	243.84	24.384	8.128	1.2192	1	1

Toluene R26 Modeled Groundwater from Vertical Modeled Soils

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
MW-5	0.0113							

Toluene R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
MW-5	35.400	30.48	3.048	1.016	0.1524	1	1
MW-8	5.000	30.48	3.048	1.016	0.1524	1	1
MW-13	1.670	30.48	3.048	1.016	0.1524	1	1

Ethylbenzene R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
MW-5	0.0032							
MW-7	0.0030							
SB-5	0.0037							
SB-6	0.0035							
MW-8	0.0035							

Ethylbenzene R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	$\sqrt{[\alpha_y \cdot X]}$)	$\sqrt{[\alpha_z \cdot X]}$)
MW-5	3.760	30.48	3.048	1.016	0.1524	1	1
MW-7	2.350	30.48	3.048	1.016	0.1524	1	1
MW-8	2.210	30.48	3.048	1.016	0.1524	1	1
MW-10	1.670	30.48	3.048	1.016	0.1524	1	1
MW-12	0.955	30.48	3.048	1.016	0.1524	1	1

Total Xylenes R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: S_w / (4 · $\sqrt{[\alpha_y \cdot X]}$)	erf: S_w / (2 · $\sqrt{[\alpha_z \cdot X]}$)
MW-5	0.0175							
MW-7	0.0125							

Total Xylenes R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
MW-5	16.300	30.48	3.048	1.016	0.1524	1	1

MTBE R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$

MTBE R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
MW-4	0.118	2438.4	81.28	81.28	12.192	0.99999622	0.58790358
MW-5	0.457	8473.44	282.448	282.448	42.3672	0.81663558	0.18659189
MW-8	0.086	1524	50.8	50.8	7.62	1	0.81059311
MW-9	0.380	7467.6	248.92	248.92	37.338	0.86887309	0.21116495
MW-11	0.232	5029.2	167.64	167.64	25.146	0.97501508	0.30913212

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$

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Illinois Enviromental Protection Agency
Leaking Underground Storage Tank Program
RBCA Input Parameters for Use with Tier 2 Calculations

A. Site Identification

IEMA Incident # (6- or 8-digit): 90-0146 & 2004-0969 IEPA LPC # (10-digit): 1390305014

Site Name: KB Food & Gas/Sullivan

Site Address (not a P.O. Box): 111 West Jackson Street

City: Sullivan County: Moultrie Zip Code: 61951

Leaking UST Technical File

B. Tier 2 Calculation Information

Equation(s) Used (ex: R12,R14,R26): Example R-1, R-2, R3

Contact Information for Individual Who Performed Calculations:

CWM Company, Inc., Bob Woodruff

Land Use: Industrial/Commercial Soil Type: Loam

Groundwater: [X] Class I [ ] Class II

Mass Limit: [ ] Yes [X] No If Yes, then Specify Acreage ________

Objective from S17 used in R26? [ ] Yes [X] No

If Yes, then Specify C_{source} from S17 [redacted] mg/L

- Mass Limit Acreage other than defaults must always be rounded up
- Failure to use site-specific parameters where allowed could affect payment from the UST Fund
- Maps depicting source width, plume dimensions, distance, etc. must also be submitted.
- Inputs must be submitted in the designated unit.

Incident #: 90-0146 & 2004-0969

Chemical: ________

Land Use: ________

AT_c	=	70	yr
AT_n	=	Ind/Com = 25 Con. Worker = 0.115	yr yr
BW	=	70	yr
C_{source}	=	[redacted]	mg/L
$C_{(x)}$	=	[redacted]	mg/L
d	=	100	cm

D^{air}	=	[redacted]	cm^2/s
D^{water}	=	[redacted]	cm^2/s
D_s^{eff}	=	[redacted]	cm^2/s
ED	=	Ind/Com = 25 Con. Worker = 1	yr yr
EF	=	Ind/Com = 250 Con. Worker = 30	d/yr d/yr

erf	=	[redacted]	unitless
f_{oc}	=	0.721	g/g
GW_{comp}	=	[redacted]	mg/L
GW_{source}	=	[redacted]	mg/L
H'	=	[redacted]	$cm3_{water}/cm^3_{air}$
i	=	0.0103	cm/cm
I	=	30	cm/yr
IR_{air}	=	20	m^3/d
IR_{soil}	=	Ind/Com = 50 Con. Worker = 480	mg/d mg/d
IR_w	=	Ind/Com = 1	L/d
K	=	1,192 435,197	cm/d cm/yr
K_{oc}	=	[redacted]	cm^3/g or L/kg
k_s (non-ionizing organics)	=	[redacted]	cm^3_{water}/g_{soil}
k_s (ionizing organics)	=	Not Applicable	cm^3_{water}/g_{soil}
k_s (inorganics)	=	Not Applicable	cm^3_{water}/g_{soil}
L_s	=	100	cm
LF_{sw}	=	[redacted]	$(mg/L_{water})/(mg/kg_{soil})$

RAF_d (PNAs)	=	0.05	unitless
RAF_d (inorganics)	=	0	unitless
RAF_o	=	1	unitless
$RBSL_{air}$ (carcinogenic)	=	[redacted]	$\mu g/m^3$
$RBSL_{air}$ (noncarcinogenic)	=	[redacted]	$\mu g/m^3$
RfD_i	=	[redacted]	mg/kg-d
SA	=	3,160	cm^2/d
S_d	=	200.2	cm
S_w	=	5,821.7	cm
SF_i	=	[redacted]	$(mg/kg\text{-}d)^{-1}$
SF_o	=	[redacted]	$(mg/kg\text{-}d)^{-1}$
THQ	=	1	unitless
TR	=	1.00E-06	unitless
U	=	0.0265	cm/d
U_{air}	=	225	cm/s
U_{gw}	=	435.207	cm/y
VF_p	=	3.97133E-12	kg/m^3
VF_{samb}	=	[redacted]	$(g/m^3_{air})/(mg/kg_{soil})$ or kg/m3
VF_{ss}	=	[redacted]	kg/m3

M	=	0.5	mg/cm^2	W	=		cm
Pe	=	$6.9 \cdot 10^{-14}$	g/cm^2-s	w	=	0.142	g_{water}/g_{soil}
RAF_d	=	0.5	unitless	δ_{pr}	=	200	cm
α_x	=	[illegible]	cm	δ_{gw}	=	200	cm
α_y	=	[illegible]	cm	θ_{as}	=	0.167868	cm^3_{air}/cm^3_{soil}
α_z	=	[illegible]	cm	θ_{ws}	=	0.262132	cm^3_{water}/cm^3_{soil}
λ	=	[illegible]	d^{-1}	θ_T	=	0.43	cm^3/cm^3_{soil}
π	=	3.1416		ρ_b	=	1.846	g/cm^3
t	=	$9.46 \cdot 10^8$	s	ρ_w	=	1	g/cm^3

(TACO SSL Equations)

Discussion of Modeling Input Parameters

KB Food & Gas/Sullivan
LUST Incident #: 90-0146 & 2004-0969

Averaging Time for Non-Carcinogens in Inhalation Equation (AT)	The **Averaging Time for Non-Carcinogens in Inhalation Equation (AT)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Averaging Time for Non-Carcinogens default values of 30 yr for residential, 25 yr for industrial/commercial, and 0.115 yr for construction worker are used in the modeling equations.
Averaging Time for Carcinogens (AT_c)	The **Averaging Time for Carcinogens (AT_c)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Averaging Time for Carcinogens default value of 70 yr is used in the modeling equations.
Averaging Time for Non-Carcinogens in Ingestion Equation (AT)	The **Averaging Time for Non-Carcinogens in Ingestion Equation (AT)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Averaging Time for Non-Carcinogens default values of 6 yr for residential, 25 yr for industrial/commercial, and 0.115 yr for construction worker are used in the modeling equations.
Body Weight (BW)	The **Body Weight (BW)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Body Weight default value of 15 kg for non-carcinogens, 70 kg carcinogens for residential, 70 kg for industrial/commercial, and 70 kg for construction worker are used in the modeling equations.

Soil Saturation Concentration (C_{sat})

The **Soil Saturation Concentration (C_{sat})** was determined from Equation S-29:

$$C_{sat} = \frac{S}{\rho_b} \cdot [(K_d \cdot \rho_b) + \theta_w + (H' \cdot \theta_a)]$$

The resulting Soil Saturation Concentration for each chemical is as follows (mg/kg):

Benzene = 74533.544
Toluene = 69089.065
Ethylbenzene = 44252.944
Total Xylenes = 34890.784
MTBE = 428622.974

Target Soil Leachate Concentration (C_w)

The Target Soil Leachate Concentration (C_w) was determined from Equation S-18 (mg/L):

Class 1 Target Soil Leachate Concentration
Benzene = 0.1
Toluene = 20
Ethylbenzene = 3665.924
Total Xylenes = 37516.972
MTBE = 11.766

Equation for Estimation of Mixing Zone Depth (d)

The **Estimation of Mixing Zone Depth (d)** was determined by using equation S-15, which defines d as:

$$d = (0.0112 \cdot L^2)0.5 + d_a[1\text{-exp}\frac{(-L \cdot I)}{(K \cdot i \cdot d_a)}]$$

The resulting Estimation of Mixing Zone Depth is 9.883 m.

Aquifer Thickness (d_a)

The Aquifer Thickness (da) is a site specific value determined by the length of the monitoring well screen. The Aquifer Thickness value used in the modeling equations was 3.048 meters.

(TACO SSL Equations)

Discussion of Modeling Input Parameters

KB Food & Gas/Sullivan
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Apparent Diffusivity (D_A)

The **Apparent Diffusivity (D_A)** was determined by using equation S-10, which defines D_A as:

$$D_A = \frac{(\theta_a^{3.33} \cdot D_i \cdot H') + (\theta_w^{3.33} \cdot D_w)}{\eta^2} \cdot \frac{1}{(\rho_b \cdot K_d) + \theta_w + (\theta_a \cdot H')}$$

The resulting Apparent Diffusivity for each chemical is as follows (cm^2/s):

Benzene = 1.21455755751624E-06
Toluene = 4.63807479969942E-07
Ethylbenzene = 2.38050310577377E-07
Total Xylenes = 2.47482814038283E-07
MTBE = 7.89567667967154E-07

Diffusivity in Air (D_i)

The **Diffusivity in Air (D_i)** is chemical specific and values from Section 742.Appendix C: Table E: Default Physical and Chemical Parameters were used in the modeling equations. The following values were used (cm^2/s):

Benzene = 0.088
Toluene = 0.087
Ethylbenzene = 0.075
Total Xylenes = 0.072
MTBE = 0.102

Diffusivity in Water (D_w)

The **Diffusivity in Water (D_w)** is chemical specific and values from Section 742.Appendix C: Table E: Default Physical and Chemical Parameters were used in the modeling equations. The following values were used (cm^2/s):

Benzene = 0.0000098
Toluene = 0.0000086
Ethylbenzene = 0.0000078
Total Xylenes = 0.00000934
MTBE = 0.000011

Dilution Factor (DF)

The **Dilution Factor (DF)** was determined by using equation S-22, which defines DF as:

$$1 + \frac{K \cdot i \cdot d}{I \cdot L}$$

The resulting Dilution Factor was 1.022. Since the calculated value is less than the default value of 20, the default value for the Dilution Factor is used in the modeling equations.

Exposure Duration for Ingestion of Carcinogens (ED)

The **Exposure Duration for Ingestion of Carcinogens (ED)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Exposure Duration for Ingestion of Carcinogens default values of 25 yr for industrial/commercial and 1 yr for construction worker are used in the modeling equations.

Exposure Duration for Inhalation of Carcinogens (ED)

The **Exposure Duration for Inhalation of Carcinogens (ED)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Exposure Duration for Inhalation of Carcinogens default values of 30 yr for residential, 25 yr for industrial/commercial, and 1 yr for construction worker are used in the modeling equations.

Exposure Duration for Ingestion

The **Exposure Duration for Ingestion of Noncarcinogens (ED)** was obtained from Section

(TACO SSL Equations)

Discussion of Modeling Input Parameters

KB Food & Gas/Sullivan
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of Noncarcinogens (ED)	742.Appendix C: Table B: SSL Parameters. The Exposure Duration for Ingestion of Noncarcinogens default values of 6 yr for residential, 25 yr for industrial/commercial, and 1 yr for construction worker are used in the modeling equations.
Exposure Duration for Inhalation of Noncarcinogens (ED)	The **Exposure Duration for Inhalation of Noncarcinogens (ED)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Exposure Duration for Inhalation of Noncarcinogens default values of 30 yr for residential, 25 yr for industrial/commercial, and 1 yr for construction worker are used in the modeling equations.
Exposure Duration for the Direct Ingestion of Groundwater (ED)	The **Exposure Duration for the Direct Ingestion of Groundwater (ED)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Exposure Duration for Inhalation of Noncarcinogens default values of 30 yr for residential, 25 yr for industrial/commercial, and 1 yr for construction worker are used in the modeling equations.
Exposure Frequency (EF)	The **Exposure Frequency (EF)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Exposure Frequency default values of 350 d/yr for residential, 250 d/yr for industrial/commercial, and 30 d/yr for construction worker are used in the modeling equations.
Organic Carbon Content of the Soil (f_{oc})	The Organic Carbon Content of the Soil (foc) is a site specific value. The Organic Carbon Content of the Soil was determined to be 0.721 g/g.
Groundwater Remediation Objective (GW_{obj})	The Groundwater Remediation Objective (GW_{obj}) was obtained from Section 742.APPENDIX B: Table E: Tier 1 Groundwater Remediation Objectives for the Groundwater Component of the Groundwater **Class 1 Groundwater Objectives** Benzene = 0.005 Toluene = 1 Ethylbenzene = 0.7 Total Xylenes = 10 MTBE = 0.07
Henry's Law Constant (H')	The value for **Henry's Law Constant (H')** is chemical specific and values from Section 742.APPENDIX C: TABLE E: Default Physical and Chemical Parameters were used in the modeliing equations. The following values were used: Benzene = 0.228 Toluene = 0.272 Ethylbenzene = 0.323 Total Xylenes = 0.25 MTBE = 0.0241
Hydraulic Gradient (i)	The Hydraulic Gradient (i) was determined from an onsite survey of each of the groundwater monitoring wells. The riser elevations were determined and the depth to groundwater was noted in each well. This data was used to generate a potentiometric flow map with contour lines which show potentiometric head. A corresponding flow line, perpendicular to the contour lines, was determined between two known points of groundwater elevation (MW-2 = 89.64 feet and MW-7 = 95.56 feet). The length of this flow line was then determined to be 214 feet. The hydraulic gradient was determined by the difference in elevation divided by the length of flow between the points: (95.56-89.64) / 214 = 0.02766 ft/ft or 0.02766 m/m or 0.02766 cm/cm.
Infiltration Rate (I)	The Infiltration Rate (I) was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Infiltration Rate default value of 0.3 m/yr was used in the modeling equations.
Age Adjusted Soil Ingestion Factor for Carcinogens ($IF_{soil-adj}$)	The **Age Adjusted Soil Ingestion Factor for Carcinogens ($IF_{soil-adj}$)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The $IF_{soil-adj}$ default value of 114 (mg-yr)/(kg-d) is used in the modeling equations.

(TACO SSL Equations)

Discussion of Modeling Input Parameters

KB Food & Gas/Sullivan
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Soil Ingestion Rate (IR_{soil})

The **Soil Ingestion Rate (IR_{soil})** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Soil Ingestion Rate default values of 200 mg/d for residential, 50 mg/d for

Daily Water Ingestion Rate (IR_w)

The **Daily Water Ingestion Rate (IR_w)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Daily Water Ingestion Rate default values of 2 L/d for residential and 1 L/d for industrial/commercial.

Aquifer Hydraulic Conductivity (K)

The falling hydraulic conductivity (0.0000138 cm/s) was utilized in the modeling equations:

$$\text{Conversion factor: } \frac{\text{cm} \cdot 1\text{ m} \cdot 3600\text{ sec} \cdot 24\text{ hr} \cdot 365\text{ day}}{\text{sec} \cdot 100\text{ cm} \cdot \text{hour} \cdot \text{day} \cdot \text{year}}$$

The resulting hydraulic conductivity is 4.351968 m/yr.

Soil-Water Partition Coefficient (K_d)

The **Soil-Water Partition Coefficient (K_d)** was determined by using equation S-19, which defines K_d as (cm^3/g):

$$K_d = K_{oc} \cdot f_{oc}$$

The resulting Soil-Water Partition Coefficient for each chemical is as follows:

Benzene = 42.4669
Toluene = 131.222
Ethylbenzene = 261.723
Total Xylenes = 187.46
MTBE = 8.2915

Organic Carbon Partition Coefficient (K_{oc})

The Organic Carbon Partition Coefficient (Koc) value is chemical specific and values from Section 742.APPENDIX C: TABLE E: Default Physical and Chemical Parameters were used in the modeling equations:

Benzene = 58.9
Toluene = 182
Ethylbenzene = 363
Total Xylenes = 260
MTBE = 11.5

Saturated Hydraulic Conductivity (K_s)

The Saturated Hydraulic Conductivity (Ks) was obtained from Section 742.APPENDIX C: Table K: Parameter Estimates for Calculating Water-Filled Soil Porosity (θw). The Saturated Hydraulic Conductivity for Loam, 60 m/yr, was used in the modeling equations.

Source Length Parallel to Groundwater Flow (L)

The Source Length Parallel to Groundwater Flow (L) was determined from the site map and analytical results. A value of 45.1104 m was used to encompass the length of contamination parallel to groundwater flow. This value is the distance between soil borings BH-1 and BH-2.

Particulate Emission Factor (PEF)

The **Particulate Emission Factor (PEF)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The PEF values of 1.32 $\times 10^9$ (m^3/kg) for residential or site specific, 1.24 $\times 10^9$ (m3/kg) for

Inverse of the Mean Concentration at the Center of a Square Source

The Inverse of the Mean Concentration at the Center of a Square Source (Q/C) was obtained from

(TACO SSL Equations)

Discussion of Modeling Input Parameters

KB Food & Gas/Sullivan
LUST Incident #: 90-0146 & 2004-0969

at the Center of a Square Source (Q/C)

The Inverse of the Mean Concentration at the Center of a Square Source (Q/C) was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Inverse default values of 68.81 $(g/m^2\text{-}s)/(kg/m^3)$ for residential, 85.81 $(g/m^2\text{-}s)/(kg/m^3)$ for industrial/commercial, and 85.81 $(g/m^2\text{-}s)/(kg/m^3)$ for construction worker are used in the modeling equations.

Inhalation Reference Concentration (RfC)

The **Inhalation Reference Concentration (RfC)** is toxicological specific and values from the IEPA Toxicology Department and/or IRIS were used in the modeling equations. The following Chronic

Benzene = 0.03
Toluene = 5
Ethylbenzene = 1
Total Xylenes = 0.1
MTBE = 3

The following Subchronic Values were used:

Benzene = 0.08
Toluene = 5
Ethylbenzene = 1
Total Xylenes = 0.4
MTBE = 3

Oral Reference Dose (RfD_o)

The **Oral Reference Dose (RfD_o)** is toxicological specific and values from the IEPA Toxicology Department and/or IRIS were used in the modeling equations. The following Chronic values were used (mg/kg-d):

Benzene = 0.004
Toluene = 0.08
Ethylbenzene = 0.1
Total Xylenes = 0.2
MTBE = 0.01

The following Subchronic Values were used:

Benzene = 0.012
Toluene = 0.8
Ethylbenzene = 1
Total Xylenes = 1
MTBE = 0.1

Solubility in Water (S)

The **Solubility in Water (S)** is chemical specific and values from Section 742.Appendix C: Table E: Default Physical and Chemical Parameters were used in the modeling equations. The following values were used (mg/L):

Benzene = 1750
Toluene = 526
Ethylbenzene = 169
Total Xylenes = 186
MTBE = 51000

Oral Slope Factor (SF_o)

The **Oral Slope Factor (SF_o)** is toxicological specific and values from the IEPA Toxicology Department were used in the modeling equations. The following values were used ((mg/kg-d)$^{-}$

Benzene = 0.055
Toluene = NA

(TACO SSL Equations)

Discussion of Modeling Input Parameters

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Ethylbenzene = NA
Total Xylenes = NA
MTBE = NA

Exposure Interval (T)

The **Exposure Interval (T)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Exposure Interval default values of 9.5×10^8 seconds for residential, 7.9×10^8 seconds for industrial/commercial, and 3.6×10^6 seconds for construction worker are used in the modeling equations.

Target Hazard Quotient (THQ)

The **Target Hazard Quotient (THQ)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The Target Hazard Quotient default value of 1 is used in the modeling equations.

Target Cancer Risk (TR)

The Tier 3 **Target Cancer Risk (TR)** value was obtained in accordance with Section 742.900 d). The Target Cancer Risk value of 10^{-5} is used in the modeling equations.

Inhalation Unit Risk Factor (URF)

The **Inhalation Unit Risk Factor (URF)** is toxicological specific and values from the IEPA Toxicology Department were used in the modeling equations. A value of 8.3×10^{-6} $(ug/m^3)^{-1}$ was used for the benzene Inhalation Unit Risk Factor.

Volatilization Factor (VF)

The **Volatilization Factor (VF)** was determined by using equation S-8, which defines VF as:

$$VF = \frac{Q}{C} \cdot \frac{(3.14 \cdot D_A \cdot T)^{1/2}}{(2 \cdot \rho_b \cdot D_A)} \cdot 10^{-4}$$

The resulting Volatilization Factor for each chemical is as follows (m^3/kg):

Industrial/Commercial
Benzene = 105037.778
Toluene = 169975.256
Ethylbenzene = 237257.638
Total Xylenes = 232692.323
MTBE = 130274.645

Construction Worker
Benzene = 7090.604
Toluene = 11474.226
Ethylbenzene = 16016.141
Total Xylenes = 15707.959
MTBE = 8794.225

Volatilization Factor Adjusted for Agitation (VF')

The **Volatilization Factor Adjusted for Agitation (VF')** was determined by using equation S-9, which defines VF' as:

$$VF' = \frac{VF}{10}$$

This factor is utilized in the construction worker remediation objective calculations. The resulting Adjusted Volatilization Factor for each chemical is as follows (m^3/kg):

Benzene = 7090.604
Toluene = 11474.226
Ethylbenzene = 16016.141
Total Xylenes = 15707.959
MTBE = 8794.225

(TACO SSL Equations)

Discussion of Modeling Input Parameters

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"SSL" Total Soil Porosity (η)

The Total Soil Porosity (η) was determined by using equation S-24, which defines η as:

$$\eta = 1 - \frac{\rho_b}{\rho_s}$$

The resulting 'SSL' Total Soil Porosity was 0.304 Lpore/Lsoil.

Air Filled Soil Porosity (θ_a)

The **Air-Filled Soil Porosity (θ_a)** was determined by using equation S-21, which defines θ_a as:

$$\theta_a = \eta - \theta_w$$

The value for Air Filled Soil Porosity (θa) was determined by SSL Equation S-21. The result for θa is 0.098.

Water Filled Soil Porosity (θ_w)

The Water Filled Soil Porosity (θw) was determined by using Equation S-20, which defines θ_w as:

$$\theta_w = \eta \cdot \left(\frac{I}{K_s}\right)^{1/(2b+3)}$$

The resulting Water-Filled Soil Porosity was 0.206 Lwater/Lsoil.

Dry Soil Bulk Density (ρ_b)

The Dry Soil Bulk Density (ρb) was determined from a soil sample collected utilizing a Shelby Tube (). According to the laboratory results, the site specific bulk density was PCF (1.846 g/cm3).

Soil Particle Density (ρ_s)

The Soil Particle Density (ρs) value was determined from a soil sample collected utilizing a Shelby Tube (). According to the laboratory results, the site specific gravity (soil particle density) was 2.652.

Water Density (ρ_w)

The **Water Density (ρ_w)** was obtained from Section 742.Appendix C: Table B: SSL Parameters. The ρ_w default value of 1 g/cm^3 is used in the modeling equations.

Exponential in Equation S20 {(1/(2b+3)}

The Exponential in Equation S20 {(1/(2b+3)} was obtained from Section 742.APPENDIX C: Table K: Parameter Estimates for Calculatin Water-Filled Soil Porosity (θw). The Exponential in Equation S-20 for Loam, 0.073, was used in modeling equations.

Equation S-5: Non-Carcinogenic Contaminants Construction Worker Inhalation

Equation S-5 was used to determine the most stringent Tier 2 Inhalation remediation objective for: Toluene, Ethylbenzene, Total Xylenes, MTBE, , .

$$\frac{THQ \cdot AT \cdot 365\ d/yr}{EF \cdot ED \cdot (1/RfC \cdot 1/VF')}$$

Toluene = 8027.177
Ethylbenzene = 2240.925
Total Xylenes = 879.122
MTBE = 3691.376

Equation S-7: Carcinogenic Contaminants Construction Worker Inhalation

Equation S-7 was used to determine the most stringent Tier 2 Inhalation remediation objective for: benzene, , , .

$$\frac{TR \cdot AT_c \cdot 365\ d/yr}{URF \cdot 1{,}000\ \mu g/mg \cdot EF \cdot ED \cdot 1/VF'}$$

(TACO SSL Equations)

Discussion of Modeling Input Parameters

KB Food & Gas/Sullivan
LUST Incident #: 90-0146 & 2004-0969

Benzene = 77.42

Equation S-4: Non-Carcinogenic Contaminants Residential and Industrial/Commercial Worker Inhalation

Equation S-4 was used to determine the most stringent Tier 2 Inhalation remediation objective for: Toluene, Ethylbenzene, Total Xylenes, MTBE, , .

$$\frac{THQ \cdot AT \cdot 365\ d/yr}{EF \cdot ED \cdot (1/RfC \cdot 1/VF)}$$

Industrial/Commercial
Toluene = 779367.77
Ethylbenzene = 217573.969
Total Xylenes = 21338.74
MTBE = 358399.907

Equation S-6: Carcinogenic Contaminants Residential and Industrial/Commercial Worker Inhalation

Equation S-6 was used to determine the most stringent Tier 2 Inhalation remediation objective for: benzene, , , .

$$\frac{TR \cdot AT_c \cdot 365\ d/yr}{URF \cdot 1{,}000\ \mu g/mg \cdot EF \cdot ED \cdot 1/VF}$$

Industrial/Commercial
Benzene = 55.05

Equation S-1: Non-Carcinogenic Contaminants Ingestion

Equation S-1 was used to determine the most stringent Tier 2 Ingestion remediation objective for: Toluene, Ethylbenzene, Total Xylenes, MTBE, , .

$$\frac{THQ \cdot BW \cdot AT \cdot 365\ d/yr}{1/RfD_o \cdot 10^{-6}\ kg/mg \cdot EF \cdot ED \cdot IR_{soil}}$$

Tier 2 Industrial/Commercial Calculations for Benzene

KB Food & Gas/Sullivan

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SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12

Version: 6/27/2008

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->	–	USDA Soil Classification:	Loam		
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000
foc conversion to g/g:	0.000						

Value	Parameter			Notes
1.846	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ρs - Soil Particle Density			2.65 or; Site Specific
0.098	Θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θw - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0103	i - Hydraulic Gradient			Site Specific
0.721	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.884	d - Mixing Zone (m)	9.884	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific 1.19E+00 cm/d 4.35E+02 cm/yr Use cm/d for R15, R19, & R26. cm/yr for R24
64.591	L - Source Length Parallel to Groundwater Flow (m)		feet = 211.9112	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
0.005	GW_{obj} - Groundwater Remediation Objective Class 1			0.025 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
0.055	SF_o -Oral Slope Factor			Benzene = 0.055
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
1750	S - Solubility in Water			Benzene = 1750
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
70	AT_c -Average Time for Carcinogens			70
7.80E-06	URF - Inhalation Unit Risk Factor			Benzene =7.8×10^{-6}
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation fo Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval			Residential = 9.5×10^8; Industrial/Commercial = 7.9×10^8; Construction Worker = 3.6×10^6
30	T_{M-L} - Exposure Interval for Mall Limit Volatilization Factor Equation S26			30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.088	D_i - Diffusivity in Air			Benzene = 0.088
0.228	H' - Henry's Law Constant			Benzene = 0.228
9.80E-06	D_w - Diffusivity in Water			Benzene = 9.8×10^{-6}
58.9	K_{oc} - Organic Carbon Partition Coefficient			Benzene = 58.9

Industrial/Commercial Ingestion Tier II Benzene Objective

$$S\text{-}2 = \frac{TR \times AT_c \times 365}{Sf_o \times 10^{-6} \times EF \times IF_{soil-adj}} = \frac{1.0E\text{-}06 \times 70 \times 365}{0.055 \times 1.00E\text{-}06 \times 250 \times 114} = \frac{2.6E\text{-}02}{1.57E\text{-}03} = 16.300 \text{ mg/kg}$$

Construction Worker Ingestion Tier II Benzene Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{Sf_o \times 10^{-6} \times EF \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{0.055 \times 1.00E\text{-}06 \times 30 \times 480} = \frac{1.8E+00}{7.92E\text{-}04} = 2258.21 \text{ mg/kg}$$

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Industrial/Commercial Inhalation Tier II Benzene Objective

$$S\text{-}6 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF} = \frac{1.0E\text{-}06 \times 70 \times 365}{7.80E\text{-}06 \times 1000 \times 250 \times 25 \times (1/\ 1.05E{+}05)} = \frac{0.02555}{4.64E\text{-}04} = 55.051 \text{ mg/kg}$$

Construction Worker Inhalation Tier II Benzene Objective

$$S\text{-}7 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF'} = \frac{1.0E\text{-}06 \times 70 \times 365}{7.80E\text{-}06 \times 1000 \times 30 \times 1 \times (1/\ 7.09E{+}02)} = \frac{0.02555}{3.30E\text{-}04} = 77.421 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 1.21E\text{-}06 \times 7.90E{+}08)^{1/2} \times 0.0001}{(2 \times 1.846 \times 1.21E\text{-}06)} = \frac{0.4710}{0.0000} = 105037.7767$$

Construction Worker

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 1.21E\text{-}06 \times 3.60E{+}06)^{1/2} \times 0.0001}{(2 \times 1.846 \times 1.21E\text{-}06)} = \frac{0.0318}{0.0000} = 7090.6040$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = \quad VF' = \frac{VF}{10} = \frac{7090.6040}{10} = 709.0604$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = \quad D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(4.37E\text{-}04 \times 0.088 \times 0.228) + (0.0052 \times 9.80E\text{-}06)}{0.0924} \times \frac{1}{(1.846 \times 42.4669) + 0.21 + (0.098 \times 0.228)} = 1.21E\text{-}06$$

Soil Component of the Migration to Groundwater Clanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{pb} \right] = 0.1 \times \left[42.4669 + \frac{(0.206 + 0.098 \times 0.228)}{1.846} \right] = 4.259 \text{ mg/kg}$$

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Tier 2 Industrial/Commercial Calculations for Benzene

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Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = \quad C_w = DF \times GW_{obj} = 20.00 \times 0.005 = 0.1$$

Soil-Water Partition Coefficient

$$S\text{-}19 = \quad K_d = K_{oc} \times f_{oc} = 58.90 \times 0.721 = 42.4669$$

Water-Filled Porosity

$$S\text{-}20 = \quad \Theta_w = \eta \times \left[\frac{I}{K_s}\right]^{1/(2b+3)} = 0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073} = 0.2065$$

Air-Filled Porosity

$$S\text{-}21 = \quad \Theta_a = \eta - \Theta_w = 0.30 - 0.21 = 0.0980$$

Dilution Factor

$$S\text{-}22 = \quad DF = 1 + \frac{K \times i \times d}{I \times L} = \frac{4.35}{0.300} \times \frac{0.0103}{64.591} \times 9.884 + 1 = 1.0229$$

GW Ingestion

$$S\text{-}23 = \quad \frac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{0.055 \times 1.000 \times 250 \times 25} = \frac{1.8E+00}{343.75} = 0.0052 \text{ mg/L}$$

Total Soil Porosity

$$S\text{-}24 = \quad \eta = 1 - \frac{\rho_b}{\rho_s} = 1 - \frac{1.846}{2.652} = 0.3039$$

Estimation of Mixing Zone Depth

$$S\text{-}25 = \quad d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\frac{(-L \times I)}{(K \times i \times d_a)}\right]$$

$$= (0.0112 \times 64.591^2)^{0.5} + 3.048 \times \left[1 - \exp\frac{(-64.591 \times 0.3)}{(4.352 \times 0.0103 \times 3.048)}\right] = 9.884 \text{ m}$$

Soil Saturation Limit

$$S\text{-}29 = \quad C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \theta a)] = \frac{1750}{1.846} \times [(42.4669 \times 1.846) + 0.206 + (0.228 \times 0.098)] = 74{,}533.54 \text{ mg/kg}$$

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Tier 2 Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan
90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12
Version: 6/27/2008

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet --> --	USDA Soil Classification: Loam
Organic Matter (%) -->	0	FOC % (0.58 conversion) --> 0.000; Organic Matter (mg/kg) 0	FOC mg/kg (0.58 conversion) 0.000; foc conversion to g/g: 0.000

1.846	ρ_b - Dry Soil Bulk Density		1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ρs - Soil Particle Density		2.65 or; Site Specific
0.098	θ_a - Air Filled Soil Porosity	*0.098* Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θw - Water Filled Soil Porosity	*0.206* Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL: Total Soil Porosity	*0.304* Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24 or R23)
0.0103	i - Hydraulic Gradient		Site Specific
0.721	foc - Total Organic Carbon (g/g)		Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023* Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.884	d - Mixing Zone (m)	9.884 Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)	feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec = 1.38E-05	Site Specific; 1.19E+00 cm/d; 4.35E+02 cm/yr; Use cm/d for R15, R19, & R26. cm/yr for R24
64.591	L - Source Length Parallel to Groundwater Flow (m)	feet = 211.9112	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)	feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)		0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity		See Table K for Input Values
1.000	GW_{obj} - Groundwater Remediation Objective Class 1		2.5 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20		See Table K for Input Values
15	BW - Body Weight		Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens		114
50	IR_{soil} -Soil Ingestion Rate		Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate		Residential = 2; Industrial/Commercial = 1
526	S - Solubility in Water		Toluene = 526
1.0E-06	TR - Target Cancer Risk		Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency		Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source		Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval		Residential = 9.5 x10^8; Industrial/Commercial = 7.9 x 10^8; Construction Worker = 3.6 x 10^6
30	T_{M-L} - Exposure Interval for Mass Limit Volatilization Factor Equation S26		30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28		70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28		0.18
0.087	D_i - Diffusivity in Air		Toluene = 0.087
0.272	H' - Henry's Law Constant		Toluene = 0.272
8.60E-06	D_w - Diffusivity in Water		Toluene = 8.6 x 10^{-6}
25	AT - Average Time for Non-Carcinogens in Ingestion Equation		Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens in Inhalation Equation		Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient		1
5	RfC - Inhalation Reference Concentration		Chronic = 5; Subchronic = 5
0.8	RfD_o - Oral Reference Dose		Chronic = 0.08; Subchronic = 0.8
182.00	K_{oc} - Organic Carbon Partition Coefficient		Toluene = 182

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/0.8 \times 250 \times 25 \times 50} = \frac{638750}{0.390625} = 1635200 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/0.8 \times 30 \times 1 \times 480} = \frac{2938.25}{0.018} = 163236 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/5 \times 1/169975.2565} = \frac{9125}{0.007354} = 1240819.372 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/5 \times 1/1147.422627} = \frac{41.975}{0.005229} = 8027.177 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 4.64E\text{-}07 \times 7.90E\text{+}08)^{1/2} \times 0.0001}{(2 \times 1.846 \times 4.64E\text{-}07)} = \frac{0.2911}{1.71E\text{-}06} = 169975.2565$$

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Tier 2 Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Construction Worker

$$\text{S-8} = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 4.64\text{E-}07 \times 3.60\text{E+}06)^{1/2} \times 0.0001}{(2 \times 1.846 \times 4.64\text{E-}07)} = \frac{0.0196}{1.71\text{E-}06} = 11474.2263$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$\text{S-9} = \quad VF' = \frac{VF}{10} = \frac{11474.2263}{10} = 1147.4226$$

Equation for Derivation of Apparent Diffusivity

$$\text{S-10} = \quad D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(4.37\text{E-}04 \times 0.087 \times 0.272) + (0.0052 \times 8.60\text{E-}06)}{0.0924} \times \frac{1}{(1.846 \times 131.222) + 0.21 + (0.098 \times 0.272)} = 4.64\text{E-}07$$

Soil Component of the Migration to Groundwater Clanup Objective (Class 1)

$$\text{S-17} = \quad C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = 20 \times \left[131.222 + \frac{(0.206 + 0.098 \times 0.272)}{1.846} \right] = 2626.961 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$\text{S-18} = \quad C_w = DF \times GW_{obj} = 20.00 \times 1.000 = 20$$

Soil-Water Partition Coefficient

$$\text{S-19} = \quad K_d = K_{oc} \times f_{oc} = 182.00 \times 0.721 = 131.222$$

Water-Filled Porosity

$$\text{S-20} = \quad \Theta_w = \eta \times \left[\frac{I}{K_s}\right]^{1/(2b+3)} = 0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073} = 0.2065$$

0186

Tier 2 Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w$ = 0.30 - 0.21 = 0.0980

Dilution Factor

S-22 = $DF = 1 + \frac{K \times I \times d}{I \times L}$ = $\frac{4.35 \times 0.0103 \times 9.884}{0.300 \quad 64.591}$ + 1 = 1.0229

GW Ingestion

S-23 = $\frac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\frac{1.0E\text{-}06 \times 15 \times 0 \times 365}{0.000 \times 1.000 \times 250 \times 25}$ = $\frac{0.0E+00}{0}$ = #DIV/0! mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = 1 - $\frac{1.846}{2.652}$ = 0.3039

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times i \times d_a)} \right]$

= (0.0112 x 64.591 $^2)^{0.5}$ +

3.048 x[1 - exp $\left(\frac{-64.591 \times 0.3}{4.352 \times 0.0103 \times 3.048} \right)$] = 9.884 m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \theta a)]$ = $\frac{526}{1.846}$ x [(131.222 x 1.846) + 0.206 + (0.272 x 0.098)] = 69,089.07 mg/kg

0187

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

KB Food & Gas/Sullivan
90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12
Version: 8/27/2008

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->	–	USDA Soil Classification:	Loam	
Organic Matter (%) -->	0	FOC % (0.58 conversion) --> 0.000	Organic Matter (mg/kg) 0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g: 0.000

1.846	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ps - Soil Particle Density			2.65 or; Site Specific
0.098	Θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θw - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0103	I - Hydraulic Gradient			Site Specific
0.721	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.884	d - Mixing Zone (m)	9.884	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific | 1.19E+00 cm/d | 4.35E+02 cm/yr | Use cm/d for R15, R19, & R26. cm/yr for R24
64.591	L - Source Length Parallel to Groundwater Flow (m)		feet = 211.9112	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
0.700	GW_{obj} - Groundwater Remediation Objective Class 1			1 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
169	S - Solubility in Water			Ethylbenzene = 169
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval			Residential = 9.5 x10^8; Industrial/Commercial = 7.9 x 10^8; Construction Worker = 3.6 x 10^6
30	T_{M-L} - Exposure Interval for Mass Limit Volatilization Factor Equation S26			30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.075	D_i - Diffusivity in Air			Ethylbenzene = 0.075
0.323	H' - Henry's Law Constant			Ethylbenzene = 0.323
7.80E-06	D_w - Diffusivity in Water			Ethylbenzene = 7.8 x 10^{-6}
25	AT - Average Time for Non-Carcinogens In Ingestion Equation			Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens In Inhalation Equation			Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient			1
1	RfC - Inhalation Reference Concentration			Chronic = 1; Subchronic = 1
0.1	RfD_o - Oral Reference Dose			Chronic = 0.1; Subchronic = 1
363.00	K_{oc} - Organic Carbon Partition Coefficient			Ethylbenzene = 363

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/\ 0.1 \times 250 \times 25 \times 50} = \frac{638750}{3.125} = 204400 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/\ 1 \times 30 \times 1 \times 480} = \frac{2938.25}{0.0144} = 204045 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/\ 1 \times 1/\ 237257.6383} = \frac{9125}{0.026343} = 346396 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/\ 1 \times 1/\ 1601.61419} = \frac{41.975}{0.018731} = 2240.925 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \left(\frac{3.14 \times 2.38E\text{-}07 \times 7.90E\text{+}08}{2 \times 1.846 \times 2.38E\text{-}07}\right)^{1/2} \times 0.0001 = \frac{0.2085}{8.79E\text{-}07} = 237257.6383$$

0188

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Construction Worker

S-8 = $VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 2.38E{-}07 \times 3.60E{+}06)^{1/2} \times 0.0001}{(2 \times 1.846 \times 2.38E{-}07)} = \frac{0.0141}{8.79E{-}07} = 16016.1419$

Equation for Derivation of Volatilization Factor - Construction Worker

S-9 = $VF' = \frac{VF}{10} = \frac{16016.1419}{10} = 1601.6142$

Equation for Derivation of Apparent Diffusivity

S-10 = $D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$

$= \frac{(4.37E{-}04 \times 0.075 \times 0.323) + (0.0052 \times 7.80E{-}06)}{0.0924} \times \frac{1}{(1.846 \times 261.723) + 0.21 + (0.098 \times 0.323)} = 2.38E{-}07$

Soil Component of the Migration to Groundwater Clanup Objective (Class 1)

S-17 = $C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{pb} \right] = 14 \times \left[261.723 + \frac{(0.206 + 0.098 \times 0.323)}{1.846} \right] = 3665.924$ mg/kg

Target Soil Leachate Concentration (Class 1)

S-18 = $C_w = DF \times GW_{obj} = 20.00 \times 0.700 = 14$

Soil-Water Partition Coefficient

S-19 = $K_d = K_{oc} \times f_{oc} = 363.00 \times 0.721 = 261.723$

Water-Filled Porosity

S-20 = $\Theta_w = \eta \times \left[\frac{I}{K_s}\right]^{1/(2b+3)} = 0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073} = 0.2065$

0189

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Air-Filled Porosity

S-21 = $\theta_a = \eta - \theta_w$ = 0.30 - 0.21 = 0.0980

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{4.35 \times 0.0103 \times 9.884}{0.300 \quad 64.591}$ + 1 = 1.0229

GW Ingestion

S-23 = $\frac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\frac{1.0E\text{-}06 \times 70 \times 0 \times 365}{0.000 \times 1.000 \times 250 \times 25}$ = $\frac{0.0E+00}{0}$ = #DIV/0! mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = $1 - \frac{1.846}{2.652}$ = 0.3039

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\frac{(-L \times I)}{(K \times i \times d_a)}\right]$

= (0.0112 x 64.591 $^2)^{0.5}$ +

3.048 x $\left[1 - \exp\frac{(-64.591 \times 0.3)}{(4.352 \times 0.0103 \times 3.048)}\right]$ = 9.884 m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \theta a)]$ = $\frac{169}{1.846}$ x [(261.723 x 1.846) + 0.206 + (0.323 x 0.098)] = 44,252.94 mg/kg

0190

Tier 2 Industrial/Commercial Calculations for Total Xylenes

KB Food & Gas/Sullivan
90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12
Version: 6/27/2008

Input Values

Holcomb's Bulk Density --> 0	Converted Value to be used in calculation sheet -->	--		USDA Soil Classification: Loam
Organic Matter (%) --> 0	FOC % (0.58 conversion) --> 0.000	Organic Matter (mg/kg) 0	FOC mg/kg (0.58 conversion) 0.000	foc conversion to g/g: 0.000
1.846	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ρs - Soil Particle Density			2.65 or; Site Specific
0.098	Θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θw - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0103	i - Hydraulic Gradient			Site Specific
0.721	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.884	d - Mixing Zone (m)	*9.884*	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific 1.19E+00 cm/d 4.35E+02 cm/yr Use cm/d for R15, R19, & R26. cm/yr for R24
64.591	L - Source Length Parallel to Groundwater Flow (m)		feet = 211.9112	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
10.000	GW_{obj} - Groundwater Remediation Objective Class 1			10 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
186	S - Solubility in Water			Total Xylenes = 186
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval			Residential = 9.5×10^8; Industrial/Commercial = 7.9×10^8; Construction Worker = 3.6×10^6
30	T_{M-L} - Exposure Interval for Mass Limit Volatilization Factor Equation S26			30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.072	D_i - Diffusivity in Air			Total Xylenes = 0.072
0.250	H' - Henry's Law Constant			Total Xylenes = 0.25
9.34E-06	D_w - Diffusivity in Water			Total Xylenes = 9.34×10^{-6}
25	AT - Average Time for Non-Carcinogens in Ingestion Equation			Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens in Inhalation Equation			Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient			1
0.1	RfC - Inhalation Reference Concentration			Chronic = 0.1; Subchronic = 0.4
0.2	RfD_o - Oral Reference Dose			Chronic = 0.2; Subchronic = 1
260.00	K_{oc} - Organic Carbon Partition Coefficient			Total Xylenes = 260

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/0.2 \times 250 \times 25 \times 50} = \frac{638750}{1.5625} = 408800 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/1 \times 30 \times 1 \times 480} = \frac{2938.25}{0.0144} = 204045 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/0.1 \times 1/232692.3237} = \frac{9125}{0.268595023} = 33973.079 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/0.4 \times 1/1570.795908} = \frac{41.975}{0.047746496} = 879.122 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 2.47E\text{-}07 \times 7.90E{+}08)^{1/2} \times 0.0001}{(2 \times 1.846 \times 2.47E\text{-}07)} = \frac{0.2126}{9.14E\text{-}07} = 232692.3237$$

0191

Tier 2 Industrial/Commercial Calculations for Total Xylenes

KB Food & Gas/Sullivan

90-0145 & 2004-0969

Construction Worker

$$\text{S-8} = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 2.47E\text{-}07 \times 3.60E{+}06)^{1/2} \times 0.0001}{(2 \times 1.846 \times 2.47E\text{-}07)} = \frac{0.0144}{9.14E\text{-}07} = 15707.9591$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$\text{S-9} = \quad VF' = \frac{VF}{10} = \frac{15707.9591}{10} = 1570.7959$$

Equation for Derivation of Apparent Diffusivity

$$\text{S-10} = \quad D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(4.37E\text{-}04 \times 0.072 \times 0.250) + (0.0052 \times 9.34E\text{-}06)}{0.0924} \times \frac{1}{(1.846 \times 187.46) + 0.21 + (0.098 \times 0.250)} = 2.47E\text{-}07$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$\text{S-17} = \quad C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = 200 \times \left[187.46 + \frac{(0.206 + 0.098 \times 0.250)}{1.846} \right] = 37518.973 \text{ mg/kg}$$

Tier 2 Soil Component of GW Ingestion Objective cannot exceed Soil Saturation Limit

Target Soil Leachate Concentration (Class 1)

$$\text{S-18} = \quad C_w = DF \times GW_{obj} = 20.00 \times 10.000 = 200$$

Soil-Water Partition Coefficient

$$\text{S-19} = \quad K_d = K_{oc} \times f_{oc} = 260.00 \times 0.721 = 187.46$$

Water-Filled Porosity

$$\text{S-20} = \quad \Theta_w = \eta \times \left[\frac{I}{K_s}\right]^{1/(2b+3)} = 0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073} = 0.2065$$

0192

Tier 2 Industrial/Commercial Calculations for Total Xylenes

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w$ $= 0.30 - 0.21 = 0.0980$

Dilution Factor

S-22 = $DF = 1 + \dfrac{K \times i \times d}{I \times L} = \dfrac{4.35 \times 0.0103 \times 9.884}{0.300 \quad 64.591} + 1 = 1.0229$

GW Ingestion

S-23 = $\dfrac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED} = \dfrac{1.0E\text{-}06 \times 70 \times 0 \times 365}{0.000 \times 1.000 \times 250 \times 25} = \dfrac{0.0E{+}00}{0} = \#DIV/0!$ mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \dfrac{\rho_b}{\rho_s} = 1 - \dfrac{1.848}{2.652} = 0.3039$

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\dfrac{(-L \times I)}{(K \times i \times d_a)}\right]$

$= (0.0112 \times 64.591^2)^{0.5} +$

$3.048 \times \left[1 - \exp\dfrac{(-64.591 \times 0.3)}{(4.352 \times 0.0103 \times 3.048)}\right] = 9.884$ m

Soil Saturation Limit

S-29 = $C_{sat} = \dfrac{S}{\rho_b} \times [(K_d \times pb) + \Theta w + (H' \times \Theta a)] = \dfrac{186}{1.846} \times [(187.46 \times 1.846) + 0.206 + (0.250 \times 0.098)] = 34{,}890.78$ mg/kg

0193

Tier 2 Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan
90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12
Version: 6/27/2008

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->		--	USDA Soil Classification:	Loam			
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

1.846	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ps - Soil Particle Density			2.65 or; Site Specific
0.098	Θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θw - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL & Θ_T - RBCA: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0103	i - Hydraulic Gradient			Site Specific
0.721	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.884	d - Mixing Zone (m)	*9.884*	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific | 1.19E+00 cm/d | 4.35E+02 cm/yr | Use cm/d for R15, R19, & R26. cm/yr for R24
64.591	L - Source Length Parallel to Groundwater Flow (m)		feet = 211.9112	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
0.070	GW_{obj} - Groundwater Remediation Objective Class 1			0.07 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil\text{-}adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
51000	S - Solubility in Water			MTBE = 51,000
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure interval			Residential = 9.5 x10^8; Industrial/Commercial = 7.9 x 10^8; Construction Worker = 3.6 x 10^6
30	$T_{M\text{-}L}$ - Exposure Interval for Mall Limit Volatilization Factor Equation S26			30
70	$ED_{M\text{-}L}$ - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	$I_{M\text{-}L}$ - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.102	D_i - Diffusivity in Air			MTBE = 0.102
0.0241	H' - Henry's Law Constant			MTBE = 0.0241
1.10E-05	D_w - Diffusivity in Water			MTBE = 1.1 x 10^{-5}
25	AT - Average Time for Non-Carcinogens In Ingestion Equation			Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens In Inhalation Equation			Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient			1
3	RfC - Inhalation Reference Concentration			Chronic = 3; Subchronic = 3
0.01	RfD_o - Oral Reference Dose			Chronic = 0.01; Subchronic = 0.1
11.50	K_{oc} - Organic Carbon Partition Coefficient			MTBE = 11.5

Residential Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/\ 0.01 \times 250 \times 25 \times 50} = \frac{638750}{31.25} = \mathbf{20440} \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/\ 0.1 \times 30 \times 1 \times 480} = \frac{2938.25}{0.144} = \mathbf{20405} \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/\ 3 \times 1/\ 130274.6459} = \frac{9125}{0.015992} = \mathbf{570602.949} \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/\ 3 \times 1/\ 879.4225671} = \frac{41.975}{0.011371} = \mathbf{3691.376} \text{ mg/kg}$$

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Tier 2 Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan
90-0146 & 2004-0969

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{\left(3.14 \times 7.90E\text{-}07 \times 7.90E{+}08\right)^{1/2} \times 0.0001}{\left(2 \times 1.846 \times 7.90E\text{-}07\right)} = \frac{0.3798}{2.92E\text{-}06} = 130274.6459$$

Construction Worker

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{\left(3.14 \times 7.90E\text{-}07 \times 3.60E{+}06\right)^{1/2} \times 0.0001}{\left(2 \times 1.846 \times 7.90E\text{-}07\right)} = \frac{0.0256}{2.92E\text{-}06} = 8794.2257$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = \quad VF' = \frac{VF}{10} = \frac{8794.2257}{10} = 879.4226$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = \quad D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(4.37E\text{-}04 \times 0.102 \times 0.024) + (0.0052 \times 1.10E\text{-}05)}{0.0924} \times \frac{1}{(1.846 \times 8.2915) + 0.21 + (0.098 \times 0.024)} = 7.90E\text{-}07$$

Soil Component of the Migration to Groundwater Clanup Objective (Class 1)

$$S\text{-}17 = \quad C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b}\right] = 1.4 \times \left[8.2915 + \frac{(0.206 + 0.098 \times 0.024)}{1.846}\right] = 11.766 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = \quad C_w = DF \times GW_{obj} = 20.00 \times 0.070 = 1.4$$

Soil-Water Partition Coefficient

$$S\text{-}19 = \quad K_d = K_{oc} \times f_{oc} = 11.50 \times 0.721 = 8.2915$$

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Tier 2 Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Water-Filled Porosity

$$S\text{-}20 = \quad \Theta_w = \eta \times \left[\frac{I}{K_s}\right]^{1/(2b+3)} = 0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073} = 0.2065$$

Air-Filled Porosity

$$S\text{-}21 = \quad \Theta_a = \eta - \Theta_w = 0.30 - 0.21 = 0.0980$$

Dilution Factor

$$S\text{-}22 = \quad DF = 1 + \frac{K \times i \times d}{I \times L} = \frac{4.35 \times 0.0103 \times 9.884}{0.300 \quad 64.591} + 1 = 1.0229$$

GW Ingestion

$$S\text{-}23 = \quad \frac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 0 \times 365}{0.000 \times 1.000 \times 250 \times 25} = \frac{0.0E{+}00}{0} = \#DIV/0! \text{ mg/L}$$

Total Soil Porosity

$$S\text{-}24 = \quad \eta = 1 - \frac{\rho_b}{\rho_s} = 1 - \frac{1.846}{2.652} = 0.3039$$

Estimation of Mixing Zone Depth

$$S\text{-}25 = \quad d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\frac{(-L \times I)}{(K \times i \times d_a)}\right]$$

$$= (0.0112 \times 64.591^2)^{0.5} + 3.048 \times \left[1 - \exp\frac{(-64.591 \times 0.3)}{(4.352 \times 0.0103 \times 3.048)}\right] = 9.884 \text{ m}$$

Soil Saturation Limit

$$S\text{-}29 = \quad C_{sat} = \frac{S}{\rho_b} \times \{(K_d \times pb) + \Theta w + (H' \times \Theta a)\} = \frac{51000}{1.846} \times [(8.2915 \times 1.846) + 0.206 + (0.024 \times 0.098)] = 428{,}622.97 \text{ mg/kg}$$

0196

Tier 2 RBCA Industrial/Commercial Calculations for Benzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12

Version: 6/27/2008

Input Values

Holcomb's Bulk Density --> 0	Converted Value to be used in calculation sheet -->	--	USDA Soil Classification: Loam
Organic Matter (%) --> 0	FOC % (0.58 conversion) --> 0.000	Organic Matter (mg/kg) 0	FOC mg/kg (0.58 conversion) 0.000; foc conversion to g/g: 0.000
1.846	ρ_b - Dry Soil Bulk Density		1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ρs - Soil Particle Density		2.65 or; Site Specific
0.430	Θ_T - RBCA: Total Soil Porosity		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36
0.0103	i - Hydraulic Gradient		Site Specific
0.721	foc - Total Organic Carbon (g/g)		Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec = 1.38E-05	Site Specific; 1.19 cm/d; 435.20 cm/yr; Use cm/d for R15, R19, & R26. cm/yr for R24
100.000	d - Lower depth to surficial soil zone (cm)	feet =	Lower depth of surficial soil zone. Site-Specific not to exceed 100
1950.720	X - Distance along CL of GW Plume (cm)	feet = 10	Distance along the centerline of the groundwater plume emanating from a Source. The x direction is the direction of gw flow.
200.2	Sd - Source width - vertical plane (cm)	feet = 6.569	Source width perpendicular to groundwater flow direction in vertical plane
2590.0	W - Width of source area (cm)	feet = 80	Width of Source Area Parallel to Direction to Wind or Groundwater Movement
0.0009	λ - First Order Degradation Constant		Benzene = 0.0009
1.00	ρ_w - Water Density		1
0.142	w - Average soil moisture content		0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific
30.0	I - Infiltration Rate (cm/yr)		30 for Illinois
200.0	δ_{gw} - Groundwater Mixing Zone Thickness (cm)		200
70	BW - Body Weight		Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA =70
0.055	SF_o -Oral Slope Factor		Benzene = 0.055
1	IR_w -Daily Water Ingestion Rate		Residential = 2; Industrial/Commercial = 1
1.0E-06	TR - Target Cancer Risk		Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	AT_c -Average Time for Carcinogens		70
25	EF - Exposure Frequency		Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
30	ED - Exposure Duration for Inhalation fo Carcinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
0.088	D_i & D^{air}- Diffusivity in Air		Benzene = 0.088
0.228	H' - Henry's Law Constant		Benzene = 0.228
9.80E-06	D_w & D^{water}- Diffusivity in Water		Benzene = 9.8×10^{-6}
225	U_{air} - Average wind speed above ground surface in ambient mixing zone		225
200	δ_{air} - Ambient mixing zone height		200
100	L_s - Depth to subsurface soils		100
0.00860	RfD_i - Inhalation Reference Dose		IRIS/HEAST
0.0270	SF_i - Inhalation Cancer Slope Factor		IRIS/HEAST
0.0040	RfD_o - Oral Reference Dose		IRIS/HEAST
25	AT_n - Average time for noncacinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
6.90E-14	P_e - Particulate Emission Rate		6.9×10^{-14}
20	IR_{air} - Daily outdoor inhalation rate		20
50	IR_{soil} - Soil ingestion rate		Residential = 100; Industrial/Commercial = 50; Construction Worker = 480
3160	SA - Skin surface area		3160
0.5	M - Soil to Skin Adherence Factor		0.5
0.5	RAF_d - Dermal Relative Absorption		0.5; PNAs = 0.05; Inorganics = 0.00
1	RAF_o - Oral relative absorption factor		1
9.46E+08	τ - Average time for vapor flux		6.46×10^{8}
1	THQ - Target Hazard Quotient		1
58.90	K_{oc} - Organic Carbon Partition Coefficient		Benzene = 58.9

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Industrial/Commercial Remediation Objectives for Cacinogenic Contaminants

$$\text{R-1} = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times ([SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)])}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 250 \times 365}{25 \times 30 \times ([0.055 \times 0.000001 \times ((50 \times 1) + (3160 \times 0.5 \times 0.5))] + [0.0270 \times 20 \times (7.42E\text{-}06 + 3.97E\text{-}12)])} = \frac{6.38750}{3.77E\text{-}02} = 169.6245 \text{ mg/kg}$$

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Cacinogenic Contaminants

$$\text{R-1} = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times ([SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)])}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 250 \times 365}{30 \times 1 \times ([0.055 \times 0.000001 \times ((480 \times 1) + (3160 \times 0.5 \times 0.5))]}$$

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Tier 2 RBCA Industrial/Commercial Calculations for Benzene
KB Food & Gas/Sullivan
90-0146 & 2004-0969

$$+ [\ 0.0270 \times 20 \times (\ 7.42E\text{-}06 + 3.97E\text{-}12\ )] \qquad = \frac{6.38750}{2.22E\text{-}03} = 2882.7474 \text{ mg/kg}$$

0198

Tier 2 RBCA Industrial/Commercial Calculations for Benzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

R-3 = $VF_{ss} = \frac{2 \times W \times \rho_s \times 10^3}{U_{air} \times \delta_{air}} \sqrt{\frac{D^{eff}_s \times H'}{\pi \times [\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \tau}} = \frac{2 \times 2590.0 \times 1.846 \times 1000}{225 \times 200} \times$

$\sqrt{\frac{1.25E\text{-}03 \times 0.228}{3.1416 \times [\ 0.26213 + (\ 42.4669 \times 1.846\ ) + (\ 0.228 \times 0.168\ ]\times 9.46E{+}08}}$ = 7.4240E-06 kg/m3

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

R-4 = $VF_{ss} = \frac{W \times \rho_s \times d \times 10^3}{U_{air} \times \delta_{air} \times \tau} = \frac{2590.0 \times 1.846 \times 100.000 \times 1000}{225 \times 200 \times 9.46E{+}08} = \frac{478114000}{4.26E{+}13}$ = 1.123E-05 kg/m3

Volatilization Factor for surficial soils regarding particulates

R-5 = $VF_p = \frac{P_e \times W \times 10^3}{U_{air} \times \delta_{air}} = \frac{6.90E\text{-}14 \times 2590.0 \times 1000}{225 \times 200} = \frac{1.79E\text{-}07}{45000}$ = 3.9713E-12 kg/m3

Effective Diffusion Coefficient in Soil Based on Vapor-phase concentration

R-6 = $D_s^{eff} = \frac{D^{air} \times \theta_{as}^{3.33}}{\theta_T^2} + \frac{D^{water} \times \theta_{ws}^{3.33}}{H' \times \theta_T^2} = \frac{0.088 \times 2.625E\text{-}03}{0.184900} + \frac{9.80E\text{-}06 \times 0.0116}{0.228 \times 0.184900}$ = 0.00125206 cm2/s

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Industrial/Commercial Remediation Objectives for Carcinogenic Contaminants

R-7 = $\frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{15.7716 \times 0.001}{3.854E\text{-}06} = \frac{1.58E\text{-}02}{3.854E\text{-}06}$ = 4092.0612 mg/kg

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Construction Worker Remediation Objectives for Carcinogenic Contaminants

R-7 = $\frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{394.2901 \times 0.001}{3.854E\text{-}06} = \frac{3.94E\text{-}01}{3.854E\text{-}06}$ = 102301.5301 mg/kg

Residential Carcinogenic risk-based screening level for air

R-9 = $RBSL_{air} = \frac{TR \times BW \times AT_c \times 365 \times 10^3}{SF_i \times IR_{air} \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 250 \times 365 \times 1000}{0.027 \times 20 \times 25 \times 30} = \frac{6387.5}{405}$ = 15.77160 ug/m3

Construction Worker Carcinogenic risk-based screening level for air

R-9 = $RBSL_{air} = \frac{TR \times BW \times AT_c \times 365 \times 10^3}{SF_i \times IR_{air} \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 250 \times 365 \times 1000}{0.027 \times 20 \times 30 \times 1} = \frac{6387.5}{16.2}$ = 394.29012 ug/m3

Volatilization Factor - Subsurface Soil to Ambient Air

R-11 = $VF_{samb} = \frac{H' \times \rho_s \times 10^3}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times [1 + \frac{(U_{air} \times \delta_{air} \times L_s)}{(D_s^{eff} \times W)}]}$

$= \frac{0.228 \times 1.846 \times 1000}{[\ 0.2621 + (\ 42.4669 \times 1.846\ ) + (\ 0.228 \times 0.168\ )] \times [\ 1 + \frac{(\ 225 \times 200 \times 100\ )}{(\ 1.25206E\text{-}03 \times 2590.0\ )}]} = \frac{420.888}{109202548.7}$ = 0.000003854 (g/m3)/(mg/kg)

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Tier 2 RBCA Industrial/Commercial Calculations for Benzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Soil Component of the Groundwater Ingestion Exposure Route: Industrial/Commercial Remediation Objective

R-12 = $\frac{GW_{source}}{LF_{sw}}$ = $\frac{\#\#\#\#\#\#\#\#\#\#}{0.02319}$ = ############ mg/kg

Groundwater at the Source

R-13 = GW_{source} = $\frac{GW_{comp}}{C_{(x)}/C_{source}}$ = $\frac{0.15485}{1.0695E\text{-}09}$ = ############ mg/L

Leaching Factor

R-14 = LF_{sw} = $\frac{\rho_s}{[\Theta_{ws} + (k_s \times \rho_s) + (H' \times \Theta_{as})] \times [1 + \frac{(U_{gw} \times \delta_{gw})}{I \times W}]}$ = $\frac{1.846}{[0.26213 + (42.4669 \times 1.846) + (0.228 \times 0.168)]}$ → $\left[1 + \frac{(4 \times 200.0)}{(30.0 \times 2590.0)}\right]$ = 0.02319029

Steady-State Attenuation Along the Centerline of a Dissolved Plume

R-15 = $C_{(x)}/C_{source}$ = $\exp(X/2\alpha_x) \times (1\text{-}SQT(1+(4\lambda \times \alpha_x)/U))$ x $\mathrm{erf}\,[S_w/(4 \times SQT(\alpha_y \times X))]$ x $\mathrm{erf}\,[S_d/(2 \times SQT(\alpha_z \times X))]$

= $\exp\left[\left(\frac{1950.720}{390.144}\right)\left(1 - \sqrt{\left(1 + \frac{0.0036 \times 195.07}{0.02856}\right)}\right)\right]$ x

$\mathrm{erf}\left[\frac{5821.7}{4 \times \sqrt{(65.024 \times 1950.72)}}\right]$ x

$\mathrm{erf}\left[\frac{200.2}{2 \times \sqrt{(9.754 \times 1950.72)}}\right]$ = 1.0695E-09

Longitudinal Dispersivity

R-16 = α_x = 0.10 x X = 0.1 x 1950.720 195.07200 cm

Transverse Dispersivity

R-17 = α_y = $\frac{\alpha_x}{3}$ = $\frac{195.07}{3}$ = 65.02400 cm

Vertical Dispersivity

R-18 = α_z = $\frac{\alpha_x}{20}$ = $\frac{195.07}{20}$ = 9.75360 cm

Specific Discharge

R-19 = U = $\frac{K \times i}{\Theta_T}$ = $\frac{1.192 \times 0.0103}{0.43000}$ = 0.02856 cm/d

0200

Tier 2 RBCA Industrial/Commercial Calculations for Benzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Soil-Water Sorption Coefficient

R-20 = $k_s = K_{oc} \times f_{oc} = 58.90 \times 0.721000 = 42.4669$

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \dfrac{(w \times \rho_s)}{\rho_w} = 0.430 - \dfrac{0.14 \times 1.846}{1.00} = 0.168$

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \dfrac{w \times \rho_s}{\rho_w} = \dfrac{0.14 \times 1.846}{1.00} = 0.26213$

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws} = 0.168 + 0.26213 = 0.430$

Industrial/Commercial Carcinogenic Groundwater Ingestion

R-25 = $\dfrac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED} = \dfrac{1.0E\text{-}06 \times 70 \times 250 \times 365}{0.055 \times 1 \times 25 \times 30} = \dfrac{6.38750}{41.25} = 0.15485$ mg/L

Construction Worker Carcinogenic Groundwater Ingestion

R-25 = $\dfrac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED} = \dfrac{1.0E\text{-}06 \times 70 \times 250 \times 365}{0.055 \times 1 \times 30 \times 1} = \dfrac{6.38750}{1.65} = 3.87121$ mg/L

0201

Tier 2 RBCA Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan
90-0148 & 2004-0969

Date Compiled: 04/03/12
Version: 6/27/2008

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->		–	USDA Soil Classification:	Loam		
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg) 0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

1.846	ρ_b - Dry Soil Bulk Density		1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ρs - Soil Particle Density		2.65 or; Site Specific
0.430	RBCA: Total Soil Porosity		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36
0.0103	i - Hydraulic Gradient		Site Specific
0.721	foc - Total Organic Carbon (g/g)		Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec = 1.38E-05	Site Specific 1.19 cm/d 435.20 cm/yr Use cm/d for R15, R19, & R26. cm/yr for R24
100.000	d - Lower depth to surficial soil zone (cm)	feet =	Lower depth of surficial soil zone. Site-Specific not to exceed 100
1950.720	X - Distance along CL of GW Plume (cm)	feet = 10	Distance along the centerline of the groundwater plume emanating from a Source. The x direction is the direction of gw flow.
200.2	Sd - Source width - vertical plane (cm)	feet = 6.569	Source width perpendicular to groundwater flow direction in vertical plane
2590.0	W - Width of source area (cm)	feet = 80	Width of Source Area Parallel to Direction to Wind or Groundwater Movement
0.0110	λ - First Order Degradation Constant		Toluene = 0.011
1.00	ρ_w - Water Density		1
0.100	w - Average soil moisture content		0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific
30.0	I - Infiltration Rate (cm/yr)		30 for Illinois
200.0	δ_{gw} - Groundwater Mixing Zone Thickness (cm)		200
70	BW - Body Weight		Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA =70
NA	SF_o -Oral Slope Factor		Toluene =
1	IR_w -Daily Water Ingestion Rate		Residential = 2; Industrial/Commercial = 1
1.0E-06	TR - Target Cancer Risk		Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
70	AT_c -Average Time for Carcinogens		70
250	EF - Exposure Frequency		Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation fo Carcinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
0.087	D_i & D^{air}- Diffusivity in Air		Toluene = 0.087
0.272	H' - Henry's Law Constant		Toluene = 0.272
8.60E-06	D_w & D^{water}- Diffusivity in Water		Toluene = 8.6×10^{-6}
225	U_{air} - Average wind speed above ground surface in ambient mixing zone		225
200	δ_{air} - Ambient mixing zone height		200
100	L_s - Depth to subsurface soils		100
	RfD_i - Inhalation Reference Dose		IRIS/HEAST
	SF_i - Inhalation Cancer Slope Factor		IRIS/HEAST
0.0800	RfD_o - Oral Reference Dose		IRIS/HEAST
25	AT_n - Average time for noncacinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
6.90E-14	P_e - Particulate Emission Rate		6.9×10^{-14}
20	IR_{air} - Daily outdoor inhalation rate		20
50	IR_{soil} - Soil ingestion rate		Residential = 100; Industrial/Commercial = 50; Construction Worker = 480
3160	SA - Skin surface area		3160
0.5	M - Soil to Skin Adherence Factor		0.5
0.5	RAF_d - Dermal Relative Absorption		0.5; PNAs = 0.05; Inorganics = 0.00
1	RAF_o - Oral relative absorption factor		1
9.46E+08	τ - Average time for vapor flux		6.46×10^8
1	THQ - Target Hazard Quotient		1
182.00	K_{oc} - Organic Carbon Partition Coefficient		Toluene = 182.0

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Residential Remediation Objectives for Cacinogenic Contaminants

$$\text{R-1} = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times \{[SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)]\}}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{250 \times 25 \times \{[\text{NA} \times 0.000001 \times ((50 \times 1) + (3160 \times 0.5 \times 0.5))] + [0.0000 \times 20 \times (8.63E\text{-}06 + 3.97E\text{-}12)]\}}$$

$$= \frac{1.78850}{\#VALUE!} = \#VALUE! \text{ mg/kg}$$

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Cacinogenic Contaminants

$$\text{R-1} = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times \{[SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)]\}}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{30 \times 1 \times \{[\text{NA} \times 0.000001 \times ((480 \times 1) + (3160 \times 0.5 \times 0.5))]}$$

0202

Tier 2 RBCA Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan

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+ [0.0000 x 20 x (8.63E-06 + 3.97E-12)]]

= 1.78850 / #VALUE! = #VALUE! mg/kg

Tier 2 RBCA Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan

90-0148 & 2004-0969

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Industrial/Commercial Remediation Objectives for Non-Cacinogenic Contaminants

$$R\text{-}2 = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED \times \left[\frac{10^{-6} \times [(IR_{soil} \times RAF_o)+(SA \times M \times RAF_d)]}{RfD_o} + \frac{IR_{air} \times (VF_{ss} + VF_p)}{RfD_i}\right]}$$

$$= \frac{1 \times 70 \times 25 \times 365}{250 \times 25 \times \left[\frac{1.E\text{-}06 \times [(50 \times 1)+(3160 \times 0.5 \times 0.5)}{0.0800} + \frac{20 \times (8.63E\text{-}06 + 3.9713E\text{-}12)}{0.00000}\right]} = \frac{638750}{\#DIV/0!} = \#DIV/0! \text{ mg/kg}$$

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Non-Cacinogenic Contaminants

$$R\text{-}2 = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED \times \left[\frac{10^{-6} \times [(IR_{soil} \times RAF_o)+(SA \times M \times RAF_d)]}{RfD_o} + \frac{IR_{air} \times (VF_{ss} + VF_p)}{RfD_i}\right]}$$

$$= \frac{1 \times 70 \times 0 \times 365}{30 \times 1 \times \left[\frac{1.E\text{-}06 \times [(480 \times 1)+(3160 \times 0.5 \times 0.5)}{0.0800} + \frac{20 \times (8.63E\text{-}06 + 3.9713E\text{-}12)}{0.00000}\right]} = \frac{2938.25}{\#DIV/0!} = \#DIV/0! \text{ mg/kg}$$

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

$$R\text{-}3 = \quad VF_{ss} = \frac{2 \times W \times \rho_s \times 10^3}{U_{air} \times \delta_{air}} \sqrt{\frac{D^{eff}_s \times H'}{\pi \times [\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \tau}} = \frac{2 \times 2590.0 \times 1.846 \times 1000}{225 \times 200} \times$$

$$\sqrt{\frac{4.37E\text{-}03 \times 0.272}{3.1416 \times \{0.18460 + (131.222 \times 1.846) + (0.272 \times 0.245\} \times 9.46E\text{+}08}} = 8.6344E\text{-}06 \text{ kg/m3}$$

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

$$R\text{-}4 = \quad VF_{ss} = \frac{W \times \rho_s \times d \times 10^3}{U_{air} \times \delta_{air} \times \tau} = \frac{2590.0 \times 1.846 \times 100.000 \times 1000}{225 \times 200 \times 9.46E\text{+}08} = \frac{478114000}{4.26E\text{+}13} = 1.123E\text{-}05 \text{ kg/m3}$$

Volatilization Factor for surficial soils regarding particulates

$$R\text{-}5 = \quad VF_p = \frac{P_e \times W \times 10^3}{U_{air} \times \delta_{air}} = \frac{6.90E\text{-}14 \times 2590.0 \times 1000}{225 \times 200} = \frac{1.79E\text{-}07}{45000} = 3.9713E\text{-}12 \text{ kg/m3}$$

Effective Diffusion Coefficient in Soil Based on Vapor-phase concentration

$$R\text{-}6 = \quad D_s^{eff} = \frac{D^{air} \times \theta_{as}^{3.33}}{\theta_T^2} + \frac{D^{water} \times \theta_{ws}^{3.33}}{H' \times \theta_T^2} = \frac{0.087 \times 9.296E\text{-}03}{0.184900} + \frac{8.60E\text{-}06 \times 0.0036}{0.272 \times 0.184900} = 0.00437447 \text{ cm2/s}$$

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Industrial/Commercial Remediation Objectives for Non-Carcinogenic Contaminants

$$R\text{-}8 = \frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{0.0000 \times 0.001}{5.213E\text{-}06} = \frac{0.00E\text{+}00}{5.213E\text{-}06} = 0.0000 \text{ mg/kg}$$

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Construction Worker Remediation Objectives for Non-Carcinogenic Contaminants

$$R\text{-}8 = \frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{0.0000 \times 0.001}{5.213E\text{-}06} = \frac{0.00E\text{+}00}{5.213E\text{-}06} = 0.0000 \text{ mg/kg}$$

Noncarcinogenic Residential risk-based screening level for air

$$R\text{-}10 = \quad RBSL_{air} = \frac{THQ \times RfD_i \times BW \times AT_n \times 365 \times 10^3}{IR_{air} \times EF \times ED} = \frac{1 \times 0 \times 70 \times 25 \times 365 \times 1000}{20 \times 250 \times 25} = 0.0000 \text{ ug/m3}$$

0204

Tier 2 RBCA Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Noncarcinogenic Construction Worker risk-based screening level for air

$$\text{R-10} = \quad RBSL_{air} = \frac{THQ \times RfD_i \times BW \times AT_n \times 365 \times 10^3}{IR_{air} \times EF \times ED} = \frac{1 \times 0 \times 70 \times 0.115 \times 365 \times 1000}{20 \times 30 \times 1} = 0.0000 \text{ ug/m3}$$

Volatilization Factor - Subsurface Soil to Ambient Air

$$\text{R-11} = \quad VF_{samb} = \frac{H' \times \rho_s \times 10^3}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times [1 + \frac{(U_{air} \times \delta_{air} \times L_s)}{(D_s^{eff} \times W)}]}$$

$$= \frac{0.272 \times 1.846 \times 1000}{[0.1846 + (131.222 \times 1.846) + (0.272 \times 0.245)] \times [1 + \frac{(225 \times 200 \times 100)}{(4.37447E\text{-}03 \times 2590.0)}]} = \frac{502.112}{96311204.78} = 0.000005213 \text{ (g/m3)/(mg/kg)}$$

Soil Component of the Groundwater Ingestion Exposure Route: Industrial/Commercial Remediation Objective

$$\text{R-12} = \frac{GW_{source}}{LF_{sw}} = \frac{\#VALUE!}{0.00753} = \#VALUE! \text{ mg/kg}$$

Soil Component of the Groundwater Ingestion Exposure Route: Construction Worker Remediation Objective

$$\text{R-12} = \frac{GW_{source}}{LF_{sw}} = \frac{\#VALUE!}{0.00753} = \#VALUE! \text{ mg/kg}$$

Residential Groundwater at the Source

$$\text{R-13} = \quad GW_{source} = \frac{GW_{comp}}{C_{(x)}/C_{source}} = \frac{\#VALUE!}{2.02736E\text{-}36} = \#VALUE! \text{ mg/L}$$

Construction Worker Groundwater at the Source

$$\text{R-13} = \quad GW_{source} = \frac{GW_{comp}}{C_{(x)}/C_{source}} = \frac{\#VALUE!}{2.02736E\text{-}36} = \#VALUE! \text{ mg/L}$$

Leaching Factor

$$\text{R-14} = \quad LF_{sw} = \frac{\rho_s}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times [1 + \frac{(U_{gw} \times \delta_{gw})}{I \times W}]} = \frac{1.846}{[0.18460 + (131.222 \times 1.846) + (0.272 \times 0.245)] \times [1 + \frac{(4 \times 200.0)}{(30.0 \times 2590.0)}]} = 0.00752594$$

Steady-State Attenuation Along the Centerline of a Dissolved Plume

$$\text{R-15} = \quad C_{(x)}/C_{source} = \exp\left(X/2\alpha_x\right) \times \left(1 - SQT(1 + (4\lambda \times \alpha_x)/U)\right) \times erf\left[S_w/(4 \times SQT(\alpha_y \times X))\right] \times erf\left[S_d/(2 \times SQT(\alpha_z \times X))\right]$$

$$= \exp\left[\left(\frac{1950.720}{390.144}\right)\left(1 - \sqrt{\left(1 + \frac{0.044 \times 195.07}{0.02856}\right)}\right)\right] \times erf\left[\frac{5821.7}{4 \times \sqrt{(65.024 \times 1950.72)}}\right] \times erf\left[\frac{200.2}{2 \times \sqrt{(9.754 \times 1950.72)}}\right] = 2.0274E\text{-}36$$

0205

Tier 2 RBCA Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan

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Longitudinal Dispersivity

R-16 = α_x = 0.10 x X = 0.1 x 1950.720 = 195.07200 cm

Transverse Dispersivity

R-17 = α_y = $\frac{\alpha_x}{3}$ = $\frac{195.07}{3}$ = 65.02400 cm

Vertical Dispersivity

R-18 = α_z = $\frac{\alpha_x}{20}$ = $\frac{195.07}{20}$ = 9.75360 cm

Specific Discharge

R-19 = U = $\frac{K \times i}{\theta_T}$ = $\frac{1.192 \times 0.0103}{0.43000}$ = 0.02856 cm/d

Soil-Water Sorption Coefficient

R-20 = k_s = $K_{oc} \times f_{oc}$ = 182.00 x 0.721000 = 131.222

Volumetric Air Content in Vadose Zone Soils

R-21 = θ_{as} = $\theta_T - \frac{(w \times \rho_s)}{\rho_w}$ = $0.430 - \frac{0.10 \times 1.846}{1.00}$ = 0.245

Volumetric Water Content in Vadose Zone Soils

R-22 = θ_{ws} = $\frac{w \times \rho_s}{\rho_w}$ = $\frac{0.10 \times 1.846}{1.00}$ = 0.18460

Total Soil Porosity

R-23 = θ_T = $\theta_{as} + \theta_{ws}$ = 0.245 + 0.18460 = 0.430

Groundwater Darcy Velocity

R-24 = U_{gw} = K x i = 435.20 x 0.0103 = 4.48 cm/y

Industrial/Commercial Carcinogenic Groundwater Ingestion

R-25 = $\frac{TR \times BW \times AT_c \times 365}{Sf_o \times IR_w \times EF \times ED}$ = $\frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{NA \times 1 \times 250 \times 25}$ = $\frac{1.78850}{\#VALUE!}$ = #VALUE! mg/L

Construction Worker Carcinogenic Groundwater Ingestion

R-25 = $\frac{TR \times BW \times AT_c \times 365}{Sf_o \times IR_w \times EF \times ED}$ = $\frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{NA \times 1 \times 30 \times 1}$ = $\frac{1.78850}{\#VALUE!}$ = #VALUE! mg/L

0206

Tier 2 RBCA Industrial/Commercial Calculations for Ethylbenzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12

Version: 6/27/2008

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->		--	USDA Soil Classification:	Loam		
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g: 0.000

1.846	ρ_b - Dry Soil Bulk Density		1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ps - Soil Particle Density		2.65 or; Site Specific
0.430	Θ_T - RBCA Total Soil Porosity		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36
0.0103	i - Hydraulic Gradient		Site Specific
0.721	foc - Total Organic Carbon (g/g)		Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec = 1.38E-05	Site Specific | 1.19 cm/d | 435.20 cm/yr | Use cm/d for R15, R19, & R26. cm/yr for R24
100.000	d - Lower depth to surficial soil zone (cm)	feet =	Lower depth of surficial soil zone. Site-Specific not to exceed 100
1950.720	X - Distance along CL of GW Plume (cm)	feet = 10	Distance along the centerline of the groundwater plume emanating from a Source. The x direction is the direction of gw flow.
200.2	Sd - Source width - vertical plane (cm)	feet = 6.569	Source width perpendicular to groundwater flow direction in vertical plane
2590.0	W - Width of source area (cm)	feet = 80	Width of Source Area Parallel to Direction to Wind or Groundwater Movement
0.0030	λ - First Order Degradation Constant		Ethylbenzene = 0.003
1.00	ρ_w - Water Density		1
0.100	w - Average soil moisture content		0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific
30.0	I - Infiltration Rate (cm/yr)		30 for Illinois
200.0	δ_{gw} - Groundwater Mixing Zone Thickness (cm)		200
70	BW - Body Weight		Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA =70
NA	SF_o -Oral Slope Factor		Ethylbenzene =
1	IR_w -Daily Water Ingestion Rate		Residential = 2; Industrial/Commercial = 1
1.0E-06	TR - Target Cancer Risk		Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
70	AT_c -Average Time for Carcinogens		70
250	EF - Exposure Frequency		Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation fo Carcinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
0.075	D_i & D^{air}- Diffusivity in Air		Ethylbenzene = 0.075
0.323	H' - Henry's Law Constant		Ethylbenzene = 0.323
7.80E-06	D_w & D^{water}- Diffusivity in Water		Ethylbenzene = 7.8×10^{-6}
225	U_{air} - Average wind speed above ground surface in ambient mixing zone		225
200	δ_{air} - Ambient mixing zone height		200
100	L_s - Depth to subsurface soils		100
	RfD_i - Inhalation Reference Dose		IRIS/HEAST
	SF_i - Inhalation Cancer Slope Factor		IRIS/HEAST
0.1000	RfD_o - Oral Reference Dose		IRIS/HEAST
25	AT_n - Average time for noncacinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
6.90E-14	P_e - Particulate Emission Rate		6.9×10^{-14}
20	IR_{air} - Daily outdoor inhalation rate		20
50	IR_{soil} - Soil ingestion rate		Residential = 100; Industrial/Commercial = 50; Construction Worker = 480
3160	SA - Skin surface area		3160
0.5	M - Soil to Skin Adherence Factor		0.5
0.5	RAF_d - Dermal Relative Absorption		0.5; PNAs = 0.05; Inorganics = 0.00
1	RAF_o - Oral relative absorption factor		1
9.46E+08	τ - Average time for vapor flux		6.46×10^8
1	THQ - Target Hazard Quotient		1
363.00	K_{oc} - Organic Carbon Partition Coefficient		Ethylbenzene = 363

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Residential Remediation Objectives for Cacinogenic Contaminants

$$\text{R-1} = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times \{[SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)]\}}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{250 \times 25 \times \{[NA \times 0.000001 \times ((50 \times 1) + (3160 \times 0.5 \times 0.5))] + [0.0000 \times 20 \times (6.19E\text{-}06 + 3.97E\text{-}12)]\}} = \frac{1.78850}{\#VALUE!} = \#VALUE! \text{ mg/kg}$$

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Cacinogenic Contaminants

$$\text{R-1} = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times \{[SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)]\}}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{30 \times 1 \times \{[NA \times 0.000001 \times ((480 \times 1) + (3160 \times 0.5 \times 0.5))]}$$

0207

Tier 2 RBCA Industrial/Commercial Calculations for Ethylbenzene
KB Food & Gas/Sullivan
90-0146 & 2004-0969

+ [0.0000 x 20 x (6.19E-06 + 3.97E-12)]} = 1.78850 / #VALUE! = #VALUE! mg/kg

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Industrial/Commercial Remediation Objectives for Non-Cacinogenic Contaminants

$$R\text{-}2 = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED \times \left[\frac{10^{-6} \times [(IR_{soil} \times RAF_o) + (SA \times M \times RAF_d)]}{RfD_o} + \frac{IR_{air} \times (VF_{ss} + VF_p)}{RfD_i} \right.}$$

$$= \frac{1 \times 70 \times 25 \times 365}{250 \times 25 \times \left[\frac{1.E\text{-}06 \times [(50 \times 1) + (3160 \times 0.5 \times 0.5)]}{0.1000} + \frac{20 \times (6.19E\text{-}06 + 3.9713E\text{-}12)}{0.00000} \right.} = \frac{638750}{\#DIV/0!} = \#DIV/0! \text{ mg/kg}$$

0208

Tier 2 RBCA Industrial/Commercial Calculations for Ethylbenzene

KB Food & Gas/Sullivan
90-0146 & 2004-0969

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Non-Cacinogenic Contaminants

$$R\text{-}2 = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED \times \left[\frac{10^{-6} \times \{(IR_{soil} \times RAF_o) + (SA \times M \times RAF_d)\}}{RfD_o} + \frac{IR_{air} \times (VF_{ss} + VF_p)}{RfD_i}\right]}$$

$$= \frac{1 \times 70 \times 365}{30 \times 1 \times \left[\frac{0.115}{0.0030} \times \frac{1.E\text{-}06}{} \times \{(480 \times 1) + (3160 \times 0.5 \times 0.5)\} + \frac{20 \times (6.19E\text{-}06 + 3.9713E\text{-}12)}{0.00000}\right]} = \frac{2938.25}{\#DIV/0!} = \#DIV/0! \text{ mg/kg}$$

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

$$R\text{-}3 = VF_{ss} = \frac{2 \times W \times \rho_s \times 10^3}{U_{air} \times \delta_{air}} \sqrt{\frac{D^{eff}_s \times H'}{\pi \times [\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \tau}} = \frac{2 \times 2590.0 \times 1.846 \times 1000}{225 \times 200} \times$$

$$\sqrt{\frac{3.77E\text{-}03 \times 0.323}{3.1416 \times [0.18460 + (261.723 \times 1.846) + (0.323 \times 0.245)] \times 9.46E\text{+}08}} = 6.1873E\text{-}06 \text{ kg/m3}$$

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

$$R\text{-}4 = VF_{ss} = \frac{W \times \rho_s \times d \times 10^3}{U_{air} \times \delta_{air} \times \tau} = \frac{2590.0 \times 1.846 \times 100.000 \times 1000}{225 \times 200 \times 9.46E\text{+}08} = \frac{478114000}{4.26E\text{+}13} = 1.123E\text{-}05 \text{ kg/m3}$$

Volatilization Factor for surficial soils regarding particulates

$$R\text{-}5 = VF_p = \frac{P_e \times W \times 10^3}{U_{air} \times \delta_{air}} = \frac{6.90E\text{-}14 \times 2590.0 \times 1000}{225 \times 200} = \frac{1.79E\text{-}07}{45000} = 3.9713E\text{-}12 \text{ kg/m3}$$

Effective Diffusion Coefficient in Soil Based on Vapor-phase concentration

$$R\text{-}6 = D_s^{eff} = \frac{D^{air} \times \theta_{as}^{3.33}}{\theta_T^2} + \frac{D^{water} \times \theta_{ws}^{3.33}}{H' \times \theta_T^2} = \frac{0.075 \times 9.296E\text{-}03}{0.184900} + \frac{7.80E\text{-}06 \times 0.0036}{0.323 \times 0.184900} = 0.00377104 \text{ cm2/s}$$

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Industrial/Commercial Remediation Objectives for Non-Carcinogenic Contaminants

$$R\text{-}8 = \frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{0.0000 \times 0.001}{2.677E\text{-}06} = \frac{0.00E\text{+}00}{2.677E\text{-}06} = 0.0000 \text{ mg/kg}$$

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Construction Worker Remediation Objectives for Non-Carcinogenic Contaminants

$$R\text{-}8 = \frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{\#DIV/0! \times 0.001}{2.677E\text{-}06} = \frac{\#DIV/0!}{2.677E\text{-}06} = \#DIV/0! \text{ mg/kg}$$

Noncarcinogenic Industrial/Commercial risk-based screening level for air

$$R\text{-}10 = RBSL_{air} = \frac{THQ \times RfD_i \times BW \times AT_n \times 365 \times 10^3}{IR_{air} \times EF \times ED} = \frac{1 \times 0 \times 70 \times 25 \times 365 \times 1000}{20 \times 250 \times 25} = 0.0000 \text{ ug/m3}$$

Noncarcinogenic Construction Worker risk-based screening level for air

$$R\text{-}10 = RBSL_{air} = \frac{THQ \times RfD_i \times BW \times AT_n \times 365 \times 10^3}{IR_{air} \times EF \times ED} = \frac{1 \times 0 \times 70 \times 0 \times 365 \times 1000}{20 \times 30 \times 1} = 0.0000 \text{ ug/m3}$$

Volatilization Factor - Subsurface Soil to Ambient Air

$$R\text{-}11 = VF_{samb} = \frac{H' \times \rho_s \times 10^3}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \left[1 + \frac{U_{air} \times \delta_{air} \times L_s}{D_s^{eff} \times W}\right]}$$

0209

Tier 2 RBCA Industrial/Commercial Calculations for Ethylbenzene

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$$= \frac{0.323 \times 1.846 \times 1000}{[0.1846 + (261.723 \times 1.846) + (0.323 \times 0.245)] \times [1 + \frac{(225 \times 200 \times 100)}{(3.77104E\text{-}03 \times 2590.0)}]} = \frac{596.258}{222722240.7} = 0.000002677 \text{ (g/m3)/(mg/kg)}$$

Soil Component of the Groundwater Ingestion Exposure Route: Industrial/Commercial Remediation Objective

$$\text{R-12} = \frac{GW_{source}}{LF_{sw}} = \frac{\#VALUE!}{0.00378} = \#VALUE! \text{ mg/kg}$$

Soil Component of the Groundwater Ingestion Exposure Route: Construction Worker Remediation Objective

$$\text{R-12} = \frac{GW_{source}}{LF_{sw}} = \frac{\#VALUE!}{0.00378} = \#VALUE! \text{ mg/kg}$$

Residential Groundwater at the Source

$$\text{R-13} = GW_{source} = \frac{GW_{comp}}{C_{(x)}/C_{source}} = \frac{\#VALUE!}{1.7182E\text{-}18} = \#VALUE! \text{ mg/L}$$

Construction Groundwater at the Source

$$\text{R-13} = GW_{source} = \frac{GW_{comp}}{C_{(x)}/C_{source}} = \frac{\#VALUE!}{1.7182E\text{-}18} = \#VALUE! \text{ mg/L}$$

Leaching Factor

$$\text{R-14} = LF_{sw} = \frac{\rho_s}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times [1 + \frac{(U_{gw} \times \delta_{gw})}{I \times W}]} = \frac{1.846}{[0.18460 + (261.723 \times 1.846) + (0.323 \times 0.245)] \times [1 + \frac{(4 \times 200.0)}{(30.0 \times 2590.0)}]} = 0.00377519$$

Steady-State Attenuation Along the Centerline of a Dissolved Plume

$$\text{R-15} = C_{(x)}/C_{source} = \exp(X/2\alpha_x) \times (1\text{-SQT}(1+(4\lambda \times \alpha_x)/U)) \times \text{erf}[S_w/(4 \times \text{SQT}(\alpha_y \times X))] \times \text{erf}[S_d/(2 \times \text{SQT}(\alpha_z \times X))]$$

$$= \exp\left[\left(\frac{1950.720}{390.144}\right)\left(1 - \sqrt{\left(1 + \frac{0.012 \times 195.07}{0.02856}\right)}\right)\right] \times \text{erf}\left[\frac{5821.7}{4 \times \sqrt{(65.024 \times 1950.72)}}\right] \times \text{erf}\left[\frac{200.2}{2 \times \sqrt{(9.754 \times 1950.72)}}\right] = 1.7182E\text{-}18$$

Longitudinal Dispersivity

$$\text{R-16} = \alpha_x = 0.10 \times X = 0.1 \times 1950.720 \quad 195.07200 \text{ cm}$$

Transverse Dispersivity

$$\text{R-17} = \alpha_y = \frac{\alpha_x}{3} = \frac{195.07}{3} = 65.02400 \text{ cm}$$

0210

Tier 2 RBCA Industrial/Commercial Calculations for Ethylbenzene

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90-0146 & 2004-0969

Vertical Dispersivity

R-18 = $\alpha_z = \dfrac{\alpha_x}{20} = \dfrac{195.07}{20} = 9.75360$ cm

Specific Discharge

R-19 = $U = \dfrac{K \times I}{\theta_T} = \dfrac{1.192 \times 0.0103}{0.43000} = 0.02856$ cm/d

Soil-Water Sorption Coefficient

R-20 = $k_s = K_{oc} \times f_{oc} = 363.00 \times 0.721000 = 261.723$

Volumetric Air Content In Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \dfrac{(w \times \rho_s)}{\rho_w} = 0.430 - \dfrac{0.10 \times 1.846}{1.00} = 0.245$

Volumetric Water Content In Vadose Zone Soils

R-22 = $\theta_{ws} = \dfrac{w \times \rho_s}{\rho_w} = \dfrac{0.10 \times 1.846}{1.00} = 0.18460$

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws} = 0.245 + 0.18460 = 0.430$

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times I = 435.20 \times 0.0103 = 4.48$ cm/y

Industrial/Commercial Carcinogenic Groundwater Ingestion

R-25 = $\dfrac{TR \times BW \times AT_c \times 365}{Sf_o \times IR_w \times EF \times ED} = \dfrac{1.0E\text{-}06 \times 70 \times 70 \times 365}{NA \times 1 \times 250 \times 25} = \dfrac{1.78850}{\#VALUE!} = \#VALUE!$ mg/L

Construction Worker Carcinogenic Groundwater Ingestion

R-25 = $\dfrac{TR \times BW \times AT_c \times 365}{Sf_o \times IR_w \times EF \times ED} = \dfrac{1.0E\text{-}06 \times 70 \times 70 \times 365}{NA \times 1 \times 30 \times 1} = \dfrac{1.78850}{\#VALUE!} = \#VALUE!$ mg/L

0211

Tier 2 RBCA Industrial/Commercial Calculations for Total Xylenes

KB Food & Gas/Sullivan

90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12

Version: 6/27/2008

Input Values

Holcomb's Bulk Density --> 0	Converted Value to be used in calculation sheet -->	–	USDA Soil Classification: Loam
Organic Matter (%) --> 0	FOC % (0.58 conversion) --> 0.000	Organic Matter (mg/kg) 0	FOC mg/kg (0.58 conversion) 0.000; foc conversion to g/g: 0.000
1.646	ρ_b - Dry Soil Bulk Density		1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ρs - Soil Particle Density		2.65 or; Site Specific
0.430	Θ_T - RBCA: Total Soil Porosity		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36
0.0103	i - Hydraulic Gradient		Site Specific
0.721	foc - Total Organic Carbon (g/g)		Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec = 1.38E-05	Site Specific; 1.19 cm/d; 435.20 cm/yr; Use cm/d for R15, R19, & R26. cm/yr for R24
100.000	d - Lower depth to surficial soil zone (cm)	feet =	Lower depth of surficial soil zone. Site-Specific not to exceed 100
1950.720	X - Distance along CL of GW Plume (cm)	feet = 10	Distance along the centerline of the groundwater plume emanating from a Source. The x direction is the direction of gw flow.
200.2	Sd - Source width - vertical plane (cm)	feet = 6.569	Source width perpendicular to groundwater flow direction in vertical plane
2590.0	W - Width of source area (cm)	feet = 80	Width of Source Area Parallel to Direction to Wind or Groundwater Movement
0.0019	λ - First Order Degradation Constant		Total Xylenes = 0.0019
1.00	ρ_w - Water Density		1
0.100	w - Average soil moisture content		0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific
30.0	I - Infiltration Rate (cm/yr)		30 for Illinois
200.0	δ_{gw} - Groundwater Mixing Zone Thickness (cm)		200
70	BW - Body Weight		Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA =70
NA	SF_o -Oral Slope Factor		Total Xylenes =
1	IR_w -Daily Water Ingestion Rate		Residential = 2; Industrial/Commercial = 1
1.0E-06	TR - Target Cancer Risk		Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
70	AT_c -Average Time for Carcinogens		70
250	EF - Exposure Frequency		Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation fo Carcinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
0.072	D_i & D^{air}- Diffusivity in Air		Total Xylenes = 0.072
0.250	H' - Henry's Law Constant		Total Xylenes = 0.250
9.34E-06	D_w & D^{water}- Diffusivity in Water		Total Xylenes = 9.34 x 10^{-6}
225	U_{air} - Average wind speed above ground surface in ambient mixing zone		225
200	δ_{air} - Ambient mixing zone height		200
100	L_s - Depth to subsurface soils		100
	RfD_i - Inhalation Reference Dose		IRIS/HEAST
	SF_i - Inhalation Cancer Slope Factor		IRIS/HEAST
0.2000	RfD_o - Oral Reference Dose		IRIS/HEAST
25	AT_n - Average time for noncacinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
6.90E-14	P_e - Particulate Emission Rate		6.9 x 10^{-14}
20	IR_{air} - Daily outdoor inhalation rate		20
50	IR_{soil} - Soil ingestion rate		Residential = 100; Industrial/Commercial = 50; Construction Worker = 480
3160	SA - Skin surface area		3160
0.5	M - Soil to Skin Adherence Factor		0.5
0.5	RAF_d - Dermal Relative Absorption		0.5; PNAs = 0.05; Inorganics = 0.00
1	RAF_o - Oral relative absorption factor		1
9.46E+08	τ - Average time for vapor flux		9.46 x 10^8
1	THQ - Target Hazard Quotient		1
260.00	K_{oc} - Organic Carbon Partition Coefficient		Total Xylenes = 260

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Residential Remediation Objectives for Cacinogenic Contaminants

$$R\text{-}1 = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times ([SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o)) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)])}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{250 \times 25 \times ([NA \times 0.000001 \times ((50 \times 1) + (3160 \times 0.5 \times 0.5))] + [0.0000 \times 20 \times (6.30E\text{-}06 + 3.97E\text{-}12)])} = \frac{1.78850}{\#VALUE!} = \#VALUE! \text{ mg/kg}$$

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Cacinogenic Contaminants

$$R\text{-}1 = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times ([SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o)) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)])}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{30 \times 1 \times ([NA \times 0.000001 \times ((480 \times 1) + (3160 \times 0.5 \times 0.5))]}$$

Tier 2 RBCA Industrial/Commercial Calculations for Total Xylenes

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+ [0.0000 x 20 x (6.30E-06 + 3.97E-12)]] = 1.78850 / #VALUE! = #VALUE! mg/kg

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Tier 2 RBCA Industrial/Commercial Calculations for Total Xylenes

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Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Industrial/Commercial Remediation Objectives for Non-Cacinogenic Contaminants

$$\text{R-2} = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED \times \left[\frac{10^{-6} \times [(IR_{soil} \times RAF_o)+(SA \times M \times RAF_d)]}{RfD_o} + \frac{IR_{air} \times (VF_{ss} + VF_p)}{RfD_i} \right]}$$

$$= \frac{1 \times 70 \times 25 \times 365}{250 \times 25 \times \left[\frac{1.E\text{-}06}{0.2000} \times [(50 \times 1) + (3160 \times 0.5 \times 0.5)] + \frac{20}{0.00000} \times (6.30E\text{-}06 + 3.9713E\text{-}12) \right]} = \frac{638750}{\#DIV/0!} = \#DIV/0! \text{ mg/kg}$$

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Non-Cacinogenic Contaminants

$$\text{R-2} = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED \times \left[\frac{10^{-6} \times [(IR_{soil} \times RAF_o)+(SA \times M \times RAF_d)]}{RfD_o} + \frac{IR_{air} \times (VF_{ss} + VF_p)}{RfD_i} \right]}$$

$$= \frac{1 \times 70 \times 0.115 \times 365}{30 \times 1 \times \left[\frac{1.E\text{-}06}{0.2000} \times [(480 \times 1) + (3160 \times 0.5 \times 0.5)] + \frac{20}{0.00000} \times (6.30E\text{-}06 + 3.9713E\text{-}12) \right]} = \frac{2938.25}{\#DIV/0!} = \#DIV/0! \text{ mg/kg}$$

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

$$\text{R-3} = VF_{ss} = \frac{2 \times W \times \rho_s \times 10^3}{U_{air} \times \delta_{air}} \sqrt{\frac{D^{eff}_s \times H'}{\pi \times [\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \tau}} = \frac{2 \times 2590.0 \times 1.846 \times 1000}{225 \times 200} \times$$

$$\sqrt{\frac{3.62E\text{-}03 \times 0.250}{3.1416 \times [0.18460 + (187.46 \times 1.846) + (0.250 \times 0.245)] \times 9.46E{+}08}} = 6.3017E\text{-}06 \text{ kg/m3}$$

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

$$\text{R-4} = VF_{ss} = \frac{W \times \rho_s \times d \times 10^3}{U_{air} \times \delta_{air} \times \tau} = \frac{2590.0 \times 1.846 \times 100.000 \times 1000}{225 \times 200 \times 9.46E{+}08} = \frac{478114000}{4.26E{+}13} = 1.123E\text{-}05 \text{ kg/m3}$$

Volatilization Factor for surficial soils regarding particulates

$$\text{R-5} = VF_p = \frac{P_e \times W \times 10^3}{U_{air} \times \delta_{air}} = \frac{6.90E\text{-}14 \times 2590.0 \times 1000}{225 \times 200} = \frac{1.79E\text{-}07}{45000} = 3.9713E\text{-}12 \text{ kg/m3}$$

Effective Diffusion Coefficient in Soil Based on Vapor-phase concentration

$$\text{R-6} = D_s^{eff} = \frac{D^{air} \times \theta_{as}^{3.33}}{\theta_T^2} + \frac{D^{water} \times \theta_{ws}^{3.33}}{H' \times \theta_T^2} = \frac{0.072 \times 9.296E\text{-}03}{0.184900} + \frac{9.34E\text{-}06 \times 0.0036}{0.250 \times 0.184900} = 0.00362047 \text{ cm2/s}$$

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Industrial/Commercial Remediation Objectives for Non-Carcinogenic Contaminants

$$\text{R-8} = \frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{0.0000 \times 0.001}{2.777E\text{-}06} = \frac{0.00E{+}00}{2.777E\text{-}06} = 0.0000 \text{ mg/kg}$$

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Construction Worker Remediation Objectives for Non-Carcinogenic Contaminants

$$\text{R-8} = \frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{0.0000 \times 0.001}{2.777E\text{-}06} = \frac{0.00E{+}00}{2.777E\text{-}06} = 0.0000 \text{ mg/kg}$$

Noncarcinogenic Industrial/Commercial risk-based screening level for air

$$\text{R-10} = RBSL_{air} = \frac{THQ \times RfD_i \times BW \times AT_n \times 365 \times 10^3}{IR_{air} \times EF \times ED} = \frac{1 \times 0 \times 70 \times 25 \times 365 \times 1000}{20 \times 250 \times 25} = 0.0000 \text{ ug/m3}$$

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Tier 2 RBCA Industrial/Commercial Calculations for Total Xylenes

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90-0146 & 2004-0969

Noncarcinogenic Construction Worker risk-based screening level for air

R-10 = $RBSL_{air} = \frac{THQ \times RfD_i \times BW \times AT_n \times 365 \times 10^3}{IR_{air} \times EF \times ED} = \frac{1 \times 0 \times 70 \times 0 \times 365 \times 1000}{20 \times 30 \times 1}$ = 0.0000 ug/m3

Volatilization Factor - Subsurface Soil to Ambient Air

R-11 = $VF_{samb} = \frac{H' \times \rho_s \times 10^3}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \left[1 + \frac{(U_{air} \times \delta_{air} \times L_s)}{(D_s^{eff} \times W)}\right]}$

$= \frac{0.250 \times 1.846 \times 1000}{[0.1846 + (187.46 \times 1.846) + (0.250 \times 0.245)] \times \left[1 + \frac{(225 \times 200 \times 100)}{(3.62047E\text{-}03 \times 2590.0)}\right]} = \frac{461.5}{166187112.9}$ = 0.000002777 (g/m3)/(mg/kg)

Soil Component of the Groundwater Ingestion Exposure Route: Industrial/Commercial Remediation Objective

R-12 = $\frac{GW_{source}}{LF_{sw}} = \frac{\#VALUE!}{0.00527}$ = #VALUE! mg/kg

Soil Component of the Groundwater Ingestion Exposure Route: Construction Worker Remediation Objective

R-12 = $\frac{GW_{source}}{LF_{sw}} = \frac{\#VALUE!}{0.00527}$ = #VALUE! mg/kg

Residential Groundwater at the Source

R-13 = $GW_{source} = \frac{GW_{comp}}{C_{(x)}/C_{source}} = \frac{\#VALUE!}{1.6542E\text{-}14}$ = #VALUE! mg/L

Construction Worker Groundwater at the Source

R-13 = $GW_{source} = \frac{GW_{comp}}{C_{(x)}/C_{source}} = \frac{\#VALUE!}{1.6542E\text{-}14}$ = #VALUE! mg/L

Leaching Factor

R-14 = $LF_{sw} = \frac{\rho_s}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \left[1 + \frac{(U_{gw} \times \delta_{gw})}{I \times W}\right]} = \frac{1.846}{[0.18460 + (187.46 \times 1.846) + (0.250 \times 0.245)] \times \left[1 + \frac{(4 \times 200.0)}{(30.0 \times 2590.0)}\right]}$ = 0.00526988

Steady-State Attenuation Along the Centerline of a Dissolved Plume

R-15 = $C_{(x)}/C_{source} = \exp(X/2\alpha_x) \times (1 - SQT(1 + (4\lambda \times \alpha_x)/U)) \times \mathrm{erf}[S_w/(4 \times SQT(\alpha_y \times X))] \times \mathrm{erf}[S_d/(2 \times SQT(\alpha_z \times X))]$

$= \exp\left[\left(\frac{1950.720}{390.144}\right)\left(1 - \sqrt{\left(1 + \frac{0.0076 \times 195.07}{0.02856}\right)}\right)\right] \times \mathrm{erf}\left[\frac{5821.7}{4 \times \sqrt{(65.024 \times 1950.72)}}\right] \times \mathrm{erf}\left[\frac{200.2}{2 \times \sqrt{(9.754 \times 1950.72)}}\right]$ = 1.6542E-14

0215

Tier 2 RBCA Industrial/Commercial Calculations for Total Xylenes

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Longitudinal Dispersivity

R-16 = α_x = 0.10 x X = 0.1 x 1950.720 = 195.07200 cm

Transverse Dispersivity

R-17 = $\alpha_y = \frac{\alpha_x}{3} = \frac{195.07}{3}$ = 65.02400 cm

Vertical Dispersivity

R-18 = $\alpha_z = \frac{\alpha_x}{20} = \frac{195.07}{20}$ = 9.75360 cm

Specific Discharge

R-19 = $U = \frac{K \times i}{\theta_T} = \frac{1.192 \times 0.0103}{0.43000}$ = 0.02856 cm/d

Soil-Water Sorption Coefficient

R-20 = k_s = $K_{oc} \times f_{oc}$ = 260.00 x 0.721000 = 187.46

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_s)}{\rho_w}$ = $0.430 - \frac{0.10 \times 1.846}{1.00}$ = 0.245

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_s}{\rho_w} = \frac{0.10 \times 1.846}{1.00}$ = 0.18460

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws}$ = 0.245 + 0.18460 = 0.430

Groundwater Darcy Velocity

R-24 = U_{gw} = K x i = 435.20 x 0.0103 = 4.48 cm/y

Industrial/Commercial Carcinogenic Groundwater Ingestion

R-25 = $\frac{TR \times BW \times AT_c \times 365}{Sf_o \times IR_w \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{NA \times 1 \times 250 \times 25} = \frac{1.78850}{\#VALUE!}$ = #VALUE! mg/L

Construction Worker Carcinogenic Groundwater Ingestion

R-25 = $\frac{TR \times BW \times AT_c \times 365}{Sf_o \times IR_w \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{NA \times 1 \times 30 \times 1} = \frac{1.78850}{\#VALUE!}$ = #VALUE! mg/L

0216

Tier 2 RBCA Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan

90-0145 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/03/12

Version: 6/27/2008

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->			--	USDA Soil Classification:	Loam		
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

1.846	ρ_b - Dry Soil Bulk Density		1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ps - Soil Particle Density		2.65 or; Site Specific
0.430	Θ_T - RBCA: Total Soil Porosity		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36
0.0103	i - Hydraulic Gradient		Site Specific
0.721	foc - Total Organic Carbon (g/g)		Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec = 1.38E-05	Site Specific / 1.19 cm/d / 435.20 cm/yr / Use cm/d for R15, R19, & R26. cm/yr for R24
100.000	d - Lower depth to surficial soil zone (cm)	feet =	Lower depth of surficial soil zone. Site-Specific not to exceed 100
1950.720	X - Distance along CL of GW Plume (cm)	feet = 10	Distance along the centerline of the groundwater plume emanating from a Source. The x direction is the direction of gw flow.
200.2	Sd - Source width - vertical plane (cm)	feet = 6.569	Source width perpendicular to groundwater flow direction in vertical plane
2590.0	W - Width of source area (cm)	feet = 80	Width of Source Area Parallel to Direction to Wind or Groundwater Movement
0.0000	λ - First Order Degradation Constant		MTBE = 0.0
1.00	ρ_w - Water Density		1
0.100	w - Average soil moisture content		0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific
30.0	I - Infiltration Rate (cm/yr)		30 for Illinois
200.0	δ_{gw} - Groundwater Mixing Zone Thickness (cm)		200
70	BW - Body Weight		Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA =70
NA	SF_o -Oral Slope Factor		MTBE =
1	IR_w -Daily Water Ingestion Rate		Residential = 2; Industrial/Commercial = 1
1.0E-06	TR - Target Cancer Risk		Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
70	AT_c -Average Time for Carcinogens		70
250	EF - Exposure Frequency		Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation fo Carcinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
0.102	D_i & D^{air}- Diffusivity in Air		MTBE = 0.102
0.024	H' - Henry's Law Constant		MTBE = 0.024
1.10E-05	D_w & D^{water}- Diffusivity in Water		MTBE = 1.1 x 10^{-5}
225	U_{air} - Average wind speed above ground surface in ambient mixing zone		225
200	δ_{air} - Ambient mixing zone height		200
100	L_s - Depth to subsurface soils		100
	RfD_i - Inhalation Reference Dose		IRIS/HEAST
	SF_i - Inhalation Cancer Slope Factor		IRIS/HEAST
0.0100	RfD_o - Oral Reference Dose		IRIS/HEAST
30	AT_n - Average time for noncacinogens		Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
6.90E-14	P_e - Particulate Emission Rate		6.9 x 10^{-14}
20	IR_{air} - Daily outdoor inhalation rate		20
50	IR_{soil} - Soil ingestion rate		Residential = 100; Industrial/Commercial = 50; Construction Worker = 480
3160	SA - Skin surface area		3160
0.5	M - Soil to Skin Adherence Factor		0.5
0.5	RAF_d - Dermal Relative Absorption		0.5; PNAs = 0.05; Inorganics = 0.00
1	RAF_o - Oral relative absorption factor		1
9.46E+08	τ - Average time for vapor flux		6.46 x 10^{8}
1	THQ - Target Hazard Quotient		1
11.50	K_{oc} - Organic Carbon Partition Coefficient		MTBE = 11.5

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Residential Remediation Objectives for Cacinogenic Contaminants

$$R\text{-}1 = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times ([SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)])}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{250 \times 25 \times ([NA \times 0.000001 \times ((50 \times 1) + (3160 \times 0.5 \times 0.5))] + [0.0000 \times 20 \times (1.10E\text{-}05 + 3.97E\text{-}12)])} = \frac{1.78850}{\#VALUE!} = \#VALUE! \text{ mg/kg}$$

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Cacinogenic Contaminants

$$R\text{-}1 = \frac{TR \times BW \times AT_c \times 365}{EF \times ED \times ([SF_o \times 10^{-6} \times ((IR_{soil} \times RAF_o) + (SA \times M \times RAF_d))] + [SF_i \times IR_{air} \times (VF_{ss} + VF_p)])}$$

$$= \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{30 \times 1 \times ([NA \times 0.000001 \times ((480 \times 1) + (3160 \times 0.5 \times 0.5))]}$$

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Tier 2 RBCA Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan
90-0146 & 2004-0969

+ [0.0000 x 20 x (1.10E-05 + 3.97E-12)]] = 1.78850 / #VALUE! = #VALUE! mg/kg

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Tier 2 RBCA Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Industrial/Commercial Remediation Objectives for Non-Cacinogenic Contaminants

$$R\text{-}2 = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED \times \left[\frac{10^{-6} \times [(IR_{soil} \times RAF_o)+(SA \times M \times RAF_d)]}{RfD_o} + \frac{IR_{air} \times (VF_{ss} + VF_p)}{RfD_i}\right]}$$

$$= \frac{1 \times 70 \times 30 \times 365}{250 \times 25 \times \left[\frac{1.E\text{-}06}{0.0100} \times [(50 \times 1) + (3160 \times 0.5 \times 0.5)] + \frac{20}{0.00000} \times (1.10E\text{-}05 + 3.9713E\text{-}12)\right]} = \frac{766500}{\#DIV/0!} = \#DIV/0! \text{ mg/kg}$$

Soil Ingestion & Inhalation of Vapors and Particulates, and Dermal Contact with Soil: Construction Worker Remediation Objectives for Non-Cacinogenic Contaminants

$$R\text{-}2 = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED \times \left[\frac{10^{-6} \times [(IR_{soil} \times RAF_o)+(SA \times M \times RAF_d)]}{RfD_o} + \frac{IR_{air} \times (VF_{ss} + VF_p)}{RfD_i}\right]}$$

$$= \frac{1 \times 70 \times 0.115 \times 365}{30 \times 1 \times \left[\frac{1.E\text{-}06}{0.0100} \times [(480 \times 1) + (3160 \times 0.5 \times 0.5)] + \frac{20}{0.00000} \times (1.10E\text{-}05 + 3.9713E\text{-}12)\right]} = \frac{2938.25}{\#DIV/0!} = \#DIV/0! \text{ mg/kg}$$

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

$$R\text{-}3 = VF_{ss} = \frac{2 \times W \times \rho_s \times 10^3}{U_{air} \times \delta_{air}} \sqrt{\frac{D^{eff}_s \times H'}{\pi \times [\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \tau}} = \frac{2 \times 2590.0 \times 1.846 \times 1000}{225 \times 200} \times$$

$$\sqrt{\frac{5.14E\text{-}03 \times 0.024}{3.1416 \times [0.18460 + (8.2915 \times 1.846) + (0.024 \times 0.245)] \times 9.46E\text{+}08}} = 1.1017E\text{-}05 \text{ kg/m3}$$

Volatilization factor for surficial soils. Whichever is less between R-3 and R-4.

$$R\text{-}4 = VF_{ss} = \frac{W \times \rho_s \times d \times 10^3}{U_{air} \times \delta_{air} \times \tau} = \frac{2590.0 \times 1.846 \times 100.000 \times 1000}{225 \times 200 \times 9.46E\text{+}08} = \frac{478114000}{4.26E\text{+}13} = 1.123E\text{-}05 \text{ kg/m3}$$

Volatilization Factor for surficial soils regarding particulates

$$R\text{-}5 = VF_p = \frac{P_e \times W \times 10^3}{U_{air} \times \delta_{air}} = \frac{6.90E\text{-}14 \times 2590.0 \times 1000}{225 \times 200} = \frac{1.79E\text{-}07}{45000} = 3.9713E\text{-}12 \text{ kg/m3}$$

Effective Diffusion Coefficient in Soil Based on Vapor-phase concentration

$$R\text{-}6 = D_s^{eff} = \frac{D^{air} \times \theta_{as}^{3.33}}{\theta_T^2} + \frac{D^{water} \times \theta_{ws}^{3.33}}{H' \times \theta_T^2} = \frac{0.102 \times 9.296E\text{-}03}{0.184900} + \frac{1.10E\text{-}05 \times 0.0036}{0.024 \times 0.184900} = 0.00513686 \text{ cm2/s}$$

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Industrial/Commercial Remediation Objectives for Non-Carcinogenic Contaminants

$$R\text{-}8 = \frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{0.0000 \times 0.001}{8.488E\text{-}06} = \frac{0.00E\text{+}00}{8.488E\text{-}06} = 0.0000 \text{ mg/kg}$$

Ambient Vapor Inhalation (outdoor) Route from Subsurface Soils: Construction Worker Remediation Objectives for Non-Carcinogenic Contaminants

$$R\text{-}8 = \frac{RBSL_{air} \times 10^{-3}}{VF_{samb}} = \frac{0.0000 \times 0.001}{8.488E\text{-}06} = \frac{0.00E\text{+}00}{8.488E\text{-}06} = 0.0000 \text{ mg/kg}$$

Noncarcinogenic Industrial/Commercial risk-based screening level for air

$$R\text{-}10 = RBSL_{air} = \frac{THQ \times RfD_i \times BW \times AT_n \times 365 \times 10^3}{IR_{air} \times EF \times ED} = \frac{1 \times 0 \times 70 \times 30 \times 365 \times 1000}{20 \times 250 \times 25} = 0.0000 \text{ ug/m3}$$

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Tier 2 RBCA Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Noncarcinogenic Construction Worker risk-based screening level for air

R-10 = $RBSL_{air} = \dfrac{THQ \times RfD_i \times BW \times AT_n \times 365 \times 10^3}{IR_{air} \times EF \times ED} = \dfrac{1 \times 0 \times 70 \times 0 \times 365 \times 1000}{20 \times 30 \times 1}$ = 0.0000 ug/m3

Volatilization Factor - Subsurface Soil to Ambient Air

R-11 = $VF_{samb} = \dfrac{H' \times \rho_s \times 10^3}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \left[1 + \dfrac{(U_{air} \times \delta_{air} \times L_s)}{(D_s^{eff} \times W)}\right]}$

$= \dfrac{0.024 \times 1.846 \times 1000}{[0.1846 + (8.2915 \times 1.846) + (0.024 \times 0.245)] \times [1 + (225 \times 200 \times 100) / (5.13686E\text{-}03 \times 2590.0)]} = \dfrac{44.4886}{5241470.651}$ = 0.000008488 (g/m3)/(mg/kg)

Soil Component of the Groundwater Ingestion Exposure Route: Industrial/Commercial Remediation Objective

R-12 = $\dfrac{GW_{source}}{LF_{sw}} = \dfrac{\#VALUE!}{0.11776}$ = #VALUE! mg/kg

Soil Component of the Groundwater Ingestion Exposure Route: Construction Worker Remediation Objective

R-12 = $\dfrac{GW_{source}}{LF_{sw}} = \dfrac{\#VALUE!}{0.11776}$ = #VALUE! mg/kg

Industrial/Commercial Groundwater at the Source

R-13 = $GW_{source} = \dfrac{GW_{comp}}{C_{(x)}/C_{source}} = \dfrac{\#VALUE!}{0.695299599}$ = #VALUE! mg/L

Construction Worker Groundwater at the Source

R-13 = $GW_{source} = \dfrac{GW_{comp}}{C_{(x)}/C_{source}} = \dfrac{\#VALUE!}{0.695299599}$ = #VALUE! mg/L

Leaching Factor

R-14 = $LF_{sw} = \dfrac{\rho_s}{[\theta_{ws} + (k_s \times \rho_s) + (H' \times \theta_{as})] \times \left[1 + \dfrac{(U_{gw} \times \delta_{gw})}{I \times W}\right]} = \dfrac{1.846}{[0.18460 + (8.2915 \times 1.846) + (0.024 \times 0.245)] \times \left[1 + \dfrac{(4 \times 200.0)}{(30.0 \times 2590.0)}\right]}$ = 0.11776396

Steady-State Attenuation Along the Centerline of a Dissolved Plume

R-15 = $C_{(x)}/C_{source} = \exp(X/2\alpha_x) \times (1 - SQT(1 + (4\lambda \times \alpha_x)/U)) \times erf[S_w/(4 \times SQT(\alpha_y \times X))] \times erf[S_d/(2 \times SQT(\alpha_z \times X))]$

$= \exp\left[\left(\dfrac{1950.720}{390.144}\right)\left(1 - \sqrt{\left(1 + \dfrac{0 \times 195.07}{0.02856}\right)}\right)\right] \times erf\left[\dfrac{5821.7}{4 \times \sqrt{(65.024 \times 1950.72)}}\right] \times erf\left[\dfrac{200.2}{2 \times \sqrt{(9.754 \times 1950.72)}}\right]$ = 0.6952996

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Tier 2 RBCA Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan
90-0146 & 2004-0969

Longitudinal Dispersivity

R-16 = $\alpha_x = 0.10 \times X = 0.1 \times 1950.720$ = 195.07200 cm

Transverse Dispersivity

R-17 = $\alpha_y = \frac{\alpha_x}{3} = \frac{195.07}{3}$ = 65.02400 cm

Vertical Dispersivity

R-18 = $\alpha_z = \frac{\alpha_x}{20} = \frac{195.07}{20}$ = 9.75360 cm

Specific Discharge

R-19 = $U = \frac{K \times i}{\Theta_T} = \frac{1.192 \times 0.0103}{0.43000}$ = 0.02856 cm/d

Soil-Water Sorption Coefficient

R-20 = $k_s = K_{oc} \times f_{oc} = 11.50 \times 0.721000$ = 8.2915

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_s)}{\rho_w} = 0.430 - \frac{0.10 \times 1.846}{1.00}$ = 0.245

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_s}{\rho_w} = \frac{0.10 \times 1.846}{1.00}$ = 0.18460

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws} = 0.245 + 0.18460$ = 0.430

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times i = 435.20 \times 0.0103$ = 4.48 cm/y

Industrial/Commercial Carcinogenic Groundwater Ingestion

R-25 = $\frac{TR \times BW \times AT_c \times 365}{Sf_o \times IR_w \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{NA \times 1 \times 250 \times 25} = \frac{1.78850}{\#VALUE!}$ = #VALUE! mg/L

Construction Worker Carcinogenic Groundwater Ingestion

R-25 = $\frac{TR \times BW \times AT_c \times 365}{Sf_o \times IR_w \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{NA \times 1 \times 30 \times 1} = \frac{1.78850}{\#VALUE!}$ = #VALUE! mg/L

0221

CW M Company
Environmental Consulting Services
701 W. South Grand Avenue
Springfield, IL 62704
Phone: (217) 522-8001
Fax: (217) 522-8009

April 27, 2012

Mr. Brad Dilbaitis, Project Manager
LUST Section, Bureau of Land
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, Illinois 62794-9276

RE: **LPC #1390305014—Moultrie County**
KB Food & Gas/Sullivan
111 West Jackson Street (Rt. 121 & 32)
Incident Number: 90-0146/2004-0969
LUST Technical Reports—Corrective Action Plan and Budget – Revised TACO Calculations

Dear Mr. Dilbaitis:

In response to your inquiry to us about the TACO Calculations contained within the February 17, 2012, Corrective Action Plan (CAP) and Budget for the above referenced site, we have re-done the calculations, and attached them. As outlined your email to us on March 26, 2012, the calculations that were included in the revised calculations had an incorrect fractional organic carbon entry, and the industrial commercial ingestion objective was calculated using an incorrect equation. The attached calculations are a complete replacement for Appendix D of the document under review. Just to be thorough, we have included pages of calculations that we do not normally publish in a report, in case you have any additional questions as to how the numbers were arrived at.

These revised calculations will change Table 2-1 on page 7 of the CAP to:

Table 2-1 Remediation Objectives

Parameter	TACO Industrial/Commercial Tier 2 Soil Clean-up Objective (mg/kg)	TACO Class 1 Groundwater Clean-up Objective (mg/L)
Benzene	6.24	0.005
Ethylbenzene	229.33	0.7
Toluene	755.56	1.0
Total Xylenes	90.70	10.0
MTBE	563.25	0.07

While each of the Clean-up Objectives has changed, there is no substantive impact on the overall CAP with the exception of total xylenes at location SB-3, which will require a construction worker caution. There is no other soil contamination above the Tier 2 Objectives. While some of the benzene modeling distances have been changed slightly, the MTBE modeling, which controlled the overall required area requiring remediation, is unchanged.

The calculations submitted April 6, 2012 should be disregarded. We apologize for the error in the calculations, and have taken steps to try to prevent that from happening again on other projects. If you have any questions or require additional information, please contact Mr. Vince Smith or me at (217) 522-8001.

Sincerely,

Carol L. Rowe, P.G.
Senior Environmental Geologist

xc: Mr. Kamlesh Patel, *KB Food & Gas*
Mr. William T. Sinnott, *CW^{3}M Company, Inc.*

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Illinois Enviromental Protection Agency
Leaking Underground Storage Tank Program
SSL Input Parameters for Use with Tier 2 Calculations

A. Site Identification

IEMA Incident # (6- or 8-digit): 90-0146 & 2004-0969 IEPA LPC # (10-digit): 1390305014

Site Name: KB Food & Gas/Sullivan

Site Address (not a P.O. Box): 111 West Jackson Street

City: Sullivan County: Moultrie Zip Code: 61951

Leaking UST Technical File

B. Tier 2 Calculation Information

Equation(s) Used (ex: S12,S17,S28): S5,6,7,8,9,10,17,18,19,20,21,22,24

Contact Information for Individual Who Performed Calculations:

CWM Company, Inc., Bob Woodruff, Vince Smith

Land Use: Industrial/Commercial Soil Type: Loam

Groundwater: [X] Class I [ ] Class II

Mass Limit: [ ] Yes [X] No If Yes, then Specify Acreage: ____________

- Mass Limit Acreage other than defaults must always be rounded up.
- Failure to use site-specific parameters where allowed could affect payment from the UST Fund
- Maps depicting source width, plume dimensions, distance, etc. must also be submitted.
- Inputs must be submitted in the designated unit.

AT (ingestion)	=	Ind/Com = 25	yr
		Con. Worker = 0.115	yr
AT (inhalation)	=	Ind/Com = 25	yr
		Con. Worker = 0.115	yr
AT_c	=	70	yr
BW	=	Ind/Com = 70	kg
			kg
		Con. Worker = 70	kg
C_{sat}	=	Benzene = 958.609	mg/kg
		Toluene = 755.563	mg/kg
		Ethylbenzene = 463.455	mg/kg
		Total Xylenes = 371.416	mg/kg
		MTBE = 9979.274	mg/kg
		Naphthalene = 449.891	mg/kg
			mg/kg
			mg/kg
			mg/kg
			mg/kg

d_a	=	3.048	m
d_s	=	3.048	m
DA	=	Benzene = 9.44339848062212E-05	cm^2/s
		Toluene = 4.24107640555468E-05	cm^2/s
		Ethylbenzene = 2.27301824425843E-05	cm^2/s
		Xylenes = 2.32484620164678E-05	cm^2/s
		MTBE = 3.39129707968163E-05	cm^2/s
		Naphthalene = 2.2205803734471E-07	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s

Incident # 90-0146 & 2004-0969

C_w	=	Benzene = 0.1	mg/L
		Toluene = 20	mg/L
		Ethylbenzene = 38.392	mg/L
		Total Xylenes = 399.372	mg/L
		MTBE = 0.273	mg/L
		Naphthalene = 40.635	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
d	=	9.886	m
ED (inhalation of carcinogens)	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
ED (ingestion of noncarcinogens)	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
ED (inhalation of noncarcinogens)	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
ED (ingestion of groundwater)	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
ED_{M-L}	=	70	yr
EF	=	Ind/Com = 250	d/yr
		Con. Worker = 30	d/yr
F(x)	=	0.194	unitless
f_{oc}	=	0.0072	g/g
GW_{obj}	=	Benzene = 0.005	mg/L
		Toluene = 1	mg/L
		Ethylbenzene = 0.7	mg/L
		Total Xylenes = 10	mg/L
		MTBE = 0.07	mg/L
		Naphthalene = 0.14	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
H'	=	Benzene = 0.228	unitless
		Toluene = 0.272	unitless
		Ethylbenzene = 0.323	unitless
		Total Xylenes = 0.25	unitless
		MTBE = 0.0241	unitless
		Naphthalene = 0.0198	unitless
			unitless
			unitless
			unitless
			unitless
i	=	0.010344828	m/m
I	=	0.3	m/yr
I_{M-L}	=	0.18	m/yr
$IF_{soil-adj}$	=	114	(mg-yr)/(kg-d)
IR_{soil}	=	Ind/Com = 50	mg/d
		Con. Worker = 480	mg/d

D_i	=	Benzene = 0.088	cm^2/s
		Toluene = 0.087	cm^2/s
		Ethylbenzene = 0.075	cm^2/s
		Total Xylenes = 0.072	cm^2/s
		MTBE = 0.102	cm^2/s
		Naphthalene = 0.0000075	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
D_w	=	Benzene = 0.0000098	cm^2/s
		Toluene = 0.0000086	cm^2/s
		Ethylbenzene = 0.0000078	cm^2/s
		Total Xylenes = 0.00000934	cm^2/s
		MTBE = 0.000011	cm^2/s
		Naphthalene = 0.0000075	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
DF	=	1.022960362	unitless
ED (ingestion of carcinogens	=	Ind/Com = 25	yr
		Con. Worker = 1	yr
K_{oc}	=	Benzene = 58.9	cm^3/g or L/kg
		Toluene = 182	cm^3/g or L/kg
		Ethylbenzene = 363	cm^3/g or L/kg
		Total Xylenes = 260	cm^3/g or L/kg
		MTBE = 11.5	cm^3/g or L/kg
		Naphthalene = 2000	cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
K_s	=	60	m/yr
L	=	64.6176	m
PEF	=		m^3/kg
PEF'	=		m^3/kg
Q/C (VF equations)	=	Ind/Com = 85.81	$(g/m^2\text{-}s)/(kg/m^3)$
		Con. Worker = 85.81	$(g/m^2\text{-}s)/(kg/m^3)$
Q/C (PEF equations)	=		$(g/m^2\text{-}s)/(kg/m^3)$

RfC (mg/m^3)		**Chronic**	**Subchronic**
Benzene	=	0.03	0.08
Toluene	=	5	5
Ethylbenzene	=	1	1
Total Xylenes	=	0.1	0.4
MTBE	=	3	3
Naphthalene	=	0.003	0.003
	=		NA
	=		NA
	=		NA
	=		NA

Incident # 90-0146 & 2004-0969

IR_w	=	Ind/Com = 1	L/d
K	=	4.351968	m/yr
K_d(non-ionizing organcis)	=	Benzene = 0.42408	cm^3/g or L/kg
		Toluene = 1.3104	cm^3/g or L/kg
		Ethylbenzene = 2.6136	cm^3/g or L/kg
		Total Xylenes = 1.872	cm^3/g or L/kg
		MTBE = 0.0828	cm^3/g or L/kg
		Naphthalene = 14.4	cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
K_d (ionizing organics)	=		cm^3/g or L/kg
K_d (inorganics)	=		cm^3/g or L/kg
VF'	=	Benzene = 804.133	m^3/kg
		Toluene = 1199.925	m^3/kg
		Ethylbenzene = 1639.044	m^3/kg
		Total Xylenes = 1620.672	m^3/kg
		MTBE = 1341.866	m^3/kg
		Naphthalene = 16582.844	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
VM_{M-L}	=	#VALUE!	m^3/kg
		Toluene = 0	m^3/kg
		#VALUE!	m^3/kg
		Total Xylenes = 0	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
VF'_{M-L}	=	#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
η	=	0.304	L_{pore}/L_{soil}
$θ_a$	=	0.098	L_{air}/L_{soil}

RfD_o mg/(kg-d)		**Chronic**	**Subchronic**
Benzene	=	0.004	0.012
Toluene	=	0.08	0.8
Ethylbenzene	=	0.1	1
Total Xylenes	=	0.2	1
MTBE	=	0.01	0.1
Naphthalene	=	0.02	0.2
	=		0.6
	=		NA
	=		NA
	=		NA

S	=	Benzene = 1750	mg/L
		Toluene = 526	mg/L
		Ethylbenzene = 169	mg/L
		Total Xylenes = 186	mg/L
		MTBE = 51000	mg/L
		Naphthalene = 31	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
SF_o	=	Benzene = 0.055	$(mg/kg\text{-}d)^{-1}$
		Toluene = NA	$(mg/kg\text{-}d)^{-1}$
		Ethylbenzene = NA	$(mg/kg\text{-}d)^{-1}$
		Total Xylenes = NA	$(mg/kg\text{-}d)^{-1}$
		MTBE = NA	$(mg/kg\text{-}d)^{-1}$
		Naphthalene = NA	$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
			$(mg/kg\text{-}d)^{-1}$
T	=	Ind/Com = 7.9E08	s
		Con. Worker = 3.6×10^6	s
T_{M-L}	=	30	yr
THQ	=	1	unitless
TR	=	1.00E-06	unitless
U_m	=	4.69	m/s
URF	=	Benzene = 7.8×10^{-6}	$(\mu g/m^3)^{-1}$
U_t	=	11.32	m/s
V	=	0.5	unitless
VF	=	Benzene = 11912.157	m^3/kg
		Toluene = 17775.283	m^3/kg
		Ethylbenzene = 24280.248	m^3/kg
		Total Xylenes = 24008.081	m^3/kg
		MTBE = 19877.953	m^3/kg
		Naphthalene = 245652.58	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg

Incident # 90-0146 & 2004-0969

θ_w	=	0.206	L_{water}/L_{soil}
ρ_b	=	1.846	kg/l or g/cm^3
ρ_s	=	2.652	g/cm^3
ρ_w	=	1	g/cm^3
1/(2b+3)	=	0.073	unitless

Illinois Enviromental Protection Agency
Leaking Underground Storage Tank Program
RBCA Input Parameters for Use with Tier 2 Calculations

A. Site Identification

IEMA Incident # (6- or 8-digit): 90-0146 & 2004-0969 IEPA LPC # (10-digit): 1390305014

Site Name: KB Food & Gas/Sullivan

Site Address (not a P.O. Box): 111 West Jackson Street

City: Sullivan County: Moultrie Zip Code: 61951

Leaking UST Technical File

B. Tier 2 Calculation Information

Equation(s) Used (ex: R12,R14,R26): R16, R17, R18,R19, R21, R22, R23, R24,R26

Contact Information for Individual Who Performed Calculations:

CWM Company, Inc., Bob Woodruff, Vince Smith

Land Use: Industrial/Commercial Soil Type: Loam

Groundwater: [X] Class I [ ] Class II

Mass Limit: [ ] Yes [X] No If Yes, then Specify Acreage: ______

Objective from S17 used in R26? [ ] Yes [X] | No

If Yes, then Specify C_{source} from S17 See Attached mg/L.

- Mass Limit Acreage other than defaults must always be rounded up.
- Failure to use site-specific parameters where allowed could affect payment from the UST Fund
- Maps depicting source width, plume dimensions, distance, etc. must also be submitted.
- Inputs must be submitted in the designated unit.

AT_c	=	70	yr
AT_n	=	Ind/Com = 25 Con. Worker = 0.115	yr yr
BW	=	70	yr
C_{source}	=	See Attached	mg/L
$C_{(x)}$	=	See Attached	mg/L
d	=	100	cm

D^{air}	=	See Attached	cm^2/s
D^{water}	=	See Attached	cm^2/s
D_s^{eff}	=	See Attached	cm^2/s
ED	=	Ind/Com = 25 Con. Worker = 1	yr yr
EF	=	Ind/Com = 250 Con. Worker = 30	d/yr d/yr

erf	=	See Attached	unitless
f_{oc}	=	0.0072	g/g
GW_{comp}	=	See Attached	mg/L
GW_{source}	=	See Attached	mg/L
H'	=	See Attached	$cm3_{water}/cm^3_{air}$
i	=	0.010344828	cm/cm
I	=	30	cm/yr
IR_{air}	=	20	m^3/d
IR_{soil}	=	Ind/Com = 50 Con. Worker = 480	mg/d mg/d
IR_w	=	Ind/Com = 1	L/d
K	=	1.192 435.197	cm/d cm/yr
K_{oc}	=	See Attached	cm^3/g or L/kg
k_s (non-ionizing organics)	=	See Attached	cm^3_{water}/g_{soil}
k_s (ionizing organics)	=	Not Applicable	cm^3_{water}/g_{soil}
k_s (inorganics)	=	Not Applicable	cm^3_{water}/g_{soil}
L_s	=	100	cm
LF_{sw}	=	See Attached	$(mg/L_{water})/(mg/kg_{soil})$
M	=	0.5	mg/cm^2
Pe	=	$6.9 \cdot 10^{-14}$	g/cm^2-s
RAF_d	=	0.5	unitless
α_x	=	See Attached	cm
α_y	=	See Attached	cm
α_z	=	See Attached	cm
λ	=	See Attached	d^{-1}
π	=	3.1416	
τ	=	$9.46 \cdot 10^8$	s

RAF_d (PNAs)	=	0.05	unitless
RAF_d (inorganics)	=	0	unitless
RAF_o	=	1	unitless
$RBSL_{air}$ (carcinoginic)	=	See Attached	$\mu g/m^3$
$RBSL_{air}$ (noncarcinoginic)	=	See Attached	$\mu g/m^3$
RfD_i	=	See Attached	mg/kg-d
SA	=	3,160	cm^2/d
S_d	=	200.0	cm
S_w	=	5,821.7	cm
SF_i	=	See Attached	$(mg/kg\text{-}d)^{-1}$
SF_o	=	See Attached	$(mg/kg\text{-}d)^{-1}$
THQ	=	1	unitless
TR	=	1.00E-06	unitless
U	=	0.0286	cm/d
U_{air}	=	225	cm/s
U_{gw}	=	435.207	cm/y
VF_p	=	3.97133E-12	kg/m^3
VF_{samb}	=	See Attached	$(mg/m^3_{air})/(mg/kg_{soil})$ or kg/m^3
VF_{ss}	=	See Attached	kg/m3
W	=		cm
w	=	0.142	g_{water}/g_{soil}
δ_{air}	=	200	cm
δ_{gw}	=	200	cm
θ_{as}	=	0.167868	cm^3_{air}/cm^3_{soil}
θ_{ws}	=	0.262132	cm^3_{water}/cm^3_{soil}
θ_T	=	0.43	cm^3/cm^3_{soil}
ρ_b	=	1.846	g/cm^3
ρ_w	=	1	g/cm^3

	H'	λ	Koc
Benzene	0.228	0.0009	58.9
Toluene	0.272	0.011	182
Ethylbenzene	0.323	0.003	363
Total Xylenes	0.25	0.0019	260
MTBE	0.0241	0	11.5
Naphthalene	0.0198	0.0027	2000

Benzene R26 Modeled Groundwater from Vertical Modeled Soils

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{\alpha_y \cdot X})$	erf: $S_w / (2 \cdot \sqrt{\alpha_z \cdot X})$
MW-5	0.459	0.005	213.36	21.336	7.112	1.0668	1	1
MW-6	0.085							
MW-8	0.109							

Benzene R26 Modeled Groundwater

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{\alpha_y \cdot X})$	erf: $S_w / (2 \cdot \sqrt{\alpha_z \cdot X})$
MW-4	0.006	30.48	3.048	1.016	0.1524	1	1
MW-5	6.280	396.24	39.624	13.208	1.9812	1	0.99999955
MW-6	1.700	304.8	30.48	10.16	1.524	1	1
MW-7	0.085	121.92	12.192	4.064	0.6096	1	1
MW-8	2.880	335.28	33.528	11.176	1.6764	1	1
MW-9	1.120	274.32	27.432	9.144	1.3716	1	1
MW-10	2.050	335.28	33.528	11.176	1.6764	1	1
MW-11	0.039	91.44	9.144	3.048	0.4572	1	1
MW-12	0.677	243.84	24.384	8.128	1.2192	1	1

Toluene R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$
MW-5	1.0338							

Toluene R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$
MW-5	35.400	30.48	3.048	1.016	0.1524	1	1
MW-8	5.000	30.48	3.048	1.016	0.1524	1	1
MW-13	1.670	30.48	3.048	1.016	0.1524	1	1

Ethylbenzene R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{\alpha_y \cdot X})$	erf: $S_w / (2 \cdot \sqrt{\alpha_z \cdot X})$
MW-5	0.3027							
MW-7	0.2899							
SB-5	0.3501							
SB-6	0.3337							
MW-8	0.3300							

Ethylbenzene R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	$\sqrt{\alpha_y \cdot X}$	$\sqrt{\alpha_z \cdot X}$
MW-5	3.760	30.48	3.048	1.016	0.1524	1	1
MW-7	2.350	30.48	3.048	1.016	0.1524	1	1
MW-8	2.210	30.48	3.048	1.016	0.1524	1	1
MW-10	1.670	30.48	3.048	1.016	0.1524	1	1
MW-12	0.955	30.48	3.048	1.016	0.1524	1	1

Total Xylenes R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$
MW-5	1.6426							
MW-7	1.1718							

Total Xylenes R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$
MW-5	16,300	30.48	3.048	1.016	0.1524	1	1

MTBE R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$

MTBE R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$
MW-4	0.118	2438.4	81.28	81.28	12.192	0.99999622	0.58790358
MW-5	0.457	8473.44	282.448	282.448	42.3672	0.81663558	0.18659189
MW-8	0.086	1524	50.8	50.8	7.62	1	0.81059311
MW-9	0.380	7467.6	248.92	248.92	37.338	0.86887309	0.21116495
MW-11	0.232	5029.2	167.64	167.64	25.146	0.97501508	0.30913212

Summary of Tier 2 Calculations
KB Food & Gas/Sullivan
90-0146 & 2004-0969
04/26/12

Table 3

Tier 1 Objectives

		Benzene		Toluene		Ethylbenzene		Total Xylenes		Naphthalene		MTBE	
Residential	Ingestion	12	mg/kg	16,000	mg/kg	7,800	mg/kg	16,000	mg/kg	1,600	mg/kg	780	mg/kg
	Inhalation	0.8	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	170	mg/kg	8,800	mg/kg
	Migration Class 1	0.03	mg/kg	12	mg/kg	13	mg/kg	150	mg/kg	12	mg/kg	0.32	mg/kg
	Migration Class 2	0.17	mg/kg	29	mg/kg	19	mg/kg	150	mg/kg	18	mg/kg	0.32	mg/kg
Industrial/Commercial	Ingestion	100	mg/kg	410,000	mg/kg	200,000	mg/kg	410,000	mg/kg	41,000	mg/kg	20,000	mg/kg
	Inhalation	1.60	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	270	mg/kg	8,800	mg/kg
Construction Worker	Ingestion	2,300	mg/kg	410,000	mg/kg	20,000	mg/kg	41,000	mg/kg	4,100	mg/kg	2,000	mg/kg
	Inhalation	2.20	mg/kg	42	mg/kg	58	mg/kg	5.6	mg/kg	1.80	mg/kg	140	mg/kg
Soil Saturation		870	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	449.89	mg/kg	8,800	mg/kg

Tier 2 SSL Objectives

		Benzene	Equation	Toluene	Equation	Ethylbenzene	Equation	Total Xylenes	Equation	Naphthalene	Equation	MTBE	
Residential	Ingestion	11.64	S-2	1,251	S-1	1,564	S-1	3,129	S-1	313	S-1	156.4	S-1
	Inhalation	3.27	S-6	81,502.94	S-4	22,265.88	S-4	2,201.63	S-4	675.82	S-4	54,666.44	S-4
	Migration Mass-Limit Class 1	0.22	S-28	44.79	S-28	31.35	S-28	447.57	S-28	6.27	S-28	3.14	S-28
	Migration Class 1	0.055	S-17	28.73	S-17	38.39	S-17	399.37	S-17	40.64	S-17	0.27	S-17
Industrial-Commercial	Ingestion	104.06	S-2	1,635,200	S-1	204,400	S-1	408,800	S-1	40,880	S-1	20,440	S-1
	Inhalation	6.24	S-6	129,769.57	S-4	35,449.18	S-4	3,505.18	S-4	1,075.96	S-4	87,085.43	S-4
	Migration Mass-Limit Class 1	0.22	S-28	44.79	S-28	31.35	S-28	447.57	S-28	6.27	S-28	3.14	S-28
	Migration Class 1	0.055	S-17	28.73	S-17	38.39	S-17	399.37	S-17	40.64	S-17	0.27	S-17
Construction Worker	Ingestion	2,258.21	S-3	163,236	S-1	204,045	S-1	204,045	S-1	40,809	S-1	20,405	S-1
	Inhalation	8.78	S-7	839.45	S-5	229.33	S-5	90.70	S-5	6.96	S-5	563.25	S-5
Soil Saturation		958.61	S-29	755.56	S-29	463.46	S-29	371.42	S-29	449.89	S-29	9,979.27	S-29

all values are in mg/kg

Site Specific Value cannot exceed Soil Saturation Limit, otherwise Tier 2 Inhalation or Tier 2 Migration objectives are the Soil Saturation objective

Groundwater Contaminate Concentration Exceedances at Surface Water or Set Back Zone (mg/L)

	Benzene	Equation	Toluene	Equation	Ethylbenzene	Equation	Total Xylenes	Equation	Naphthalene	Equation	MTBE	
Result	#DIV/0!	R-26	#DIV/0!	R-26	#DIV/0!	R-26	#DIV/0!	R-26			#DIV/0!	R-26
Surface Water Objective	0.86		0.6		0.014		0.36					

Version: 4/26/2012

0234

R-26 Input/Summary Sheet

Version: 4/26/2012

IEMA Incident # (6 or 8 digit)	90-0146 & 2004-0969
IEPA LPC # (10 digit)	1390305014
Site Name:	KB Food & Gas/Sullivan
Site Address:	111 West Jackson Street
City:	Sullivan
County:	Moultrie
Zip Code:	61951
SSL Equations Used:	S5,6,7,8,9,10,17,18,19,20,21,22,24
RBCA Equations Used:	Example R-1, R-2, R3
Contact Information for Individual who Performed Calculat	CWM Company, Inc., Bob Woodruff, Vince Smith
Land Use:	Ind./Com. & Construction Worker
Objective from S17 used in R26:	No
Groundwater:	Class 1
Standard or Mass Limit Equations:	Standard Equations — If Mass Limit, then Specifiy Acres:
Square Feet of Plume for Mass Limit Eq.:	0.00 — < use this # above
Date Data is Entered:	April 26, 2012

Entry	Description	Reference	
	Holcomb Bulk Density (pcf), or — Shelby Tube Location:		
1.846	Dry Soil Bulk Density (g/cm³ or kg/L): 1.5, or Gravel =2.0, Sand = 1.8, Silt = 1.6, Clay = 1.7, or site specific		
2.652	ρs - Soil Particle Density	Reference	
0.304	Total Soil Porosity	0.304	0.304
0.206	Water Filled Porosity	0.206	0.206
0.098	Air Filled Porosity	0.098	0.098
0.430	θ_T - Total Soil Porosity (RBCA)	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36	
0.142	w - Average Soil Moisture Content	0.1, or: Subsurface Soil (top 1m) = 0.1; Subsurface Soil (below 1 m) =0.2; or Site Specific	
Loam	USDA Soil Classification (Pick from List)		Entry
0.00720	Fractional Organic Carbon (foc) in g/g	Organic Matter (%):	
		Organic Matter (mg/kg):	
		Total Organic Carbon (g/g):	0.00721

Entry	Description	Well Name / Meters
1.38E-05	Average Hydraulic Conductivity (cm/sec)	Well Name
1.38E-05	Falling Hydraulic Conductivity (cm/sec)	MW-3
	Rising Hydraulic Conductivity (cm/sec)	
0.01034	Hydraulic Gradient (0.02 for sites with no groundwater)	Meters
10	d_a - Aquifer Thickness (ft)	3.048 m
10	d_s - Depth of Source (ft) (Vertical Thickness of Contamination)	3.048 m
	X - Distance along the centerline of the groundwater plume emanating to setback zone or surface water from the source in the direction of groundwater flow (ft) (RBCA)	0 cm
212	L - Source Length Parallel to Groundwater Flow (ft)	64.6176 m
191	Sw: Source Width -horizontal plane (ft) (RBCA)	5821.68 cm

Hydraulic Gradient Calculations

MW-12	95.33
MW-8	94.13
Distance:	116

$C_{(x)}$ - Concentration of Contaminant in groundwater at distance X from the source (mg/L)		
	Benzene	MTBE
	Toluene	
	Ethylbenzene	
	Total Xylenes	

Surface Water

Chemicals of Concern		
Benzene	Naphthalene	[redacted]
Toluene	[redacted]	Chrysene
Ethylbenzene	[redacted]	Benzo(k)fluoranthene
Total Xylenes	[redacted]	Indeno(1,2,3-cd)pyrene
MTBE		

SSL Equations Needed

- ☐ Mass Limit Equations
- ☑ Inhalation Equations
- ☑ Groundwater Ingestion Equations
- ☑ Csat Equations
- ☐ Fugitive Dust Equations
- ☑ Ingestion Equations

Text discussion for "I", L, d_a, d_s, S_w, S_d	
Hydraulic Gradient	The **Hydraulic Gradient** (*i*) was determined from an onsite survey of each of the groundwater monitoring wells. The riser elevations were determined and the depth to groundwater was noted in each well. This data was used to generate a potentiometric flow map with contour lines which show potentiometric head. A corresponding flow line, perpendicular to the contour lines, was determined between two known points of groundwater elevation. The hydraulic gradient was determined by the difference in elevation divided by the length of flow between the points.
Source Length	The **Source Length Parallel to Groundwater Flow** (L) was determined from the site map and analytical results. A value of 45.1104 m was used to encompass the length of contamination parallel to groundwater flow. This value is the distance between soil borings BH-1 and BH-2.
Aquifer Thickness	The **Aquifer Thickness** (**d_a**) is a site specific value determined by the length of the monitoring well screen. The Aquifer Thickness value used in the modeling equations was 3.048 meters.
Depth of Source	The **Depth of Source** (**d_s**) was determined from the analytical results and soil boring logs. A value of 3.048 m was used to encompass the vertical thickness of contamination based upon a clean soil sample at BH-1A, "hot" samples at BH-2B and BH-2C, and a clean soil sample at BH-2D. Thus the vertical thickness of soil contamination has been determined to be 3.048 m.
Source Width	**The source width perpendicular to groundwater flow direction in the Horizontal Plane** (**S_w**) was determined from the site map and analytical results. A value of 3566.16 cm was used to encompass the width of contamination in the horizontal plane. This value is the distance between clean wells MW-4 and and MW-6.
Source Depth	**The source width perpendicular to groundwater flow direction in the Vertical Plane** (**S_d**) was determined from the soil boring logs and analytical results. A value of 304.8 cm was used to encompass the width of contamination in the vertical plane based on the depths of contamination present and the PID readings from the bore logs.
Distance (X)	

BENZENE								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
MW-5	5.03	7	0.459	0.0047	MW-4	0.006	1	0.0025
MW-6	0.926		0.085		MW-5	6.290	13	0.0046
MW-8	1.19		0.109		MW-6	1.700	10	0.0043
					MW-7	0.085	4	0.0044
					MW-8	2.880	11	0.0047
					MW-9	1.120	9	0.0044
					MW-10	2.050	11	0.0034
					MW-11	0.039	3	0.0038
					MW-12	0.677	8	0.0042

Toluene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
MW-5	29.7		1.0338		MW-5	35.400	1	0.0353
					MW-8	5.000	1	0.0050
					MW-13	1.670	1	0.0017

Ethylbenzene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
MW-5	16.6		0.30266123		MW-5	3.760	1	0.2960
MW-7	15.9		0.290		MW-7	2.350	1	0.1850
SB-5	19.2		0.350		MW-8	2.210	1	0.1740
SB-6	18.3		0.334		MW-10	1.670	1	0.1315
MW-8	18.1		0.330		MW-12	0.955	1	0.0752

Total Xylenes								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
MW-5	65.6		1.642575088		MW-5	16.300	1	2.9121
MW-7	46.8		1.172					

MTBE								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
					MW-4	0.118	80	0.0694
					MW-5	0.457	278	0.0696
					MW-8	0.086	50	0.0697
					MW-9	0.380	245	0.0697
					MW-11	0.232	165	0.0699

Naphthalene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)

Benzo[a]pyrene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)

KB Food & Gas/Sullivan *90-0146 & 2004-0969*

Math for R-26 Calculations
BENZENE MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_w = (soil contamination at modeling point) / (Equation S-17)				C_w	$GW_{obj} = C_w / DF$: C_w	/ DF	=	GW_{obj} (mg/L)	Conversion: 1 foot = 30.48 cm: X (ft)	X (cm)
MW-5	5.03	/	0.548	=	9.183	9.183	/ 20.000	=	0.45913	7	213.36
MW-6	0.926	/	0.548	=	1.690	1.690	/ 20.000	=	0.08452		
MW-8	1.19	/	0.548	=	2.172	2.172	/ 20.000	=	0.10862		

Sample Location	R-16: $\alpha_x = 0.10 * X$: 0.1	x	X (cm)	=	α_x (cm)	R-17: $\alpha_y = \alpha_x / 3$: α_x (cm)	/	3	=	α_y (cm)	R-18: $\alpha_z = \alpha_x / 20$: α_x (cm)	/	20	=	α_z (cm)
MW-5	0.1	x	213.36	=	21.336	21.336	/	3	=	7.112	21.336	/	20	=	1.0668
MW-6															
MW-8															

Sample Location	"Term 1" = $[X / (2 * \alpha_x)]$: X	/	2	x	α_x	=	"Term 1"	"Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$: 1	-	SQRT [	1	+ (	4	x	λ	x	α_x	) /	U	] =	"Term 2"
MW-5	213.36	/	2	x	21.336	=	5	1	-	SQRT [	1	+ (	4	x	0.0009	x	21.336	) /	0.02868	] =	-0.8177
MW-6																					
MW-8																					

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$: S_w	/ (	4	x	SQRT	(	α_y	x	X	)) =	β_1	$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$: S_d	/ (	2	x	SQRT	(	α_z	x	X	)) =	β_2
MW-5	5621.88	/ (	4	x	SQRT	(	7.112	x	213.36	)) =	37.36250	200	/ (	2	x	SQRT	(	1.0668	x	213.36	)) =	6.62830
MW-6																						
MW-8																						

Sample Location	ERF(β_1) (Section 742 APPENDIX C: Table G)	ERF(β_2) (Section 742 APPENDIX C: Table G)	$C_{(x)} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$: C_{source}	x e	("Term 1"	+	"Term 2")	x ERF(β_1)	x ERF(β_2)	=	mg/L
MW-5	1.000000	1.000000	0.45913	x e	5	+	-0.8177	x 1.000000	x 1.000000	=	0.00467
MW-6			0.08452								
MW-8			0.10862								

KB Food & Gas/Sullivan *90-0146 & 2004-0969*

R-26 Calculations
BENZENE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm		R-16: $\alpha_x = 0.10 * X$					R-17: $\alpha_y = \alpha_x / 3$					R-18: $\alpha_z = \alpha_x / 20$				
		X (ft)	X (cm)	0.1	x	X (cm)	=	α_x (cm)	α_x (cm)	/	3	=	α_y (cm)	α_x (cm)	/	20	=	α_z (cm)
MW-4	0.006	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-5	6.29	13	396.24	0.1	x	396.24	=	39.624	39.624	/	3	=	13.208	39.624	/	20	=	1.9812
MW-6	1.7	10	304.8	0.1	x	304.8	=	30.48	30.48	/	3	=	10.16	30.48	/	20	=	1.524
MW-7	0.065	4	121.92	0.1	x	121.92	=	12.192	12.192	/	3	=	4.064	12.192	/	20	=	0.6096
MW-8	2.88	11	335.28	0.1	x	335.28	=	33.528	33.528	/	3	=	11.176	33.528	/	20	=	1.6764
MW-9	1.17	9	274.32	0.1	x	274.32	=	27.432	27.432	/	3	=	9.144	27.432	/	20	=	1.3716
MW-10	2.05	11	335.28	0.1	x	335.28	=	33.528	33.528	/	3	=	11.176	33.528	/	20	=	1.6764
MW-11	0.039	3	91.44	0.1	x	91.44	=	9.144	9.144	/	3	=	3.048	9.144	/	20	=	0.4572
MW-12	0.677	8	243.84	0.1	x	243.84	=	24.384	24.384	/	3	=	8.128	24.384	/	20	=	1.2192

Sample Location	"Term 1" = [X / (2 * α_x)]							"Term 2" = {1 - SQRT[1 + (4 * λ * α_x) / (U)]}												
	X	/	2	x	α_x	=	"Term 1"	1	-	SQRT[	1	+(	4	x	λ	x	α_x	)/	U	]=	"Term 2"
MW-4	30.48	/	2	x	3.048	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	3.048	)/	0.02868	]=	-0.1756
MW-5	396.24	/	2	x	39.624	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	39.624	)/	0.02868	]=	-1.4449
MW-6	304.8	/	2	x	30.48	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	30.48	)/	0.02868	]=	-1.1967
MW-7	121.92	/	2	x	12.192	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	12.192	)/	0.02868	]=	-0.5906
MW-8	335.28	/	2	x	33.528	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	33.528	)/	0.02868	]=	-1.2921
MW-9	274.32	/	2	x	27.432	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	27.432	)/	0.02868	]=	-1.1678
MW-10	335.28	/	2	x	33.528	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	33.528	)/	0.02868	]=	-1.2921
MW-11	91.44	/	2	x	9.144	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	9.144	)/	0.02868	]=	-0.4866
MW-12	243.84	/	2	x	24.384	=	5	1	-	SQRT[	1	+(	4	x	0.0009	x	24.384	)/	0.02868	]=	-1.0150

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$										$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$									
	S_w	/(	4	x	SQRT	(	α_y	x	X	))=	β_1	S_d	/(	2	x SQRT	(	α_z	x	X	))=	β_2
MW-4	5421.66	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.83782	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39808
MW-5	5421.66	/(	4	x	SQRT	(	13.208	x	396.24	))=	20.11827	200	/(	2	x SQRT	(	1.9812	x	396.24	))=	3.56906
MW-6	5421.66	/(	4	x	SQRT	(	10.16	x	304.8	))=	26.15376	200	/(	2	x SQRT	(	1.524	x	304.8	))=	4.63961
MW-7	5421.66	/(	4	x	SQRT	(	4.064	x	121.92	))=	65.38436	200	/(	2	x SQRT	(	0.6096	x	121.92	))=	11.59862
MW-8	5421.66	/(	4	x	SQRT	(	11.176	x	335.28	))=	23.77614	200	/(	2	x SQRT	(	1.6764	x	335.28	))=	4.21801
MW-9	5421.66	/(	4	x	SQRT	(	9.144	x	274.32	))=	29.06072	200	/(	2	x SQRT	(	1.3716	x	274.32	))=	5.15534
MW-10	5421.66	/(	4	x	SQRT	(	11.176	x	335.28	))=	23.77614	200	/(	2	x SQRT	(	1.6764	x	335.28	))=	4.21801
MW-11	5421.66	/(	4	x	SQRT	(	3.048	x	91.44	))=	67.17917	200	/(	2	x SQRT	(	0.4572	x	91.44	))=	15.46603
MW-12	5421.66	/(	4	x	SQRT	(	8.128	x	243.84	))=	32.69219	200	/(	2	x SQRT	(	1.2192	x	243.84	))=	5.79876

Sample Location	ERF(β_1)	ERF(β_2)	$C_{gw} = C_{source} \times e^{(Term\ 1 + Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$									
	Section 742 APPENDIX C: Table G		C_{source}	x e	("Term 1"	x	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	= mg/L
MW-4	1.000000	1.000000	0.00600	x e	5	x	-0.1756	x	1.000000	x	1.000000	= 0.00249
MW-5	1.000000	1.000000	6.29000	x e	5	x	-1.4449	x	1.000000	x	1.000000	= 0.00400
MW-6	1.000000	1.000000	1.70000	x e	5	x	-1.1967	x	1.000000	x	1.000000	= 0.00428
MW-7	1.000000	1.000000	0.06500	x e	5	x	-0.5906	x	1.000000	x	1.000000	= 0.00443
MW-8	1.000000	1.000000	2.88000	x e	5	x	-1.2921	x	1.000000	x	1.000000	= 0.00474
MW-9	1.000000	1.000000	1.17000	x e	5	x	-1.1678	x	1.000000	x	1.000000	= 0.00449
MW-10	1.000000	1.000000	2.05000	x e	5	x	-1.2921	x	1.000000	x	1.000000	= 0.00537
MW-11	1.000000	1.000000	0.03900	x e	5	x	-0.4866	x	1.000000	x	1.000000	= 0.00386
MW-12	1.000000	1.000000	0.67700	x e	5	x	-1.0150	x	1.000000	x	1.000000	= 0.00423

KB Food & Gas/Sullivan ***90-0146 & 2004-0969***

Math for R-26 Calculations

TOLUENE MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_w = (soil contamination at modeling point) / (Equation S-17)	$GW_{obj} = C_w / DF$	Conversion: 1 foot = 30.48 cm	R-16: $\alpha_x = 0.10 * X$	R-17: $\alpha_y = \alpha_x / 3$	R-18: $\alpha_z = \alpha_x / 20$	"Term 1" = $[X / (2 * \alpha_x)]$	"Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$
	C_w	C_w / DF = GW_{obj} (mg/L)	X (ft) X (cm)	0.1 x X (cm) α_x (cm)	α_x (cm) / 3 = α_y (cm)	α_x (cm) / 20 = α_z (cm)	X / 2 x α_x = "Term 1"	1 - SQRT[1 + (4 x λ x α_x)/ U]= "Term 2"
MW-6	29.7 / 1.436 = 20.676	20.676 / 20,000 = 1.03381						

Sample Location	$\beta_1 = S_y / (4 * SQRT(\alpha_y * X))$	$\beta_2 = S_z / (2 * SQRT(\alpha_z * X))$	ERF(β_1)	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$
	S_y /(4 x SQRT (α_y x X))= β_1	S_z /(2 x SQRT (α_z x X))= β_2	Section 742 APPENDIX C: Table G		C_{source} x e ("Term 1" + "Term 2") x ERF(β_1) x ERF(β_2) = mg/L
MW-6					1.03381

KB Food & Gas/Sullivan — **90-0146 & 2004-0969**

R-26 Calculations

TOLUENE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm X (ft)	X (cm)	R-16: $\alpha_x = 0.10 * X$ 0.1	x	X (cm)	=	α_x (cm)	R-17: $\alpha_y = \alpha_x / 3$ α_x (cm)	/	3	=	α_y (cm)	R-18: $\alpha_z = \alpha_x / 20$ α_x (cm)	/	20	=	α_z (cm)
MW-5	35.4	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-8	5	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-13	1.67	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524

Sample Location	"Term 1" = [X / (2 * α_x)] X	/	2	x	α_x	=	"Term 1"	"Term 2" = (1 - SQRT[1 + (4 * λ * α_x) / (U)]) 1	-	SQRT (	1	+ (	4	x	λ	x	α_x	) /	U	) =	"Term 2"
MW-5	30.48	/	2	x	3.048	=	5	1	-	SQRT (	1	+ (	4	x	0.011	x	3.048	) /	0.02868	) =	-1.3823
MW-8	30.48	/	2	x	3.048	=	5	1	-	SQRT (	1	+ (	4	x	0.011	x	3.048	) /	0.02868	) =	-1.3823
MW-13	30.48	/	2	x	3.048	=	5	1	-	SQRT (	1	+ (	4	x	0.011	x	3.048	) /	0.02868	) =	-1.3823

Sample Location	$\beta_1 = S_z / (4 * SQRT[\alpha_y * X])$ S_w	/ (	4	x	SQRT	(	α_y	x	X	)) =	β_1	$\beta_2 = S_z / (2 * SQRT[\alpha_z * X])$ S_d	/ (	2	x SQRT	(	α_z	x	X	)) =	β_2
MW-5	5821.68	/ (	4	x	SQRT	(	1.016	x	30.48	)) =	261.53792	200	/ (	2	x SQRT	(	0.1524	x	30.48	)) =	46.29808
MW-8	5821.68	/ (	4	x	SQRT	(	1.016	x	30.48	)) =	261.53792	200	/ (	2	x SQRT	(	0.1524	x	30.48	)) =	46.29808
MW-13	5821.68	/ (	4	x	SQRT	(	1.016	x	30.48	)) =	261.53792	200	/ (	2	x SQRT	(	0.1524	x	30.48	)) =	46.29808

Sample Location	ERF(β_1)	ERF(β_2)	$C_{gw} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$ C_{source}	x e	("Term 1"	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	=	mg/L
	Section 742 APPENDIX C: Table G											
MW-5	1.000000	1.000000	35.40000	x e	5	-1.3823	x	1.000000	x	1.000000	=	0.03627
MW-8	1.000000	1.000000	5.00000	x e	5	-1.3823	x	1.000000	x	1.000000	=	0.00496
MW-13	1.000000	1.000000	1.67000	x e	5	-1.3823	x	1.000000	x	1.000000	=	0.00186

KB Food & Gas/Sullivan ***90-0146 & 2004-0969***

Math for R-26 Calculations

ETHYLBENZENE MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_x = (soil contamination at modeling point) / (Equation S-17)				$GW_{obj} = C_x / DF$				Conversion: 1 foot = 30.48 cm		R-16: $\alpha_x = 0.10 * X$			R-17: $\alpha_y = \alpha_x / 3$			R-18: $\alpha_z = \alpha_x / 20$			"Term 1" = [X / (2 * α_x)]			"Term 2" = [1 - SQRT(1 + (4 * λ * α_x) / (U))]
		/		C_x	C_x	/ DF	=	GW_{obj} (mg/L)	X (ft)	X (cm)	0.1 × X (cm)		α_x (cm)	α_x (cm) / 3	=	α_y (cm)	α_x (cm) / 20	=	α_z (cm)	X / 2 × α_x	=	"Term 1"	1 - SQRT(1 + (4 × λ × α_x) / U) = "Term 2"
MW-5	16.6	/ 2.742	=	6.053	6.053	/ 20.000	=	0.30266															
MW-7	15.9	/ 2.742	=	5.796	5.796	/ 20.000	=	0.28980															
SB-5	19.2	/ 2.742	=	7.001	7.001	/ 20.000	=	0.35007															
SB-6	18.3	/ 2.742	=	6.673	6.673	/ 20.000	=	0.33366															
MW-6	18.1	/ 2.742	=	6.600	6.600	/ 20.000	=	0.33001															

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$	$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$	ERF(β_1)	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$
	S_w / ((4 × SQRT (α_y × X)) = β_1	S_d / ((2 × SQRT (α_z × X)) = β_2	Section 742 APPENDIX C: Table G		C_{source} × e ^("Term 1" + "Term 2") × ERF(β_1) × ERF(β_2) = mg/L
MW-5					0.30266
MW-7					0.28980
SB-5					0.35007
SB-6					0.33366
MW-6					0.33001

KB Food & Gas/Sullivan **90-0146 & 2004-0969**

R-26 Calculations
ETHYLBENZENE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm		R-16: $\alpha_x = 0.10 * X$					R-17: $\alpha_y = \alpha_x / 3$					R-18: $\alpha_z = \alpha_x / 20$				
		X (ft)	X (cm)	0.1	x	X (cm)		α_x (cm)	α_x (cm)	/	3	=	α_y (cm)	α_x (cm)	/	20	=	α_z (cm)
MW-6	3.76	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-7	2.35	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-8	2.21	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-10	1.67	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524
MW-12	0.955	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524

Sample Location	"Term 1" = [X / (2 * α_x)]							"Term 2" = (1 - SQRT[1 + (4 * λ * α_x) / (U)])													
	X	/	2	x	α_x	=	"Term 1"	1	-	SQRT[	1	+(	4	x	λ	x	α_x	)/	U	)=	"Term 2"
MW-6	30.48	/	2	x	3.048	=	6	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02866	)=	-0.5083
MW-7	30.48	/	2	x	3.048	=	6	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02866	)=	-0.5083
MW-8	30.48	/	2	x	3.048	=	6	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02866	)=	-0.5083
MW-10	30.48	/	2	x	3.048	=	6	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02866	)=	-0.5083
MW-12	30.48	/	2	x	3.048	=	6	1	-	SQRT[	1	+(	4	x	0.003	x	3.048	)/	0.02866	)=	-0.5083

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$											$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$									
	S_w	/(	4	x	SQRT	(	α_y	x	X	))=	β_1	S_d	/(	2	x SQRT	(	α_z	x	X	))=	β_2
MW-6	5821.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63792	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39806
MW-7	5821.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63792	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39806
MW-8	5821.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63792	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39806
MW-10	5821.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63792	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39806
MW-12	5821.68	/(	4	x	SQRT	(	1.016	x	30.48	))=	261.63792	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39806

Sample Location	ERF(β_1)	ERF(β_2)	$C_{ss} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$									
	Section 742.APPENDIX C: Table G		C_{source}	x e	("Term 1"	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	=	mg/L
MW-6	1.000000	1.000000	3.76000	x e	6	-0.5083	x	1.000000	x	1.000000	=	0.29002
MW-7	1.000000	1.000000	2.35000	x e	6	-0.5083	x	1.000000	x	1.000000	=	0.18601
MW-8	1.000000	1.000000	2.21000	x e	6	-0.5083	x	1.000000	x	1.000000	=	0.17390
MW-10	1.000000	1.000000	1.67000	x e	6	-0.5083	x	1.000000	x	1.000000	=	0.13148
MW-12	1.000000	1.000000	0.95500	x e	6	-0.5083	x	1.000000	x	1.000000	=	0.07519

KB Food & Gas/Sullivan *90-0148 & 2004-0989*

Math for R-26 Calculations

TOTAL XYLENES MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_s = (soil contamination at modeling point) / (Equation S-17)				C_s	$GW_{obj} = C_s / DF$ C_s	/ DF		= GW_{obj} (mg/L)	Conversion: 1 foot = 30.48 cm X (ft)	X (cm)	R-16 $\alpha_x = 0.10 * X$ 0.1	x	X (cm)	α_x (cm)	R-17: $\alpha_y = \alpha_x / 3$ α_x (cm)	/	3	= α_y (cm)	R-18: $\alpha_z = \alpha_x / 20$ α_x (cm)	/	20	= α_z (cm)	"Term 1" = [X / (2 * α_x)] X	/	2	x	α_x	= "Term 1"	"Term 2" = (1 - SQRT[1 + (4 * λ * α_x) / (U)]) 1 - SQRT[	1	+ (4	x	λ	x	α_x	) /	U	] = "Term 2"
MW-6	65.6	/	1.997	=	32.852	32.852	/	20.000	= 1.64258																													
MW-7	46.8	/	1.997	=	23.437	23.437	/	20.000	= 1.17184																													

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$ S_w	/ (4	x	SQRT	(	α_y	x	X	)) =	β_1	$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$ S_d	/ (2	x	SQRT	(	α_z	x	X	)) =	β_2	ERF(β_1) Section 742 APPENDIX C: Table G	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$ C_{source}	x e	("Term 1"	x	"Term 2")	x ERF(β_1)	x ERF(β_2)	=	mg/L
MW-6																							1.64258								
MW-7																							1.17184								

KB Food & Gas/Sullivan — *90-0145 & 2004-0969*

R-26 Calculations

Total Xylenes MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 (sq) = 30.48 cm		R-16: $a_x = 0.10 \cdot X$					R-17: $a_y = a_x / 3$					R-18: $a_z = a_x / 20$					"Term 1" = $[X / (2 \cdot a_x)]$							"Term 2" = $[1 - \mathrm{SQRT}(1 + (4 \cdot \lambda \cdot a_x) / U)]$												
		X (ft)	X (cm)	0.1	x	X (cm)		a_x (cm)	a_x (cm)	/	3	=	a_y (cm)	a_x (cm)	/	20	=	a_z (cm)	X	/	2	x	a_x	=	"Term 1"	1	-	SQRT [	1	+ (	4	x	λ	x	a_x	)/	U	] = "Term 2"
MW-6	16.3	1	30.48	0.1	x	30.48	=	3.048	3.048	/	3	=	1.016	3.048	/	20	=	0.1524	30.48	/	2	x	3.048	=	5	1	-	SQRT [	1	+ (	4	x	0.0019	x	3.048	)/	0.02968	] = -0.3446

Sample Location	$\beta_1 = S_z / (4 \cdot \mathrm{SQRT}(a_y \cdot X))$											$\beta_2 = S_d / (2 \cdot \mathrm{SQRT}(a_z \cdot X))$											ERF(β_1)	ERF(β_2)	$C_{gw} = C_{source} \times e^{(\text{Term 1} \times \text{Term 2})} \times \mathrm{erf}(\beta_1) \times \mathrm{erf}(\beta_2)$									
																							Section 742.APPENDIX C: Table G											
	S_w	/(	4	x	SQRT	(	a_y	x	X	))=	β_1	S_d	/(	2	x SQRT	(	a_z	x	X	))=	β_2			C_{source}	x e	("Term 1"	x	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	=	mg/L
MW-6	5621.88	/(	4	x	SQRT	(	1.016	x	30.48	))=	281.63752	200	/(	2	x SQRT	(	0.1524	x	30.48	))=	46.39808	1.000000	1.000000	16.30000	x e	5	x	-0.3446	x	1.000000	x	1.000000	=	2.91799

KB Food & Gas/Sullivan — **90-0146 & 2004-0969**

R-26 Calculations

MTBE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm X (ft)	X (cm)	R-16: $\alpha_x = 0.10 * X$ 0.1	x	X (cm)	=	α_x (cm)	R-17: $\alpha_y = \alpha_x / 3$ α_x (cm)	/	3	=	α_y (cm)	R-18: $\alpha_z = \alpha_x / 20$ α_x (cm)	/	20	=	α_z (cm)	"Term 1" = (X / (2 * α_x)) X	/	2	x	α_x	=	"Term 1"
MW-4	0.118	80	2438.4	0.1	x	2438.4	=	243.84	243.84	/	3	=	81.28	243.84	/	20	=	12.192	2438.4	/	2	x	243.84	=	5
MW-5	0.457	278	8473.44	0.1	x	8473.44	=	847.344	847.344	/	3	=	282.448	847.344	/	20	=	42.3672	8473.44	/	2	x	847.344	=	5
MW-6	0.088	50	1524	0.1	x	1524	=	152.4	152.4	/	3	=	50.8	152.4	/	20	=	7.62	1524	/	2	x	152.4	=	5
MW-9	0.38	245	7467.6	0.1	x	7467.6	=	746.76	746.76	/	3	=	248.92	746.76	/	20	=	37.338	7467.6	/	2	x	746.76	=	5
MW-11	0.232	165	5029.2	0.1	x	5029.2	=	502.92	502.92	/	3	=	167.64	502.92	/	20	=	25.146	5029.2	/	2	x	502.92	=	5

Sample Location	"Term 2" = (1 - SQRT(1 + (4 * λ * α_x) / (U))) 1	-	SQRT(	1	+(	4	x	λ	x	α_x	)/	U	)=	"Term 2"
MW-4	1	-	SQRT(	1	+(	4	x	0	x	243.84	)/	0.02888	)=	0.0000
MW-5	1	-	SQRT(	1	+(	4	x	0	x	847.344	)/	0.02888	)=	0.0000
MW-6	1	-	SQRT(	1	+(	4	x	0	x	152.4	)/	0.02888	)=	0.0000
MW-9	1	-	SQRT(	1	+(	4	x	0	x	746.76	)/	0.02888	)=	0.0000
MW-11	1	-	SQRT(	1	+(	4	x	0	x	502.92	)/	0.02888	)=	0.0000

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$ S_w	/(	4	x	SQRT	(	α_y	x	X	))=	β_1
MW-4	5821.68	/(	4	x	SQRT	(	81.28	x	2438.4	))=	3.26922
MW-5	5821.68	/(	4	x	SQRT	(	282.448	x	8473.44	))=	0.94078
MW-6	5821.68	/(	4	x	SQRT	(	50.8	x	1524	))=	5.23075
MW-9	5821.68	/(	4	x	SQRT	(	248.92	x	7467.6	))=	1.06790
MW-11	5821.68	/(	4	x	SQRT	(	167.64	x	5029.2	))=	1.58508

Sample Location	$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$ S_d	/(	2	x SQRT	(	α_z	x	X	))=	β_2	ERF(β_1) Section 742 APPENDIX C: Table G	ERF(β_2)
MW-4	200	/(	2	x SQRT	(	12.192	x	2438.4	))=	0.57998	0.999996	0.567904
MW-5	200	/(	2	x SQRT	(	42.3672	x	8473.44	))=	0.16690	0.816636	0.186592
MW-6	200	/(	2	x SQRT	(	7.62	x	1524	))=	0.92796	1.000000	0.810563
MW-9	200	/(	2	x SQRT	(	37.338	x	7467.6	))=	0.18939	0.868673	0.211165
MW-11	200	/(	2	x SQRT	(	25.146	x	5029.2	))=	0.28120	0.975015	0.308132

Sample Location	$C_{gw} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$ C_{source}	x e	("Term 1"	x	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	=	mg/L
MW-4	0.11800	x e	5	x	0.0000	x	0.999996	x	0.567904	=	0.06837
MW-5	0.45700	x e	5	x	0.0000	x	0.816636	x	0.186592	=	0.06964
MW-6	0.08800	x e	5	x	0.0000	x	1.000000	x	0.810563	=	0.06871
MW-9	0.38000	x e	5	x	0.0000	x	0.868673	x	0.211165	=	0.06972
MW-11	0.23200	x e	5	x	0.0000	x	0.975015	x	0.308132	=	0.06983

Tier 2 Industrial/Commercial Calculations for Benzene

KB Food & Gas/Sullivan

90-0148 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/26/12

Version: 4/26/2012

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->	–	USDA Soil Classification:	Loam		
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000
						foc conversion to g/g:	0.000

1.848	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ps - Soil Particle Density			2.65 or; Site Specific
0.098	θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	θw - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0103448	i - Hydraulic Gradient			Site Specific
0.007	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.886	d - Mixing Zone (m)	9.886	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific | 1.19E+00 cm/d | 4.35E+02 cm/yr | Use cm/d for R15, R19, & R26. cm/yr for R24
64.618	L - Source Length Parallel to Groundwater Flow (m)		feet = 212	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
0.005	GW_{obj} - Groundwater Remediation Objective Class 1			0.025 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
0.055	SF_o -Oral Slope Factor			Benzene = 0.055
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
1750	S - Solubility in Water			Benzene = 1750
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
70	AT_c -Average Time for Carcinogens			70
7.80E-06	URF - Inhalation Unit Risk Factor			Benzene =7.8×10^{-6}
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation to Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval			Residential = 9.5×10^8; Industrial/Commercial = 7.9×10^8; Construction Worker = 3.6×10^6
30	T_{M-L} - Exposure Interval for Mall Limit Volatilization Factor Equation S26			30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.088	D_i - Diffusivity in Air			Benzene = 0.088
0.228	H' - Henry's Law Constant			Benzene = 0.228
9.80E-06	D_w - Diffusivity in Water			Benzene = 9.8×10^{-6}
58.9	K_{oc} - Organic Carbon Partition Coefficient			Benzene = 58.9

Industrial/Commercial Ingestion Tier II Benzene Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{SF_o \times 10^{-6} \times EF \times ED \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{0.055 \times 1.00E\text{-}06 \times 250 \times 25 \times 50} = \frac{1.8E+00}{1.72E\text{-}02} = 104.058 \text{ mg/kg}$$

Construction Worker Ingestion Tier II Benzene Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{SF_o \times 10^{-6} \times EF \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{0.055 \times 1.00E\text{-}06 \times 30 \times 480} = \frac{1.8E+00}{7.92E\text{-}04} = 2258.21 \text{ mg/kg}$$

0249

Tier 2 Industrial/Commercial Calculations for Benzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Industrial/Commercial Inhalation Tier II Benzene Objective

$$S\text{-}6 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF} = \frac{1.0E\text{-}06 \times 70 \times 365}{7.80E\text{-}06 \times 1000 \times 250 \times 25 \times (1/\ 1.19E+04)} = \frac{0.02555}{4.09E\text{-}03} = 6.243 \text{ mg/kg}$$

Construction Worker Inhalation Tier II Benzene Objective

$$S\text{-}7 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF'} = \frac{1.0E\text{-}06 \times 70 \times 365}{7.80E\text{-}06 \times 1000 \times 30 \times 1 \times (1/\ 8.04E+01)} = \frac{0.02555}{2.91E\text{-}03} = 8.780 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 9.44E\text{-}05 \times 7.90E+08)^{1/2} \times 0.0001}{(2 \times 1.846 \times 9.44E\text{-}05)} = \frac{4.1532}{0.0003} = 11912.1573$$

Construction Worker

$$S\text{-}8 = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 9.44E\text{-}05 \times 3.60E+08)^{1/2} \times 0.0001}{(2 \times 1.846 \times 9.44E\text{-}05)} = \frac{0.2604}{0.0003} = 804.1334$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = \quad VF' = \frac{VF}{10} = \frac{804.1334}{10} = 80.4133$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = \quad D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(4.37E\text{-}04 \times 0.088 \times 0.228) + (0.0052 \times 9.80E\text{-}06)}{0.0924} \times \frac{1}{(1.846 \times 0.42408) + 0.21 + (0.098 \times 0.228)} = 9.44E\text{-}05$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{pb} \right] = 0.1 \times \left[0.42408 + \frac{(0.206 + 0.098 \times 0.228)}{1.846} \right] = 0.055 \text{ mg/kg}$$

0250

Tier 2 Industrial/Commercial Calculations for Benzene

KB Food & Gas/Sullivan
90-0146 & 2004-0969

Target Soil Leachate Concentration (Class 1)

S-18 = $C_w = DF \times GW_{obj}$ = 20.00 x 0.005 = 0.1

Soil-Water Partition Coefficient

S-19 = $K_d = K_{oc} \times f_{oc}$ = 58.90 x 0.007 = 0.42408

Water-Filled Porosity

S-20 = $\Theta_w = \eta \times \left[\frac{1}{K_s}\right]^{1/(2b+3)}$ = $0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073}$ = 0.2065

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \theta_w$ = 0.30 - 0.21 = 0.0980

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{4.35 \times 0.0103 \times 9.886}{0.300 \quad 64.618} + 1$ = 1.0230

GW Ingestion

S-23 = $\frac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{0.055 \times 1.000 \times 250 \times 25}$ = $\frac{1.8E+00}{343.75}$ = 0.0052 mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = $1 - \frac{1.846}{2.652}$ = 0.3039

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\frac{(-L \times I)}{(K \times i \times d_a)}\right]$

= (0.0112 x 64.618 $^2)^{0.5}$ +

3.048 x [1 - exp (-64.618 / 4.352 x 0.3 / 0.0103) / 3.048] = 9.886 m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times pb) + \Theta w + (H' \times \theta a)]$ = $\frac{1750}{1.846}$ x [(0.42408 x 1.846) + 0.206 + (0.228 x 0.098)] = 958.61 mg/kg

0251

Tier 2 Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/26/12

Version: 4/26/2012

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->	–	USDA Soil Classification: Loam
Organic Matter (%) -->	0	FOC % (0.58 conversion) --> 0.000	Organic Matter (mg/kg) 0	FOC mg/kg (0.58 conversion) 0.000; foc conversion to g/g: 0.000

Value	Parameter			Notes
1.846	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ps - Soil Particle Density			2.65 or; Site Specific
0.098	Θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt = 0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θ_w - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt = 0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24 or R23)
0.0103448	i - Hydraulic Gradient			Site Specific
0.007	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.886	d - Mixing Zone (m)	*9.886*	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific; 1.19E+00 cm/d; 4.35E+02 cm/yr; Use cm/d for R15, R19, & R26. cm/yr for R24
64.616	L - Source Length Parallel to Groundwater Flow (m)		feet = 212	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
1.000	GW_{obj} - Groundwater Remediation Objective Class 1			2.5 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
15	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
526	S - Solubility in Water			Toluene = 526
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval			Residential = 9.5 x10^8; Industrial/Commercial = 7.9 x 10^8; Construction Worker = 3.6 x 10^6
30	T_{M-L} - Exposure Interval for Mall Limit Volatilization Factor Equation S26			30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.087	D_i - Diffusivity in Air			Toluene = 0.087
0.272	H' - Henry's Law Constant			Toluene = 0.272
8.60E-06	D_w - Diffusivity in Water			Toluene = 8.6 x 10^{-6}
25	AT - Average Time for Non-Carcinogens in Ingestion Equation			Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens in Inhalation Equation			Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient			1
5	RfC - Inhalation Reference Concentration			Chronic = 5; Subchronic = 5
0.8	RfD_o - Oral Reference Dose			Chronic = 0.08; Subchronic = 0.8
182.00	K_{oc} - Organic Carbon Partition Coefficient			Toluene = 182

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/\ 0.8 \times 250 \times 25 \times 50} = \frac{638750}{0.390625} = 1635200 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/\ 0.8 \times 30 \times 1 \times 480} = \frac{2938.25}{0.018} = 163236 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/\ 5 \times 1/\ 17775.28329} = \frac{9125}{0.070322} = 129759.568 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF')} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/\ 5 \times 1/\ 119.992537} = \frac{41.975}{0.050003} = 839.448 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 4.24E\text{-}05 \times 7.90E{+}08)^{1/2} \times 0.0001}{(2 \times 1.846 \times 4.24E\text{-}05)} = \frac{2.7833}{1.57E\text{-}04} = 17775.2833$$

0252

Tier 2 Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan
90-0146 & 2004-0969

Construction Worker

S-8 = $VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 4.24E\text{-}05 \times 3.60E\text{+}06)^{1/2} \times 0.0001}{(2 \times 1.846 \times 4.24E\text{-}05)} = \frac{0.1879}{1.57E\text{-}04} = 1199.9254$

Equation for Derivation of Volatilization Factor - Construction Worker

S-9 = $VF' = \frac{VF}{10} = \frac{1199.9254}{10} = 119.9925$

Equation for Derivation of Apparent Diffusivity

S-10 = $D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$

$= \frac{(4.37E\text{-}04 \times 0.087 \times 0.272) + (0.0052 \times 8.60E\text{-}06)}{0.0924} \times$

$\frac{1}{(1.846 \times 1.3104) + 0.21 + (0.098 \times 0.272)} = 4.24E\text{-}05$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

S-17 = $C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{pb} \right] = 20 \times \left[1.3104 + \frac{(0.206 + 0.098 \times 0.272)}{1.846} \right] = 28.729$ mg/kg

Target Soil Leachate Concentration (Class 1)

S-18 = $C_w = DF \times GW_{obj} = 20.00 \times 1.000 = 20$

Soil-Water Partition Coefficient

S-19 = $K_d = K_{oc} \times f_{oc} = 182.00 \times 0.007 = 1.3104$

Water-Filled Porosity

S-20 = $\Theta_w = \eta \times \left[\frac{I}{K_s}\right]^{1/(2b+3)} = 0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073} = 0.2065$

0253

Tier 2 Industrial/Commercial Calculations for Toluene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \theta_w$ = 0.30 - 0.21 = 0.0980

Dilution Factor

S-22 = $DF = 1 + \dfrac{K \times I \times d}{I \times L}$ = $\dfrac{4.35}{0.300} \times \dfrac{0.0103}{64.618} \times 9.886$ + 1 = 1.0230

GW Ingestion

S-23 = $\dfrac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\dfrac{1.0E\text{-}06 \times 15 \times 0 \times 365}{0.000 \times 1.000 \times 250 \times 25}$ = $\dfrac{0.0E+00}{0}$ = #DIV/0! mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \dfrac{\rho_b}{\rho_s}$ = $1 - \dfrac{1.846}{2.652}$ = 0.3039

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\dfrac{(-L \times I)}{(K \times i \times d_a)}\right]$

= (0.0112 x 64.618 $^2)^{0.5}$ +

3.048 x [1 - exp ($\dfrac{-64.618}{4.352}$ x $\dfrac{0.3}{0.0103}$) x $\dfrac{}{3.048}$)] = 9.886 m

Soil Saturation Limit

S-29 = $C_{sat} = \dfrac{S}{\rho_b} \times [(K_d \times pb) + \Theta w + (H' \times \theta a)]$ = $\dfrac{526}{1.846}$ x [(1.3104 x 1.846) + 0.206 + (0.272 x 0.098)] = 755.56 mg/kg

0254

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

KB Food & Gas/Sullivan
90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/26/12
Version: 4/26/2012

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->	--	USDA Soil Classification:	Loam		
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

Value	Parameter	Calculated	Source	Notes
1.846	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ρs - Soil Particle Density			2.65 or; Site Specific
0.098	Θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θw - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0103448	i - Hydraulic Gradient			Site Specific
0.007	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.886	d - Mixing Zone (m)	9.886	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific | 1.19E+00 cm/d | 4.35E+02 cm/yr | Use cm/d for R15, R19, & R26. cm/yr for R24
64.618	L - Source Length Parallel to Groundwater Flow (m)		feet = 212	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
0.700	GW_{obj} - Groundwater Remediation Objective Class 1			1 | GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
169	S - Solubility in Water			Ethylbenzene = 169
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval			Residential = 9.5 x10^8; Industrial/Commercial = 7.9 x 10^8; Construction Worker = 3.6 x 10^6
30	T_{M-L} - Exposure Interval for Mass Limit Volatilization Factor Equation S26			30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.075	D_i - Diffusivity in Air			Ethylbenzene = 0.075
0.323	H' - Henry's Law Constant			Ethylbenzene = 0.323
7.80E-06	D_w - Diffusivity in Water			Ethylbenzene = 7.8 x 10^{-6}
25	AT - Average Time for Non-Carcinogens in Ingestion Equation			Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens in Inhalation Equation			Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient			1
1	RfC - Inhalation Reference Concentration			Chronic = 1; Subchronic = 1
0.1	RfD_o - Oral Reference Dose			Chronic = 0.1; Subchronic = 1
363.00	K_{oc} - Organic Carbon Partition Coefficient			Ethylbenzene = 363

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$\text{S-1} = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/\ 0.1 \times 250 \times 25 \times 50} = \frac{638750}{3.125} = 204400 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$\text{S-1} = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/\ 1 \times 30 \times 1 \times 480} = \frac{2938.25}{0.0144} = 204045 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$\text{S-4} = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/\ 1 \times 1/\ 24280.24801} = \frac{9125}{0.257411} = 35449 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$\text{S-5} = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF')} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/\ 1 \times 1/\ 163.9044796} = \frac{41.975}{0.183033} = 229.330 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$\text{S-8} = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \left(\frac{3.14 \times 2.27E\text{-}05 \times 7.90E\text{+}08}{2 \times 1.846 \times 2.27E\text{-}05}\right)^{1/2} \times 0.0001 = \frac{2.0376}{8.39E\text{-}05} = 24280.2480$$

0255

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

KB Food & Gas/Sullivan

90-0148 & 2004-0969

Construction Worker

$$\text{S-8} = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 2.27\text{E-}05 \times 3.60\text{E+}06)^{1/2} \times 0.0001}{(2 \times 1.846 \times 2.27\text{E-}05)} = \frac{0.1375}{8.39\text{E-}05} = 1639.0448$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$\text{S-9} = \quad VF' = \frac{VF}{10} = \frac{1639.0448}{10} = 163.9045$$

Equation for Derivation of Apparent Diffusivity

$$\text{S-10} = \quad D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(4.37\text{E-}04 \times 0.075 \times 0.323) + (0.0052 \times 7.80\text{E-}06)}{0.0924} \times \frac{1}{(1.846 \times 2.6136) + 0.21 + (0.098 \times 0.323)} = 2.27\text{E-}05$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$\text{S-17} = \quad C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = 14 \times \left[2.6136 + \frac{(0.206 + 0.098 \times 0.323)}{1.846} \right] = 38.393 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$\text{S-18} = \quad C_w = DF \times GW_{obj} = 20.00 \times 0.700 = 14$$

Soil-Water Partition Coefficient

$$\text{S-19} = \quad K_d = K_{oc} \times f_{oc} = 363.00 \times 0.007 = 2.6136$$

Water-Filled Porosity

$$\text{S-20} = \quad \Theta_w = \eta \times \left(\frac{I}{K_s}\right)^{1/(2b+3)} = 0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073} = 0.2065$$

0256

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w = 0.30 - 0.21 = 0.0980$

Dilution Factor

S-22 = $DF = 1 + \dfrac{K \times i \times d}{I \times L} = \dfrac{4.35 \times 0.0103 \times 9.886}{0.300 \quad 64.618} + 1 = 1.0230$

GW Ingestion

S-23 = $\dfrac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED} = \dfrac{1.0E\text{-}06 \times 70 \times 0 \times 365}{0.000 \times 1.000 \times 250 \times 25} = \dfrac{0.0E{+}00}{0} = \#DIV/0!$ mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \dfrac{\rho_b}{\rho_s} = 1 - \dfrac{1.846}{2.652} = 0.3039$

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \dfrac{(-L \times I)}{(K \times i \times d_a)} \right]$

$= (0.0112 \times 64.618\ ^2)^{0.5} +$

$3.048 \times \left[1 - \exp \dfrac{(-64.618 \times 0.3)}{(4.352 \times 0.0103 \times 3.048)} \right] = 9.886$ m

Soil Saturation Limit

S-29 = $C_{sat} = \dfrac{S}{\rho_b} \times [(K_d \times pb) + \Theta w + (H' \times \Theta a)] = \dfrac{169}{1.846} \times [(2.6136 \times 1.846) + 0.206 + (0.323 \times 0.098)] = 463.46$ mg/kg

0257

Tier 2 Industrial/Commercial Calculations for Total Xylenes

KB Food & Gas/Sullivan
90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/26/12
Version: 4/26/2012

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->	--	USDA Soil Classification: Loam
Organic Matter (%) -->	0	FOC % (0.58 conversion) --> 0.000	Organic Matter (mg/kg) 0	FOC mg/kg (0.58 conversion) 0.000; foc conversion to g/g: 0.000

Value	Parameter			Notes
1.846	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ρs - Soil Particle Density			2.65 or; Site Specific
0.098	Θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θw - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0103448	i - Hydraulic Gradient			Site Specific
0.007	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.886	d - Mixing Zone (m)	9.886	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific 1.19E+00 cm/d 4.35E+02. cm/yr Use cm/d for R15, R19, & R26. cm/yr for R24
64.618	L - Source Length Parallel to Groundwater Flow (m)		feet = 212	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
10.000	GW_{obj} - Groundwater Remediation Objective Class 1			10 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
186	S - Solubility in Water			Total Xylenes = 186
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval			Residential = 9.5 $\times 10^8$; Industrial/Commercial = 7.9 $\times 10^8$; Construction Worker = 3.6 $\times 10^6$
30	T_{M-L} - Exposure Interval for Mall Limit Volatilization Factor Equation S26			30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.072	D_i - Diffusivity in Air			Total Xylenes = 0.072
0.250	H' - Henry's Law Constant			Total Xylenes = 0.25
9.34E-06	D_w - Diffusivity in Water			Total Xylenes = 9.34 $\times 10^{-6}$
25	AT - Average Time for Non-Carcinogens In Ingestion Equation			Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens In Inhalation Equation			Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient			1
0.1	RfC - Inhalation Reference Concentration			Chronic = 0.1; Subchronic = 0.4
0.2	RfD_o - Oral Reference Dose			Chronic = 0.2; Subchronic = 1
260.00	K_{oc} - Organic Carbon Partition Coefficient			Total Xylenes = 260

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$\text{S-1} = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/0.2 \times 250 \times 25 \times 50} = \frac{638750}{1.5625} = 408800 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$\text{S-1} = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/1 \times 30 \times 1 \times 480} = \frac{2938.25}{0.0144} = 204045 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$\text{S-4} = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/0.1 \times 1/24008.08198} = \frac{9125}{2.603290011} = 3505.180 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$\text{S-5} = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/0.4 \times 1/162.0672154} = \frac{41.975}{0.462770955} = 90.704 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$\text{S-8} = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 2.32E\text{-}05 \times 7.90E\text{+}08)^{1/2} \times 0.0001}{(2 \times 1.846 \times 2.32E\text{-}05)} = \frac{2.0607}{8.58E\text{-}05} = 24008.0820$$

0258

Tier 2 Industrial/Commercial Calculations for Total Xylenes

KB Food & Gas/Sullivan
90-0145 & 2004-0969

Construction Worker

S-8 = $VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)}$ = 85.81 $\times \left(\frac{3.14 \times 2.32E\text{-}05 \times 3.60E\text{+}06}{2 \times 1.846 \times 2.32E\text{-}05}\right)^{1/2} \times 0.0001$ = $\frac{0.1391}{8.58E\text{-}05}$ = 1620.6722

Equation for Derivation of Volatilization Factor - Construction Worker

S-9 = $VF' = \frac{VF}{10} = \frac{1620.6722}{10}$ = 162.0672

Equation for Derivation of Apparent Diffusivity

S-10 = $D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$

$= \frac{(4.37E\text{-}04 \times 0.072 \times 0.250) + (0.0052 \times 9.34E\text{-}06)}{0.0924} \times$

$\frac{1}{(1.846 \times 1.872) + 0.21 + (0.098 \times 0.250)}$ = 2.32E-05

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

S-17 = $C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b}\right]$ = 200 $\times \left[1.872 + \frac{(0.206 + 0.098 \times 0.250)}{1.846}\right]$ = 399.373 mg/kg

Tier 2 Soil Component of GW Ingestion Objective cannot exceed Soil Saturation Limit

Target Soil Leachate Concentration (Class 1)

S-18 = $C_w = DF \times GW_{obj}$ = 20.00 X 10.000 = 200

Soil-Water Partition Coefficient

S-19 = $K_d = K_{oc} \times f_{oc}$ = 260.00 X 0.007 = 1.872

Water-Filled Porosity

S-20 = $\Theta_w = \eta \times \left[\frac{I}{K_s}\right]^{1/(2b+3)}$ = 0.30 $\times \left[\frac{0.300}{60.000}\right]^{0.073}$ = 0.2065

0259

Tier 2 Industrial/Commercial Calculations for Total Xylenes

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \theta_w$ = 0.30 - 0.21 = 0.0980

Dilution Factor

S-22 = $DF = 1 + \dfrac{K \times i \times d}{I \times L}$ = $\dfrac{4.35 \times 0.0103 \times 9.886}{0.300 \quad 64.618}$ + 1 = 1.0230

GW Ingestion

S-23 = $\dfrac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\dfrac{1.0E\text{-}06 \times 70 \times 0 \times 365}{0.000 \times 1.000 \times 250 \times 25}$ = $\dfrac{0.0E{+}00}{0}$ = #DIV/0! mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \dfrac{\rho_b}{\rho_s}$ = $1 - \dfrac{1.846}{2.652}$ = 0.3039

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\dfrac{(-L \times I)}{(K \times i \times d_a)}\right]$

= $(0.0112 \times 64.618\ ^2)^{0.5}$ +

$3.048 \times \left[1 - \exp \left(\dfrac{-64.618 \times 0.3}{4.352 \times 0.0103 \times 3.048}\right)\right]$ = 9.886 m

Soil Saturation Limit

S-29 = $C_{sat} = \dfrac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \theta a)]$ = $\dfrac{186}{1.846} \times [(1.872 \times 1.846) + 0.206 + (0.250 \times 0.098)]$ = 371.42 mg/kg

0260

Tier 2 Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan

90-0146 & 2004-0969

SSL	SSL & RBCA
RBCA	IRIS/HEAST

Date Compiled: 04/26/12

Version: 4/26/2012

Input Values

Holcomb's Bulk Density -->	0	Converted Value to be used in calculation sheet -->		--	USDA Soil Classification:	Loam		
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g: 0.000

Value	Parameter			Notes
1.846	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.652	ps - Soil Particle Density			2.65 or; Site Specific
0.098	Θ_a - Air Filled Soil Porosity	*0.098*	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.206	Θw - Water Filled Soil Porosity	*0.206*	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.304	η - SSL & Θ_T - RBCA: Total Soil Porosity	*0.304*	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0103448	i - Hydraulic Gradient			Site Specific
0.007	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	*1.023*	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
9.886	d - Mixing Zone (m)	9.888	Value from S-25	2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)
4.35	K - Hydraulic Conductivity (m/yr)	cm/sec =	1.38E-05	Site Specific 1.19E+00 cm/d 4.35E+02 cm/yr Use cm/d for R15, R19, & R26. cm/yr for R24
64.618	L - Source Length Parallel to Groundwater Flow (m)		feet = 212	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
60	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
0.070	GW_{obj} - Groundwater Remediation Objective Class 1			0.07 GW_{obj} - Groundwater Remediation Objective Class 2
0.073	1/(2b+3) - Exponent for S20			See Table K for Input Values
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1
51000	S - Solubility in Water			MTBE = 51,000
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval			Residential = 9.5 $\times 10^8$; Industrial/Commercial = 7.9 $\times 10^8$; Construction Worker = 3.6 $\times 10^6$
30	T_{M-L} - Exposure Interval for Mall Limit Volatilization Factor Equation S26			30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18
0.102	D_i - Diffusivity in Air			MTBE = 0.102
0.0241	H' - Henry's Law Constant			MTBE = 0.0241
1.10E-05	D_w - Diffusivity in Water			MTBE = 1.1 $\times 10^{-5}$
25	AT - Average Time for Non-Carcinogens in Ingestion Equation			Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens in Inhalation Equation			Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient			1
3	RfC - Inhalation Reference Concentration			Chronic = 3; Subchronic = 3
0.01	RfD_o - Oral Reference Dose			Chronic = 0.01; Subchronic = 0.1
11.50	K_{oc} - Organic Carbon Partition Coefficient			MTBE = 11.5

Residential Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/\ 0.01 \times 250 \times 25 \times 50} = \frac{638750}{31.25} = 20440 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/\ 0.1 \times 30 \times 1 \times 480} = \frac{2938.25}{0.144} = 20405 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/\ 3 \times 1/\ 19877.95309} = \frac{9125}{0.104806} = 87065.435 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/\ 3 \times 1/\ 134.1866671} = \frac{41.975}{0.074523} = 563.249 \text{ mg/kg}$$

0261

Tier 2 Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan

90-0146 & 2004-0969

RESIDENTIAL OR COMMERCIAL

$$\text{S-8} = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 3.39\text{E-}05 \times 7.90\text{E+}08)^{1/2} \times 0.0001}{(2 \times 1.846 \times 3.39\text{E-}05)} = \frac{2.4889}{1.25\text{E-}04} = 19877.9531$$

Construction Worker

$$\text{S-8} = \quad VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 3.39\text{E-}05 \times 3.60\text{E+}06)^{1/2} \times 0.0001}{(2 \times 1.846 \times 3.39\text{E-}05)} = \frac{0.1680}{1.25\text{E-}04} = 1341.8667$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$\text{S-9} = \quad VF' = \frac{VF}{10} = \frac{1341.8667}{10} = 134.1867$$

Equation for Derivation of Apparent Diffusivity

$$\text{S-10} = \quad D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(4.37\text{E-}04 \times 0.102 \times 0.024) + (0.0052 \times 1.10\text{E-}05)}{0.0924} \times$$

$$\frac{1}{(1.846 \times 0.0828) + 0.21 + (0.098 \times 0.024)} = 3.39\text{E-}05$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$\text{S-17} = \quad C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = 1.4 \times \left[0.0828 + \frac{(0.206 + 0.098 \times 0.024)}{1.846} \right] = 0.274 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$\text{S-18} = \quad C_w = DF \times GW_{obj} = 20.00 \times 0.070 = 1.4$$

Soil-Water Partition Coefficient

$$\text{S-19} = \quad K_d = K_{oc} \times f_{oc} = 11.50 \times 0.007 = 0.0828$$

0262

Tier 2 Industrial/Commercial Calculations for MTBE

KB Food & Gas/Sullivan

90-0146 & 2004-0969

Water-Filled Porosity

S-20 = $\Theta_w = \eta \times \left[\frac{I}{K_s}\right]^{1/(2b+3)} = 0.30 \times \left[\frac{0.300}{60.000}\right]^{0.073} = 0.2065$

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \theta_w = 0.30 - 0.21 = 0.0980$

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L} = \frac{4.35 \times 0.0103 \times 9.886}{0.300 \quad 64.618} + 1 = 1.0230$

GW Ingestion

S-23 = $\frac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED} = \frac{1.0E\text{-}06 \times 70 \times 0 \times 365}{0.000 \times 1.000 \times 250 \times 25} = \frac{0.0E+00}{0} =$ #DIV/0! mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s} = 1 - \frac{1.846}{2.652} = 0.3039$

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\frac{(-L \times I)}{(K \times i \times d_a)}\right]$

$= (0.0112 \times 64.618\ ^2)^{0.5} +$

$3.048 \times \left[1 - \exp\frac{(-64.618 \times 0.3)}{(4.352 \times 0.0103 \times 3.048)}\right] = 9.886$ m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \theta a)] = \frac{51000}{1.846} \times \{(0.0828 \times 1.846) + 0.206 + (0.024 \times 0.098)\} = 9{,}979.27$ mg/kg

0263

LEAKING UST TECHNICAL REVIEW NOTES

Reviewed by: Brad Dilbaitis
Date Reviewed: 5/9/2012

Re: LPC #1390305014—Moultrie County
Sullivan/ KB Food & Gas
111 West Jackson Street (Rt. 121 & 32)
Leaking UST Incident No. 20040969 & 900146
Leaking UST Technical File

Document(s) Reviewed:
2/17/2012 Corrective Action Plan and Budget—received 2/17/12
4/6/2012 Revised TACO calculations—received 4/10/12
4/27/2012 Re-revised TACO calculations—received 4/27/12

General Site Information:

Site subject to: 734

IEMA date(s): 7/9/2004 & 1/17/1990	Reimbursement: yes
UST System removed: yes—removed 7/8/04	OSFM Fac. ID #: 4-013187
Encountered Groundwater: yes, wells screened from 4' bgs-13.5'bgs	SWAP mapping and evaluation completion date: 8/24/2010—not in an ordinanced area
Free Product: no	Site placement correct in SWAP: yes
Current/Past Land Use: gas station	MTBE > 40 ppb in groundwater: no
Size & Product of Tanks: (1) 10,000g unleaded gasoline, (1) 8,000g leaded gasoline, (1) 8,000g diesel, (1) 5,000g diesel, (1) 5,000g unleaded gasoline and (1) 2,000g kerosene USTs	

Corrective Action Plan/Budget Review Notes:

- Soil and groundwater contamination extends off site to the north (Jackson Street-Rt. 32), east (Van Buren Street), south (newspaper office, Willaredt Properties) and west (Hamilton Street—Rt. 121)
- Established tier 2 SROs—I/C and construction worker
- Proposing to use an ELUC with the property to the south—News Progress property
- Proposing Highway Authority Agreements for Hamilton Street (Il. Rt. 32), Jackson Street (IL. Rt. 121) and Van Buren Street—will include both the City of Sullivan and IDOT
- Proposing that the City of Sullivan adopt either a citywide or a limited groundwater ordinance to exclude the groundwater ingestion exposure route

TACO calculations:

Hydraulic conductivity (K)	1.38×10^{-5} cm/sec
Soil bulk density (ρ_b)	1.846 g/cm^3
Soil particle density (ρ_s)	2.652 g/cm^3
Moisture content (w)	0.142 g_{water}/g_{soil}
Organic carbon content (f_{oc})	0.00721 g/g

- The site-specific Tier 2 SROs are:
  - Benzene—6.24 mg/kg (S-6, I/C inhalation)
  - Ethylbenzene—229.33 mg/kg (S-5, const. worker Inhalation)
  - Toluene—755.56 mg/kg (S-29, site-specific C_{sat})
  - Total xylenes—90.70 mg/kg (S-5, const. worker Inhalation)
  - MTBE—563.25 mg/kg (S-5, const. worker Inhalation)
- The highest on-site soil BETX concentrations are below the site-specific tier 2 soil remediation objectives

Corrective Action Budget:

Drilling and Monitoring Well Costs	$0.00
Analytical Costs	$0.00
Remediation and Disposal Costs	$0.00
UST Removal and Abandonment Costs	$0.00
Paving, Demolition and Well Abandonment Costs	$1,719.00
Consulting Personnel Costs	$31,443.23
Consultant's Materials Costs	$734.30

- Includes well abandonment costs
- Consultant's Materials Costs requesting 300 copies for the Corrective Action Budget at $0.10/copy for a total of $30.00—the budget is 15 pages long—this represents twenty copies of the budget (we received two)—will allow (4) copies; two for us, one for the owner and one for the consultant—that's 60 copies at $0.10/copy for a total of $6.00—a $24.00 deduction—unreasonable, lack of supp doc (a 75-page budget)
- The Consultant's Materials Costs request a total of $370.00 for copies (3,700 copies)
- Consulting Personnel Costs include:
  - $4,182.51 for CAP preparation
  - $2,383.45 for the budget preparation
  - $3,529.30 for TACO calculations etc.
  - $687.54 for well abandonment (coordination?)
  - $3,082.48 for Highway Authority Agreement preparation
  - $4,205.42 for the preparation/review of the groundwater ordinance
  - $2,245.94 for the ELUC
  - $6,096.17 for the preparation of the CACR
  - $5,030.42 for the claim preparation
    - The claim preparation costs include (30) hours for a Sr. Acct. Tech and (16) hours for a Sr. PM (compliance/oversight) and (6) hours for a Sr. PE for review and certification—a total of 54 hours
- The Stage 3 actual costs originally requested (50), (12) and (4) hours, respectively—this became an issue because the consultant performed the drilling—we only needed one invoice from the lab (and p.o.p for handling charges) and the consultant's personnel time sheets for the claim
- After much back-and-forth, the consultant stated that they overestimate the reimbursement hours because they are expecting us to make deductions and that they have to correct their coding on their time sheets
- The upcoming corrective action claim will require NO documentation from anyone other than the consultant
- The claim for the Stage 3 actual costs is in my hand—it requests a total of 23.5 hours for the claim preparation (approved for 24)
- It is a very safe assumption that the requested hours for reimbursement preparation requested (46) in this Corrective Action Budget are a huge overestimation and the actual hours will be less than the 23.5 hours submitted for the preparation of the Stage 3 claim:
  - The consultant had previously indicated that the preparation hours for reimbursement are estimated on the high side in order to anticipate possible budget deductions (time to correct the coding on their personnel sheets)—I am not making any deductions in Consulting Personnel Costs as this is a proposed budget

- Because this Corrective Action Plan does not include any active remediation the only supporting documentation needed for the claim is the consultant's work summary sheets—this is less work and documentation than was needed for the Stage 3 claim, where they requested 23.5 hours
- The consultant was able to previously provide me with the Stage 3 work summary sheets within a couple of hours when requested—it would stand to reason that it would take about the same amount of time to have them ready for the corrective action claim (we need nothing else other than our required Agency forms)
- The consultant has assured me that they will only request payment for the hours spent doing the task, not the hours that were approved for the task

Illinois EPA Recommendation/Comments:

- All on-site soil contamination is below the Tier 2 SROs for BETX and MTBE—the proposed HAAs and ELUCs will address the off-site soil contamination—proposing the adoption of an ordinance—Corrective Action Plan is approved
- Spoke with the consultant concerning the requested copies in the budget-she assured me that, although the budgeted number of copies is exaggerated, only the amount used will be requested in the claim—in addition, she mentioned something about other copies that are internal that get marked up during review and such—will approve the copies at this time as I'm sure I'll get the application for payment when it's received
- Approving the Corrective Action Plan and Budget

BD\CAPnotes.docx

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-3397
PAT QUINN, GOVERNOR JOHN J. KIM, INTERIM DIRECTOR

217/782-6762

CERTIFIED MAIL

MAY 16 2012

7009 3410 0002 3749 4461

KB Sullivan, Inc.
Kamlesh Patel
140 Hearthstone Drive
Bartlett, Illinois 60103

Re: LPC #1390305014—Moultrie County
Sullivan/ KB Food & Gas
111 West Jackson Street (Rt. 121 & 32)
Leaking UST Incident No. 20040969 and 900146
Leaking UST Technical File

Dear Mr. Patel:

The Illinois Environmental Protection Agency (Illinois EPA) has reviewed the Corrective Action Plan (plan) submitted for the above-referenced incident. This plan, dated February 17, 2012, was received by the Illinois EPA on February 17, 2012. Additional information was received by the Illinois EPA on April 10, 2012 and April 27, 2012. Citations in this letter are from the Environmental Protection Act (Act), as amended by Public Act 92-0554 on June 24, 2002, and Public Act 96-0908 on June 8, 2010, and 35 Illinois Administrative Code (35 Ill. Adm. Code).

Pursuant to Sections 57.7(b)(2) and 57.7(c) of the Act and 35 Ill. Adm. Code 734.505(b) and 734.510(a), the plan is approved. The activities proposed in the plan are appropriate to demonstrate compliance with Title XVI of the Act. Please note that all activities associated with the remediation of this release proposed in the plan must be executed in accordance with all applicable regulatory and statutory requirements, including compliance with the proper permits.

In addition, the total budget is approved for the amounts listed in Attachment A. Please note that the costs must be incurred in accordance with the approved plan. Be aware that the amount of payment from the Fund may be limited by Sections 57.7(c), 57.8(d), 57.8(e), and 57.8(g) of the Act, as well as 35 Ill. Adm. Code 734.630 and 734.655.

NOTE: Pursuant to Section 57.8(a)(5) of the Act, if payment from the Fund will be sought for any additional costs that may be incurred as a result of the Illinois EPA's modifications, an amended budget must be submitted. Amended plans and/or budgets must be submitted and approved prior to the issuance of a No Further Remediation (NFR) Letter. Costs associated with a plan or budget that have not been approved prior to the issuance of an NFR Letter will not be paid from the Fund.

Pursuant to Sections 57.7(b)(5) and 57.12(c) and (d) of the Act and 35 Ill. Adm. Code 734.100 and 734.125, the Illinois EPA requires that a Corrective Action Completion Report that achieves compliance with applicable remediation objectives be submitted within 30 days after completion of the plan to:

Illinois Environmental Protection Agency
Bureau of Land - #24
Leaking Underground Storage Tank Section
1021 North Grand Avenue East
Post Office Box 19276
Springfield, IL 62794-9276

Please submit all correspondence in duplicate and include the Re: block shown at the beginning of this letter.

If within four years after the approval of this plan, compliance with the applicable remediation objectives has not been achieved and a Corrective Action Completion Report has not been submitted, the Illinois EPA requires the submission of a status report pursuant to Section 57.7(b)(6) of the Act.

Please be advised that, pursuant to Public Act 96-0908, effective June 8, 2010, all releases of petroleum from USTs are subject to Title XVI of the Act, as amended by Public Act 92-0554 on June 24, 2002, and Public Act 96-0908 on June 8, 2010, and 35 Ill. Adm. Code 734. The regulations at 35 Ill. Adm. Code 732 no longer exist, and the only releases subject to 35 Ill. Adm. Code 731 are those from hazardous substance USTs.

If you have any questions or need further assistance, please contact Brad Dilbaitis at (217) 785-8378 or at Bradley.Dilbaitis@illinois.gov.

Sincerely,

Thomas A. Henninger
Unit Manager
Leaking Underground Storage Tank Section
Division of Remediation Management
Bureau of Land

TAH:BD\CAPappBUDapp.docx

Attachment: Attachment A

c: CWM Company
BOL File

Attachment A

Re: LPC #1390305014—Moultrie County
Sullivan/ KB Food & Gas
111 West Jackson Street (Rt. 121 & 32)
Leaking UST Incident No. 20040969 and 900146
Leaking UST Technical File

The following amounts are approved:

$0.00	Drilling and Monitoring Well Costs
$0.00	Analytical Costs
$0.00	Remediation and Disposal Costs
$0.00	UST Removal and Abandonment Costs
$1,719.00	Paving, Demolition, and Well Abandonment Costs
$31,443.23	Consulting Personnel Costs
$734.30	Consultant's Materials Costs

Handling charges will be determined at the time a billing package is reviewed by the Illinois EPA. The amount of allowable handling charges will be determined in accordance with Section 57.1(a) of the Environmental Protection Act and 35 Illinois Administrative Code 734.635.

BD\CAPappBUDappA

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois 62794-9276 • (217) 782-3397
Pat Quinn, Governor John J. Kim, Interim Director

217/782-6762

CERTIFIED MAIL

MAY 16 2012

7009 3410 0002 3749 4461

KB Sullivan, Inc.
Kamlesh Patel
140 Hearthstone Drive
Bartlett, Illinois 60103

Re: LPC #1390305014—Moultrie County
Sullivan/ KB Food & Gas
111 West Jackson Street (Rt. 121 & 32)
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SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

KB Sullivan, Inc.
140 Hearthstone Drive
Bartlett, IL
60103

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X KBPatel ☒ Agent ☐ Addressee

B. Received by (Printed Name) Kamlesh Patel C. Date of Delivery 5/18/12

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

TAH/BO 20040969
900146

24

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Total Postage & Fees	$

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Street, Apt. No.; or PO Box No. 140 Hearthstone Drive
City, State, ZIP+4 Bartlett, IL 60103

PS Form 3800, August 2006 See Reverse for Instructions

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Illinois Environmental
Protection Agency
P.O. BOX 19276 MAIL CODE #
SPRINGFIELD, IL 62794-9276

24

02

CW®M Company

701 W. South Grand Avenue
Springfield, IL 62704

Environmental Consulting Services

Phone: (217) 522-8001
Fax: (217) 522-8009

139030S014-Moultrie
KB Food & Gas
LUST Tech

June 12, 2012

Mr. Bradley Dilbaitis
Illinois Environmental Protection Agency (IEPA)
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Re: KB Sullivan / Incident #2004-0969

Dear Brad:

I tried to tackle some of your items, where I see some need for additional information or comment.

Item 1. That is what we are attempting to do. We are striving for a consistent, smooth as we can make, transition from proposed to actual to reimbursement document preparation.

The titles used in the budgets are really evolutions of titles that numerous PMs have commented on or we have altered over the years to describe tasks of various personnel. Our staff is constantly modifying to incorporate comments, justifications, etc. in the budget approval process.

We have left the reimbursement claim titles alone over the same course of time as this is the first time anyone has asked or questioned the difference. Since the reimbursement claim, when reviewed on its own merit, sufficiently describes the tasks of the invoices attached, we've had no previous reason to change.

Item 2. Yes, rates do change. Contrary to your citation, the method of accounting is factored into the Reimbursement Claim and identified as such. For example, if a 2011 rate is approved in an SI Budget and the work took place over a 3-year time frame, we don't just throw a total Reimbursement Claim to match the budget to the Agency and ask for the entire amount, which is fundamentally the heart of this disagreement, misunderstanding and debate. As we only bill the Agency for actual costs incurred and other firms pre-bill, we go back into our system, input all the field purchases, etc. and invoices. The personnel rates will be reflective of the year incurred. We do not go back and change a 2008 rate to a 2011, nor do we change a 2011 rate to a 2012 rate. Yes, if the Agency wants to be petty, they can cut the higher rate by a few cents, although we gave on the earlier lower rates.

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IEPA - DIVISION OF RECORDS MANAGEMENT
RELEASABLE
AUG 08 2012
REVIEWER MED

If we were to go into the database and change the rate of every hour to match a rate in an approved budget (usually approved long after the work was done), our reimbursement time would double or triple (especially on a Stage 3 or a long duration phase). We simply believe it's not in the best interest of either party to do so, given the minimal net proceeds or deductions. Mind you, the number could go either way. Firms that do so are fraudulently presenting their supporting documentation.

For example, you get a promotion, get your new pay rate on February 1, it would be like your boss telling you that you can only get paid that on certain projects, not others, or by rates per fiscal year or some such variable. So, we can't possibly distinguish in any other way than use a rate dated as incurred.

Item 3. Yes, you are correct; however, this is an issue that highly varies among Project Managers. We believe that we are making progress but still have not conquered this issue. Just last week, we received a couple of other budget modifications. In one, three personnel were listed for reimbursement tasks – Senior Project Manager, Senior Professional Engineer and Account Technician. **All** hours were reduced to the rate of an Account Technician. We're told only one rate would be approved, as the others were duplicative, so from here forward, submit PE rate or we'll only get one of the lowest rates. Obviously, the reimbursement will never reflect the actual budget. Three personnel titles will be used to complete the work.

That is what we are trying to work towards. We are not seeing much uniformity between Project Managers on this issue.

Item 4. You are combining different points. One is "actual" is not 100% actual when the actual budget is prepared, as the work is not complete. The second point was that for instance, if an actual budget for a project was being prepared by us today, April 2012, May 2012 and June 2012 are not fully input into our system, and therefore are not finalized to be a part of the actual budget preparation. The current delay is larger than usual, but a three or four week lag is not unusual. Not everything for April, May, and now June that have been entered into the system are checked.

As we discussed last week, we are re-looking at the last claim in terms of hours and task descriptions. Given that the project came in near budget, I'm speculating that the task descriptions and possibly personnel were varied. As Vince has tried to explain multiple times, we budget to the point of "know" and estimate for the completion. Today is a very good example: if one of our staff was working on a budget, they would get the print-out, knowing full well April, May and June to-date are not yet available, or only so in draft, plus all personnel to complete the report and budget and the subsequent for reimbursement.

Items 6 and 7. Again, we are not seeing uniformity from the Agency. On the date you sent your email, I had a conversation with another Project Manager that said the

Agency does not even look at actual budgets in anywhere near that level of detail. In an attempt to make this claim review more easy to review and comparable to the budget actual; we attempted to utilize the budget actual task descriptions. No reallocations were done. The numbers do look somewhat comparable, but not exact as it was not intended to do so from the onset. We hope that our efforts to do so won't be held as another strike toward our claim if they still don't watch 100%. Again, and according to PMs, we were clearly at or under the total for Plan preparation costs.

I spoke with yet another PM regarding budget development. I wanted to submit via e-mail amended budget pages so all needed tasks and personnel would be included with the budget. I was told: "Don't worry about how the hours break down, as long as the total is OK, we don't look at that." Some drilling was changed, off-site added, on-site changed, budget and plan time changed by percentages, additions and deletions. I was trying to get details so I could track, but was informed not to worry about. This type of review and level of detail is not included in the review and we obviously did not budget enough. In reference to the hours accumulated by the Scientist I, the total was higher than intended. If the hours cannot fit, they are classified as non-billable.

So now Item 7, we develop a budget that incorporates most of what we expect, along with what we've anticipated, including, or sometimes not anticipating another person may step in at the last moment to assist in completion, spend time with a PM to modify the project, the PE review, etc., and now it's somehow distasteful. We've been cultivated to monitor our line items.

Item 8. Certified the actual. OK – we don't monitor others so much, only hearsay on a few other firms, we just can explain how and why we do what we do.

Item 9. We are trying to become more standard internally, if this is the type of detail that will be required, which should translate into a more consistent budget process for both proposed and actual. That should make it easier for us and for the Agency.

Item 10. Our PM can take a stab at the PE, Sr. PM, Administrative Assistant, their own time, unless big red flags are raised during the review, or suddenly a new, or previously non-responsive off-site property appears, and the owner decides to call, the station closes, eligibility needs changed, task status changes, etc. We can't anticipate the Agency's review, either no questions, can I have another boring, can I have the off-site affidavits now instead of later (in the CACR as requested by the "Act"), can we modify a map, budget, general questions, etc. Requests in Budget number decisions have never been based on what we have in a project; other PMs play a bidding game – share some hours here and there, take some personnel titles out here, thus to get to the total that they're pre-established for the number of borings drilled for the phase. I understand that the PMs are to call and "work" out issues with us. The methods vary widely. It would be so far off from what we've actually done by the end of a negotiation. Vince typically does this just for some continuity in-house. But, we participate in good faith to reduce conflicts and appeals. We write the off-site property owners and present their results. Typically we wait until we can tell them the Agency has approved the SICR. On some occasions, when we're comfortable with the PM, plume delineations, budget confidence, etc., we'll proceed before or during the SICR process.

We've incurred significant hours on this site with additional opt-in, eligibility, deductible, W-9s, etc. The technical research for the re-reporting is discussed later. Hours to opt-in, amend, and create new eligibilities, W-9, deductibles, etc. are charged to the Reimbursement Task Code. Some are charged to reimbursements, many are not charged at all, as sufficient hours were not sufficiently anticipated or budgeted and we end up having to eat as overhead. We've spent significant time getting the last budget approved. The last few weeks, between Sr. Account Technician, Engineer III and Senior Project Manager, we're probably pushing 20-50 plus hours.

Our hope is that with a better understanding of how we operate, albeit differently from other firms, we'll at a minimum explain the pending claim, and also give us insight into how you review budgets and claims. The difficulty moving forward will be to continue to improve our internal standardization, yet designing different methods for different reviewers.

Item 11. Senior Project Manager and Senior Professional Engineer look at what the project should take and in what order, and if any obstacles were mentioned in its progress. We review in differing perspectives in an attempt to cover hours incurred and speculation of hours, hours yet to be incurred, or in some cases yet to be incorporated into the system.

Item 12. Claim preparation. Senior Project Manager begins by reviewing all time already incurred to project for pending phase(s), assembles subs, verifies budgeted rates amounts, number of samples, when and where drilling occurred, field expenses, etc. Then together, the Sr. Account Technician begins segregating hours into tasks by personnel into Agency forms. This is not done electronically. I'm not sure how you perceive this process, but we use the various reimbursement tasks (which we now realize differ from the Agency's tasks just in the way they are laid out and lumped together, actual budget to reimbursement forms) to group personnel and hours by rates, and years, if necessary. We then try to sort them by the phase codes, too.

If, for example, a Geologist II charged 60 hours to plan development and the budget was 45 hours, we would look into the situation to determine the reason for the overage. If there was sufficient room in the budget; contributing personnel had less hours.

If we were to wait until all items entered could be coded, reviewed and assembled as such, we would have completed tech reports sitting in want for 2-3 months. Then, additional time would be incurred to edit them and submit them. For a delay in time versus a few hours that have slightly differing task descriptions, this seems extremely excessive. We can increase our expected plan, budget and reimbursement time and get the plan out the door. If the time actually needed is slightly less, how is the Fund hurt? We certainly can't bill more. Other consultants are claiming exact amounts prior to completion of the work. Quite honestly, you're praising them for fraud because it looks neat and makes for an easy review. Once again, CW^3M is punished because ours is different and we're somehow, someway, doing something horribly wrong when our title/task descriptions don't quite look alike, yet the budget comes in under the approved amount. Se we'll spend 20-50 hours explaining it and modifying it. I have no idea how much time it takes you to review this and write and send these e-mails and correspondence. You get paid regardless of what you do. We do not. Our budget tasks all come in under budget, or we don't get paid.

Item 14. Although the SICR was submitted in November of last year, we are still hashing out the details of Stage 3, as witnessed by this email exchange. So please, enlighten me on how we were supposed to make a determination of exactly what Stage 3 was going to cost last October or November? At this point, I am not comfortable making an estimate of how much more will be needed after today.

We totally understand the "actual is not actual" problem; and believe we have at least a partial solution for future budgeting clarity. We were not taking the "actual" to the literal and even then to the same benchmark as the Agency. We did not define actual in a "budget" as stiffly as the Agency. It was just a budget. So the largest problem with the system is described in your email; the Agency believes that the costs for a stage end (or are at least a known quantity) when the summary of work for that stage is submitted. You state, "Stage 3 ends when the SICR is submitted". We partially concur. To us, the costs for a stage end when the technical work is done and when the final claim is paid. It is during that gap of time where we are seeing most of the confusion for both the consultants and the Agency. KB Sullivan Stages 1, 2 and 3 is a classic example for each party. Based on the scrutiny, the Agency apparently believes that we are trying to pull one over on them, and we are going to pocket more money than we should have. At the same time, we believe that we may not collect what we were due when the claim was submitted, and by now have spent more time and effort than the approved budget allows, which translates to unrecoverable costs. We even had to submit another budget for Stage 1 and 2 because the task codes weren't listed; however, the total dollars were sufficient in personnel. Claims have already been approved against that budget. Are we now to submit another reimbursement claim for Stage 1 and 2 Budget preparation? Or call it a CA? We elected not to charge the Agency for this work. Another cost lost. Just draw the line and these are lost costs or say they are Corrective Action. Kind of feels like a Pandora's Box here. The stage that never ends. If that claim would have been left alone, Stage 1 and 2 would have been done, never to be heard from again.

Given that each side feels it is being shortchanged, I really do not think we are really that far apart. We are just looking at a lot of the same information from different perspectives, we were looking at line item task totals. In hindsight, I think giving you the printout of the summary of our Stage 3 costs in the email a few months ago was a big mistake. The data in there was raw, and in a format that you do not see and understand, almost like a foreign language. That data is just a snapshot of where the project was at that point in time. We know the hours logged. In some cases, and I am not specifically talking KB Sullivan, there are still a decent amount of hours to be entered, in other cases, some hours need to be clarified or corrected to the right Stage, for example, disappear (be written off as over budget, another phase or ineligible). Depending upon who was involved, categories may need to be adjusted, for example hours entered as "Plan", but the description clearly is a "Field" activity. Just as a PID is used – levels read that day in the field are only given that day and next. We do data base checks for all kinds of verifications and corrections. It is not until the final reimbursement preparation that really detailed review of all the costs associated with a site and phase(s) are really scrutinized, and corrected, if necessary. Corrections are usually minor or relate to our own codes. If we reprint that same report after a reimbursement is prepared, it will be different than before, if nothing more than some or all of the hours associated with the reimbursement preparation are now included. It's generally not until claims are prepared that we know one stage has ended, hours for the month or, need re-coded to the next phase. Unless, it's a clean example of a situation discussed on the next page. The understanding of what the report does means (and doesn't mean) is crucial to using it as a tool to prepare an actual budget, or a reimbursement.

When the real data was submitted, in the form of the claim, it probably had changed. To us, the raw data has been translated and polished into the format you are used to seeing, just like any other claim we prepare. To you, this raised suspicions and questions. If we made a clean cut-off for Stage 3, it may not have been done in the data base at the correct timeframe until reimbursement time. We reviewed the claim. I can assure you that we are not raising titles or rates unless we find an error in the entry. There likely were re-classifications of work done to match the approved budget rates. (For example, the issue resulted in item Handling Charges, or verifying Plan versus Budget time, particularly in the editing process.) This is where the time and expertise of the actual budget preparation and the reimbursement preparation come into play. That is where Vince and I spend time, a little of that is in the actual budget preparation, and then the final is during the reimbursement preparation.

As a company that has been involved with LUST work for over twenty years, we have always been a participant, and sometimes a victim, in the constant evolution of policies and procedures within the program. We understand that minimizing costs are essential to the long-term success of the program, but it should not be the only function of the program because it will then be the death of the program. If the exact minimum amount of detail needed to make it through the program can be defined, then that is what we can strive to provide, no more, no less. Providing detail beyond the minimum required costs someone money, the UST fund, consultants, and/or the owner/operators. We have been attempting to cut costs, but to cut costs beyond maximizing efficiency means to not be doing something we've been striving to do, and now we're being asked to provide more, tipping the scale of efficiency. We don't mind as long as its consistent. Inconsistency within the program ends up costing everyone. We do not like to see worst case scenario; when something was questioned, we not only provided additional detail for that submittal, but also incorporated it into all similar future submittals. Now, we are trying to be in a cost-cutting mode, so we are trying to lessen the effort and details, but we need to learn what the minimum is. When we have some project managers saying we are still overdoing it, and others saying we are not giving enough, it leaves both sides frustrated. This frustration is not limited to just monetary concerns, but also technical issues. The technical issues have become lost. When a PM can cut a budget by merely cutting a MW, they will strive to do so. We need to get these reimbursement issues resolved, once and for all, and focus on the technical side of the program before the surplus is swept again.

What I am asking for is, give some additional thought to what the costs after the Site Investigation Completion Report is submitted could add up to, and then we can come up with a way to address these fairly. Also, and I cannot stress this enough, consistency is the key to saving time and money for each side. Guessing what is enough, or too much, means someone will be spending unnecessary money. I guess we can just tell you what is actual and what is pending and have our P.E. certify that.

One particular PM, not you, calls with every report, and does the review on the phone with us. Hour after hour. Page by page. How could we possibly know those hours in advance? We can again, only project. If that is what it takes to review the report – fine; but let us estimate it, be prepared for it, give that PM the time they need and ultimately review and approve the document.

Yes, claims are less complicated and cumbersome, but to think that we hit "print" and it's done, is completely over-stated. We're weeding through 10-30 task codes, phase codes, sorting, plugging into forms that don't feed, verifying once again. If we find ourselves over budget, we have to go in and write off hours or determine if justifiable unbudgeted work has occurred that requires a Budget Amendment and pull-out for later submittal. All field expenses are logged at reimbursement time in order to include the correct HC at the appropriate time. The supporting documentation is reviewed and assembled. Technical and fiscal verifications are performed; required drilling is not modified, correct. Site Investigation is generally less than CA and Early Action, but if Site Investigation extends into multiple years, there's no way it should ever be considered minimal. Another that we had with a different PM, also, where the PM added an off-site well to a Stage 2 Plan. No big deal. We modified the budget, changed the maps, etc. Sounds simple; now, however, we have to modify every entry in the entire data base. This PM is kind and workable. I asked about how they review claims on the back end. I was told: "Don't worry if we don't have tasks for the off-site and some other modifications, as long as our line items match, we're Ok." So, this is the complete opposite.

It just places us in a quandary. Do we design budgets and claims specific to PMs? What about when we don't know who the reviewer will be? We spend more time making sure the reimbursement claim is exact and accurate as it is an actual invoice payable as an accounts receivable. We, somehow, mistakenly, through years of modifications, finally tried this process as we thought it was more serious in nature; mistakes punishable by law, not knowing where and how to establish the comparable items. As stated above, the focus was to come in at or below our line items. Contrary to the discussion underway. We simply are not even looking at those pages, only the line items and sub totals were relevant.

For example, another firm budgets $4,000 for reimbursement preparation, and in reality, pre-bills and provides no supporting documentation. If audited, it took them half the time. They know they do not have to support that claim. For us, this gets split into 2 claims due to our accounting/data entry dealys and we charge, let's say $3,600...who has damaged the fund? This lack of understanding is apparently hurting us badly. We elected to take this route, believing it was the right thing to do. If ever audited or investigated, ours is accurate. We've in fact been investigated and all but crucified over supporting documentation, and to this day, held to a different level of accountability. If others can't withstand the scrutiny, that will be their cross to bear. Just as we had this lengthy letter nearly done, we got wrapped up in some other demands, folks on vacation, but had an opportunity to discuss with HernandoAlbarracin and Tom Henninger.

We've just had a pleasant and productive discussion with Tom and Hernando regarding this claim and possibly others. Simply stated, we didn't try to match the two forms. From budget development, we focused on looking at who had performed the work done, what other items might be needed (from it's a draft in my hand to reimbursement letter approval timeframe that we can all argue forever) and generated our "actual" budget. Then, when developing the claim, we looked at our line item totals and sub totals; never looked at the "actual" budget pages. The two documents never met; they had their own courses. Only the Agency's letter and the breakdown.

If this is how you want it, we'll try to get it as close as possible and prepare our claim by actually using the actual budget forms as templates for the mirror. I think there's an understanding that the reimbursement hours haven't all been incurred but some have.

All that's done. It's Corrective Action. We've not charged the Agency for the numerous hours spent with this review, debate, and re-build of our claim. I'm doing so in good faith that what we present is honest and true and probably just junked around. I know for certain that I wrote off many hours of Stage 3 because they were over budget. Now, I'm writing off more and eating a $10,000.00 hit. I've paid the lab and met with my partners who've told me to dump this job. We're duped in the appeal. Just file a new Election to Proceed, we've settled, they'll get paid. We do. We then get hit with the $10,000.00 blind-sided. Our attorney has no idea. So we're out attorney's fees.

We're trying to get along with you and be honest and you're being tainted by another PM with an axe to grind. Where in the heck can you see us ever breaking even on this? The only reason we've not dumped this far is to settle this issue with you and demonstrate there is no foul play. Despite venting and explaining everything in this letter, we're trying to get along and not create rifts. But, if your ear is bent otherwise, all I can do is submit things in the future your way and make you happy.

By no means am I implying that we are perfect and won't change. We are constantly changing. I can't give up on the pre-billing issue. We just want a system that if worked out today can still be relied upon in six weeks. We don't want this to be another "rule-of-the-week" club member.

In an attempt to replace the reimbursement claim forms with descriptions that more closely align those in budget, attached, please find modified forms. Please keep in mind that we had 2 personnel changes during the waning days of Stage 3 and as discussed above, didn't have the work product as the targeted goal when preparing the actual budget; we were led to believe line item budget totals were the barometer. After further review, we see that all task summaries also came at or within budget which was our internal criteria for monitoring budget status.

We regret the stress this has caused on both of us and look for continued guidance and insight on how the Agency's process works. I'm holding countless plans, budgets and claims to address this whole issue and we're trying to modify our approvals to the "actual" situation or at least budget the gap. I promised Hernando and Tom that I will. Without it, we can't even begin to better our framework. We also thank you for maintaining a professional and pleasant attitude while doing this; many of your counterparts don't and progress is halted. So, thank you.

Sincerely,

Carol L. Rowe, P.G.
Senior Environmental Geologist

Xc: Mr. William T. Sinnott, *CW³M Company, Inc.*

Z:\KB Sullivan\ClientCor\Brad corr1.doc

Consulting Personnel Costs Form

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	Task			
(7/09)	Senior Project Manager	6.25	111.20	$695.00
Stage 3-Field	Office Prep., Scheduling, Arrangements for investigation activities/Technical Compliance			
(7/09)	Project Manager	3.00	100.08	$300.24
Stage 3-Field	On-site drilling and sampling			
(7/10)	Project Manager	1.25	102.08	$127.60
Stage 3-Field	On-site drilling and sampling			
(7/09)	Engineer I	5.25	83.40	$437.85
Stage 3-Field	MW surveying/sampling			
(7/09)	Engineer III	4.00	111.20	$444.80
Stage 3-Field	Off-Site Drilling and Sampling/MW Surveying and Sampling			
(7/10)	Engineer III	.50	113.44	$56.72
Stage 3-Field	Off-Site Drilling and Sampling/MW Surveying and Sampling			
(7/11)	Senior Admin. Assistant	.25	51.56	$12.89
Stage 3-Field	Office Prep., Scheduling, Arrangements for investigation/JULIE/off-site correspondence			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
(7/09)	Senior Project Manager	4.00	111.20	$444.80
Stage 3-Plan	Stage 3 Report technical compliance/oversight			
(7/10)	Senior Project Manager	.50	113.44	$56.72
Stage 3-Plan	Stage 3 Report technical compliance/oversight			
(7/11)	Senior Project Manager	.50	114.56	$57.28
Stage 3-Plan	Stage 3 Report technical compliance/oversight			
(7/09)	Senior Prof. Engineer	1.75	144.60	$253.05
Stage 3-Plan	Stage 3 Report Certification			
(7/11)	Senior Prof. Engineer	1.50	148.96	$223.44
Stage 3-Plan	Stage 3 Report Certification			
(7/11)	Engineer I	1.50	85.92	$128.88
Stage 3-Plan	Stage 3 Report Preparation/Development change			
(7/09)	Scientist I	48.00	66.72	$3,202.56
Stage 3-Plan	Stage 3 Plan Preparation			
(7/10)	Scientist I	8.75	68.04	$595.35
Stage 3-Plan	Stage 3 Plan Preparation			
(07/09)	Engineer III	6.50	111.20	$722.80
Stage 3-Plan	Stage 3 Plan Completion			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
(7/10)	Engineer III	.50	113.44	$56.72
Stage 3-Plan	Stage 3 Plan Completion			
(7/09)	Draftperson/CAD I	2.50	44.48	$111.20
Stage 3-Plan	Drafting of maps for report			
(07/09)	Senior Project Manager	1.25	111.20	$139.00
Stage 3-Budget	Stage 3 Budget/technical compliance/overview			
(7/11)	Senior Project Manager	.75	114.56	$85.92
Stage 3-Budget	Stage 3 Budget/technical compliance/overview			
(07/09)	Senior Prof. Engineer	1.00	144.60	$144.60
Stage 3-Budget	Stage 3 Budget Certification			
(07/11)	Senior Prof. Engineer	1.00	148.96	$148.96
Stage 3-Budget	Stage 3 Budget Certification			
(07/10)	Scientist I	1.00	68.04	$68.04
Stage 3-Budget	Stage 3 Budget calculations and preparations			
(07/09)	Scientist I	15.75	66.72	$1,050.84
Stage 3-Budget	Stage 3 Budget calculations and preparations			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	Task			
(07/09)	Engineer III	1.75	111.20	$194.60
Stage 3-Budget	Stage 3 Budget calculations and preparations			
(07/11)	Engineer III	2.75	114.56	$315.04
Stage 3-Budget	Stage 3 Budget calculations and preparations			
	Senior Admin. Assistant			
Stage 3-Budget	Stage 3 Budget compilation, assembly and distribution			
(07/09)	Scientist I	18.75	66.72	$1,251.00
Stage 3-Field	Off-site access			
(07/10)	Scientist I	33.25	68.04	$2,262.33
Stage 3-Field	Off-site access			
(07/11)	Scientist II	1.50	74.48	$111.72
Stage 3-Field	Off-site access			
(07/10)	Engineer I	5.00	83.40	$417.00
Stage 3-Field	Off-site access/affidavits			
(07/11)	Engineer I	9.00	85.92	$773.28
Stage 3-Field	Off-site access/affidavits			
(07/10)	Senior Project Manager	4.00	113.44	$453.76
Stage 3-Field	Off-site access requests, agreement, correspondence/affidavits			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
(07/11)	Senior Project Manager	3.75	114.56	$429.60
Stage 3-Field	Off-site access requests, agreement, correspondence/affidavits			
(07/10)	Engineer III	4.25	113.44	$482.12
Stage 3-Field	Off-site access/affidavits			
(07/11)	Engineer III	2.75	114.56	$315.04
Stage 3-Field	Off-site access/affidavits			
(07/10)	Senior Draftperson/CAD	.50	68.04	$34.02
Stage 3-Field	Drafting/Locations/Elevation/Contamination Levels			
(07/11)	Draftperson/CAD IV	1.25	68.72	$85.90
Stage 3-Field	Drafting/Locations/Elevation/Contamination Levels			
(07/11)	Draftperson/CAD III	5.00	52.92	$264.60
Stage 3-Field	Drafting/Locations/Elevation/Contamination Levels			
(07/10)	Draftperson/CAD I	4.75	45.36	$215.46
Stage 3-Field	Drafting/Locations/Elevation/Contamination Levels			
(07/09)	Scientist I	3.00	66.72	$200.16
Stage 2-Results	Stage 2 Results			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
(07/09)	Senior Project Manager	.75	111.20	$83.40
Stage 3-Pay	Stage 3 Reimbursement oversight/technical compliance			
(07/10)	Senior Project Manager	.25	113.44	$28.36
Stage 3-Pay	Stage 3 Reimbursement oversight/technical compliance			
(07/11)	Senior Project Manager	3.50	114.56	$400.96
Stage 3-Pay	Stage 3 Reimbursement oversight/technical compliance			
(07/11)	Senior Acct. Technician	2.75	63.00	$173.25
Stage 3-Pay	Stage 3 Reimbursement Preparation			
(07/11)	Geologist III	1.00	100.84	$100.84
Stage 3-Pay	Stage 3 Reimbursement Preparation			
(07/09)	Scientist I	5.75	66.72	$383.64
Stage 3-Pay	Stage 3 Reimbursement Preparation/OSFM eligibility and deductible application			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
(07/10)	Scientist I	8.75	68.04	$595.35
Stage 3-Pay	Stage 3 Reimbursement Preparation/OSFM eligibility and deductible application			
(07/09)	Engineer III	.75	111.20	$83.40
Stage 3-Pay	Stage 3 Reimbursement Preparation			
(07/11)	Senior Prof. Engineer	3.00	148.96	$446.88
SICR	SICR Certification			
(07/11)	Geologist III	32.00	100.84	$3,226.88
SICR	SICR Preparation			
(07/11)	Engineer I	1.50	85.92	$128.88
SICR	SICR Preparation			
(07/10)	Senior Project Manager	.25	114.56	$28.64
SICR	SICR technical compliance/oversight			
(07/11)	Senior Project Manager	8.25	114.56	$945.12
SICR	SICR technical compliance/oversight			
(07/10)	Engineer III	.50	113.44	$56.72
SICR	SICR Preparation			
(07/11)	Engineer III	11.25	114.56	$1,288.80
SICR	SICR Preparation			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
(07/10)	Scientist I	4.00	68.04	$272.16
SICR	SICR Preparation			

*Refer to the applicable Maximum Payment Amounts document.

Total of Consulting Personnel Costs	**$25,614.17**

TITLE XVI PAYMENT SUMMARY

Reviewer:	Stephanie Kincaid	Queue Date:	10/28/20	Initial Review Date:	11/19/20
		Subject to Program:	734		
LPC # & County:	1390305014 / Moultrie			PM:	Dilbaitis
Site Name:	Sullivan / KB Food & Gas				
LUST Incident--Claim #	20040969--71556	Billing Period:	1/1/15	to	3/31/20

Early Action: ______ Site Class.: ______ Low Priority: ______ High Priority: ______

Free Product: ______ Site Invest.: ______ Corrective Action: x

Amount requested for	2,125.96
SUB TOTAL:	$2,125.96
Less: STANDARD DEDUCTIBLE:	met
Less: DEDUCTIONS:	
deny whole claim, lack of doc	(2,125.96)

SUMMARY DATE: ______ ______

NFR DATE: ______

OPT-IN DATE: ______ Total Amount Due: $0.00

Payee:	KB Food & Gas	Facility:	KB Food & Gas
Attention:	CWM Company, Inc.	Address:	111 West Jackson Street/Routes 121&132
		City/State:	Sullivan, Illinois
Address:	P.O. Box 571	County:	Moultrie
City/St./Zip:	Carlinville, Illinois 62626		

TO: Mohammed Rahman
FROM: Stephanie Kincaid

Initial Review Date: 11/19/20
Project Manager: Dilbaitis
Subject to Program: 734

LPC # & County: 1390305014 / Moultrie
Site City & Name: Sullivan / KB Food & Gas
Site Address: 111 West Jackson Street/Routes 121 & 132
LUST Incident-Claim # 20040969--71556
Queue Date: 10/28/2020
LUST / FISCAL FILE

The above referenced facility's consultants/contractors submission regarding invoices and billings has been reviewed.

The consultant/contractor in this billing package is: CWM Company, Inc.

Queue Date: 10/28/20
120 Day Date: 2/25/21
Revised 120 Day Date:

IEMA: 7/9/04
59 Days After IEMA: 9/6/04
OSFM:
Date of 45 Day Report:
F.P. Discovered:
45 Days After Free Product was Discovered:
E.A. Ext Date:
Date of Site Class. Comp. Report:
NFR Date:
Date of Site Invest. Comp. Report:
Opt-In Date:
Or Stage of Site Invest. work being billed:
Opt-In as New Owner:

# of Eligible Tanks: 6
Tank Size: 10,000 gas, 2x 8,000 gas, 5,000 diesel, 5,000 gas, 2,000 ker
Tank Pull:
Planned:
Not Planned:

The **Billing Period** for this claim covers: 1/1/15 to 3/31/20

The **Amount Requested** in this billing package is: $2,125.96

The **Budget Amount Approved** for this site is:

The **Deductible Applied** to this billing package is: met

Early Action:
Site Class.:
Low Priority:
High Priority:
Free Product:
Site Invest.:
Corrective Action: x

MANDATORY DOCUMENTS:

x 1. Payment Certification Form.
x 2. Owner/Operator & Professional Engineer/Geologist Billing Certification Form.
x 3. Private Insurance Coverage Questionnaire & Affidavit Forms.
x 4. Federal Taxpayer Identification Number &/or W-9 Form(s):
x 5. Copy of OSFM Eligibility / Deductibility Letter.
x 6. Women / Minority Business Enterprise Form.

(Comments on Page 2)

Approved LUST Budget/Billing Tracking Summary

Project Manager: Dilbaitis

LUST Incident #: 20040969

LUST Site City & Name: Sullivan / KB Sullivan

Phase of Work being billed for: ______ SI ______ FP XX CA

APPROVED BUDGET AMOUNTS:

Budget Line Items	Approved Costs	Amendment #1	Amendment #2	Amendment #3	Amendment #4	Amendment #5	Approved Cumulative
Date of Approved Budget	5/16/12						
Drilling & Monitoring Well Costs:	0.00						$0.00
Analysis Costs:	0.00						$0.00
Remediation & Disposal Costs:	0.00						$0.00
UST Removal & Abandonment Costs:	0.00						$0.00
Paving, Demo. & Well Aband. Costs:	1,719.00						$1,719.00
Consulting Fees:							$0.00
Consulting Personnel Costs:	31,443.23						$31,443.23
Consulting Materials Costs:	734.30						$734.30
Handling Charges:							
Totals	$33,896.53	$0.00	$0.00	$0.00	$0.00	$0.00	$33,896.53

AMOUNTS PER CLAIM APPLIED TO APPROVED BUDGET LINES:

Billing Line Items	Billing #1	Billing #2	Billing #3	Billing #4	Billing #5	Billing #6	Billing Cumulative
Date of Billing	7/29/13	5/19/14	4/24/15	10/28/20			
Drilling & Monitoring Well Costs:	0.00	0.00	0.00	0.00			$0.00
Analysis Costs:	0.00	0.00	0.00	0.00			$0.00
Remediation & Disposal Costs:	0.00	0.00	0.00	0.00			$0.00
UST Removal & Abandonment Costs:	0.00	0.00	0.00	0.00			$0.00
Paving, Demo. & Well Aband. Costs:	0.00	0.00	0.00	0.00			$0.00
Consulting Fees:							$0.00
Consulting Personnel Costs:	11,116.80	4,875.80	1,818.58	0.00			$17,811.18
Consulting Materials Costs:	211.75	37.96	38.43	0.00			$288.14
Handling Charges:	2.35	1.10	0.24	0.00			$3.69
Totals	11,330.90	4,914.86	1,857.25	0.00	0.00	0.00	18,103.01

BILLING TO BUDGET DIFFERENTIALS:

Budget/Billing Line Items	Line Item Differences
Drilling & Monitoring Well Costs:	$0.00
Analysis Costs:	$0.00
Remediation & Disposal Costs:	$0.00
UST Removal & Abandonment Costs:	$0.00
Paving, Demo. & Well Aband. Costs:	$1,719.00
Consulting Fees:	$0.00
Consulting Personnel Costs:	$13,632.05
Consulting Materials Costs:	$446.16
Handling Charges:	

0292

Illinois Environmental Protection Agency
LUST Claims Unit

LCTS Queue Date Tracking Worksheet

Friday, October 30, 2020

LPC Number 1390305014

Incident Number 20040969 -- **71556**

120-Day Date ~~12/26/2020~~ 2/25/2021

Queue Date ~~8/28/2020~~ 10/28/2020

Site Name KB FOOD & GAS

Owner Name KB FOOD & GAS

Operator Name KB FOOD & GAS

Class Code CA Program 734

Amount Requested $2,125.96

Billing Period From 1/1/2015 To 3/31/2020

Consultant Name CWM Company, Inc.

Opt-In Date 2/18/2010

NFR Date

NFR Recorded Date

Division File

Comments

IEMA 7-9-2004

Ded. $10,000 applied to prior claim (associated incident 900146)

First claim for this Incident Number? Yes No

Yearly breakdowns required? Yes No

REIMBURSEMENT CLAIM
January1, 2015 - March 31, 2020
KB SULLIVAN, INC.
Sullivan/Moultrie County

LPC #1390305014
Incident Number 1990-0146
Incident Number 2004-0969

CW3M Company
Environmental Consulting Services

701 W. South Grand Avenue
Springfield, IL 62704

Phone: (217) 522-8001
Fax: (217) 522-8009

October 20, 2020

Mr. Gregory W. Dunn, Manager
Illinois Environmental Protection Agency
Leaking Underground Storage Tank Section
P.O. Box 19276
Springfield, IL 62794-9276

Re: LPC#1390305014
KB Sullivan, Inc.
Sullivan (Moultrie), IL
LUST Incident #90-0146
LUST Incident #04-0969

Dear Mr. Dunn:

Enclosed under this cover please find the original(s) and copy(s) of **IEPA Owner / Operator Billing Certification Form for Leaking Underground Storage Tank Sites (With appropriate signatures by the Owner/Operator and the Registered Professional Engineer), Form C-1/C-2 Approved Budget Summary & Billing Summary, and Form A-1/A-2 Budget and Billing Form For Leaking Underground Storage Tank Sites** for Corrective Action Activities for the above referenced Facility, for each billing period represented.

As indicated the Certification(s) apply to work conducted during the following time periods. Accordingly, please find the Illinois Environmental Protection Agency Reimbursement (With Supporting Documentation) for UST **Corrective Action** as follows:

Period: 01/01/15 – through 01/31/15 – Summary Total Cost:	**$**	**91.11**
CW3M Company, Inc.	$	91.11
Subcontractor(s)	$	0.00
Period: 03/01/15 - through 03/31/15 - Summary Total Cost:	**$**	**164.15**
CW3M Company, Inc.	$	164.15
Subcontractor(s)	$	0.00
Period: 04/01/15 - through 04/30/15 - Summary Total Cost:	**$**	**3.45**
CW3M Company, Inc.	$	3.45
Subcontractor(s)	$	0.00
Period: 09/01/15 - through 09/30/15 - Summary Total Cost:	**$**	**0.49**
CW3M Company, Inc.	$	0.49
Subcontractor(s)	$	0.00
Period: 03/01/16 – through 03/31/16 – Summary Total Cost:	**$**	**546.89**
CW3M Company, Inc.	$	546.89
Subcontractor(s)	$	0.00
Period: 04/01/16 - through 04/30/16 - Summary Total Cos:	**$**	**34.07**
CW3M Company, Inc.	$	34.07
Subcontractor(s)	$	0.00
Period: 10/01/16 - through 10/31/16 - Summary Total Cost:	**$**	**31.28**
CW3M Company, Inc.	$	31.28
Subcontractor(s)	$	0.00

Period: 10/01/18 – through 10/31/18 – Summary Total Cost:	**$ 1,085.01**
CW^{3}M Company, Inc.	$ 1,085.01
Subcontractor(s)	$ 0.00
Period: 11/01/18 – through 11/30/18 – Summary Total Cost:	**$ 70.90**
CW^{3}M Company, Inc.	$ 70.90
Subcontractor(s)	$ 0.00
Period: 03/01/20 – through 03/31/20 – Summary Total Cost:	**$ 98.61**
CW^{3}M Company, Inc.	$ 98.61
Subcontractor(s)	$ 0.00

All Time Periods Represented: **Summary Total(s) Cost: $ 2,125.96**

We trust the enclosed reimbursement documentation, Engineer Certification(s) and the Owner/Operator Billing Certification are in accord with your needs and requirements. However, should you or your staff have any questions or require additional information please do not hesitate to contact us at your convenience.

Sincerely,

William T. Sinnott

cc: Kamlesh Patel
Ms. Carol L. Sinnott-Rowe, P.G.
File

General Information for the Budget and Billing Forms

LPC #: 1390305014 County: Moultrie

City: Sullivan Site Name: KB Food & Gas

Site Address: 111 West Jackson Street/Routes 121 & 132

IEMA Incident No.: 90-0146 2004-0969

IEMA Notification Date.: Jan 17, 1990 7/9/04

Date this form was prepared: Oct 20, 2020

This form is being submitted as a (check one):

☐ Budget Proposal

☐ Budget Amendment (Budget amendments must include only the costs over the previous budget.)

☒ Billing Package

Please provide the name(s) and date(s) of report(s) documenting the costs requested:

Name(s): Corrective Action Plan

Date(s): 2/17/2012

This package is being submitted for the site activities indicated below :

35 Ill. Adm. Code 734:

☐ Early Action

☐ Free Product Removal after Early Action

☐ Site Investigation Stage 1: ☐ Stage 2: ☐ Stage 3: ☐

☒ Corrective Action

35 Ill. Adm. Code 732:

☐ Early Action

☐ Free Product Removal after Early Action

☐ Site Classification

☐ Low Priority Corrective Action

☐ High Priority Corrective Action

35 Ill. Adm. Code 731:

☐ Site Investigation

☐ Corrective Action

General Information for the Budget and Billing Forms

The following address will be used as the mailing address for checks and any final determination letters regarding payment from the Fund.

Pay to the order of: KB Food & Gas

Send in care of: CWM Company, Inc.

Address: P.O. Box 571

City: Carlinville State: IL Zip: 62626

The payee is the: Owner ☒ Operator ☐ (Check one or both.)

K. B. Patel

Signature of the owner or operator of the UST(s) (required)

If you have a change of address, click here to print off a W-9 Form.

Number of petroleum USTs in Illinois presently owned or operated by the owner or operator; any subsidiary, parent or joint stock company of the owner or operator; and any company owned by any parent, subsidiary or joint stock company of the owner or operator:

Fewer than 101: ☒ 101 or more: ☐

Number of USTs at the site: 11 (Number of USTs includes USTs presently at the site and USTs that have been removed.)

Number of incidents reported to IEMA for this site: 2

Incident Numbers assigned to the site due to releases from USTs: 90-01416 2004-0969

Please list all tanks that have ever been located at the site and tanks that are presently located at the site.

Product Stored in UST	Size (gallons)	Did UST have a release?	Incident No.	Type of Release Tank Leak / Overfill / Piping Leak
Gasoline	10,000	Yes ☒ No ☐	90-0146 2004-0969	Spills & Overfills
Gasoline	8,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Gasoline	8,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Diesel	5,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Gasoline	5,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Kerosene	2,000	Yes ☒ No ☐	2004-0969	Spills & Overfills
Gasoline	10,000	Yes ☐ No ☒	None	None
Gasoline	10,000	Yes ☐ No ☒	None	None
Diesel	8,000	Yes ☐ No ☒	None	None

Product Stored in UST	Size (gallons)	Did UST have a release?	Incident No.	Type of Release Tank Leak / Overfill / Piping Leak
Kerosene	5,000	Yes ☐ No ☒	None	None
Gasoline	5,000	Yes ☐ No ☒	None	None
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		

Add More Rows   Undo Last Add

Payment Certification Form

This certification must be included with every application for payment from the UST Fund.

I, KB Sullivan, Inc., the owner or operator of the Leaking UST site for which this application for payment is being submitted, certify that $ 2,125.96 is the amount being sought in this application for payment, $ 79,052.37 has already been paid from the Fund for this occurrence, and $ 0.00 has been sent to the Illinois EPA for payment for this occurrence but has not yet been paid. I further certify that the number of petroleum USTs in Illinois presently owned or operated by the owner or operator, any subsidiary, parent or joint stock company of the owner or operator, and any company owned by any parent, subsidiary or joint stock company of the owner or operator is (check one):

Fewer than 101 ☒ 101 or more ☐

Except for applications for payment associated with Early Action, I certify that a plan for the work included in this application for payment was approved by the Illinois EPA on 5/6/12; except for applications for payment associated with to 35 Ill. Adm. Code 731, certify that a budget for the work included in this application for payment was approved by the Illinois EPA on 5/6/12; and certify that the amount sought for payment was expended in conformance with the approved budget and approved plan. I further certify that, if the costs included in this application for payment are approved for payment, the following limitations will not be exceeded:

1. Payment will not result in the owner or operator receiving payment of corrective action costs or indemnification costs from the Fund for more than $1,000,000 per occurrence for sites subject to 35 Ill. Adm. Code 731 or 732. (OR) Payment will not result in the owner or operator receiving payment of corrective action costs or indemnification costs from the Fund for more than $1,500,000 per occurrence for sites subject to 35 Ill. Adm. Code 734.

2. Payment will not result in the owner or operator receiving payment of corrective action costs or indemnification costs from the Fund incurred during a calendar year in excess of the following amounts:

For costs incurred in calendar years prior to 2002:

$1,000,000, if fewer than 101 tanks are owned or operated in Illinois.
$2,000,000, if 101 or more tanks are owned or operated in Illinois.

For costs incurred in calendar years 2002 and later:

$2,000,000, if fewer than 101 tanks are owned or operated in Illinois.
$3,000,000, if 101 or more tanks are owned or operated in Illinois.

Owner/Operator Name: KB Sullivan, Inc.

Authorized Representative*: Kamlesh Patel Title: Owner

Signature: KBpatel Date: 10-16-2020

Subscribed and sworn to before me the 16TH day of OCTOBER, 2020.

(This certification must be notarized when the certification is signed.)

(Notary Public) Seal: WILLIAM T SINNOTT OFFICIAL SEAL Notary Public - State of Illinois My Commission Expires January 24, 2024

*For a corporation, a principal executive officer of at least the level of vice president, or a person authorized by resolution of the board of directors to sign the applicable document if a copy of the resolution, certified as a true copy by the secretary of the corporation, is submitted with the document.

Owner/Operator and Licensed Professional Engineer/Geologist Billing Certification Form

Under penalty of perjury as defined in Section 32-2 of the Criminal Code of 1961 [720 ILCS 5/32-2], I certify to the following:

- The bills in the attached application for payment are for performing corrective action activities associated with Incident # 90-0146/04-0969 reported for the Leaking Underground Storage Tank site located at Address: 111 West Jackson St. / Route 121 & Route 32
  City: Sullivan State: Illinois Zip: 61951
- The bills are for the billing period January 1, 2015 through March 31, 2020 and were incurred in conformance with the Environmental Protection Act and 35 Ill. Adm. Code 731, 732, or 734.
- The attached application for payment and all documents submitted with it were prepared under the supervision of the licensed professional engineer or licensed professional geologist and the owner and/or operator whose signatures are set forth below and in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information provided. The information in the attached application for payment is, to the best of my knowledge and belief, true, accurate, and complete.
- The costs for remediating the above-listed incident are correct, are reasonable, and if applicable, were determined in accordance with Subpart H: Maximum Payment Amounts, Appendix D Sample Handling and Analysis amounts, and Appendix E Personnel Titles and Rates of 35 Ill. Adm. Code 732 or 734.
- I am aware there are significant penalties for submitting false statements or representations to the Illinois EPA, including but not limited to fines, imprisonment, or both as provided in Section 44 of the Environmental Protection Act [415 ILCS 5/44] and Section 32-2 of the Criminal Code of 1961 [720 ILCS 5/32-2].

RECEIVED
OCT 28 2020
IEPA/BOL

Owner/Operator Name: KB Sullivan, Inc.

Authorized Representative*: Kamlesh Patel

Address: 140 Hearthstone Drive Phone: 630-730-4450

City: Bartlett State: Illinois Zip: 60103

Signature: KBpatel Date: 10-16-2020

Subscribed and sworn to before me the 16TH day of OCTOBER, 2020.

(Notary Public) Seal: WILLIAM T SINNOTT OFFICIAL SEAL Notary Public - State of Illinois My Commission Expires January 24, 2024 NOTARY PUBLIC STATE OF ILLINOIS

L.P.E./L.P.G. Name: Vince E. Smith L.P.E./L.P.G. Seal: VINCE E. SMITH 46118

L.P.E./L.P.G. Illinois Registration No.: 062-046118

L.P.E./L.P.G. Registration Expiration Date: 11/30/21

Company Name: CWM Company, Inc.

Address: 701 South Grand Avenue West Phone: 217-522-8001

City: Springfield State: Illinois Zip: 62704

L.P.E./L.P.G. Signature: V E Smith Date: 10/20/20

Subscribed and sworn to before me the 20TH day of OCTOBER, 2020.

(Notary Public) Seal: WILLIAM T SINNOTT OFFICIAL SEAL Notary Public - State of Illinois My Commission Expires January 24, 2024 NOTARY PUBLIC STATE OF ILLINOIS

*For a corporation, a principal executive officer of at least the level of vice president, or a person authorized by a resolution of the board of directors to sign the applicable document if a copy of the resolution, certified as a true copy by the secretary of the corporation, is submitted with the document.

Private Insurance Coverage Questionnaire

This form must be completed in full by all owners or operators, or their authorized representatives, that have a claim for payment from the State of Illinois Underground Storage Tank Fund for the labor, materials, overhead, and profit costs related to the investigation and/or remediation of a Leaking UST site.

1. Site Name: KB Food & Gas

   Address: 111 West Jackson / Route 121 & 132

   City: Sullivan State: Illinois Zip: 61951

2. Name of insurance company providing coverage for this Leaking UST site:
   None

3. Amount of coverage provided: $ ______

4. Have you or your firm filed a claim against your insurance company for this Leaking UST site?

   Yes ☐ No ☒

   a. If yes, how much is the claim? $ ______

   b. If no, explain why. No Insurance

5. Have you or your firm received payment for a claim against your insurance company for this Leaking UST site?

   Yes ☐ No ☒

   a. If yes, how much and when? $ ______

      Date: ______

   b. If no, explain why. No Insurance

6. Are you going to file a claim against your insurance policy?

   Yes ☐ No ☒

   a. If yes, how much and when? $ ______

      Date: ______

   b. If no, explain why. No Insurance

This Illinois EPA is authorized to request this information under the Environmental Protection Act, 415 ILCS 5/1 et seq. (formerly Ill. Rev. Stat. Ch 111-1/2, 1001 et seq.). Disclosure of this information is required. Failure to properly complete this form in its entirety may result in the delay or denial of any payment requested hereunder. This form has been approved by the Forms Management Center.

Private Insurance Affidavit

I, Kamlesh Patel, a duly authorized representative of

KB Sullivan, Inc.,
(owner/operator or firm's name)

hereby certify that KB Sullivan, Inc. (owner/operator or firm's name) (does, does not) does not (choose one) have private insurance coverage for all or part of the costs related to claim for payment of KB Sullivan, Inc. (owner or firm's name) investigation or remediation costs for work performed at KB Food & Gas (site name) located at 111 West Jackson St. (Routes 121 & 132), Sullivan, Illinois (address).

I, Kamlesh Patel (name), Owner (title) of KB Sullivan, Inc. (owner/operator or firm's name),

certify that, as of this date, the above information is accurate and complete. Furthermore, I also agree to reimburse the Illinois EPA for any overpayment made by my private insurance company in excess of the deductible amount for each site.

Owner/Operator: KB Sullivan, Inc. Title: Kamlesh Patel, Owner

Signature: K. B. Patel Date: 02-02-2010

Subscribed and sworn to before me the 2nd day of February, 2010.

[signature] (Notary Public) Seal:

OFFICIAL SEAL
WILLIAM T. SINNOTT
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 1-18-2012

The Illinois EPA is authorized to require this information under 415 ILCS 5/1. Disclosure of this information is required. Failure to do so may result in the delay or denial of any budget or payment requested hereunder. This form has been approved by the Forms Management Center.

Federal Taxpayer Identification Number and Legal Status Disclosure Certification Requirements

In order to comply with requirements mandated by Internal Revenue Service rules and regulations, the tank owner or operator must complete the section entitled TAXPAYER IDENTIFICATION NUMBER AND LEGAL STATUS DISCLOSURE CERTIFICATION below.

Enter your taxpayer identification number (TIN) in the appropriate space. For individuals and sole proprietors, this is your social security number. For other entities, it is your employer identification number. Federal Employer Identification Numbers (FEINs) must not be used for sole proprietorships.

If you do not have a TIN, apply for one immediately. To apply, get Form SS-5, Application for a Social Security Number Card (for individuals), from your local office of the Social Security Administration, or Form SS-4, Application for Employer Identification Number (for businesses and all other entities), from your local Internal Revenue Service office.

To complete the certification if you do not have a TIN, fill out the certification including that a TIN has been applied for, sign and date the form, and return it to the Illinois EPA. As soon as you receive your TIN, fill out another such form including your TIN, sign and date the form, and send it to the Illinois EPA.

If you fail to furnish your correct TIN to the Illinois EPA, you are subject to an IRS penalty of $50.00 for each such failure unless your failure is due to reasonable cause and not to willful neglect.

WILLFULLY FALSIFYING CERTIFICATIONS OR AFFIRMATIONS MAY SUBJECT YOU TO CRIMINAL PENALTIES INCLUDING FINES AND/OR IMPRISONMENT.

Please return the completed form to the Illinois EPA, Bureau of Land, Leaking UST Claims Unit, Post Office Box 19276, Springfield, Illinois 62794-9276.

TAXPAYER IDENTIFICATION NUMBER AND LEGAL STATUS DISCLOSURE CERTIFICATION.
Under penalties of perjury, I certify that the FEIN or Social Security Number indicated below is my correct Federal Taxpayer Identification Number. I am doing business as a (please check one):

☐ Individual	☒ Sole Proprietorship	☐ Real Estate Agent
☐ Partnership	☐ Governmental Entity	☐ Not-for-Profit Corporation
☐ Corporation	☐ Tax Exempt Organization	☐ Medical & Health Care
☐ Trust or Estate	☐ (IRC 501(a) only)	☐ Services Provider Corporation

26-0235568	K. D. Patel	02-02-2010
Taxpayer Identification Number	Signature	Date

KB Sullivan, Inc.

Name of Firm (Please print or type)

If you have a change of address, click here to print off a W-9 Form.

Note: Original signature required

The Illinois EPA is authorized to request this information under the Environmental Protection Act, 415 ILCS 5/1 et seq. (formerly Ill. Rev. Stat. Ch 111-1/2, 1001 et seq.). Disclosure of this information is required. Failure to properly complete this form in its entirety may result in the delay or denial of any payment requested hereunder. This form has been approved by the Forms Management Center.

Electronic Filing: Received, Clerk's Office 3/18/2022

Form **W-9**
(Rev. October 2007)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Give form to the requester. Do not send to the IRS.

Print or type
See Specific Instructions on page 2.

Name (as shown on your income tax return)
KB Sullivan, Inc.

Business name, if different from above

Check appropriate box: ☑ Individual/Sole proprietor ☐ Corporation ☐ Partnership
☐ Limited liability company. Enter the tax classification (D=disregarded entity, C=corporation, P=partnership) ▶ ....
☐ Other (see instructions) ▶

☐ Exempt payee

Address (number, street, and apt. or suite no.)
P.O. Box 571

Requester's name and address (optional)

City, state, and ZIP code
Carlinville, Illinois 62626

List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on Line 1 to avoid backup withholding. For individuals, this is your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN* on page 3.

Note. If the account is in more than one name, see the chart on page 4 for guidelines on whose number to enter.

Social security number

or

Employer identification number
26 0235568

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me), and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding, and
3. I am a U.S. citizen or other U.S. person (defined below).

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the Certification, but you must provide your correct TIN. See the instructions on page 4.

Sign Here Signature of U.S. person ▶ K. B. Patel Date ▶ 02-02-2010

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Purpose of Form

A person who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) to report, for example, income paid to you, real estate transactions, mortgage interest you paid, acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA.

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN to the person requesting it (the requester) and, when applicable, to:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),

2. Certify that you are not subject to backup withholding, or

3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income.

Note. If a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:

- An individual who is a U.S. citizen or U.S. resident alien,
- A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States,
- An estate (other than a foreign estate), or
- A domestic trust (as defined in Regulations section 301.7701-7).

Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax on any foreign partners' share of income from such business. Further, in certain cases where a Form W-9 has not been received, a partnership is required to presume that a partner is a foreign person, and pay the withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid withholding on your share of partnership income.

The person who gives Form W-9 to the partnership for purposes of establishing its U.S. status and avoiding withholding on its allocable share of net income from the partnership conducting a trade or business in the United States is in the following cases:

- The U.S. owner of a disregarded entity and not the entity,

Office of the Illinois
State Fire Marshal
"Partnering With the Fire Service to Protect Illinois"

CERTIFIED MAIL - RECEIPT REQUESTED #7010 0780 0002 1296 1934

August 9, 2011

KB Sullivan, Inc.
P.O. Box 571
Carlinville, IL 62626

In Re: Facility No. 4-013187
IEMA Incident No. 04-0969
KB Sullivan, Inc.
105 West Jackson
Sullivan, Moultrie Co., IL

Dear Applicant:

The Reimbursement Eligibility and Deductible Application received on August 9, 2011 for the above referenced occurrence has been reviewed. The following determinations have been made based upon this review.

You have filed an "Election to Proceed as Owner" and have received acceptance from the Illinois Environmental Protection Agency. It has been determined, therefore, that you are eligible to seek payment of costs in excess of **$10,000.** The costs must be in response to the occurrence referenced above and associated with the following tanks:

<u>Eligible Tanks</u>

Tank 1 10,000 gallon Gasoline
Tank 2 8,000 gallon Gasoline
Tank 3 8,000 gallon Gasoline
Tank 4 5,000 gallon Diesel Fuel
Tank 5 5,000 gallon Gasoline
Tank 6 2,000 gallon Kerosene

You must contact the Illinois Environmental Protection Agency to receive a packet of Agency billing forms for submitting your request for payment.

An owner or operator is eligible to access the Underground Storage Tank Fund if the eligibility requirements are satisfied:

1. Neither the owner nor the operator is the United States Government,

2. The tank does not contain fuel which is exempt from the Motor Fuel Tax Law,

3. The costs were incurred as a result of a confirmed release of any of the following substances:

   "Fuel", as defined in Section 1.19 of the Motor Fuel Tax Law

Aviation fuel

Heating oil

Kerosene

Used oil, which has been refined from crude oil used in a motor vehicle, as defined in Section 1.3 of the Motor Fuel Tax Law.

4. The owner or operator registered the tank and paid all fees in accordance with the statutory and regulatory requirements of the Gasoline Storage Act.

5. The owner or operator notified the Illinois Emergency Management Agency of a confirmed release, the costs were incurred after the notification and the costs were a result of a release of a substance listed in this Section. Costs of corrective action or indemnification incurred before providing that notification shall not be eligible for payment.

6. The costs have not already been paid to the owner or operator under a private insurance policy, other written agreement, or court order.

7. The costs were associated with "corrective action".

This constitutes the final decision as it relates to your eligibility and deductibility. We reserve the right to change the deductible determination should additional information that would change the determination become available. An underground storage tank owner or operator may appeal the decision to the Illinois Pollution Control Board (Board), pursuant to Section 57.9 (c) (2). An owner or operator who seeks to appeal the decision shall file a petition for a hearing before the Board within 35 days of the date of mailing of the final decision, (35 Illinois Administrative Code 105.504(b)).

For information regarding the filing of an appeal, please contact:

Clerk
Illinois Pollution Control Board
State of Illinois Center
100 West Randolph, Suite 11-500
Chicago, Illinois 60601
(312) 814-3620

The following tanks are also listed for this site:

Tank 7 10,000 gallon Gasoline
Tank 8 10,000 gallon Gasoline
Tank 9 8,000 gallon Diesel Fuel
Tank 10 5,000 gallon Kerosene
Tank 11 5,000 gallon Gasoline

Your application indicates that there has not been a release from these tanks under this incident number. You may be eligible to seek payment of corrective action costs associated with these tanks if it is determined that there has been a release from one or more of these tanks. Once it is determined that there has been a release from one or more of these tanks you may submit a separate application for an eligibility determination to seek corrective action costs associated with this/these tanks.

If you have any questions, please contact our office at (217) 785-5878.

Sincerely,

Deanne Lock
Administrative Assistant
Division of Petroleum and Chemical Safety

cc: IEPA
Facility File

Women and Minority Business Enterprises Form

The Illinois EPA is required to report State and Federal funds paid to Women Business Enterprises (WBE) and Minority Business Enterprises (MBE). Therefore, please provide the required information for all Prime Consultants/Contractors and Subcontractors used to perform the work for this billing:

Name of Leaking UST site: KB Sullivan (Former Willaredt Oil) Incident No.: 90-0146,04-0969

The work for this billing was performed from 1/1/15 to 3/31/20

Prime Consultant: CWM Company, Inc.

FIRM'S NAME, ADDRESS, AND TELEPHONE NUMBER	IS THIS FIRM A WBE OR MBE?	IF WBE OR MBE, WHAT IS ITS STATE OF ILLINOIS VENDOR NUMBER?	AMOUNT PAID OR DUE THIS BILLING ($)
CWM Company, Inc. 701 South Grand Avenue West Springfield, Illinois 62704 217-522-8001	NO		2,125.96

BILLING TOTAL $ 2,125.96

The Illinois EPA is authorized to request this information under the Environmental Protection Act, 415 ILCS 5/1 et seq. (formerly Ill. Rev. Stat. Ch 111-1/2, 1001 et seq.). Disclosure of this information is required. Failure to properly complete this form in its entirety may result in the delay or denial of any payment requested hereunder. This form has been approved by the Forms Management Center.

Billing Summary

	$ Amount Approved in the Budget	$ Amount Requested for Payment from the Fund
1. Drilling and Monitoring Well Costs Form	.00	.00
2. Analytical Costs Form	.00	.00
3. Remediation and Disposal Costs Form	.00	.00
4. UST Removal and Abandonment Costs Form	.00	.00
5. Paving, Demolition, and Well Abandonment Costs Form	1,719.00	.00
6. Consulting Personnel Costs Form	31,443.23	2,108.37
7. Consultant's Materials Costs Form	734.30	17.08
Total Amount Approved in the Budget *	$33,896.53	**NOT APPLICABLE**
Subtotal of lines 1-7:	**NOT APPLICABLE**	$2,125.45
8. Handling Charges Form	**NOT APPLICABLE**	.51
TOTAL AMOUNT REQUESTED FOR PAYMENT	**NOT APPLICABLE**	$2,125.96

*Date(s) this Budget(s) was approved: May 16, 2012

Consulting Personnel Costs Form

Employee Name / Remediation Category	Personnel Title / Task	Hours	Rate* ($)	Total Cost
V.E. Smith	Engineer III	.75	114.56	$85.92
ELUC	Groundwater Ordinance			
V.E. Smith	Professional Engineer	1.00	126.04	$126.04
ELUC	Groundwater Ordinance			
M. Kube	Engineer I	.75	85.92	$64.44
ELUC	Groundwater Agreements			
C.L. Rowe	Senior Project Manager	2.50	114.56	$286.40
ELUC	Groundwater Ordinance			
V.E. Smith	Senior Prof. Engineer	4.00	148.96	$595.84
ELUC	PE Review & Certification			
C.L. Rowe	Senior Project Manager	2.25	114.56	$257.76
HAA	City/Local HAA Agreements			
M. Kube	Engineer I	.50	85.92	$42.96
HAA	City/Local HAA Agreements			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	Task			
W.T. Sinnott	Senior Project Manager	1.25	114.56	$143.20
CCA-Field	Documentation			
V.E. Smith	Professional Engineer	.25	126.04	$31.51
CCA-Field	Documentation			
R. Stanley	Senior Prof. Geologist	4.50	105.40	$474.30
CACR	Completion Report			
		17.75 hrs		

*Refer to the applicable Maximum Payment Amounts document.

Total of Consulting Personnel Costs	$2,108.37

Consultant's Materials Costs Form

Materials, Equipment, or Field Purchase / Remediation Category	Description/Justification	Time or Amount Used	Rate ($)	Unit	Total Cost
PID Rental / CCA-Field	To detect VOC levels in soil samples		129.00	/day	$.00
Survey Equipment Rental / CCA-Field	Survey monitoring well elevations for groundwater flow calculations	.00	65.00	/day	$.00
Water Level Indicator / CCA-Field	Test for gw during drilling activities/Measure static gw elevations		24.00	/day	$.00
Measuring Wheel / CCA-Field	Mapping sampling locations		18.00	/day	$.00
Mileage / CCA-Field	Travel to site		.58	/mile	$.00
Disposable Gloves / CCA-Field	Disposable latex gloves for soil and groundwater sampling		13.00	/box	$.00
Bailing Twine / CCA-Field	String for Bailers		5.00	/roll	$.00
Bailers / CCA-Field	Disposable bailers for monitoring well development and sampling		12.00	/each	$.00
Copies / HAA	IDOT HAA Corr/Attachments		.10	/each	$.00

Materials, Equipment, or Field Purchase		Time or Amount Used	Rate ($)	Unit	Total Cost
Remediation Category	**Description/Justification**				
Measuring Wheel		.00	21.00	/day	$.00
CCA-Field	Measure dimensions during excavation activities, wall sample spacing				
Postage		1.00	3.08	/each	$3.08
CA-Pay	UST Fund Reimb Claim				
Postage		1.00	1.21	/each	$1.21
ELUC	City GW Ordinance Correspondence				
Digital Camera		.00	10.00	/day	$.00
CCA-Field	To take pictures for documentation of excavation activities				
Copies			.10	/copy	$.00
CA-Pay	UST Fund Reimb Claim				
Copies			.10	/copy	$.00
ELUC	GW Ordinance Development/Attachments				
Postage		1.00	.49	/each	$.49
CA-Pay	UST Fund Reimb Claim/Corr - no receipt; used internal postage meter				
Copies		82.00	.15	/copy	$12.30
CA-Pay	UST Fund Reimb Claim/Supp Doc				
Postage			2.03	/each	$.00
HAA	City HAA Correspondence				

Total of Consultant Materials Costs	**$17.08**

Handling Charges Form

Subcontract or Field Purchase Cost:	Eligible Handling Charges as a Percentage of Cost:
$0 - $5,000	12%
$5,001 - $15,000	$600 + 10% of amt. over $5,000
$15,001- $50,000	$1,600 + 8% of amt. over $15,000
$50,001 - $100,000	$4,400 + 5% of amt. over $50,000
$100,001 - $1,000,000	$6,900 + 2% of amt. over $100,000

Subcontractor Name or Field Purchase	Type of Work Performed by Subcontractor	Subcontractor or Field Purchase Amount ($)
Field Purchase	Postage: UST Fund Reimb Claim	3.08
Field Purchase	Postage: City GW Ordinance Correspondence	1.21

Total Subcontractor and Field Purchase Costs:	$4.29

Total Handling Charges:	$.51

CW M Company

Environmental Consulting Services

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Work Summary for: **KB Food and Gas 2004-0969** *For the Month of:* **January 2015**

Date of Work	Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Tuesday, January 27, 2015							
	Smith, V.E.	Engineer III 7/1/2014	6 ELUC	$121.48	0.75	$91.11	$0.00
				Line Item Totals:	**0.75**	**$91.11**	**$0.00**

Total project charges for month: $91.11

0316

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **January 2015**

Employee	Position		Hourly Rate	Hours Worked	Labor Subtotal
Smith, V.E.	Engineer III 7/1/2014	6 ELUC	$121.48	0.75	$91.11
		Smith, V.E.	**Total:**	**0.75**	**$91.11**
			Project Totals:	**0.75**	**$91.11**

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Project Work Summary for: **KB Food and Gas 2004-0969** *For the Month of:* **March 2015**

Date of Work / Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Thursday, March 5, 2015						
Haas, R.	Sr. Acct. Technician 7/1/2014	6 CA-Reimb	$66.80	0.00	$0.00	$4.80
Friday, March 6, 2015						
Haas, R.	Sr. Acct. Technician 7/1/2014	6 CA-Reimb	$66.80	0.00	$0.00	$7.50
Saturday, March 7, 2015						
Sinnott, W.T.	Senior Project Manager 7/1/20	6 CCA-Field	$121.48	1.25	$151.85	$0.00
			Line Item Totals:	**1.25**	**$151.85**	**$12.30**

Total project charges for month: $164.15

0318

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **March 2015**

Employee	Position	Hourly Rate	Hours Worked	Labor Subtotal
Haas, R.	Sr. Acct. Technician 7/1/2014 6 CA-Reimb	$66.80	0.00	$0.00
	Haas, R. Total:		**0.00**	**$0.00**
Sinnott, W.T.	Senior Project Manager 7/1/20 6 CCA-Field	$121.48	1.25	$151.85
	Sinnott, W.T. Total:		**1.25**	**$151.85**
	Project Totals:		**1.25**	**$151.85**

CW M Company

Environmental Consulting Services

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Expenses for: **KB Food and Gas 2004-0969** **March 2015**

Date	Description of Expense	Comment	Phase Code	Quantity	Rate	Expenditure	Field Purchase
March 5, 2015	Copies	UST Fund Reimb Claim/Supp Doc	6 CA-Reimb	32.00	$0.150	$4.80	☐
March 6, 2015	Copies	UST Fund Reimb Claim/Supp Doc	6 CA-Reimb	50.00	$0.150	$7.50	☐
					Phase Total:	$12.30	

0320

CW M Company

Environmental Consulting Services

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Work Summary for: **KB Food and Gas 2004-0969**

For the Month of: **April 2015**

Date of Work	Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Friday, April 24, 2015							
	Saladino, M.J.	Engineer I 7/2015	6 CA-Reimb	$92.92	0.00	$0.00	$3.08
Thursday, April 30, 2015							
	Sinnott, W.T.	Senior Project Manager 7/1/20	6 CA-Reimb	$121.48	0.00	$0.00	$0.37
			Line Item Totals:		**0.00**	**$0.00**	**$3.45**

Total project charges for month: **$3.45**

0321

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **April 2015**

Employee	Position		Hourly Rate	Hours Worked	Labor Subtotal
Saladino, M.J.	Engineer I 7/2015	6 CA-Reimb	$92.92	0.00	$0.00
		Saladino, M.J. Total:		**0.00**	**$0.00**
Sinnott, W.T.	Senior Project Manager 7/1/20	6 CA-Reimb	$121.48	0.00	$0.00
		Sinnott, W.T. Total:		**0.00**	**$0.00**
		Project Totals:		**0.00**	**$0.00**

CW M Company

Environmental Consulting Services

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Expenses for: **KB Food and Gas 2004-0969**

April 2015

Date	Description of Expense	Comment	Phase Code	Quantity	Rate	Expenditure	Field Purchase
April 24, 2015	Field Purchase	UST Fund Reimb Claim	6 CA-Reimb	3.08	$1.000	$3.08	☑
April 30, 2015	Field Purchase Handling Charge	Field Purchases Handling Charge	6 CA-Reimb	0.37	$1.000	$0.37	☐
					Phase Total:	$3.45	

0323

MJS

SPRINGFIELD DWN TWN STA
SPRINGFIELD, Illinois
627019998
1615500604-0099
04/24/2015 (217)753-3432 03:07:56 PM

Sales Receipt

Issue Postage: $5.95

FARMER CITY IL 61842 Zone-2 $2.45
First-Class Mail Large Env WALKER TIRE
7.50 oz. STAGE 1 REIMB.
Expected Delivery: Mon 04/27/15

Issue Postage: $2.45

@@ ~~ BELLEVILLE IL $5.95
62222-0122 Zone-2 MOTO-FREEBURG
Priority Mail 2-Day By
Weight CA REIMB.
1 lb. 2.10 oz.
Expected Delivery: Mon 04/27/15
Includes up to $50 insurance

USPS Tracking #:
9505 5111 6853 5114 5422 09

Issue Postage: $5.95

BARTLETT IL 60103-1390 $3.08
Zone-3 KB SULLIVAN
First-Class Mail Large Env CA REIMB.
10.60 oz.
Expected Delivery: Mon 04/27/15

Issue Postage: $3.08

CARMI IL 62821-1389 Zone-2 $2.87
First-Class Mail Large Env HUCKS BENTON
9.30 oz. CA REIMB.
Expected Delivery: Mon 04/27/15

Issue Postage: $2.87

EFFINGHAM IL 62401 Zone-2 $2.66
First-Class Mail Large Env SMOOT OIL
8.40 oz. CA REIMB.
Expected Delivery: Mon 04/27/15

Issue Postage: $2.66

@@ ~~ ROSSVILLE IL $5.95
60963-1106 Zone-2 VILLAGE OF ROSSVILLE
Priority Mail 1-Day By STAGE 1 AND CA
Weight REIMB.
1 lb. 5.30 oz.
Expected Delivery: Sat 04/25/15
Includes up to $50 insurance

USPS Tracking #:
9505 5111 6853 5114 5435 03

Issue Postage: $5.95

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Project Work Summary for: **KB Food and Gas 2004-0969** *For the Month of:* **September 2015**

Date of Work / Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Monday, September 28, 2015						
Haas, R.	Sr. Acct. Technician 7/1/2015	6 CA-Reimb	$68.12	0.00	$0.00	$0.49
		Line Item Totals:		**0.00**	**$0.00**	**$0.49**

Total project charges for month: $0.49

0325

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **September 2015**

Employee	Position	Hourly Rate	Hours Worked	Labor Subtotal
Haas, R.	Sr. Acct. Technician 7/1/2015 6 CA-Reimb	$68.12	0.00	$0.00
	Haas, R. Total:		**0.00**	**$0.00**
	Project Totals:		**0.00**	**$0.00**

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Project Expenses for: **KB Food and Gas 2004-0969** **September 2015**

Date	Description of Expense	Comment	Phase Code	Quantity	Rate	Expenditure	Field Purchase
September 28, 2015	Postage	UST Fund Reimb Claim/Cor	6 CA-Reimb	0.49	$1.000	$0.49	☐
				Phase Total:		$0.49	

0327

CW M Company
Environmental Consulting Services

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Work Summary for: **KB Food and Gas 2004-0969**

For the Month of: **March 2016**

Date of Work / Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Friday, March 25, 2016						
Stanley, R.J.	Professional Geologist 7/1/201 6	CACR	$113.96	3.00	$341.88	$0.00
Monday, March 28, 2016						
Stanley, R.J.	Professional Geologist 7/1/201 6	CACR	$113.96	1.50	$170.94	$0.00
Smith, V.E.	Professional Engineer 7/1/2015 6	ELUC	$136.28	0.25	$34.07	$0.00
			Line Item Totals:	**4.75**	**$546.89**	**$0.00**

Total project charges for month: $546.89

0328

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **March 2016**

Employee	Position		Hourly Rate	Hours Worked	Labor Subtotal
Stanley, R.J.	Professional Geologist 7/1/201 6 CACR		$113.96	4.50	$512.82
		Stanley, R.J. Total:		**4.50**	**$512.82**
Smith, V.E.	Professional Engineer 7/1/2015 6 ELUC		$136.28	0.25	$34.07
		Smith, V.E. Total:		**0.25**	**$34.07**
		Project Totals:		**4.75**	**$546.89**

CW M Company
Environmental Consulting Services

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Work Summary for: **KB Food and Gas 2004-0969**

For the Month of: **April 2016**

Date of Work	Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Tuesday, April 5, 2016							
	Smith, V.E.	Professional Engineer 7/1/2015 6	CCA-Field	$136.28	0.25	$34.07	$0.00
			Line Item Totals:		**0.25**	**$34.07**	**$0.00**

Total project charges for month: **$34.07**

0330

CW M Company
400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **April 2016**

Employee	Position	Hourly Rate	Hours Worked	Labor Subtotal
Smith, V.E.	Professional Engineer 7/1/2015 6 CCA-Field	$136.28	0.25	$34.07
	Smith, V.E. Total:		**0.25**	**$34.07**
	Project Totals:		**0.25**	**$34.07**

CW M Company

Environmental Consulting Services

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Work Summary for: **KB Food and Gas 2004-0969**

For the Month of: **October 2016**

Date of Work	Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Tuesday, October 18, 2016							
	Rowe, C.L.	Senior Project Manager 7/1/20	6 HAA	$125.12	0.25	$31.28	$0.00
			Line Item Totals:		**0.25**	**$31.28**	**$0.00**

Total project charges for month: $31.28

0332

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **October 2016**

Employee	Position	Hourly Rate	Hours Worked	Labor Subtotal
Rowe, C.L.	Senior Project Manager 7/1/20 6 HAA	$125.12	0.25	$31.28
	Rowe, C.L. Total:		**0.25**	**$31.28**
	Project Totals:		**0.25**	**$31.28**

CW M Company
Environmental Consulting Services
400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238
701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Work Summary for: **KB Food and Gas 2004-0969** *For the Month of:* **October 2018**

Date of Work / Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Monday, October 1, 2018						
Smith, V.E.	Senior Professional Engineer 7/	6 ELUC	$167.60	0.75	$125.70	$0.00
Tuesday, October 2, 2018						
Smith, V.E.	Senior Professional Engineer 7/	6 ELUC	$167.60	1.00	$167.60	$0.00
Wednesday, October 3, 2018						
Smith, V.E.	Senior Professional Engineer 7/	6 ELUC	$167.60	0.75	$125.70	$0.00
Thursday, October 4, 2018						
Smith, V.E.	Senior Professional Engineer 7/	6 ELUC	$167.60	1.00	$167.60	$0.00
Monday, October 8, 2018						
Kube, M.	Engineer I 7/2018	6 ELUC	$96.68	0.50	$48.34	$0.00
Rowe, C.L.	Senior Project Manager 7/1/20	6 ELUC	$128.92	0.25	$32.23	$0.00
Smith, V.E.	Senior Professional Engineer 7/	6 ELUC	$167.60	0.50	$83.80	$0.00
Kube, M.	Engineer I 7/2018	6 HAA	$96.68	0.25	$24.17	$0.00
Rowe, C.L.	Senior Project Manager 7/1/20	6 HAA	$128.92	0.50	$64.46	$0.00
Tuesday, October 9, 2018						
Kube, M.	Engineer I 7/2018	6 ELUC	$96.68	0.25	$24.17	$0.00
Rowe, C.L.	Senior Project Manager 7/1/20	6 ELUC	$128.92	0.50	$64.46	$0.00
Kube, M.	Engineer I 7/2018	6 HAA	$96.68	0.25	$24.17	$0.00
Friday, October 12, 2018						
Rowe, C.L.	Senior Project Manager 7/1/20	6 ELUC	$128.92	0.75	$96.69	$0.00
Rowe, C.L.	Senior Project Manager 7/1/20	6 HAA	$128.92	0.75	$96.69	$0.00
Monday, October 15, 2018						
Sinnott, W.T.	Senior Project Manager 7/1/20	6 CA-Reimb	$128.92	0.00	$0.00	$0.14

0334

CW M Company
Environmental Consulting Services
400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238
701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Work Summary for: **KB Food and Gas 2004-0969** *For the Month of:* **October 2018**

Date of Work / Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Kube, M.	Engineer I 7/2018	6 ELUC	$96.68	0.00	$0.00	$1.21
Wednesday, October 31, 2018						
Budget Adjustment	Rate Adjustment	6 CA-Reimb	$0.60	-0.82	($0.49)	$0.00
Budget Adjustment ($60)	Rate Adjustment	6 CA-Reimb	$60.00	-3.77	($226.00)	$0.00
Rowe, C.L.	Senior Project Manager 7/1/20	6 ELUC	$128.92	0.50	$64.46	$0.00
Smith, V.E.	Professional Engineer 7/1/2018	6 ELUC	$141.80	0.25	$35.45	$0.00
Rowe, C.L.	Senior Project Manager 7/1/20	6 HAA	$128.92	0.50	$64.46	$0.00
			Line Item Totals:	**4.67**	**$1,083.66**	**$1.35**

Total project charges for month: $1,085.01

0335

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **October 2018**

Employee	Position		Hourly Rate	Hours Worked	Labor Subtotal
Budget Adjustment	Rate Adjustment	6 CA-Reimb	$0.60	-0.82	($0.49)
		Budget Adjustment	**Total:**	**-0.82**	**($0.49)**
Budget Adjustment ($60)	Rate Adjustment	6 CA-Reimb	$60.00	-3.77	($226.00)
		Budget Adjustment ($60)	**Total:**	**-3.77**	**($226.00)**
Sinnott, W.T.	Senior Project Manager 7/1/20	6 CA-Reimb	$128.92	0.00	$0.00
		Sinnott, W.T.	**Total:**	**0.00**	**$0.00**
Kube, M.	Engineer I 7/2018	6 ELUC	$96.68	0.75	$72.51
		Kube, M.	**Total:**	**0.75**	**$72.51**
Rowe, C.L.	Senior Project Manager 7/1/20	6 ELUC	$128.92	2.00	$257.84
		Rowe, C.L.	**Total:**	**2.00**	**$257.84**
Smith, V.E.	Professional Engineer 7/1/2018	6 ELUC	$141.80	0.25	$35.45
	Senior Professional Engineer 7/	6 ELUC	$167.60	4.00	$670.40
		Smith, V.E.	**Total:**	**4.25**	**$705.85**
Kube, M.	Engineer I 7/2018	6 HAA	$96.68	0.50	$48.34
		Kube, M.	**Total:**	**0.50**	**$48.34**
Rowe, C.L.	Senior Project Manager 7/1/20	6 HAA	$128.92	1.75	$225.61
		Rowe, C.L.	**Total:**	**1.75**	**$225.61**
			Project Totals:	**4.67**	**$1,083.66**

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Project Expenses for: **KB Food and Gas 2004-0969** **October 2018**

Date	Description of Expense	Comment	Phase Code	Quantity	Rate	Expenditure	Field Purchase
October 15, 2018	Field Purchase Handling Charge	Field Purchase Handling Charge	6 CA-Reimb	0.14	$1.000	$0.14	☐
October 15, 2018	Field Purchase	City GW Ordinance Correspondence	6 ELUC	1.21	$1.000	$1.21	☑
					Phase Total:	$1.35	

0337

MKC

DOWNTOWN SPRINGFIELD
411 E MONROE ST
SPRINGFIELD
IL
62701-9998
1674180604
10/15/2018 (800)275-8777 3:52 PM

Product Description	Sale Qty	Final Price
First-Class Mail Large Envelope (Domestic) (SULLIVAN, IL 61951) (Weight:0 Lb 1.80 Oz) (Estimated Delivery Date) (Wednesday 10/17/2018)	1	$1.21
First-Class Mail Large Envelope (Domestic) (EDWARDSVILLE, IL 62025) (Weight:0 Lb 1.80 Oz) (Estimated Delivery Date) (Wednesday 10/17/2018)	1	$1.21
First-Class Mail Large Envelope (Domestic) (GILLESPIE, IL 62033) (Weight:0 Lb 3.80 Oz) (Estimated Delivery Date) (Wednesday 10/17/2018)	1	$1.63
First-Class Mail Large Envelope (Domestic) (EDWARDSVILLE, IL 62025) (Weight:0 Lb 1.80 Oz) (Estimated Delivery Date) (Wednesday 10/17/2018)	1	$1.21

KB Sullivan ~~Gas~~ GW ordnance

Keller Ginger Creek HAA

Motomart Gillespie HAA and GWt

Keller Ginger Creek HAA

Total $5.26

Debit Card Remit'd $5.26
(Card Name:VISA)
(Account #:XXXXXXXXXXXX3889)
(Approval #:)
(Transaction #:888)
(Receipt #:015715)
(Debit Card Purchase:$5.26)
(Cash Back:$0.00)
(AID:A0000000980840 Chip)
(AL:US DEBIT)
(PIN:Verified US DEBIT)

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CW M Company

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Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Project Work Summary for: **KB Food and Gas 2004-0969**

For the Month of: **November 2018**

Date of Work / Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Thursday, November 1, 2018						
Smith, V.E.	Professional Engineer 7/1/2018 6 ELUC		$141.80	0.50	$70.90	$0.00
		Line Item Totals:		**0.50**	**$70.90**	**$0.00**

Total project charges for month: **$70.90**

0339

CW M Company

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **November 2018**

Employee	Position	Hourly Rate	Hours Worked	Labor Subtotal
Smith, V.E.	Professional Engineer 7/1/2018 6 ELUC	$141.80	0.50	$70.90
	Smith, V.E.	**Total:**	**0.50**	**$70.90**
		Project Totals:	**0.50**	**$70.90**

CW M Company

Environmental Consulting Services

400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238

701 W. South Grand
Springfield, IL 62704
217/522-8001

Project Work Summary for: **KB Food and Gas 2004-0969**

For the Month of: **March 2020**

Date of Work	Employee	Position	Type of Work	Hourly Rate	Hours Worked	Labor Subtotal	Expenses
Friday, March 27, 2020							
	Rowe, C.L.	Senior Project Manager 7/1/20	6 ELUC	$131.48	0.50	$65.74	$0.00
	Rowe, C.L.	Senior Project Manager 7/1/20	6 HAA	$131.48	0.25	$32.87	$0.00
				Line Item Totals:	**0.75**	**$98.61**	**$0.00**

Total project charges for month: **$98.61**

0341

CW M Company
400 W. Jackson Street, Suite C
Marion, IL 62959
618/997-2238
701 W. South Grand
Springfield, IL 62704
217/522-8001
Environmental Consulting Services

Work Summary for **KB Food and Gas 2004-0969** **March 2020**

Employee	Position	Hourly Rate	Hours Worked	Labor Subtotal
Rowe, C.L.	Senior Project Manager 7/1/20 6 ELUC	$131.48	0.50	$65.74
	Rowe, C.L. Total:		**0.50**	**$65.74**
Rowe, C.L.	Senior Project Manager 7/1/20 6 HAA	$131.48	0.25	$32.87
	Rowe, C.L. Total:		**0.25**	**$32.87**
	Project Totals:		**0.75**	**$98.61**

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-3397

JB PRITZKER, GOVERNOR JOHN J. KIM, DIRECTOR

(217) 524-3300

CERTIFIED MAIL #
7017 2680 0001 0209 6065

FEB 05 2021

KB Food & Gas
CWM Company, Inc.
P.O. Box 571
Carlinville, Illinois 62626

Re: 1390305014 -- Moultrie County
Sullivan / KB Food & Gas
111 West Jackson Street/Routes 121 & 132
Incident-Claim No.: 20040969 -- 71556
Queue Date: October 28, 2020
Leaking UST Fiscal File

Dear Mr. Patel:

The Illinois Environmental Protection Agency (Illinois EPA) has completed the review of your application for payment from the Underground Storage Tank (UST) Fund for the above-referenced Leaking UST incident pursuant to Section 57.8(a) of the Environmental Protection Act (415 ILCS 5) (Act) and 35 Illinois Administrative Code (35 Ill. Adm. Code) 734.Subpart F.

This information is dated October 20,2020 and was received by the Illinois EPA on October 28,2020. The application for payment covers the period from January 1, 2015 to March 31, 2020. The amount requested is $2,125.96.

On October 28, 2020, the Illinois EPA received your application for payment for this claim. As a result of the Illinois EPA's review of this application for payment, a voucher cannot be prepared for submission to the Comptroller's office for payment. Subsequent applications for payment that have been/are submitted will be processed based upon the date subsequent application for payment requests are received by the Illinois EPA. This constitutes the Illinois EPA's final action with regard to the above application(s) for payment.

There are costs from this claim that are not being paid. Listed in Attachment A are the costs that are not being paid and the reasons these costs are not being paid.

An underground storage tank system owner or operator may appeal this decision to the Illinois Pollution Control Board. Appeal rights are attached.

If you have any questions or require further assistance, please contact Stephanie Kincaid of my staff at (217) 558-2693.

Sincerely,

Md. Zillur Rahman

Mohammed Z. Rahman, Manager
Leaking Underground Storage Tank Section
Bureau of Land

c: CWM Company, Inc.
Leaking UST Claims Unit

Appeal Rights

An underground storage tank owner or operator may appeal this final decision to the Illinois Pollution Control Board pursuant to Sections 40 and 57.7(c)(4) of the Act by filing a petition for a hearing within 35 days after the date of issuance of the final decision. However, the 35-day period may be extended for a period not to exceed 90 days by written notice from the owner or operator and the Illinois EPA within the initial 35-day appeal period. If the owner or operator wishes to receive a 90-day extension, a written request that includes a statement of the date the final decision was received, along with a copy of this decision, must be sent to the Illinois EPA as soon as possible.

For information regarding the filing of an appeal, please contact:

Clerk of the Board
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph, Suite 11-500
Chicago, IL 60601
(312) 814-3620

For information regarding the filing of an extension, please contact:

Illinois Environmental Protection Agency
Division of Legal Counsel
1021 North Grand Avenue East
PO Box 19276
Springfield, IL 62794-9276
(217) 782-5544

Attachment A
Accounting Deductions

Re: 1390305014 -- Moultrie County
Sullivan/KB Food & Gas
111 West Jackson Street/Routes 121 & 132
Incident-Claim No.: 20040969 -- 71556
Queue Date: October 28, 2020
Leaking UST FISCAL FILE

Citations in this attachment are from the Environmental Protection Act (415 ILCS 5) (Act) and 35 Illinois Administrative Code (35 Ill. Adm. Code).

Item # Description of Deductions

1. $2,125.96, deduction for all costs, which lack supporting documentation. Such costs are ineligible for payment from the Fund pursuant to 35 Ill. Adm. Code 734.630(cc). Since there is no supporting documentation of costs, the Illinois EPA cannot determine that costs will not be used for activities in excess of those necessary to meet the minimum requirements of Title XVI of the Act. Therefore, such costs are not approved pursuant to Section 57.7(c)(3) of the Act because they may be used for site investigation or corrective action activities in excess of those required to meet the minimum requirements of Title XVI of the Act.

   The claim requests costs associated with a Corrective Action Completion Report. To date the IEPA has not received this Corrective Action Completion Report and has not received any technical documentation since February 17, 2012.