BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	R11-9
PROPOSED AMENDMENTS TO	)	(Rulemaking-Land)
TIERED APPROACH TO CORRECTIVE	)	
ACTION OBJECTIVES	)	
(35 Ill. Adm. Code 742)	)	
	)	

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Pollution Control Board

NOTICE

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PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Illinois Pollution Control Board the Illinois Environmental Protection Agency's ("Illinois EPA") Motion for Acceptance, Pre-filed Written Testimony of Gary P. King and Tracey Hurley, Errata Sheet Number 1, and two additional Incorporations by Reference (to the Clerk of the Board only) copy of each of which is herewith served upon you.

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

By: Kimberly A. Geving
Kimberly A. Geving
Assistant Counsel
Division of Legal Counsel

DATE: January 27, 2011

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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	R11-9
PROPOSED AMENDMENTS TO	)	(Rulemaking-Land)
TIERED APPROACH TO CORRECTIVE	)	
ACTION OBJECTIVES	)	
(35 Ill. Adm. Code 742)	)	
	)	

MOTION FOR ACCEPTANCE

NOW COMES the Illinois Environmental Protection Agency ("Illinois EPA") and, pursuant to 35 Ill. Adm. Code 101.Subpart C and 35 Ill. Adm. Code 102.424, moves the Illinois Pollution Control Board ("Board") to accept the attached Pre-filed Written Testimony of Gary P. King and Tracey Hurley, Errata Sheet Number 1, and two additional Incorporations by Reference for the above-captioned matter.

Respectfully submitted,

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

By: Kimberly A. Geving

Kimberly A. Geving
Assistant Counsel
Division of Legal Counsel

DATE: January 27, 2011

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PROPOSED AMENDMENTS TO	)	
TIERED APPROACH TO CORRECTIVE	)	R11-9
ACTION OBJECTIVES	)	(Rulemaking-Land)
(35 Ill. Adm. Code 742)		

PRE-FILED TESTIMONY OF GARY KING

Qualifications

My name is Gary King. I am the Manager of the Division of Remediation Management for the Bureau of Land at the Illinois Environmental Protection Agency. Since 1990, I have been senior manager for the Illinois EPA site cleanup programs: the voluntary cleanup program, federal and state Superfund cleanup programs, Department of Defense cleanup program, Brownfields assistance program and the Leaking Underground Storage Tank program. I led Illinois EPA's development of the original 35 Ill. Adm. Code Part 742 rule, Tiered Approach to Corrective Action Objectives (TACO, R97-12) and all subsequent amendments.

I also chaired the Association of State and Territorial Solid Waste Management Officials ("ASTSWMO") CERCLA Research Center from January 2001 to October 2008. In that role I had frequent contact with other States and U.S. EPA concerning important issues to State and federal Superfund programs.

Prior to 1990, I managed Illinois EPA land enforcement programs. I am an attorney and hold a B.S degree in civil engineering from Valparaiso University.

Testimonial Statement

I will be testifying in support of the proposed amendments to 35 Ill. Adm. Code 742: Tiered Approach to Corrective Action Objectives. I will present an overview of the pathway evaluation and tiered approach to the indoor inhalation exposure route; describe the derivation of the Tier 1 remediation objectives for the indoor inhalation exposure route, including the recommended parameter values for the modified Johnson and Ettinger (J&E) model; and explain the rationale and requirements for the use of soil gas data and building control technologies.

Subpart A: Introduction

Section 742.115 introduces the exposure routes to be evaluated under this Part, including the indoor inhalation exposure route. The indoor inhalation route has two components: a soil gas component and a groundwater component. The soil gas component is the migration of contaminants from soil through soil gas into a building interior. The groundwater component is the migration of contaminants from groundwater through soil gas into a building interior. This pathway is unique in that it involves three types of media: soil, groundwater, and soil gas.

Although the indoor inhalation route involves three media (soil, soil gas and groundwater), the Agency proposal only develops remediation objectives for two of those media: soil gas and groundwater. Unlike the August 2008 proposal (R09-9), the current November 2010 proposal does not develop remediation objectives for soil per se. Soil, like groundwater, can be a source for volatile chemicals to release into soil gas; however, the Agency's review of scientific literature during the intervening period between proposals has revealed considerable skepticism as to whether risks to human health through the indoor inhalation route can be meaningfully determined based on concentrations of volatile chemicals in soils. On the other hand, the scientific literature continues to confirm that indoor inhalation risks can be meaningfully developed based on levels of volatile chemicals in soil gas and in groundwater. As such, the current Agency proposal does not provide soil remediation objectives under Tier 1 or 2, although a site specific proposal could be developed under Tier 3 (Section 742.935(d)).

Section 742.115 also introduces the concept of using soil gas measurements to determine outdoor inhalation risks. Sites that determine soil gas levels for compliance purposes for the indoor inhalation route may also be able to use that data to determine if an outdoor inhalation risk exists. As a result the Agency is proposing a new table in Appendix B, Table G that provides Tier 1 objectives for soil gas for the outdoor inhalation route. For the outdoor inhalation route, the Agency has not proposed deletion of the soil remediation objectives in Appendix B, Tables A and B. The outdoor inhalation route and the indoor inhalation route use two different models. The outdoor route uses the SSL model; this model has been in place for the outdoor route since TACO became effective in 1997. The indoor route uses a modified J&E model. These models use different input elements. For example, the SSL model uses a fraction of organic carbon (foc) value of .006 based on shallow, surficial soils while the modified J&E model uses a foc of .002 based on deeper subsurface soils.

The November 2010 proposal also amends Subpart A by adding a new subsection (i) to Section 742.105. This change makes it clear that the proposed indoor inhalation rules are evaluating whether chemical contamination outside a building may cause a human health risk within a building. The proposal does not address whether contamination within the building, either in the building structure itself or in products within the building, may be creating human health risks.

Subpart B: General

The August 2008 version of Section 742.200 contained new definitions for the terms "building," "building control technology," "soil gas," and "soil vapor saturation limit." The November 2010 version still proposes to use these definitions and adds definitions for "capillary fringe", "saturated zone", "water table" and "Qsoil". These terms appeared in 2008 proposal, but were undefined. The Agency believes that inclusion of these definitions gives greater clarity to the current proposal. The Agency has made a minor change to the definition of "building control technology". The use of "building control technology" describes mitigation systems for indoor inhalation risks and is compatible with the existing term "engineered barriers." The change makes a minor edit deleting a reference to "geologic materials" and making the revised definition consistent with the building control technologies identified in Subpart L. The current proposal continues with the definition of "volatile chemicals" proposed in 2008. The definition resulted from a re-examination (and eventual deletion) of the original definitions of "volatile organic compounds" and "volatile chemicals." The term is used to define contaminants subject to evaluation under the indoor inhalation exposure route, including elemental mercury.

Section 742.210 contains 22 new incorporations by reference. The vast majority of these 22 also appeared in the 2008 proposal. The most notable of these are U.S. EPA's draft guidance, *Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*, which established the use of the J&E model, and its companion document, *Users Guide for Evaluating Subsurface Vapor Intrusion into Buildings*, which provided justification for certain parameter values. Other significant publications include ASTM International's *Standard Practice for Assessment for Vapor Intrusion into Structures on Property Involved in Real Estate Transactions* and the Interstate Technology and Regulatory Council (ITRC)'s *Vapor Intrusion Pathway: A Practical Guide*. Additional incorporations have been included to provide soil gas analytical methods, source information for parameter value selection, and techniques for mitigation systems.

Section 742.222 provides methods for determining the soil vapor saturation limit and parallels Section 742.220, which is used for determining the soil saturation limit. The soil vapor saturation limit is the maximum vapor concentration that can exist in the soil pore air at a given temperature and pressure. Section 742.Appendix A, Table K presents the soil vapor saturation limits for volatile chemicals. For the indoor inhalation exposure route, soil gas remediation objectives cannot exceed the soil vapor saturation limit; otherwise, the assumptions of the modified J&E model would be violated. The modified J&E model as well as the existing RBCA and SSL models operate on similar assumptions regarding soil saturation and solubility. These risk-based models assume an equilibrium between contaminant concentrations that exist as vapors in soil pores, contaminants that adhere to soil particles, and contaminants that dissolve into water within soil pores.

The Agency has modified existing Section 742.225 to clarify that it applies to soil and groundwater remediation objectives.

New Section 742.227 provides minimum requirements for the collection and analysis of soil gas samples for both the indoor and outdoor inhalation routes. Ordinarily, sampling locations, quantities and protocol are determined by the program under which the remediation is being performed (LUST, RCRA, Site Remediation Program); however, because the use of soil gas data is not as well understood by site evaluators, Illinois EPA decided to specify the most essential criteria to reduce the likelihood of error, the misrepresentation of actual conditions, and the need for repeat sampling. The November 2010 proposal specifies that a helium tracer or other leak apparatus detection system, approved by the Agency, is to be used. Scientific literature since 2008 favors the use of helium as a tracer.

Subpart C: Exposure Route Evaluations

Section 742.312 identifies ways in which the indoor inhalation exposure route may be excluded from consideration. Indoor inhalation presents a risk only if volatile chemicals are the contaminants of concern. If a site has none of the 59 chemicals listed in Section 742.Appendix A, Table J or any other contaminants meeting the new definition of "volatile chemicals," then the indoor inhalation pathway does not need to be evaluated.

If volatile chemicals are present, the site evaluator has the option of excluding the pathway by either restricting buildings above contaminated areas or by implementing building control technologies. The general pathway exclusion criteria of existing Sections 742.300 and 742.305 must also be met; these are the "speed bumps" to prevent free product, the leaving behind of materials with the potential impact of hazardous waste, and concentrations of polychlorinated biphenyls above 50 parts per million. The November 2010 proposal adds to Section 742.305 a new "speed bump" provision for soil gas. Subsection (g) specifies that an exposure route cannot be excluded if the soil gas exceeds 10 percent of the Lower Explosive Limit.

The proposed building-specific exclusions would need institutional controls as follows:

1. A land use restriction prohibiting a building or man-made pathway above the contaminated soil gas or groundwater. (The indoor inhalation exposure route is incomplete if a building does not exist.)
2. Operation and maintenance requirements for approved building control technologies, including sub-slab depressurization, sub-membrane depressurization, membrane barriers or vented raised floors. These requirements are contained in the new Subpart L: Building Control Technologies.

The indoor inhalation exposure route cannot be excluded by use of a groundwater ordinance. This exclusion is not allowed because an ordinance restricting the use of groundwater as a source of drinking water would not protect the enclosed air space of a building from the migration of contaminants emanating from the groundwater.

Section 742.310 applies to outdoor inhalation; Section 742.312 applies to indoor inhalation. In both sections the Agency has included provisions that allow for pathway exclusion for the petroleum constituents benzene, toluene, ethylbenzene and total xylenes (BTEX) based on a demonstration of active bio-degradation. Although technically a bio-degradation proposal could be submitted under Tier 3, without regard to changes in Subtitle C, the Agency believes that a specific recognition as to the progress made in identifying active biodegradation of the BETX components of petroleum as part of the inhalation pathway is appropriate and will significantly assist in addressing this pathway. It is important to note that the biodegradation research for petroleum constituents and this pathway do not apply to other volatile chemicals.

Sections 35 Ill. Adm. Code 742.310(a)(2) and 742.312(b)(1)(C) have been drafted broadly enough to accommodate different models as they emerge in the future. One model that is gaining acceptance for use in demonstrating active biodegradation of petroleum constituents (including BTEX) is BioVapor – A 1-D Vapor Intrusion Model with Oxygen-Limited Aerobic Biodegradation, Version 2.0, American Petroleum Institute, 2009. This model is publicly available at www.api.org. The testimony that follows is not intended to be an endorsement, or even an approval of this model for use at Illinois sites, but is intended to summarize how it functions.

BioVapor uses a spreadsheet function to perform calculations that allow prediction of indoor air concentrations and associated risks from contaminants in soil gas or groundwater. It also calculates backwards to determine acceptable soil gas and groundwater concentrations from indoor-air screening levels. The model applies bioattenuation only when sufficient oxygen is present in the vadose zone (i.e., aerobic bioattenuation). It uses a mass-balance approach to ensure that the amount of bioattenuation does not exceed the amount of available oxygen (LUSTLine Bulletin 66, December 2010, p.19). In general uncontaminated soils have higher oxygen levels than contaminated soils, thus allowing bioattenuation to occur. The Utah Department of Environmental Quality, Leaking Underground Storage Tank Section has done considerable work in demonstrating the capacity of uncontaminated soils to bioattenuate BTEX levels moving upward through the vadose zone. That work was recently reported at www.newipcc.org/lustline/supplements.asp.

Input parameters for BioVapor include environmental factors, the chemicals to be evaluated, and the chemical concentrations. Use of BioVapor, or any other model, at Illinois sites will have to be consistent with the default parameters in 35 Ill. Adm. Code 742, Appendix C, Table B or Table M for the outdoor or indoor inhalation exposure route, respectively. If there is a conflict, the default parameters in Appendix C, Table B or Table M will have to be used.

Following a successful demonstration of active biodegradation, a clean soil layer above the contamination will need to be maintained to allow biodegradation to occur and to prevent BTEX migration into a structure. This requirement would be incorporated into an institutional control as provided under Section 742.1000(a)(6).

Subpart E: Tier 1 Evaluation

A Tier 1 remediation objective is a numerical chemical concentration that represents a level of contamination at or below which there are no human health concerns. Sites achieving residential Tier 1 remediation objectives are intended to clearly indicate that the property meets an unrestricted land use category for that category of use. Tier 1 requires a determination of either residential or industrial/commercial land use. Generally, equally protective but less restrictive remediation objectives apply to the industrial/commercial sites. [Note: whenever remediation objectives are based on an industrial/commercial land use, an institutional control must be placed on the property in accordance with Section 742.1000(a)(1).]

As with the other exposure routes, the indoor inhalation remediation objectives are calculated based on a one-in-a-million individual excess cancer risk for chemicals causing carcinogenic adverse health effects and a hazard quotient of one for chemicals causing noncarcinogenic adverse health effects.

Risk-based indoor inhalation remediation objectives were derived from equations combining exposure assumptions with toxicity data. The steps used to develop the soil gas and groundwater remediation objectives included:

1. Calculating a concentration of the contaminant of concern in indoor air that adequately protects humans who inhale this air (i.e., meets the above mentioned risk criteria);

2. Calculating an acceptable concentration of the contaminant of concern in the soil gas at the source of contamination. This concentration will not cause the contaminant in indoor air to exceed the concentration calculated in Step 1. This calculation was made using an attenuation factor derived from a mathematical model developed by Johnson and Ettinger (J&E). [Note: the ratio of the concentration in the indoor air (Step 1) to the soil gas concentration is called the attenuation factor. Thus the primary use of the J&E model is to calculate the attenuation factor.]

3. Calculating acceptable groundwater remediation objectives using the soil gas remediation objective calculated in Step 2, with the assumption that this contaminant is in three phase equilibrium.

The J&E model is the most common predictive model used by State environmental agencies in calculating the attenuation of contaminant concentrations from the subsurface to indoor air. The attenuation factor accounts for the following processes:

1. Migration of contaminants from the source upwards through the vadose zone. The source of contaminant concentrations in the subsurface may be either soil or groundwater. If the source is groundwater, the attenuation factor considers the initial migration of contaminants through the capillary fringe.
2. Migration of contaminants through the dirt filled cracks in the slab-on-grade or basement floor.
3. Mixing of the contaminants with air inside the building.

Illinois EPA provides 18 J&E equations and 54 default parameter values (Section 742.Appendix C, Tables L and M). Exposure factors are consistent with the values used in the current TACO regulations. Toxicity factors were obtained using U.S. EPA's hierarchy and are chemical-specific. Existing Sections 742.505(b)(3) and (4), which contain the procedures for addressing the additive effects of similar-acting chemicals in developing Tier 1 groundwater remediation objectives, also apply to the indoor inhalation exposure route.

Tier 1 remediation objectives have been developed for a slab-on-grade building. A slab-on-grade building is a more conservative scenario because there is less air available in the building to mix with the contamination. A building with a basement assumes there is mixing of the air between the basement and the first floor. Tier 1 remediation objectives are applicable to both slab-on-grade buildings and buildings with basements.

A slab-on-grade building is one with a concrete floor at about the same level as the grade of the surrounding area; a basement would typically be below the grade of the surrounding area. Tier 1 indoor inhalation remediation objectives calculated for a slab-on-grade building are not much lower than what would be developed for a similar building with a basement.

Building-specific default values for the following parameters were used to develop the Tier 1 remediation objectives: length of building (L_B), width of building (W_B), height of building (H_B), surface area of enclosed space at or below grade (A_B), and building ventilation rate (Q_{bldg}). The same default values must be used for the same parameters when performing Tier 2 calculations. The actual values of these parameters do not have a great impact on the remediation objective; however, the default values are based on a conservative representation of the type of buildings that are or may be present at the site in the future. Without these conservative values, restrictions would be required on the minimum size of a building that can be constructed over the contaminated area.

For the indoor inhalation exposure route, the industrial/commercial remediation objective differs from the residential remediation objective in three ways: exposure duration, building size, and air exchange rate. The air exchange rate (ER) is used to represent the mixing that occurs within a building. The air within a residence is assumed to be flushed out of the building at a rate of 13.8 times per day (0.53 times per hour) and at a commercial location at the rate of 22.32 times per day (0.93 times per hour) based on values listed by Hers et al. (2001) and Murray and Burmaster (1995). These two papers are the source of the recommendations in U.S. EPA's *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (2004).

For the J&E equations, Illinois EPA used a chemical-specific value for

Dimensionless Henry's Law Constant set to a default system temperature of 13°C. U.S. EPA's draft vapor intrusion guidance – as well as the other exposure routes in TACO – set the system temperature for Dimensionless Henry's Law Constant at 25°C. Illinois EPA decided to use a lower system temperature for the indoor inhalation route in Tiers 1 and 2 because it is more representative of the groundwater temperature in Illinois. The groundwater temperature in Illinois ranges from 8.3° C to 16.7° C; the average within that range is 13.19° C. The lower temperature reduces the Dimensionless Henry's Law Constant, resulting in a less stringent remediation objective. The States of New Jersey and Michigan also apply a state-specific system temperature (13° C and 12.5° C, respectively) for Dimensionless Henry's Law Constant under the indoor inhalation exposure route.

Section 742.Appendix B, Table G provides a Tier 1 table of numerical soil gas values for residential, industrial/commercial and construction worker receptors for the outdoor inhalation route. Section 742.Appendix B, Tables H and I provide a Tier 1 table of numerical soil gas and groundwater values for both residential and industrial/commercial receptors for the indoor inhalation route. Remediation objectives are not provided in Tables H and I for the construction worker population since this receptor group is not at risk from indoor inhalation exposure. The exposure duration for indoor construction in almost all cases is less than the exposure duration for the residents or commercial workers. Thus the protection of these two receptors will ensure protection of the construction worker during the period of indoor construction.

The November 2010 proposal makes a significant change to the Tier 1 portion of the indoor inhalation proposal with regards to the principles of advection. The August 2008 proposal did not include an advection component. U.S. EPA's concerns with Illinois EPA's 2008 proposal centered around the lack of an advection component.

In response, Illinois EPA added the advection component to the modified J&E model it uses to calculate remediation objectives for the proposed indoor inhalation exposure route. The advection component accounts for the migration of contaminants in soil gas brought about by differences in pressure gradients between the interior of a building and the soil nearest the building foundation. Illinois EPA set the parameter value used to measure advective flow, called Q_{soil}, to the U.S. EPA default number.

On May 25, 2010, Illinois EPA met with representatives from U.S. EPA Region 5 to brief them on the revisions Illinois EPA had made to the vapor intrusion proposal in response to their original comments; to answer questions and provide further explanations as needed; and, to request additional review by U.S. EPA Region 5 to obtain their concurrence with the modifications. On August 12, 2010, Illinois EPA received a letter from U.S. EPA Region 5 commenting on and recommending changes to the revised proposal.

U.S. EPA Region 5 recommended that when the Diffusion Only Table (Appendix B, Table I) is used to demonstrate compliance that compliance with both soil gas remediation objectives and groundwater remediation objectives be required. Illinois EPA agreed that multiple lines of evidence from soil gas and groundwater should be obtained prior to using Appendix B, Table I.

In addition, U.S. EPA Region 5 raised concerns about the use of a water filled soil porosity value of 30 percent as being non-representative of Illinois soil conditions. The 30 percent value is the subsurface default parameter value recommended by U. S. EPA's Soil Screening Guidance Document (1996); however, the Site Remediation Advisory Committee (SRAC) raised the same concern when meeting with Illinois EPA to discuss the changes. As a result, in the November 2010 proposal Illinois EPA adjusted the water filled soil porosity value to 15 percent, a value more consistent with typical Illinois soils. Changing this input parameter, however, meant recalculating the remediation objectives in Appendix B, Tables H and I, lowering them (making them more conservative) by as much as 25 percent in Table H (Diffusion and Advection) and by as much as 90 percent in Table I (Diffusion Only). By using the more conservative water filled soil porosity value of 15 percent typical of Illinois soils, Illinois EPA has developed a more conservative set of screening values and no longer needs to condition use of the Tier 1 Tables based on determining site specific water filled soil porosity (as proposed in the May 2010 draft provided to U.S. EPA and SRAC).

In addition to describing Section 742.Appendix B, Tables H and I, Section 742.515 explains how these Tables are to be used. Table H is used when soil or groundwater contamination is within 5 feet of an existing or potential building or manmade pathway. Table I is used when the distance is more than 5 feet. The Table H values are more conservative than the Table I values because the Table H values reflect forces of both diffusion and advection moving contamination to the interior of a structure. Table I values are based on diffusion only. The extent of the difference in values between the Tables is contaminant specific. For some of the contaminants the difference is a few multiples; for others, it can be an order of magnitude. If Table H values are used, then compliance with Tier 1 values can be based on meeting either the soil gas remediation objectives or the groundwater remediation objectives. If Table I is used, then the Tier I values must be met for both soil gas and groundwater.

When Table I is used, it will be necessary to condition use of the site in the NFR determination such that no future buildings or manmade pathways can be located within 5 feet of the contamination. (See Section 742.1000(a)(7)) If Table H values are complied with, then that conditioning of site use is not required.

The use of indoor air data as a general method to demonstrate compliance with remediation objectives under Tier 1 or 2 was rejected early by Illinois EPA. The Agency continues that approach with the November 2010 proposal. Indoor air samples are highly susceptible to bias from occupant sources (smoking, dry cleaning, household chemical use and storage, etc.). They are also invasive, requiring site evaluators to obtain access to indoor space. The rules do not prohibit the use of indoor air data; however, any such request would be a Tier 3 evaluation. (See Section 742.935(a))

Subpart G: Tier 2 Soil Evaluation

Tier 2 remediation objectives are developed using the J&E equations provided in Section 742.Appendix C, Table L.

Tier 2 calculations require information on the physical and chemical properties of the individual contaminants at a site. As in Tier 1, a chemical's toxicological parameters, physical parameters (obtained from Section 742.Appendix C, Table E), and the J&E equations themselves may not be varied. This is also true for Tier 2 evaluations applying the SSL and RBCA models for the other exposure routes.

Section 742.Appendix C, Table M contains all of the parameters used for the J&E equations. These parameters use either default values (i.e., standardized and/or health protective values) or actual site-specific field data. Where default values are provided, they may be used in Tier 2 equations. That is, only partial site-specific information need be obtained and default values may be used for the rest of an equation's parameter inputs. This practice is consistent with Tier 2 evaluations for the other exposure routes.

Under Tier 2, the attenuation factor is based on site-specific soil properties, including: depth to contaminated soil; types of soil present beneath the ground surface and the contamination source; and geotechnical parameters (dry soil bulk density, soil total porosity, water-filled soil porosity, and fraction organic carbon content).

Under existing Section 742.610, which will also apply to the indoor inhalation route, to determine site-specific physical soil parameters, a minimum of one boring per 0.5 acre of contamination must be collected. Each soil sample analyzed for one or more of the applicable contaminants of concern must also be analyzed for water content; at sites where multiple samples from multiple depths are analyzed for contaminants on a dry weight basis and their volumetric water content can be measured based on available data, additional samples solely for analysis of water content may not be necessary.

Samples for geotechnical data are not required from directly under the building. Samples collected adjacent to a building are acceptable. In lieu of sampling the different soil types for geotechnical parameters, use of the default soil parameters provided in TACO is also acceptable. Soil parameters obtained from other literature searches and not from site-specific determinations may be allowed under Tier 3.

The depth to contaminated media (D_{source}) is the shortest distance from the base of any existing or potential building (or man-made pathway into the building) to a location where a sample result exceeds the Tier 1 value for a contaminant of concern for the indoor inhalation exposure route.

It is essential to determine the type of soil between the ground surface and the contamination source, as the contaminants must migrate through this soil before entering a building. If the site stratigraphy varies in this zone, it should be divided into different layers. For each different soil layer, the soil type, thickness, water-filled soil porosity and soil total porosity are necessary to calculate the Tier 2 remediation objectives. Specifically, the water-filled soil porosity and soil total porosity are used to estimate the effective diffusion coefficient for each layer. If the contaminated medium is groundwater, then the capillary fringe is included as one of the soil layers.

The geotechnical parameters – dry soil bulk density, soil total porosity, water-filled soil porosity, and fraction organic carbon content – are used to estimate soil gas concentrations at the source, assuming that the risk being calculated is based on representative soil concentrations. Methods for determining soil parameters for the indoor inhalation exposure route are provided in Section 742.Appendix C, Table F.

The most sensitive parameters are water content and thickness of the capillary fringe. Fraction of organic carbon content (f_{oc}) is also sensitive; increasing f_{oc} increases the remediation objectives. Depth to soil source is not sensitive because the modified J&E model assumes an infinite source with no biodegradation as the vapors migrate through the vadose zone.

Section 742.717 explains how the J&E equations are to be applied when calculating soil gas remediation objectives for the indoor inhalation exposure route. Equations J&E1 through J&E3 are used to calculate the acceptable concentration of the contaminant in indoor air. Equation J&E1 applies only to chemicals that cause carcinogenic health effects, J&E2 applies only to chemicals that cause noncarcinogenic health effects, and J&E3 is used by both types of contaminants to convert from parts per million volume to milligrams per cubic meter. Estimation of indoor air remediation objectives using J&E1 or J&E2 requires two categories of input parameters: toxicological information and receptor-specific exposure factors (exposure frequency, exposure duration and averaging time).

Equation J&E4 calculates a soil gas remediation objective using the appropriate indoor air remediation objective (from either J&E1 or J&E2) and an attenuation factor developed from

Equations J&E7 through J&E18. The soil gas remediation objective must be compared to the saturated vapor concentration (C_v^{sat}). Section 742.222 presents the methods by which the C_v^{sat} concentration is obtained; for example, site evaluators may use the list of C_v^{sat} values in Section 742.Appendix A, Table K or calculate a site-specific C_v^{sat} using equation J&E5. If the calculated soil gas remediation objective is greater than C_v^{sat}, then C_v^{sat} is used as the soil gas remediation objective.

When comparing the calculated soil gas remediation objective to soil gas samples from the site, Section 742.717(j) instructs site evaluators to use soil gas data collected at a depth at least three feet below the ground surface and above the saturated zone. This is to ensure the quality of the soil gas sample. Samples taken less than three feet from the ground surface can be compromised by the influence of barometric pressure fluctuations that may cause an influx of ambient air into the soil, variations in ambient temperature, and precipitation. Samples taken from the capillary fringe or below are unacceptable because of high water saturation.

The C_{sat} table in Section 742.Appendix A, Table A now has two exposure route specific columns because it uses different values for fraction organic carbon content (f_{oc}). The migration to groundwater pathway uses a f_{oc} 0.002 (mg/mg) because the contamination is moving into deeper soils with a lower organic carbon content. The outdoor inhalation exposure route uses a f_{oc} value of 0.006 because the contamination is moving up through the soils. Illinois EPA decided to use a f_{oc} value of 0.002 for the indoor inhalation exposure route because basements are below surface; using a lower f_{oc} value results in a more conservative remediation objective.

Equation J&E7 or 8 may be used to calculate the attenuation factor. This is the heart of the predictive model, measuring how much contamination from the subsurface is expected to reach the indoor air. The source of the contaminant concentrations in the subsurface may be either soil, groundwater or soil gas. J&E8 assumes that there is no significant pressure difference between the subsurface soil and the building. This means that contaminants emanating from the source do not migrate into the building by advection. Migration by advection is represented by the parameter Q_{soil}, also known as the volumetric flow rate of soil gas into the enclosed space. When Q_{soil} is assumed to equal zero – as is the case with Appendix B, Table I – diffusion is the only contaminant transport mechanism. If advection and diffusion are the modes of contaminant transport, site evaluators would use equation J&E7 to calculate the attenuation factor.

The remaining equations, J&E9a through J&E18, are used to establish the input parameters for application in J&E7 and 8. Equation J&E9a calculates the total overall chemical-specific effective diffusion coefficient. For this equation, each layer of soil (sand, loamy sand, loam etc.) through which contaminant vapors migrate from source to building must be accounted for. The total thickness of the soil layers must equal the distance from the bottom of the slab to the top of the contamination; this relationship is presented in equation J&E9b. The distance, called the source to building separation distance, is calculated by equation J&E10.

Equation J&E11 calculates the chemical-specific effective diffusion coefficient for each soil layer and is used in equation J&E9a. Equations J&E12a and 12b are used to calculate the surface area of the enclosed space at or below grade through which vapors enter into the building. For slab-on-grade buildings, site evaluators must use J&E12a. For buildings with basements, site evaluators must use J&E12b. Equation J&E13 calculates the building ventilation rate using the air exchange rate and the size of the building. For equations J&E12a, J&E12b and J&E13, site evaluators must use the same default values as in Tier 1.

Equation J&E14 calculates the area of total cracks assumed to exist in the portion of the structure below grade through which contaminants migrate into the building; default values from

Tier 1 must be used here as well. Contaminants intrude into the building only through cracks that completely penetrate the slab; these cracks are assumed to be filled with dirt. The thickness of these cracks is represented by the slab thickness, which is set at 10 cm for both Tier 1 and Tier 2. Equation J&E15 calculates the effective diffusion coefficient through the cracks using soil parameters representative of the soil within the cracks; as these parameters cannot be measured directly, the default values in Tier 1 apply.

Equations J&E16 through J&E18 calculate site-specific geotechnical parameters. J&E16 gives the total porosity, which is the ratio of the volume of voids to the volume of soil sample. J&E17 gives the water-filled soil porosity, which is the ratio of the volume of water to the volume of soil. J&E18 gives the air-filled soil porosity, which is a measure of the total porosity minus the water-filled porosity. Porosity values representative of the soil layer at the source of contamination as well as each soil layer through which contaminants migrate are needed to calculate the effective diffusion coefficient (J&E11). Additional methods for determining the physical soil parameters are presented in Section 742.Appendix C, Table F.

It is possible to calculate a Tier 2 soil remediation objective more stringent than the Tier 1 soil remediation objective for the indoor inhalation pathway; in such cases, the Tier 1 remediation objective applies. This practice is consistent with the other exposure routes in TACO.

Subpart H: Tier 2 Groundwater Evaluation

Section 742.805(e) requires site evaluators to follow Section 742.812 in calculating groundwater remediation objectives for the indoor inhalation exposure route.

Under Section 742.812, site evaluators follow the J&E equations presented in Section 742.717, only equation J&E6 is used instead of equation J&E4, and when determining the attenuation factor, the capillary fringe must be considered one of the layers in equation J&E9a.

The capillary fringe is the zone immediately above the saturated zone where capillary attraction causes upward movement of water molecules from the saturated zone into the soil above; it contains more water than the rest of the soil above the water table. This zone is distinct in that it has characteristics of both the vadose and saturated zones. Because the capillary fringe impacts the migration of contaminants from the water table, it must be considered as a separate soil layer when developing remediation objectives for groundwater and a default thickness of 37.5 cm must be used. This value comes from the U.S. Soil Conservation Service soil texture classification table, which is also used by U.S. EPA for determining soil-dependent properties for the J&E model. In addition, the default water-filled soil porosity of the capillary fringe is assumed to be 90 percent of the total porosity of the soil that comprises the capillary fringe. The thickness of the capillary fringe and its water-filled soil porosity cannot be measured accurately in the field on a site-specific basis, which is why site-specific values are not allowed.

Subpart I: Tier 3 Evaluation

Section 742.900(c)(10) identifies the use of building control technologies – different from those presented in Subpart L – as a situation eligible for a Tier 3 evaluation. Site evaluators wanting to perform a Tier 3 evaluation for reasons of impractical remediation (Section 742.920) or exposure route exclusion (Section 742.925) for the indoor inhalation pathway are directed to follow Section 742.935.

Under Section 742.935, site evaluators may propose to exclude the exposure route; to use building control technologies different from those presented in Subpart L; to use calculations and modeling to establish soil gas remediation objectives; and to use calculations and modeling to establish soil remediation objectives.

Section 742.935(a) has changed substantially from the August 2008 proposal. The August 2008 version focused on the use of Qsoil where contaminants were within 5 feet of a building or manmade pathway. That discussion was made irrelevant by the addition of Appendix B, Table H and the amendments to Section 742.515. The November 2010 version is more open ended in terms of the types of Tier 3 proposals that can be considered.

Section 742.935(b) must be used when site evaluators propose a mitigation system that deviates from the building control technology requirements presented in Subpart L. This section identifies what information a site evaluator must submit to Illinois EPA to demonstrate the effectiveness of an alternative building control technology to prevent or mitigate indoor inhalation exposure risks.

In Section 742.935(c), site evaluators may propose to establish remediation objectives using soil gas data in lieu of the requirements of Section 742.227. One such difference is the use of sub-slab samples collected directly beneath a building foundation. Section 742.227 applies to exterior samples collected near the building, which is Illinois EPA's preferred approach as it is the least invasive. However, because sub-slab sampling is an accepted methodology nationwide, Illinois EPA decided to reference it specifically under Tier 3. This section identifies what information a site evaluator must submit to Illinois EPA to demonstrate the validity of alternative soil gas data in calculating indoor inhalation remediation objectives.

As noted earlier in my testimony, the Agency has dropped from Tier 1 and the Tier 1 Indoor Inhalation Tables (Appendix B, Tables H and I) the concept of using soil remediation objectives as a general methodology for predicting indoor inhalation risks. Here in Section 742.935(d) the Agency has left open the potential for a site evaluator to make a site specific demonstration that a soil remediation objective can be a meaningful predictor of indoor inhalation risk. Of critical importance in this regard will be the ability of a site evaluator to make the mathematical and technical justification for the proposed model. (Section 742.935(d)(6))

Subpart J: Institutional Controls

In my earlier discussion of Tier 1 remediation objectives I noted that if a site evaluator uses Appendix B, Table I (Diffusion Only) then an institutional control must be placed to limit location of buildings and manmade pathways. Section 742.1000(a)(7) makes it clear that any time the diffusion only mode of transport is used (whether under Tier 1, 2, or 3) an institutional control will be necessary. Following is an example of an institutional control that could be included with the NFR determination when Appendix B, Table I (Diffusion Only) is used:

No building shall be constructed or occupied with the basement or lowest level X feet below the ground surface in the area indicated on the site base map.

The "X" referenced in the example above represents the distance that must be maintained to prevent the lowest level of the building from being located within 5 feet of the soil and groundwater contamination. Contamination located closer than 5 feet may exhibit an increased migration rate into the indoor space due to a pressure differential from the building. This would result in soil gas or groundwater remediation objectives that are not protective.

Section 742.1000(a)(8) requires the use of institutional controls whenever remediation objectives are based on a building control technology. Following is an example of an institutional control that could be included with the NFR determination when a building control technology is used:

No building shall be occupied in the area indicated on the site base map unless building control technologies are in place complying with 742 Subpart L: Building Control Technologies.

In some cases the site evaluator may request that a complete prohibition from buildings be a condition of the No Further Remediation determination. With the majority of sites, however, we expect that an institutional control like the one above will be preferred. This control would allow for the future construction and occupancy of buildings that have the appropriate Building Control Technologies provided in Subpart L.

Section 742.1015(j) prohibits the use of a groundwater ordinance to exclude the indoor inhalation exposure route. As described previously, an ordinance restricting the source of drinking water would not protect the enclosed air space of a building from the migration of contaminants in the groundwater.

Subpart L: Building Control Technologies

Building control technologies are designed to prevent the migration of volatile chemicals into enclosed spaces. They control unacceptable health risks due to vapor intrusion by reducing or eliminating the concentrations in the indoor air without necessarily reducing the residual concentrations in soil gas or groundwater. The objective of these measures is to make the indoor inhalation exposure route incomplete by preventing the migration of chemicals into a building. The November 2010 proposal duplicates the August 2008 proposal, except for the inclusion of an additional building control technology, vented raised floors in Section 742.1210(c)(4).

Section 742.1200 establishes the use of building control technologies as an acceptable final corrective action and requires that the site evaluator also comply with the provisions of Subpart J regarding institutional controls. This Section allows for no further remediation determinations to be made on building control technologies for buildings not yet constructed, provided that the approved technology is in place and operational before human occupancy. Site owners and operators are required to maintain building control technologies; specific maintenance duties will be contained in the institutional control. In the event that the system shuts down, site owners and operators are required to notify building occupants and workers and implement protective measures to prevent exposure to the contaminants of concern. System inoperability may occur during routine maintenance or power failures. Contingency measures will be contained in the institutional control; this practice is consistent with provisions in place for engineered barriers used by the other exposure routes. Lastly, this Section states that the no further remediation determination may be voided if the building control technology is not maintained as stipulated in the institutional control.

Section 742.1205 lists the information to be submitted in a proposal to use any of the four mitigation systems under Subpart L.

Section 742.1210 defines the specific requirements for four mitigation systems: sub-slab depressurization, sub-membrane depressurization, membrane barrier systems, and vented raised floors. This Section specifically prohibits natural attenuation, access controls and point of use treatment from use as building control technologies. Also, building control technologies cannot be used as part of a Tier 1 evaluation.

Sub-slab depressurization is an active venting system that draws contaminated soil gas from beneath the building and expels it to the atmosphere. Sub-slab depressurization systems can be used for existing and new buildings. Sub-membrane depressurization is similar to the sub-slab depressurization system, but used for existing buildings with crawl spaces.

Membrane barrier systems are generally used for new building construction and serve to physically block the entry of contaminants into interior air space.

Vented raised floors have interconnected void systems that passively vent air flows from beneath a slab to the outdoor air with the capability to convert to an active depressurization system. Vented raised floors are generally used in new building construction.

This concludes my testimony.

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
PROPOSED AMENDMENTS TO:	)	
TIERED APPROACH TO CORRECTIVE	)	R11-9
ACTION OBJECTIVES	)	(Rulemaking-Land)
(35 Ill. Adm. Code 742)	)	

PRE-FILED TESTIMONY OF TRACEY HURLEY

Qualifications

My name is Tracey Hurley. I am an Environmental Toxicologist with the Toxicity Assessment Unit at the Illinois Environmental Protection Agency ("Illinois EPA"). I have been with the Illinois EPA for twenty-four years. I have been a member of the Illinois EPA's workgroups that developed the original 35 Ill. Adm. Code Part 742 rule, Tiered Approach to Corrective Action Objectives ("TACO", R97-12) and subsequent amendments.

I was a member of the Agency's workgroup that developed the original 35 Ill. Adm. Code Part 620 rule, Groundwater Quality Standards (PCB R89-14).

I have a Bachelor of Science degree in Biology and a Master of Public Health degree.

Testimonial Statement

I will be testifying in support of the proposed amendments to 35 Ill. Adm. Code 742: Tiered Approach to Corrective Action Objectives. I will present an overview of the updates to the tables in Appendices A, B, and C and Errata Sheet 1.

There are four main explanations for the revisions to the tables: 1) changes in the physical and chemical parameters, 2) changes in the toxicity values, 3) addition of chemicals as a result of their inclusion in the proposed Groundwater Quality Standards (35 Ill. Adm. Code 620, R08-18), and 4) addition of the Indoor Inhalation exposure pathway. Rick Cobb and Tom Hornshaw, Illinois EPA, provided testimony on the addition of chemicals to the proposed Groundwater Quality Standards during the Part 620 hearings (R08-18). (See pages 11 – 17 of Rick Cobb's pre-filed testimony, pages 5 – 7 of Tom Hornshaw's pre-filed testimony, questions and responses numbers 2, 17, and 18 from the supplemental testimony of Richard P. Cobb and Thomas C. Hornshaw.) Gary King, Illinois EPA, will provide more detailed testimony on the Indoor Inhalation exposure pathway. I will first describe the basis of the physical and chemical parameters and toxicity values in more detail before I discuss the changes to the tables.

Physical and Chemical Parameter Values

The Tier 1 Remediation Objectives for the indoor inhalation route have been calculated using updated physical and chemical parameter values and toxicity values for several of the chemicals. The revised physical and chemical parameter values are the result of updates in the sources the Illinois EPA uses for this information. These sources include the following online databases: USEPA's Superfund Chemical Data Matrix, (SCDM), CHEMFATE, PhysProp, USEPA's Water9 software for diffusivity values, and *Handbook of Environmental Degradation Rates* by P.H. Howard (1991) for first order degradation constant values. The SCDM database and Water software were used by USEPA in developing the Soil Screening Levels (SSL). The CHEMFATE and PhysProp databases are the original sources for some of the information in the SCDM database. Howard (1991) also was used by USEPA in developing the Soil Screening Levels.

We have added a footnote to the end of the title of Appendix C, Table E, proposed footnote "e". Footnote "e" reads: "The values in this table were taken from the following sources (in order of preference): SCDMS online database (http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm); CHEMFATE online database (http://www.srcinc.com/what-we-do/databaseforms.aspx?id=381); PhysProp online database (http://www.srcinc.com/what-we-do/databaseforms.aspx?id=386); Water9 (http://www.epa.gov/ttn/chief/software/water/) for diffusivity values; and *Handbook of Environmental Degradation Rates* by P.H. Howard (1991) for first order degradation constant values."

Toxicity Values

On December 5, 2003, USEPA issued a memorandum (OSWER Directive 9285.7-53) from Michael B. Cook, Director of the Office of Superfund Remediation and Technology Information, to the Superfund National Policy Managers, Regions 1-10, on Human Health Toxicity Values in Superfund Risk Assessments. As a result, several of the toxicity values changed and some new values were added. As discussed by Tom Hornshaw during the Part 620 hearings (R08-18) pages 2 – 4 of his pre-filed testimony, this memo revised the hierarchy for selecting human health toxicity values that had been used since the issuance of the original hierarchy in the 1989 Risk Assessment Guidance for Superfund (RAGS). The RAGS hierarchy, which has also been used by the Toxicity Assessment Unit in developing human health toxicity values, was to first use values from USEPA's Integrated Risk Information System (IRIS) database, if available; otherwise, values from the most recent Health Effects Assessment Summary Tables (HEAST) were to be used. If no toxicity value was available from either of these sources, then values could be derived from literature sources or a request could be made to USEPA's National

Center for Environmental Assessment (NCEA) for provisional toxicity values.

The revised hierarchy still specifies the IRIS database as the first option for toxicity values, but now includes second and third tiers of data sources. The second tier is a recently introduced database, USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs), available from NCEA. The third tier, Other Toxicity Values, includes three named sources but could also include other sources as appropriate. The three named sources are the Agency for Toxic Substances and Disease Registry's (ATSDR) Minimal Risk Levels (MRLs), developed for ATSDR risk assessments; California EPA's toxicity values, developed to support various rules and programs; and USEPA's HEAST, which was last updated in 1997.

The Toxicity Assessment Unit has adopted this hierarchy, with some minor revisions, as the basis for determining the toxicity values for its activities. As we began using the new hierarchy, we became aware of some minor issues that ultimately lead to certain revisions of the hierarchy. Three issues that resulted in a minor revision are:

- PPRTVs are given an "eligible for update" date by USEPA, leading us to question what should be the role of these PPRTV values after this specified date; we ultimately decided to continue using them instead of going to tier three.
- PPRTVs for some chemicals contain some screening level toxicity values in an appendix. If information is available for a chemical that, although insufficient to support derivation of a provisional toxicity value, may be of limited use to risk assessors, a screening value is developed. These screening values are available in an appendix and receive the same level of internal and external scientific peer review as the PPRTV documents. Therefore, we decided to consider these values

but give them lesser weight than a PPRTV provisional toxicity value by considering them in tier three.

- USEPA's hierarchy does not provide guidance on which value to use if more than one value is available from the three named sources in tier three. We decided to follow the same order from USEPA's Regional Screening Levels website (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm): ATSDR chronic MRL, California EPA chronic toxicity value, chronic toxicity value from a PPRTV appendix, or chronic toxicity value from HEAST.
- IRIS does not contain values for subchronic exposures, only values for chronic exposures, so there is essentially no first tier for shorter-duration exposures; however, some chronic IRIS values use an Uncertainty Factor to extrapolate to chronic exposures from a study of subchronic duration, and we have used the IRIS value with this Uncertainty Factor removed as the first tier when available.

The toxicity parameters, their values, and the sources of these values are listed on the Illinois EPA website. The tables on the website are updated on a quarterly basis. We refer users of TACO to the website to ensure that they have the most current information. Therefore, we are proposing the following changes: For the symbols RfC, RfD_o, SF_o, URF in Appendix C, Table B, the Source column will now read "Illinois EPA (http://www.epa.state.il.us/land/taco/toxicity-values.xls)". The same source is listed for the symbols RfC and URF in Appendix C, Table M.

The OSWER Directive 9285.7-53 has been added to the Incorporations by Reference, Section 742.210. The reference to IRIS has been removed and the OSWER Directive 9285.7-53 added in its place in Sections 742.705(d)(2), 742.710(c)(2), 742.710(c)(3), and 742.715(b)(2).

Appendix A

Table A has an added column for the Soil Saturation Concentration ("C_{sat}") values for the Soil Component of the Groundwater Ingestion Exposure Route. In the process of updating the tables, we realized that each chemical actually has two different C_{sat} values, one for the Outdoor Inhalation Exposure Route and one for the Soil Component of the Groundwater Ingestion Exposure Route. These exposure routes assume different default fraction organic carbon content of soil ("foc") values as listed in Appendix C, Table B. The Soil Component of the Groundwater Ingestion Exposure Route uses an foc value of 0.002 g/g because it is modeling a contaminant that is moving into deeper soils with a lower organic carbon content. The Outdoor Inhalation Exposure Route uses 0.006 g/g because it is modeling a contaminant that is moving through surface soils with a higher organic carbon content. The C_{sat} values listed in Appendix A, Table A of the 2007 version of TACO are actually for the Outdoor Inhalation Exposure Route only. It was an oversight that C_{sat} values for the Soil Component of the Groundwater Ingestion Exposure Route were not included also.

The C_{sat} values listed in Appendix A, Table A have been calculated with the updated Solubility, Organic Carbon Partition Coefficient ("K_{oc}"), and Dimensionless Henry's Law Constant ("H'") properties of the chemicals. The C_{sat} values were calculated using equations S19 and S29 in Appendix C, Table A. The physical and chemical properties used in the equations are listed in Appendix C, Table E. Three footnotes have been added. Footnote "a" specifies that the C_{sat} values were calculated using an foc of 0.006 g/g and a system temperature of 25°C. The values with a "b" footnote were calculated using an foc of 0.002 and a system temperature of 25°C. Footnote "c" specifies that the C_{sat} was calculated at a pH of 6.8. If a site's soil pH is a value other than 6.8, then a site-specific C_{sat} should be calculated using equations S19 and S29 and the pH-specific K_{oc} values listed in Appendix C, Table I. The K_{oc} values for ionizing organic chemicals will vary with pH. The footnotes are new, but the practices are not.

Tables E and F have been updated with fourteen new chemicals. These are the same chemicals that have been added to the proposed Groundwater Quality Standards (35 Ill. Adm. Code 620, R08-18). The target organs have been updated to reflect new toxicity information. Additionally, the tables have been alphabetized by target organ.

Table J is a new table containing a list of volatile chemicals that must be considered for the indoor inhalation route. "Volatile chemical" is defined in 742.200 as a chemical with an H' value greater than 1.9×10^{-2} or a vapor pressure greater than 0.1 Torr (mm Hg) at 25°C and elemental mercury. USEPA, in its "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils" (November 2002), defines a volatile chemical as having a Henry's Law Constant greater than 10^{-5} atm m^3/mol (equivalent to an H' value of 4.1×10^{-4}). The existing TACO definition for volatile organic compounds is based on SW-846 analytical methods or a boiling point less than 200 °C and a vapor pressure greater than 0.1 Torr (mm Hg) at 25°C. We felt that having two separate definitions for volatile chemicals, one for the indoor inhalation pathway using USEPA's definition and one for the other pathways, would be too confusing. In addition, USEPA's definition includes many polynuclear aromatic hydrocarbons (such as acenaphthene and chrysene) that really do not volatilize in a significant amount. In order to reconcile the two definitions, we looked at certain physical-chemical properties of the chemicals and whether these properties determined if the chemical was analyzed by an SW-846 method for volatiles or analyzed as a semi-volatile.

The physical-chemical properties we examined included vapor pressure, boiling point, H', molecular weight, and the log of the octanol-water partition coefficient ("logP"). logP is used to calculate K_{oc}. There did not appear to be a relationship between boiling point, molecular weight, and logP to the analytical method for the chemical. It appears that chemicals with a vapor pressure greater than 0.1 Torr (mm Hg) at 25°C are primarily analyzed as volatiles. However, this criterion does not classify naphthalene as a volatile. We wanted to include naphthalene in the definition of a volatile chemical because it can be analyzed either as a volatile chemical (using SW-846 method 8260) or as a semi-volatile (using SW-846 method 8270). Naphthalene generally is considered to exhibit characteristics of both a volatile chemical and a semi-volatile chemical and it does volatilize. Therefore, following USEPA's lead, we decided to include H' in the definition of volatile chemical. We chose a value for H' of 1.9×10^{-2} in order to include naphthalene (H' of 1.98×10^{-2}). Elemental mercury was specifically included in the definition of volatile chemical because it is volatile and has outdoor inhalation remediation objectives already in TACO.

Table K is another new table. It lists the Soil Vapor Saturation Concentration ("C_v^{sat}") values for the volatile chemicals. The C_v^{sat} values have been calculated using equation J&E5 from Appendix C, Table L, the default parameters listed in Appendix C, Table M, and the physical and chemical parameters listed in Appendix C, Table E.

Appendix B

Table G is a new table. In it are listed the Soil Gas Remediation Objectives for the Outdoor Inhalation Exposure Route for Residential, Industrial/Commercial, and Construction Worker receptors for the 59 volatile chemicals. The Remediation Objectives have been calculated using the new equation S30 listed in Appendix C, Table A, the default parameters listed in Appendix C, Table B, and the Tier 1 soil remediation objectives from the 2007 version of TACO (adopted in R06-10). The chemical-specific values for C_v^{sat} are listed in Appendix A, Table K, and physical/chemical parameters are listed in Appendix C, Table E. If the calculated Tier 1 soil gas remediation objective exceeds the C_v^{sat} value of the chemical, the C_v^{sat} value is shown as the remediation objective. Capping the remediation objectives in this way precludes a two-phase system, or free product. The models used in TACO are invalid if there are two phases.

The C_v^{sat} value of the chemical is listed as the remediation objective if there are no inhalation toxicity values for the chemical. Inhalation toxicity values were not available for ten volatile chemicals: acetone, bromodichloromethane, butanol, chlorodibromomethane, 2-chlorophenol, dalapon, cis-1,2-dichloroethylene, hexachloroethane (for residents and industrial/commercial workers), 2-methylnaphthalene, and 1,1,2-trichloroethane. Tier 1 soil gas remediation objectives developed for these chemicals are set at the soil vapor saturation limit calculated using the Tier 1 default values. Illinois EPA decided to use this approach rather than using the oral toxicity values because extrapolating oral toxicity values is not appropriate. The chlorinated solvents are metabolized in the liver when they are ingested but not when they are inhaled. This means that the amount of chemical or form or both and, ultimately, the toxicity, of the chemical that is circulating in the body is going to be different for inhalation and ingestion exposures. By not substituting oral toxicity values for missing inhalation toxicity values Illinois EPA is consistent with USEPA's *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final,* as incorporated by reference in Section 742.210.

Tables H and I are both new tables. They list the soil gas and groundwater remediation objectives for the indoor inhalation exposure route for residential and industrial/commercial receptors. The remediation objectives in Table H are calculated using both diffusive and advective transport mechanisms while Table I remediation objectives are calculated using diffusion only as the transport mechanism through soil. Both Table H and Table I remediation objectives were calculated using toxicity values from the hierarchy discussed earlier, physical/chemical values listed in Appendix C, Table E, the J&E equations listed in Appendix C, Table L, and the default parameter values listed in Appendix C, Table M. As in Table G, if the calculated Tier 1 soil gas remediation objective exceeds the C_v^{sat} value of the chemical or if there are no inhalation toxicity values, the C_v^{sat} value is shown as the remediation objective. Similarly, if the calculated groundwater remediation objective exceeds the solubility of the chemical in water (listed in Appendix C, Table E) or there are no oral toxicity values available, the solubility limit becomes the remediation objective. The chloroform groundwater remediation objective for residential receptors is the Groundwater Quality Standard listed in 35 Ill. Adm. Code 620, Section 620.410 (R08-18). The calculated remediation objective for chloroform was lower than its Groundwater Quality Standard. Illinois EPA made a decision that groundwater remediation objectives for the indoor inhalation route of exposure should not be lower than the Groundwater Quality Standards or the groundwater remediation objectives for the groundwater ingestion exposure route. We feel that standards or objectives based on protecting people who may directly ingest the chemical in drinking water should be sufficiently protective of people who may be exposed through the indoor inhalation route.

Appendix C

Table A has a new equation, S30. This equation is used to calculate the soil gas remediation objectives for the outdoor inhalation exposure route listed in Appendix B, Table G. Equation S30 uses the soil remediation objectives for the outdoor inhalation route of exposure and converts them to soil gas remediation objectives using an equilibrium conversion which assumes that the soil gas is in three phase equilibrium with the contaminated soil at the source. This calculation takes into account soil-specific properties – water-filled soil porosity, the soil-water partition coefficient, the air-filled soil porosity, and the dry soil bulk density – and uses a chemical-specific Dimensionless Henry's Law Constant set at a system temperature of 13°C (as in Tier 1 indoor inhalation exposure route).

In Table B the source of the toxicity values has been changed from IEPA (IRIS/HEAST) to Illinois EPA: http://www.epa.state.il.us/land/taco/toxicity-values.xls. As discussed previously in my testimony, USEPA's latest hierarchy (OSWER Directive 9285.7-53, December 5, 2003) for Human Health Toxicity Values no longer lists only IRIS and HEAST. There are three tiers of available sources. To simplify the source, we have just listed Illinois EPA's TACO website.

Table E lists updated Default Physical and Chemical Parameters. The 14 new chemicals from the proposed Groundwater Quality Standards (R08-18) have been added. All values are now expressed in scientific notation for ease of readability. The sources for the physical and chemical parameter values include the online databases: USEPA's Superfund Chemical Data Matrix System, CHEMFATE, PhysProp, USEPA's Water9 software for diffusivity values, and *Handbook of Environmental Degradation Rates* by P.H. Howard (1991) for first order degradation constant values. These sources are listed in new footnote "e".

Table F has been updated to include the J&E equations to the "Method" column for the parameters of total soil porosity, air-filled soil porosity, and water-filled soil porosity.

Table L is a new table that includes all of the equations required for the J&E model. Gary King, Illinois EPA, will provide testimony on the modified J&E equations.

Table M includes the parameters and default values used in the J&E equations. Gary King also will provide a more in depth discussion of these.

The equations from Table L and the parameters and default values in Table M were used to generate the Tier 1 Indoor Inhalation Remediation Objectives listed in Appendix B, Tables H and I.

Errata Sheet Number 1

This part of my testimony concerns the changes made in Errata Sheet Number 1, which is being filed concurrently with Illinois EPA's pre-filed testimony.

Two additional documents are being added to the list of Incorporations by Reference in Section 742.210. The first document is "API. American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005-4070 (202) 682-8000. 'BIOVAPOR – A 1-D Vapor Intrusion Model with Oxygen-Limited Aerobic Biodegradation, Version 2.0 (January 2010).'" The Biovapor model is a method that can be used to demonstrate biodegradation under Section 742.312(b)(1)(C). The second document is "Illinois Environmental Protection Agency, 1021 N Grand Ave East, Springfield, IL 62702 (217) 785-0830. 'A Summary of Selected Background Conditions for Inorganics in Soil,' Publication No. IEPA/ENV/94-161, August 1994." This document is the basis for the concentrations of inorganic chemicals in background soils listed in Appendix A, Table G.

Also in Section 742.210, the reference to "Risk Assessment Guidance for Superfund, Volume I; Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment Interim Guidance", Draft (August 18, 1992)" should be deleted. The final version of this guidance has been proposed for addition to the Incorporations by Reference.

The reference to a previous subsection in Section 742.505(c)(4) should read "If the conditions of subsection (c)(3) of this Section are not met, the Class I groundwater remediation objectives set forth in Appendix B, Table E shall be corrected for the cumulative effect of mixtures of similar-acting chemicals using the following methodologies." The subsection lettering was changed but the corresponding change to the reference was not made.

In Appendix B, Tables G, H, and I, the CAS No. for 1,2-Dichloropropane should be changed to78-87-5. It is incorrectly listed as 78-97-5.

In Appendix C, Table E, the footnote for PCBs for the Dimensionless Henry's Law Constant (H') at 13°C indicates that PCBs are not volatile. Some PCBs do meet the definition of volatile chemical in Section 742.200. Therefore, we are changing the footnote from "b" to "a". In footnote "a", we are changing the reference to Tier 2 so that it includes Tier 3, correcting the incorporation by reference, and adding a sentence to the end. Footnote "a" should now read "Soil remediation objectives are determined pursuant to 40 CFR 761, as incorporated by reference at Section 742.210(b) (the USEPA "PCB Spill Cleanup Policy"), for most sites; persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired. PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical parameters depend on the congeners present at the site."

While the requirements of 40 CFR 761 apply to soil remediation objectives, they do not apply to soil gas or groundwater remediation objectives. Calculation of a single soil gas or groundwater remediation objective for the indoor inhalation exposure route for PCBs is complicated by the fact that PCBs are a mixture of different congeners, the congeners have different physical/chemical parameter values and toxicity values, and only some of the congeners are volatile. Therefore, Illinois EPA is replacing footnote "d" in Appendix B, Tables G and H and footnote "e" in Appendix B, Table I to read "PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired."

In Appendix C, Table M, the parameter value for Theta A (θ_a) should be 0.28 cm^3/cm^3, not 0.13 cm^3/cm^3. When Illinois EPA changed the Theta W (θ_w) to 15 percent, a corresponding change should have been made to θ_a so that θ_a and θ_w values added together equal the total soil porosity value (Theta T, θ_T). The correct value for θ_a of 0.28 cm^3/cm^3 was used in calculating the remediation objectives.

This concludes my testimony.

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

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JAN 31 2011

STATE OF ILLINOIS
Pollution Control Board

IN THE MATTER OF:	)	
	)	R11-9
PROPOSED AMENDMENTS TO	)	(Rulemaking-Land)
TIERED APPROACH TO CORRECTIVE	)	
ACTION OBJECTIVES	)	
(35 Ill. Adm. Code 742)	)	
	)	

ORIGINAL

ERRATA SHEET NUMBER 1

NOW COMES the Illinois Environmental Protection Agency ("Illinois EPA") through one of its attorneys, Kimberly Geving, and submits this ERRATA SHEET NUMBER 1 to the Illinois Pollution Control Board ("Board") and the participants on the Service List. Tracey Hurley has provided testimony in support of these changes in her pre-filed written testimony, which is also being served upon the Board and the Service List.

Section

742.210(a) Add two new incorporations by reference and strike a third.

API. American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005-4070 (202) 682-8000. "BIOVAPOR-A 1-D Vapor Intrusion Model with Oxygen-Limited Aerobic Biodegradation, Version 2.0 (January 2010)."

Illinois Environmental Protection Agency, 1021 N Grand Ave East, Springfield, IL 62702 (217) 785-0830. "A Summary of Selected Background Conditions for Inorganics in Soil, Publication No. IEPA/ENV/94-161, August 1994."

~~"Risk Assessment Guidance for Superfund, Volume I; Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment Interim Guidance", Draft (August 18, 1992).~~

742.505(~~b~~c)(4) If the conditions of subsection (c)(3) ~~(b)(3)~~ of this Section are not met, the Class I groundwater remediation objectives set forth in Appendix B, Table E shall be corrected for the cumulative effect of mixtures of similar-acting chemicals using the following methodologies:

App. B, Table G App. B, Table H App. B, Table I	Change the CAS No. for 1,2-Dichloropropane from 78-97-5 to 78-87-5. It was a typographical error in all three of those tables.
App. B, Table G	Replace footnote "d" in its entirety with the following language: "PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired."
App. B, Table H	Replace footnote "d" in its entirety with the following language: "PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired."
App. B, Table I	Replace footnote "e" in its entirety with the following language: "PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired."
App. C, Table E	In the column entitled "Dimensionless Henry's Law Constant (H')($13^{\circ}C$) for the chemical Polychlorinated biphenyls (PCBs), change the footnote "b" to footnote "a."
App. C, Table E	Replace the existing language for footnote "a" with the following language: "Soil remediation objectives are determined pursuant to 40 CFR 761, as incorporated by reference at Section 742.210(b)(the USEPA "PCB Spill Cleanup Policy"), for most sites; persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired. PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical parameters depend on congeners present at the site."
App. C, Table M	Replace the Tier 1 parameter value for Θ_a so that it reads "0.28 or Calculated Value" and not "0.13 or Calculated Value."

Respectfully submitted,

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

By: Kimberly A. Geving
Kimberly A. Geving
Assistant Counsel

DATE: January 27, 2011

1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276
(217)782-5544

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JAN 31 2011

STATE OF ILLINOIS
Pollution Control Board

ORIGINAL

STATE OF ILLINOIS)
)
COUNTY OF SANGAMON)

PROOF OF SERVICE

I, the undersigned, on oath state that I have served the attached Motion for Acceptance, Pre-filed Written Testimony of Gary P. King and Tracey Hurley, Errata Sheet Number 1, and two additional Incorporations by Reference (to the Clerk of the Board only) upon the persons to whom they are directed, by placing a copy of each in an envelope addressed to:

Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph, Suite 11-500
Chicago, Illinois 60601

Mitchell Cohen
Chief Legal Counsel
Illinois Dept. of Natural Resources
One Natural Resources Way
Springfield, Illinois 62702-1271

Matthew J. Dunn, Chief
Environmental Enforcement/Asbestos
Illinois Attorney General's Office
Litigation Division
69 W. Washington Street, 18th Floor
Chicago, Illinois 60602

Richard McGill, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph, Suite 11-500
Chicago, Illinois 60601

Participants on Service List

and mailing them (First Class Mail) from Springfield, Illinois on January 27, 2011 with sufficient postage affixed as indicated above.

Kimberly A. Geving

SUBSCRIBED AND SWORN TO BEFORE ME
This 27th day of January, 2011.

Brenda Boehner, Notary Public

"OFFICIAL SEAL"
BRENDA BOEHNER
NOTARY PUBLIC
STATE OF ILLINOIS
MY COMMISSION EXPIRES 11-14-2013

		(see Clerk's Office)	
11/18/2010	Order	Order of the Board by T. E. Johnson: Accept rulemaking proposal for hearing	View File
11/18/2010	Appearance	Appearance of Alec M. Davis for Illinois Environmental Regulatory Group (electronic filing)	View File
11/9/2010	Initial Filing	Proposed Amendments (< 4MB, 172 Pages)	View File
11/9/2010	Initial Filing	Motion for Acceptance; Appearance of Kimberly A. Geving; Certification of Origination; Statement of Reasons; and List of Studies and Reports Used in Regulatory Development	View File

Service List

Party Name	Address	City/State/Zip	Phone/Fax
IEPA **Petitioner** • Kimberly A.Geving - Assistant Counsel	1021 North Grand Avenue East P.O. Box 19276	Springfield IL 62794-9276	217/782-5544 217/782-9807
Hodge Dwyer & Driver **Complainant** • Katherine D. Hodge • Monica T. Rios	3150 Roland Avenue Post Office Box 5776	Springfield IL 62705-5776	217/523-4900 217/523-4948
Mayer, Brown LLP **Interested Party** • Kevin G. Desharnais	71 South Wacker Drive	Chicago IL 60606-4637	312/782-0600 312/701-7711
Sidley Austin LLP **Interested Party** • William G. Dickett	One South Dearborn Suite 900	Chicago IL 60603	312/853-7000 312/853-7036
EPI **Interested Party** • Bob Mankowski	16650 South Canal	South Holland IL 60473	
Illinois Environmental Regulatory Group **Interested Party**	215 East Adams Street	Springfield IL 62701	217/522-5512 217/522-5518

• Alec M. Davis			
Chemical Industry Council of Illinois **Interested Party** • Lisa Frede	1400 East Touhy Avenue Suite 110	DesPlaines IL 60019-3338	
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Hanson Engineers, Inc. **Interested Party** • Tracy Lundein	1525 South Sixth Street	Springfield IL 62703-2886	217/788-2450 217/788-2503
Conestoga-Rovers & Associates **Interested Party** • Douglas G. Soutter	8615 West Bryn Mawr Avenue	Chicago IL 60631	773/380-9933 773/380-6421
Office of the Attorney General **Interested Party** • Matthew J. Dunn - Division Chief	Environmental Bureau 69 W. Washington, 18th Floor	Chicago IL 60602	312/814-0660 312/814-2347
Seyfarth Shaw **Interested Party** • Craig B. Simonsen - Paralegal • Phil Comella	131 South Dearborn Street Suite 2400	Chicago IL 60603-5803	312/460-5000 312/460-7000
Navy Facilities and Engineering Command **Interested Party** • Mark Schultz - Regional Environmental Coordinator	201 Decatur Avenue Building 1A	Great Lakes IL 60088-2801	847/688-2600 847/688-2319
Illinois Pollution Control Board **Interested Party** • - Clerk of the Board • Richard McGill - Hearing Officer	100 W. Randolph St. Suite 11-500	Chicago IL 60601	312/814-3620 312/814-3669
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Weaver Boos & Gordon	2021 Timberbrook	Springfield IL 62702	

Interested Party • Elizabeth Steinhour	Lane		
Andrews Environmental Engineering **Interested Party** • Kenneth W. Liss	3300 Ginger Creek Drive	Springfield IL 62711	
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Trivedi Associates, Inc. **Interested Party** • Chetan Trivedi	2055 Steeplebrook Court	Naperville IL 60565	
Illinois Department of Natural Resources **Interested Party** • Stan Yonkauski • Mitchell Cohen - General Counsel	One Natural Resources Way	Springfield IL 62702-1271	217/782-1809 217/524-9640
Suburban Laboratories, Inc. **Interested Party** • Jarrett Thomas - V.P.	4140 Litt Drive	Hillside IL 60162	708-544-3260
Illinois Department of Transportation **Interested Party** • Steven Gobelman	2300 S. Dirksen Parkway Room 302	Springfield IL 62764	
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Environmental Management & Technologies, Inc. **Interested Party** • Craig Gocker - President	3010 Gill Street	Bloomington IL 61704	309/661-2300 309661-2306

Chicago Department of Law **Interested Party** • Charles A. King - Assistant Corporation Counsel	30 N. LaSalle Street Suite 900	Chicago IL 60602	312/742-3990 312/744-6798
SRAC **Interested Party** • Harry Walton	2510 Brooks Drive	Decatur IL 62521	
Burns & McDonnell Engineering Company, Inc. **Interested Party** • Lawrence L. Fieber - Principal	210 South Clark Street, Suite 2235 The Clark Adams Building	Chicago IL 60603	6306751625

Total number of participants: 28

Notice List

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Drinker Biddle & Reath **Interested Party** • Sheila H. Deely • Stephanie Jackson	191 N. Wacker Drive Suite 3700	Chicago IL 60606-1698	312/569/1000 312/569-3000
Jones, Day, Reavis & Pogue **Interested Party** • LaNail C. Griffin	77 West Wacker Drive	Chicago IL 60601-1692	312/782-3939 312/782-8585
Illinois Power Company **Interested Party** • Brian Martin	500 South 27th Street P.O. Box 511	Decatur IL 62525-1805	217/424-6833
Hinshaw & Culbertson **Interested Party** • Jon S. Faletto	416 Main Street 6 th Floor	Peoria IL 61602	309/674-1025 309/674-9328
Mohan, Alewelt, Prillaman & Adami **Interested Party** • Fred C. Prillaman	First of America Center 1 North Old State Capitol Plaza, Suite 325	Springfield IL 62701-1323	217/528-2517 217/528-2553
Sonnenschein Nath & Rosenthal **Interested Party** • Frank H. Hackmann	One Metropolitan Square Suite 3000	St. Louis MO 63102	314/241-1800
Deutsch, Levy & Engel, Chartered	225 West Washington	Chicago IL 60606	312/346-1460