ILLINOIS POLLUTION CONTROL BOARD
November 7, 1996

IN THE MATTER OF:	)	
	)	R 97-12
TIERED APPROACH TO CORRECTIVE ACTION OBJECTIVES 35 ILL. ADM. CODE 742.	)	(Rulemaking - Land)

Proposed Rule. First Notice.

OPINION AND ORDER OF THE BOARD (by M. McFawn, R. C. Flemal and J. Yi):

On September 16, 1996 the Illinois Environmental Protection Agency (Agency) filed a proposal to add a new Part 742 to the Board's rules, which would establish a tiered approach to corrective action objectives (also known as TACO). Such rules are required by P.A. 89-431 (known as the Brownfield legislation), which was signed and became effective December 15, 1995. P.A. 89-431 added Title XVII to the Environmental Protection Act, and is intended to achieve five objectives. Those objectives are to: (1) establish a risk-based system of remediation based on the protection of human health and the environment relative to present and future use of the land; (2) assure that the land use for which remedial action was undertaken will not be modified without consideration of the adequacy of such remedial action for the new land use; (3) provide incentives for the private sector to undertake remedial action; (4) establish expeditious alternatives for the review of site investigation and remedial activities, including a privatized review process; and (5) assure that the resources of the Hazardous Waste Fund are used in a manner that is protective of human health and the environment relative to present and future uses of the site and surrounding area. The first two of these objectives are to be achieved by the proposed TACO rules.

The proposed rules create a tiered approach to establishing clean-up objectives, based on risks to human health and the environment, in consideration of the proposed land use at a subject site. Although this approach is premised upon the statutory mandates in the Brownfield legislation, it is proposed to be applicable across all types of remediation programs under the Environmental Protection Act, including not only the site remdiation program (also known as Brownfields), but also the Underground Storage Tank (UST) and Resource Conservation and Recovery Act (RCRA) programs.

The Board accepted this matter for hearing on September 19, 1996. As noted by the Board in its September 19, 1996 order, the Agency had filed two additional rulemaking petitions when it filed this rulemaking: a proposal for a new Part 740, establishing procedures for the Brownfields program, docketed as R 97-11; and a proposal to amend the regulations governing USTs, docketed as R97-10. Like the TACO rules in the instant docket, the Brownfields rules were mandated by P.A. 89-431, while the UST amendments were mandated by P.A. 89-457, effective May 22, 1996.

Pursuant to P.A. 89-431, specifically Section 58.11(c), the Board is required to complete this rulemaking on or before June 16, 1997. The last regularly scheduled Board meeting preceding the statutory deadline is set for June 5, 1997. Due to the stringent timeframe for final adoption, the Board is today sending this proposal to first notice without commenting on the merit of the proposal.

The Board directs the Clerk to cause the filing of the following proposal for first notice in the Illinois Register:

ORDER

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE G: WASTE DISPOSAL
CHAPTER I: POLLUTION CONTROL BOARD
SUBCHAPTER f: RISK BASED CLEANUP OBJECTIVES

PART 742
TIERED APPROACH TO CORRECTIVE ACTION OBJECTIVES

SUBPART A: INTRODUCTION

SUBPART B: GENERAL

SUBPART C: EXPOSURE ROUTE EVALUATIONS

SUBPART D: DETERMINING AREA BACKGROUND

SUBPART E: TIER 1 EVALUATION

SUBPART F: TIER 2 GENERAL EVALUATION

SUBPART G: TIER 2 SOIL EVALUATION

SUBPART H: TIER 2 GROUNDWATER EVALUATION

SUBPART I: TIER 3 EVALUATION

SUBPART J: INSTITUTIONAL CONTROLS

SUBPART K: ENGINEERED BARRIERS

AUTHORITY: Implementing Sections 22.4, 22.12, 57-57.17, and 58.1-58.12 and authorized by Sections 27, 57.14, and 58.5 of the Environmental Protection Act [415 ILCS 5/22.4, 22.12, 57-57.17, 57.14, and 58.5] (see P.A. 88-496, effective September 13, 1993 and P.A. 89-0431, effective December 15, 1995).

SOURCE:

NOTE: Capitalization indicates statutory language.

SUBPART A: INTRODUCTION

Section 742.100 Intent and Purpose

a) This Part sets forth procedures for use in evaluating the risk to human health posed by environmental conditions and in developing objectives for remediation that assure such risks achieve acceptable levels.

b) The purpose of these procedures is to provide for the adequate protection of human health and the environment based on the risks to human health posed by environmental conditions while incorporating site related information, to the extent practicable, which may allow for more cost-effective site remediation.

Section 742.105 Applicability

a) Any person, including a person required to perform investigation pursuant to the Illinois Environmental Protection Act [415 ILCS 5] (Act), may elect to proceed under this Part to the extent allowed by State or federal law and regulations and the provisions of this Part. A person proceeding under this Part may do so to the extent such actions are consistent with the requirements of the program under which site remediation is being addressed.

b) This Part is intended to be used in following the procedures and requirements applicable to the following programs:

1) Leaking Underground Storage Tanks (35 Ill. Adm. Code 731 and 732);

2) Site Remediation Program (35 Ill. Adm. Code 740); and

3) RCRA Part B Permits and Closure Plans (35 Ill. Adm. Code 724 and 725).

c) The procedures in this Part may not be used if their use would delay response action when timeliness is critical to address imminent and substantial threats to human health and the environment. This Part may only be used after actions to address such threats have been completed.

d) Consistent with the regulations of other programs, and as approved by the Agency, this Part may be used to develop remediation objectives to protect surface waters, sediments, or ecological concerns.

e) A determination issued by the Agency prior to the effective date of this Part pursuant to Section 4(y) of the Act or one of the programs listed in subsection (b) of this Section that approves completion of remedial action relative to a release shall remain in effect in accordance with the terms of the determination.

f) Site specific groundwater remediation objectives determined under this Part for contaminants of concern may exceed the groundwater quality standards established pursuant to the rules promulgated under the Illinois Groundwater Protection Act [415 ILCS 55].

BOARD NOTE: Sections 58.5 and 57.7 of the Act authorize the use of groundwater remediation objectives for contaminants of concern that are greater than the groundwater quality standards established pursuant to the Illinois Groundwater Protection Act and rules promulgated thereunder.

g) The Agency's issuance of a "No Further Remediation" determination pursuant to the requirements applicable to the program under which the remediation is performed shall be considered, while the determination is in effect, prima facie evidence that the contaminants of concern at the site do not, relative to

groundwater, cause or tend to cause water pollution under Section 12(a) of the Act or create a water pollution hazard under Section 12(d) of the Act.

Section 742.110 Overview of Tiered Approach

a) This Part presents an approach to development of remediation objectives (see Appendix A, Illustrations A and B) that includes an option for exclusion of pathways from further consideration, use of area background concentrations as remediation objectives, and three tiers for selecting applicable remediation objectives. An understanding of human exposure routes is necessary to properly conduct an evaluation under this approach. In some cases, human exposure route(s) can be excluded from further consideration prior to any tier evaluation. The option of selecting which tier or combination of tiers shall be used to develop remediation objectives will be dependent on the site-specific conditions and remediation goals. Tier 1 evaluations and Tier 2 evaluations are not prerequisites to conducting Tier 3 evaluations.

b) Tier 1. A Tier 1 evaluation compares the concentration of contaminants detected at a site to the corresponding remediation objectives contained in Appendix B, Tables A, B, C, D, and E. To complete a Tier 1 evaluation, the extent and concentrations of the contaminants of concern, the groundwater class, the land use classification, human exposure routes at the site, and, if appropriate, soil pH must be known. If remediation objectives are developed based on industrial/commercial property use, then institutional controls under Subpart J are required.

c) Tier 2. A Tier 2 evaluation uses the Soil Screening Level (SSL) and Risk Based Corrective Action (RBCA) approaches' risk-based equations listed in Appendix C, Tables A and C, respectively. In addition to the information that is required for a Tier 1 evaluation, site-specific information is used to calculate Tier 2 remediation objectives. Tier 2 remediation objectives are equally protective of human health based on identified risks and site-specific conditions at the site. Tier 2 also considers the use of institutional controls or engineered barriers and institutional controls in accordance with Subparts J and K.

d) Tier 3. A Tier 3 evaluation allows alternative parameters and factors, not available under a Tier 1 evaluation or a Tier 2 evaluation, to be considered when developing remediation objectives. A Tier 3 evaluation can be simple or complex depending on the remediation method and the site conditions.

e) Remediation objectives developed using area background concentrations or any of three tiers may be used if the evaluation is conducted in accordance with applicable requirements in Subparts D through I. When contaminant concentrations do not exceed area background concentrations or remediation objectives under one of the tiers, evaluation under any of the other tiers is not required.

Section 742.115 Key Elements

To develop remediation objectives under this Part, the following key elements shall be addressed.

a) Exposure Routes

1) This Part identifies the following as potential exposure routes to be addressed:

A) Inhalation;

B) Soil Ingestion;

C) Groundwater Ingestion; and

D) Dermal contact with soil.

2) The evaluation of exposure routes under subsections (a)(1)(A),(a)(1)(B), and (a)(1)(C) of this Section is required for all sites when developing remediation objectives or excluding exposure pathways. Evaluation of the dermal contact exposure route is required for use of RBCA equations in Appendix C, Table C or use of formal risk assessment under Section 742.915.

3) The groundwater ingestion exposure route is comprised of two portions:

A) Migration to Groundwater (Soil Component); and

B) Direct Ingestion of Groundwater (Groundwater Component).

b) Contaminants of Concern

The contaminants of concern to be remediated depend on the following:

1) The materials and wastes managed at the site;

2) The extent of the determination being requested from the Agency; and

3) The requirements applicable to the specific program under which the remediation is being performed.

c) Land Use

The present and post-remediation uses of the site where exposures may occur shall be evaluated. The land use of a site, or portion thereof, shall be classified as one of the following:

1) Residential property;

2) Conservation property;

3) Agricultural property; or

4) Industrial/commercial property.

Section 742.120 Site Characterization

Characterization of the extent and concentrations of contamination at a site shall be performed before beginning development of remediation objectives. The actual steps and methods taken to characterize a site are determined by the requirements applicable to the program under which site remediation is being addressed.

SUBPART B: GENERAL

Section 742.200 Definitions

Except as stated in this Section, or unless a different meaning of a word or term is clear from the context, the definition of words or terms in this Part shall be the same as that applied to the same words or terms in the Act.

"Act" means the Illinois Environmental Protection Act [415 ILCS 5].

"ADL" means Acceptable Detection Limit, which is the detectable concentration of a substance which is equal to the lowest appropriate Practical Quantitation Limit (PQL) as defined in this Section.

"Agency" means the Illinois Environmental Protection Agency.

"Agricultural Property" means any real property for which present or post-remediation use is planned to consist of the growing of agricultural crops for food or feed either as harvested crops, cover crops, or as pasture. This definition includes, but is not limited to, properties used for confinement or grazing of livestock or poultry and for silviculture operations. Excluded from this definition are farm residences, farm outbuildings, and agrichemical facilities.

"Area Background" means CONCENTRATIONS OF REGULATED SUBSTANCES THAT ARE CONSISTENTLY PRESENT IN THE ENVIRONMENT IN THE VICINITY OF A SITE THAT ARE THE RESULT OF NATURAL CONDITIONS OR HUMAN ACTIVITIES, AND NOT THE RESULT SOLELY OF RELEASES AT THE SITE (Section 58.2 of the Act).

"ASTM" means the American Society for Testing and Materials.

"Board" means the Illinois Pollution Control Board.

"Cancer Risk" means a unitless probability of an individual developing cancer from a defined exposure rate and frequency.

"Cap" means a barrier designed to prevent the infiltration of precipitation or other surface water, or impede the ingestion or inhalation of contaminants.

"Carcinogen" means A CONTAMINANT THAT IS CLASSIFIED AS A CATEGORY A1 OR A2 CARCINOGEN BY THE AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS; OR A CATEGORY 1 OR 2A/2B CARCINOGEN BY THE WORLD HEALTH ORGANIZATION'S INTERNATIONAL AGENCY FOR RESEARCH ON CANCER; OR A "HUMAN CARCINOGEN" OR "ANTICIPATED HUMAN CARCINOGEN" BY THE UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICE NATIONAL TOXICOLOGICAL PROGRAM; OR A CATEGORY A OR B1/B2 CARCINOGEN BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY IN INTEGRATED RISK INFORMATION SYSTEM OR A FINAL RULE ISSUED IN A FEDERAL REGISTER NOTICE BY THE USEPA. (Section 58.2 of the Act)

"Class I Groundwater" means groundwater that meets the Class I: Potable Resource Groundwater criteria set forth in 35 Illinois Administrative Code 620.

"Class II Groundwater" means groundwater that meets the Class II: General Resource Groundwater criteria set forth in 35 Illinois Administrative Code 620.

"Conservation Property" means any real property for which present or post-remediation use is primarily for wildlife habitat.

"Construction Worker Population" means a situation where persons are engaged on a temporary basis to perform work involving invasive construction activities including, but not limited to, personnel performing demolition, earth-moving, building, and routine and emergency utility installation or repair activities.

"Contaminant of Concern" or "Regulated Substance of Concern" means ANY CONTAMINANT THAT IS EXPECTED TO BE PRESENT AT THE SITE BASED UPON PAST AND CURRENT LAND USES AND ASSOCIATED

RELEASES THAT ARE KNOWN TO THE person conducting a remediation BASED UPON REASONABLE INQUIRY. (Section 58.2 of the Act)

"Engineered Barrier" means a barrier designed or verified using engineering practices that limits exposure to or controls migration of the contaminants of concern.

"Exposure Route" means the transport mechanism by which a contaminant of concern reaches a receptor.

"Free Product" means a contaminant that is present as a non-aqueous phase liquid for chemicals whose melting point is less than 30° C (e.g., liquid not dissolved in water).

"GROUNDWATER" MEANS UNDERGROUND WATER WHICH OCCURS WITHIN THE SATURATED ZONE AND GEOLOGIC MATERIALS WHERE THE FLUID PRESSURE IN THE PORE SPACE IS EQUAL TO OR GREATER THAN ATMOSPHERIC PRESSURE. (Section 3.64 of the Act)

"Groundwater Quality Standards" means the standards for groundwater as set forth in 35 Illinois Administrative Code 620.

"Hazard Quotient" means the ratio of a single substance exposure level during a specified time period to a reference dose for that substance derived from a similar exposure period.

"Human Exposure Pathway" means a physical condition which may allow for a risk to human health based on the presence of all of the following: contaminants of concern; an exposure route; and a receptor activity at the point of exposure that could result in contaminant of concern intake.

"Industrial/Commercial Property" means any real property that does not meet the definition of residential property, conservation property, or agricultural property.

"Infiltration" means the amount of water entering into the ground as a result of precipitation.

"Institutional Control" means a legal mechanism for imposing a restriction on land use, as described in Subpart J.

"Man-Made Pathways" means CONSTRUCTED physical conditions THAT MAY ALLOW FOR THE TRANSPORT OF REGULATED SUBSTANCES INCLUDING, BUT NOT LIMITED TO, SEWERS, UTILITY LINES, UTILITY VAULTS, BUILDING FOUNDATIONS, BASEMENTS, CRAWL

SPACES, DRAINAGE DITCHES, OR PREVIOUSLY EXCAVATED AND FILLED AREAS. (Section 58.2 of the Act)

"Natural Pathways" means NATURAL physical conditions that may allow FOR THE TRANSPORT OF REGULATED SUBSTANCES INCLUDING, BUT NOT LIMITED TO, SOIL, GROUNDWATER, SAND SEAMS AND LENSES, AND GRAVEL SEAMS AND LENSES. (Section 58.2 of the Act)

"Negative Easement" means a right in the owner of the dominant or benefitted estate or property to restrict the property rights of the owner of the servient or burdened estate or property.

"Person" means an INDIVIDUAL, TRUST, FIRM, JOINT STOCK COMPANY, JOINT VENTURE, CONSORTIUM, COMMERCIAL ENTITY, CORPORATION (INCLUDING A GOVERNMENT CORPORATION), PARTNERSHIP, ASSOCIATION, STATE, MUNICIPALITY, COMMISSION, POLITICAL SUBDIVISION OF A STATE, OR ANY INTERSTATE BODY INCLUDING THE UNITED STATES GOVERNMENT AND EACH DEPARTMENT, AGENCY, AND INSTRUMENTALITY OF THE UNITED STATES. (Section 58.2 of the Act)

"Point of Human Exposure" means the point(s) at which human exposure to a contaminant of concern may reasonably be expected to occur. The point of human exposure is at the source, unless an institutional control limiting human exposure for the applicable exposure route has been or will be in place, in which case the point of human exposure will be the boundary of the institutional control. Point of human exposure may be at a different location than the point of compliance.

"PQL" means Practical Quantitation Limit or Estimated Quantitation Limit, which is the lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions in accordance with "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", EPA Publication No. SW-846, incorporated by reference in Section 742.210. When applied to filtered water samples, PQL includes the Method Detection Limit or Estimated Detection Limit in accordance with the applicable method revision in: "Methods for the Determination of Organic Compounds in Drinking Water", Supplement II", EPA Publication No. EPA/600/4-88/039; "Methods for the Determination of Organic Compounds in Drinking Water, Supplement III", EPA Publication No. EPA/600/R-95/131, all of which are incorporated by reference in Section 742.210.

"RBCA" means Risk Based Corrective Action as defined in ASTM E-1739-95, as incorporated by reference in Section 742.210.

"RCRA" means the Resource Conservation and Recovery Act of 1976 (as amended)(42 U.S.C. Sec. 6921 et seq.)

"Reference Concentration (RfC)" means an estimate of a daily exposure, in units of milligrams of chemical per cubic meter of air (mg/m^3), to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a portion of a lifetime (up to approximately seven years, subchronic) or for a lifetime (chronic).

"Reference Dose (RfD)" means an estimate of a daily exposure, in units of milligrams of chemical per kilogram of body weight per day (mg/kg/d), to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a portion of a lifetime (up to approximately seven years, subchronic) or for a lifetime (chronic).

"Regulated Substance" means ANY HAZARDOUS SUBSTANCE AS DEFINED UNDER SECTION 101(14) OF THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (P.L. 96-510) AND PETROLEUM PRODUCTS INCLUDING CRUDE OIL OR ANY FRACTION THEREOF, NATURAL GAS, NATURAL GAS LIQUIDS, LIQUEFIED NATURAL GAS, OR SYNTHETIC GAS USABLE FOR FUEL (OR MIXTURES OF NATURAL GAS AND SUCH SYNTHETIC GAS). (Section 58.2 of the Act)

"Residential Property" means any real property that is used for habitation by individuals or properties where children have the opportunity for exposure to contaminants through ingestion or inhalation at educational facilities, health care facilities, child care facilities, or playgrounds.

"Restrictive Covenant or Deed Restriction" means a provision placed in a deed limiting the use of the property and prohibiting certain uses. (Black's Law Dictionary, 5th Edition)

"Site" means ANY SINGLE LOCATION, PLACE, TRACT OF LAND OR PARCEL OF PROPERTY, OR PORTION THEREOF, INCLUDING CONTIGUOUS PROPERTY SEPARATED BY A PUBLIC RIGHT-OF-WAY. (Section 58.2 of the Act)

"Slurry Wall" means a man-made barrier made of geologic material which is constructed to prevent or impede the movement of contamination into a certain area.

"Soil Saturation Limit (C_{sat})" means the contaminant concentration at which soil pore air and pore water are saturated with the chemical and the adsorptive limits of the soil particles have been reached.

"Solubility" means a chemical specific maximum amount of solute that can dissolve in a specific amount of solvent (groundwater) at a specific temperature.

"SSL" means Soil Screening Levels as defined in USEPA's Soil Screening Guidance: User's Guide and Technical Background Document, as incorporated by reference in Section 742.210.

"Stratigraphic Unit" means a site-specific geologic unit of native deposited material and/or bedrock of varying thickness (e.g., sand, gravel, silt, clay, bedrock, etc.). A change in stratigraphic unit is recognized by a clearly distinct contrast in geologic material or a change in physical features within a zone of gradation. For the purposes of this Part, a change in stratigraphic unit is identified by one or a combination of differences in physical features such as texture, cementation, fabric, composition, density, and/or permeability of the native material and/or bedrock.

"TCLP" means Toxicity Characteristic Leaching Procedure (Method 1311) as published in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," U.S. EPA Publication number SW-846, as incorporated by reference in Section 742.210.

"Total Petroleum Hydrocarbon (TPH)" means the additive total of all petroleum hydrocarbons found in an analytical sample.

"Volatile Organic Compounds (VOCs)" means organic chemical analytes identified as volatiles as published in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," U.S. EPA Publication number SW-846 (incorporated by reference in Section 742.210) method numbers 8010, 8011, 8015, 8020, 8021, 8030, 8031, 8240, 8260, 8315, and 8316. For analytes not listed in any category in those methods, those analytes which have a boiling point less than 200^0C and a vapor pressure greater than 0.1 Torr (mm Hg) at 20^0C.

Section 742.205 Severability

If any provision of this Part or its application to any person or under any circumstances is adjudged invalid, such adjudication shall not affect the validity of this Part as a whole or any portion not adjudged invalid.

Section 742.210 Incorporations by Reference

a) The Board incorporates the following material by reference:

ASTM. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (215) 299-5400

ASTM D 2974-87, Standard Test Methods for Moisture, Ash and Organic Matter of Peat and Other Organic Soils, approved May 29, 1987. (reapproved 1995)

ASTM D 2488-93, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), approved September 15, 1993.

ASTM D 1556-90, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method, approved June 29, 1990.

ASTM D 2167-94, Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method, approved March 15, 1994.

ASTM D 2922-91, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth), approved December 23, 1991.

ASTM D 2937-94, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method, approved June 15, 1994.

ASTM D 854-92, Standard Test Method for Specific Gravity of Soils, approved November 15, 1992.

ASTM D 2216-92, Standard Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock, approved June 15, 1992.

ASTM D 4959-89, Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method, approved June 30, 1989 (reapproved 1994).

ASTM D 4643-93, Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method, approved July 15, 1993.

ASTM D 5084-90, Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, approved June 29, 1990.

ASTM D 422-63, Standard Test Method for Particle-Size Analysis of Soils, approved November 21, 1963 (reapproved 1990).

ASTM D 1140-92, Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 um) Sieve, approved November 15, 1992.

ASTM D 3017-88, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth), approved May 27, 1988.

ASTM D 4525-90, Standard Test Method for Permeability of Rocks by Flowing Air, approved May 25, 1990.

ASTM D 2487-93, Standard Test Method for Classification of Soils for Engineering Purposes, approved September 15, 1993.

ASTM E 1527-93, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, approved March 15, 1993. Vol. 11.04.

ASTM E 1739-95, Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, approved September 10, 1995.

Barnes, Donald G. and Dourson, Michael. (1988). Reference Dose (RfD): Description and Use in Health Risk Assessments. Regulatory Toxicology and Pharmacology. 8, 471-486.

GPO. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20401, (202) 783-3238.

USEPA Guidelines for Carcinogenic Risk Assessment, 51 Fed. Reg. 33992-34003, (September 24, 1986).

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," U.S. EPA Publication number SW-846 (Third Edition, November, 1986), as amended by Updates I and IIA (Document Number 955-001-00000-1)(contact U.S. EPA, Office of Solid Waste, for Update IIA).

"Methods for the Determination of Organic Compounds in Drinking Water", EPA Publication No. EPA/600/4-88/039 (December 1988 (Revised July 1991)).

"Methods for the Determination of Organic Compounds in Drinking Water, Supplement II", EPA Publication No. EPA/600/R-92/129 (August 1992).

"Methods for the Determination of Organic Compounds in Drinking Water, Supplement III", EPA Publication No. EPA/600/R-95/131 (August 1995).

IRIS. Integrated Risk Information System, National Center for Environmental Assessment, U.S. Environmental Protection Agency, 26 West Martin Luther King Drive, MS-190, Cincinnati, Ohio 45268 (513) 569-7254.

"Reference Dose (RfD): Description and Use in Health Risk Assessments", Background Document 1A, (March 15, 1993).

"EPA Approach for Assessing the Risks Associated with Chronic Exposures to Carcinogens", Background Document 2, (January 17, 1992).

Nelson, D.W., and L.E. Sommers. 1982. Total carbon, organic carbon, and organic matter. In: A.L. Page (ed.), Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. 2nd Edition, p.p. 539-579, American Society of Agronomy. Madison, WI.

NTIS. National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4600.

"Dermal Exposure Assessment: Principals and Applications", EPA Publication No. EPA/600/8-91/011B, (January 1992).

"Exposure Factors Handbook", EPA Publication No. EPA/600/8-89/043, (July 1989).

"Risk Assessment Guidance for Superfund, Vol. I; Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors", OSWER Directive 9285.6-03, (March 1991).

"Risk Assessment Guidance for Superfund, Volume I; Human Health Evaluation Manual (Part A)", Interim Final, EPA Publication No. EPA/540/1-89/002, (December 1989).

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

"Soil Screening Guidance: Technical Background Document", EPA Publication No. EPA/540/R-95/128, PB96-963502 (May 1996).

"Soil Screening Guidance: User's Guide", EPA Publication No. EPA/540/R-96/018, PB96-963505 (April 1996).

"Superfund Exposure Assessment Manual", EPA Publication No. EPA/540/1-88/001, (April 1988).

RCRA Facility Investigation Guidance, Interim Final, developed by USEPA (EPA 530/SW-89-031), 4 volumes, May 1989.

b) CFR (Code of Federal Regulations). Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (202) 783-3238:

40 CFR 761.120 (1993).

c) This Section incorporates no later editions or amendments.

Section 742.215 Determination of Soil Attenuation Capacity

a) The concentrations of organic contaminants of concern remaining in the soil shall not exceed the attenuation capacity of the soil, as determined under subsection (b) of this Section.

b) The soil attenuation capacity is not exceeded if:

1) The sum of the organic contaminant residual concentrations analyzed for the purposes of the remediation program for which the analysis is performed, at each discrete sampling point, is less than the natural organic carbon fraction of the soil. If the information relative to the concentration of other organic contaminants is available, such information shall be included in the sum. The natural organic carbon fraction (foc) shall be either:

A) A default value of 6000 mg/kg for soils within the top meter and 2000 mg/kg for soils below one meter of the surface; or

B) A site-specific value as measured by ASTM D2974-87, Nelson and Sommers, or by SW-846 Method 9060, as incorporated by reference in Section 742.210.

2) The total petroleum hydrocarbon concentration is less than the natural organic carbon fraction of the soil as demonstrated using a method approved by the Agency. The method selected shall be appropriate for the contaminants of concern to be addressed; or

3) Another method, approved by the Agency, shows that the soil attenuation capacity is not exceeded.

Section 742.220 Determination of Soil Saturation Limit

a) For any organic contaminant that has a melting point below 30^0C, the remediation objective for the inhalation exposure route developed under Tier 2

or Tier 3 shall not exceed the soil saturation limit, as determined under subsection (c) of this Section.

b) For any organic contaminant, the remediation objective under Tier 2 or Tier 3 for the migration to groundwater portion of the groundwater ingestion exposure route shall not exceed the soil saturation limit, as determined under subsection (c) of this Section.

c) The soil saturation limit shall be:

1) The value listed in Appendix A, Table A for that specific contaminant;

2) A value derived from Equation S29 in Appendix C, Table A; or

3) A value derived from another method approved by the Agency.

Section 742.225 Determination of Compliance with Remediation Objectives

a) Compliance with groundwater remediation objectives developed under Subparts D through F and H through I shall be determined by comparing the contaminant concentrations of discrete samples at each sample point to the applicable groundwater remediation objective. Sample points shall be determined by the program under which remediation is performed.

b) Unless the person elects to composite samples or average sampling results as provided in subsections (c) and (d) of this Section, compliance with soil remediation objectives developed under Subparts D through G and I shall be determined by comparing the contaminant concentrations of discrete samples to the applicable soil remediation objective. Compliance is achieved if each sample result does not exceed that respective remediation objective.

1) Except as provided in subsections (c) and (d) of this Section, compositing of samples is not allowed.

2) Except as provided in subsection (c) and (d) of this Section, averaging of sample results is not allowed.

3) Notwithstanding subsections (c) and (d) of this Section, compositing of samples and averaging of sample results is not allowed for the construction worker population.

4) The number of sampling points required to demonstrate compliance is determined by the requirements applicable to the program under which remediation is performed.

c) If a person chooses to composite soil samples or average soil sample results to determine compliance relative to the migration to groundwater portion of the groundwater ingestion exposure route, the following requirements apply:

1) A minimum of two sampling locations for every 0.5 acre of contaminated area is required, with discrete samples at each sample location obtained at every two feet of depth, beginning at six inches below the ground surface and continuing through the zone of contamination. Alternatively, a sampling method may be approved by the Agency based on an appropriately designed site-specific evaluation. Samples obtained at or below the water table shall not be used in compositing or averaging.

2) For contaminants of concern other than volatile organic contaminants:

A) Discrete samples from the same boring may be composited.

B) Discrete sample results from the same boring may be averaged.

3) For volatile organic contaminants:

A) Compositing of samples is not allowed.

B) Discrete sample results from the same boring may be averaged.

d) If a person chooses to composite soil samples or average soil sample results to determine compliance relative to the inhalation exposure route or the soil ingestion exposure route, the following requirements apply:

1) Unless an alternative method is approved by the Agency, a minimum of twenty-four (24) aliquots per 0.5 acre, to be collected within the area of contamination, is required. No more than 6 aliquots of equal volume shall be composited into one sample. Samples composited must be located proximate to each other. Each discrete sample shall be obtained at a depth of one foot or less.

2) Unless an alternative method is approved by the Agency based on an appropriately designed site-specific evaluation, for contaminants of concern other than volatile organic contaminants:

A) Each 0.5 acre portion of contaminated area of a site may be divided into quadrants of equal size and shape. The samples within the quadrant may be composited.

B) Averaging of sample results taken from separate quadrants is not allowed.

3) For volatile organic contaminants compositing of samples is not allowed. Discrete sample results from the same quadrant may be averaged.

e) For purposes of calculating averages under this subsection, if no more than 50 percent of sample results are reported as "non-detect", "no contamination", "below detection limits", or similar terms, such results shall be included in the averaging calculation as one-half of the reported analytical detection limit for the contaminant. If more than 50 percent of sample results are "non-detect", another procedure acceptable to the Agency may be used to determine an average.

f) A person may propose an alternative method for determining compliance with remediation objectives.

Section 742.230 Agency Review and Approval

a) Documents and requests filed with the Agency under this Part shall be submitted in accordance with the procedures applicable to the program under which remediation is performed.

b) Agency review and approval of documents and requests under this Part shall be performed in accordance with the procedures applicable to the program under which the remediation is performed (e.g., 35 Ill. Adm. Code 732, Subpart E for petroleum leaking underground storage tanks).

SUBPART C: EXPOSURE ROUTE EVALUATIONS

Section 742.300 General

This Subpart sets forth requirements to demonstrate that an actual or potential impact to a receptor or potential receptor from a contaminant of concern can be excluded from consideration from one or more exposure routes. As an alternative to the use of the requirements in this Part, a person may use the procedures for evaluation of exposure routes under Tier 3 as set forth in Section 742.925. If an evaluation under this Part demonstrates the applicable requirements for excluding an exposure route are met, then the exposure route is excluded from consideration and no remediation objectives need be developed for that exposure route.

a) No exposure route may be excluded from consideration until characterization of the extent and concentrations of contaminants of concern at a site has been performed. The actual steps and methods taken to characterize a site shall be determined by the requirements under which the site remediation is being addressed.

b) The inhalation exposure route may be excluded from consideration if the requirements of Sections 742.305 and 742.310 are met.

c) The soil ingestion exposure route may be excluded from consideration if the requirements of Sections 742.305 and 742.315 are met.

d) The groundwater ingestion exposure route may be excluded from consideration if the requirements of Sections 742.305 and 742.320 are met.

Section 742.305 Contaminant Source and Free Product Determination

No exposure route shall be excluded from consideration relative to a contaminant of concern unless the following requirements are met:

a) The sum of the concentrations of all organic contaminants of concern shall not exceed the attenuation capacity of the soil as determined under Section 742.215;

b) The concentrations of any organic contaminants of concern remaining in the soil shall not exceed the soil saturation limit as determined under Section 742.220;

c) Any soil which contains contaminants of concern shall not exhibit any of the characteristics of reactivity for hazardous waste as determined under 35 Ill. Adm. Code 721.123;

d) Any soil which contains contaminants of concern shall not exhibit a pH less than or equal to 2.0 or greater than or equal to 12.5, as determined by SW-846 Method 9040B for soils with 20 percent or greater aqueous (moisture) content or by SW-846 Method 9045C for soils with less than 20 percent aqueous (moisture) content as incorporated by reference in Section 742.210; and

e) Any soil which contains contaminants of concern in the following list of inorganic chemicals or their salts shall not exhibit any of the characteristics of toxicity for hazardous waste as determined by 35 Ill. Adm. Code 721.124, or an alternative method approved by the Agency: arsenic, barium, cadmium, chromium, lead, mercury, selenium, or silver.

Section 742.310 Inhalation Exposure Route

The inhalation exposure route may be excluded from consideration if:

a) The requirements of Section 742.305 are met;

b) An institutional control, in accordance with Subpart J, is in place that meets the following requirements:

1) Requires compliance with the requirements of subsection (c) of this Section; and

2) Requires safety precautions for construction worker populations (e.g., use of appropriate personal protective equipment, if applicable).

c) 1) The concentration of any contaminant of concern within ten feet of the land surface or within ten feet of any man-made pathway shall not exceed the Tier 1 remediation objective under Subpart E for the inhalation exposure route; or

2) An engineered barrier, as set forth in Subpart K and approved by the Agency, is in place.

Section 742.315 Soil Ingestion Exposure Route

The soil ingestion exposure route may be excluded from consideration if:

a) The requirements of Section 742.305 are met;

b) An institutional control, in accordance with Subpart J, is in place that meets the following requirements:

1) Requires compliance with the requirements of subsection (c) of this Section; and

2) Requires safety precautions for construction worker populations (e.g., use of appropriate personal protective equipment, if applicable).

c) 1) The concentration of any contaminant of concern within three feet of the land surface shall not exceed the Tier 1 remediation objective under Subpart E for the ingestion of soil exposure route; or

2) An engineered barrier, as set forth in Subpart K and approved by the Agency, is in place.

Section 742.320 Groundwater Ingestion Exposure Route

The groundwater ingestion exposure route may be excluded from consideration if:

a) The requirements of Section 742.305 are met;

b) The source of the release is not located within the minimum or maximum setback zone of a potable water supply well nor within a regulated recharge area of a potable water supply well;

c) As demonstrated in accordance with Subpart J, for any area within 2500 feet from the source of the release, an ordinance adopted by a unit of local government that effectively prohibits the use of groundwater as a potable supply of water, except at points of withdrawal by the unit of local government, is in place;

d) As demonstrated using Equation R26, in Appendix C, Table C, in accordance with Section 742.810, the concentration of any contaminant of concern in groundwater within the minimum or maximum setback zone of an existing water supply well will meet the applicable Tier 1 groundwater remediation objective; and

e) As demonstrated using Equation R26, in Appendix C, Table C, in accordance with Section 742.810, the concentration of any contaminant of concern in groundwater discharging into a surface water will meet the applicable surface water quality standard under 35 Ill. Adm. Code 302.

SUBPART D: DETERMINING AREA BACKGROUND

Section 742.400 General

This Subpart provides procedures for determining area background concentrations for contaminants of concern. Except as described in Section 742.415(c) of this Subpart, area background concentrations may be used as remediation objectives for contaminants of concern at a site.

Section 742.405 Determination of Area Background for Soil

a) Soil sampling results shall be obtained for purposes of determining area background levels in accordance with the following procedures:

1) For volatile organic contaminants, sample results shall be based on discrete samples;

2) Unless an alternative method is approved by the Agency, for contaminants other than volatile organic contaminants, sample results shall be based on discrete samples or composite samples. If a person elects to use composite samples, each 0.5 acre of the area to be sampled shall be divided into quadrants and 5 aliquots of equal volume per quadrant shall be composited into 1 sample;

3) Samples shall be collected from similar depths and soil types, which shall be consistent with the depths and soil types in which contaminant maxima are found in the areas of known or suspected releases; and

4) Samples shall be collected from areas of the site or adjacent to the site that are unaffected by releases at the site.

b) Area background shall be determined according to one of the following procedures:

1) Statewide Background Approach:

A) The maximum value of the range of concentrations of inorganic chemicals in background soils listed in Appendix A, Table F may be used as the upper limit of the area background concentration for the site. The first column to the right of the chemical name presents the range of concentrations of inorganic chemicals in background soils for counties within Metropolitan Statistical Areas. Counties within Metropolitan Statistical Areas are identified in Appendix A, Table F, Footnote a. Sites located in counties outside Metropolitan Statistical Areas shall use the range

of concentrations of inorganic chemicals in background soils shown in the second column to the right of the chemical name.

B) Soil area background concentrations determined according to this statewide background approach shall be used as provided in Section 742.415(b)(1). For each parameter whose sampling results demonstrate concentrations above those in Appendix A, Table F, the person shall develop appropriate soil remediation objectives in accordance with this Part, or may determine area background in accordance with the procedures specified in this Section.

2) A statistically valid approach for determining area background concentrations appropriate for the characteristics of the data set, and approved by the Agency.

Section 742.410 Determination of Area Background for Groundwater

a) Groundwater sampling results shall be obtained for purposes of determining area background in accordance with the following procedures:

1) Samples shall be collected from areas of the site or adjacent to the site that are unaffected by releases at the site;

2) The background monitoring wells, as determined in consultation with the Agency, shall be sufficient in number to account for the spatial and temporal variability, size, and number of known or suspected off-site releases of contaminants of concern, and the hydrogeological setting of the site;

3) The samples shall be collected in consecutive quarters for a minimum of one year for each well or another sample schedule approved by the Agency;

4) The samples shall be collected from the same stratigraphic unit(s) as the groundwater contamination at the site; and

5) The background monitoring wells shall be located hydraulically upgradient from the release(s) of contaminants of concern, unless the Agency approves that the upgradient location is undefinable or infeasible.

b) Area background shall be determined according to one of the following procedures:

1) Prescriptive Approach

A) If more than 15 percent of the groundwater sampling results for a chemical obtained in accordance with Section 742.410(a) are less than the appropriate detection limit for that chemical, the Prescriptive Approach may not be used for that chemical. If 15 percent or less of the sampling results are less than the appropriate detection limit, a concentration equal to one-half the detection limit shall be used for that chemical in the calculations contained in this Prescriptive Approach.

B) The groundwater sampling results obtained in accordance with Section 742.410(a) shall be used to determine if the sample set is normally distributed. The Shapiro-Wilk Test of Normality shall be used, if the sample set for the background well(s) contains 50 or less samples, to determine whether the sample set is normally distributed. Values necessary for the Shapiro-Wilk Test shall be determined using Appendix A, Tables E and F.

If the computed value of W is greater than the 5 percent Critical Value in Appendix A, Table D, the sample set shall be assumed to be normally distributed, and the Prescriptive Approach is allowed. If the computed value of W is less than 5 percent Critical Value in Appendix A, Table D, the sample set shall be assumed to not be normally distributed, and the Prescriptive Approach shall not be used.

C) If the sample set contains at least ten sample results, the Upper Tolerance Limit (UTL) of a normally distributed sample set may be calculated using the mean (x) and standard derration (s), from:

$$UTL = x + (K \bullet s),$$

where K = the one-sided normal tolerance factor for estimating the 95 percent upper confidence limit of the 95th percentile of a normal distribution. Values for K shall be determined using Appendix A, Table B.

D) If the sample set contains at least ten sample results, the UTL shall be the upper limit of the area background concentration for the site. If the sample set contains less than ten sample results, the maximum value of the sample set shall be the upper limit of the area background concentration for the site.

E) This Prescriptive Approach shall not be used for determining area background for the parameter pH.

2) Another statistically valid approach for determining area background concentrations appropriate for the characteristics of the data set, and approved by the Agency.

Section 742.415 Use of Area Background Concentrations

a) A person may request that area background concentrations determined pursuant to Sections 742.405 and 742.410 be used according to the provisions of Section 742.415(b). Such request shall address the following:

1) The natural or man-made pathways of any suspected off-site contamination reaching the site;

2) Physical and chemical properties of suspected off-site contaminants of concern reaching the site; and

3) The location and justification of all background sampling points.

b) Except as specified in Section 742.415(c), area background concentrations may be used as follows:

1) If determined under Sections 742.405 or 742.410, to support a request to exclude a chemical as a contaminant of concern from further consideration for remediation at a site due to its presence as a result of background conditions; or

2) If determined under Sections 742.405 or 742.410, as remediation objectives for contaminants of concern at a site in lieu of remediation objectives developed pursuant to the other procedures of this Part.

c) Area background concentrations shall not be used IN THE EVENT THAT THE AGENCY HAS DETERMINED IN WRITING THAT THE BACKGROUND LEVEL FOR A REGULATED SUBSTANCE POSES AN ACUTE THREAT TO HUMAN HEALTH OR THE ENVIRONMENT AT THE SITE WHEN CONSIDERING THE POST-REMEDIAL ACTION LAND USE. (Section 58.5(b)(3) of the Act)

SUBPART E: TIER 1 EVALUATION

Section 742.500 Introduction

a) A Tier 1 evaluation compares the concentration of contaminants of concern detected at a site to the baseline remediation objectives provided in Appendix B, Tables A, B, C, D, and E. Use of Tier 1 remediation objectives requires only limited site-specific information: concentrations of contaminants of concern,

groundwater classification, land use classification, and, if appropriate, soil pH (see Appendix B, Illustration A).

b) Although Tier 1 allows for differentiation between residential and industrial/commercial property use of a site, institutional controls under Subpart J are required where remediation objectives are based on an industrial/commercial property use.

c) Any given exposure route is not a concern if the concentrations of contaminants of concern detected at the site are all below the Tier 1 values of that given route. In such cases, no further evaluation of that route is necessary.

Section 742.505 Tier 1 Soil and Groundwater Remediation Objectives

a) Soil

1) Inhalation Exposure Route

A) The Tier 1 soil remediation objectives for this exposure route based upon residential property use are listed in Appendix B, Table A.

B) The Tier 1 soil remediation objectives for this exposure route based upon industrial/commercial property use are listed in Appendix B, Table B. Soil remediation objective determinations relying on this table require use of institutional controls in accordance with Subpart J.

2) Ingestion Exposure Route

A) The Tier 1 soil remediation objectives for this exposure route based upon residential property use are listed in Appendix B, Table A.

B) The Tier 1 soil remediation objectives for this exposure route based upon industrial/commercial property use are listed in Appendix B, Table B. Soil remediation objective determinations relying on this table require use of institutional controls in accordance with Subpart J.

3) Migration to Groundwater Portion of the Groundwater Ingestion Route

A) The Tier 1 soil remediation objectives for this exposure route based upon residential property use are listed in Appendix B, Table A.

B) The Tier 1 soil remediation objectives for this exposure route based upon industrial/commercial property use are listed in Appendix B, Table B.

C) The pH-dependent Tier 1 soil remediation objectives for identified ionizable organics or inorganics for the migration to groundwater portion of the groundwater ingestion exposure route (based on the total amount of contaminants present in the soil sample results and groundwater classification) are provided in Appendix B, Tables C and D.

4) Evaluation of the dermal contact with soil exposure route is not required under Tier 1.

b) Groundwater

1) The Tier 1 groundwater remediation objectives for the direct ingestion of groundwater portion of the groundwater ingestion route are listed in Appendix B, Table E.

2) The Tier 1 groundwater remediation objectives for this exposure route are given for Class I and Class II groundwaters, respectively.

Section 742.510 Tables

a) Soil remediation objectives are listed in Appendix B, Tables A, B, C, and D.

1) Appendix B, Table A is based upon residential property use.

A) The first column to the right of the chemical name lists soil remediation objectives for the soil ingestion exposure route.

B) The second column lists the soil remediation objectives for the inhalation exposure route.

C) The third and fourth columns list soil remediation objectives for the migration to groundwater portion of the groundwater ingestion exposure route for the respective classes of groundwater:

i) Class I groundwater

ii) Class II groundwater

D) The final column is the Acceptable Detection Limit (ADL), only where applicable.

2) Appendix B, Table B is based upon industrial/commercial property use.

A) The first and third columns to the right of the chemical name list the soil remediation objectives for the soil ingestion exposure route based on two receptor populations:

i) Industrial/commercial population

ii) Construction worker population

B) The second and fourth columns to the right of the chemical name list the soil remediation objectives for the inhalation exposure route based on two receptor populations:

i) Industrial/commercial population

ii) Construction worker population

C) The fifth and sixth columns to the right of the chemical name list the soil remediation objectives for the migration to groundwater portion of the groundwater ingestion exposure route based on TCLP analyses for two classes of groundwater:

i) Class I groundwater

ii) Class II groundwater

3) For those chemicals listed in Appendix B, Tables C and D, if a person elects to evaluate the migration to groundwater portion of the groundwater ingestion exposure route based on the total amount of contaminant in a soil sample result (rather than TCLP analysis), the person shall determine the soil pH at the site and then select the appropriate soil remediation objectives based on Class I and Class II groundwaters using Tables C and D, respectively. If the soil pH is less than 4.5 or greater than 8.0, then Tables C and D cannot be used.

4) Unless one or more exposure routes are excluded from consideration under Subpart C, the most stringent soil remediation objective of the exposure routes (i.e., soil ingestion exposure route, inhalation exposure route, and migration to groundwater portion of the groundwater ingestion exposure route) shall be compared to the concentrations of soil contaminants of concern measured at the site. When using Appendix B, Table B to select soil remediation objectives for the ingestion exposure route and inhalation exposure route, the remediation objective shall be

the more stringent soil remediation objective of the industrial/commercial populations and construction worker populations.

5) Confirmation sample results may be averaged or soil samples may be composited in accordance with Section 742.225.

6) If a soil remediation objective for a chemical is less than the ADL, the ADL shall serve as the soil remediation objective.

b) Groundwater remediation objectives for the direct ingestion of groundwater portion of the groundwater ingestion exposure route are listed in Appendix B, Table E.

1) The first column to the right of the chemical name lists groundwater remediation objectives for Class I groundwater, and the second column lists the groundwater remediation objectives for Class II groundwater.

2) To use Table E, the Part 620 classification for groundwater at the site shall be determined. The concentrations of groundwater contaminants of concern at the site are compared to the applicable Tier 1 groundwater remediation objectives for the direct ingestion of groundwater portion of the groundwater ingestion exposure route in Appendix B, Table E. Appendix D describes the procedures to be used in determining whether groundwater is Class II.

c) For contaminants of concern not listed in Appendix B, Tables A, B, and E, a person may request site-specific remediation objectives from the Agency or propose site-specific remediation objectives in accordance with 35 Ill. Adm. Code 620, Subpart I, or both.

SUBPART F: TIER 2 GENERAL EVALUATION

Section 742.600 Introduction

a) Tier 2 remediation objectives are developed through the use of equations which allow site-specific data to be used (see Appendix C, Illustrations A and B). The equations identified in Appendix C, Tables A and C may be used to develop Tier 2 remediation objectives.

b) Tier 2 evaluation is only required for contaminants of concern and corresponding exposure routes (except where excluded from further consideration under Subpart C) exceeding the Tier 1 remediation objectives. When conducting Tier 2 evaluations, the values used in the calculations must have the appropriate units of measure as identified in Appendix C, Tables B and D.

c) Any development of remediation objectives using site-specific information or equations outside the Tier 2 framework shall be evaluated under Tier 3.

d) In conducting a Tier 2 evaluation, the following conditions shall be met:

1) For each discrete sample, the total soil contaminant concentration of either a single contaminant or multiple contaminants of concern shall not exceed the attenuation capacity of the soil as provided in Section 742.215.

2) Remediation objectives for noncarcinogenic compounds which affect the same target organ shall meet the requirements of Section 742.610.

3) The soil remediation objectives based on the inhalation and migration to groundwater portion of the groundwater ingestion exposure routes shall not exceed the soil saturation limit as provided in Section 742.220.

e) If the calculated Tier 2 soil remediation objective for an applicable exposure route is more stringent than the corresponding Tier 1 remediation objective, then the Tier 1 remediation objective applies.

f) If the calculated Tier 2 soil remediation objective for an exposure route is more stringent than the Tier 1 soil remediation objective(s) for the other exposure routes, then the Tier 2 calculated soil remediation objective applies and Tier 2 soil remediation objectives for the other exposure routes are not required.

g) If the calculated Tier 2 soil remediation objective is less stringent than one or more of the soil remediation objectives for the remaining exposure routes, then the Tier 2 values are calculated for the remaining exposure route(s) and the most stringent Tier 2 calculated value applies.

Section 742.605 Land Use

a) Present and post-remediation land use is evaluated in a Tier 2 evaluation. Acceptable exposure factors for the Tier 2 evaluation for residential, industrial/commercial, and construction worker populations are provided in the far right column of both Appendix C, Tables B and D. Use of exposure factors different from those in Appendix C, Tables B and D must be approved by the Agency as part of a Tier 3 evaluation.

b) If a Tier 2 evaluation is based on an industrial/commercial property use, then:

1) Construction worker populations shall also be evaluated; and

2) Institutional controls are required in accordance with Subpart J.

Section 742.610 Chemicals with Cumulative Noncarcinogenic Effects

Appendix A, Table E lists the groups of chemicals from Appendix B, Tables A and B that have remediation objectives based on noncarcinogenic toxicity and that affect the same target organ. If more than one chemical detected at a site affects the same target organ (i.e., has the same critical effect as defined by the RfD), the initially calculated remediation value for each chemical in the group shall be corrected for cumulative effects by one of the following two methods:

a) Calculate the weighted average using the following equations:

$$\frac{x_1}{CUO_{x_1}} + \frac{x_2}{CUO_{x_2}} + \frac{x_3}{CUO_{x_3}} + \ldots + \frac{x_a}{CUO_{x_a}}$$

where:

x_1 through x_a = Concentration of each individual contaminant at the location of concern. Note that, depending on the target organ/mode of action, the actual number of contaminants will range from 2 to 14.

CUO_{xa} = A Tier 2 remediation objective must be developed for each x_a.

If the value of the weighted average calculated in accordance with the equations above is less than or equal to 1.0, then the remediation objectives are met for those chemicals.

If the value of the weighted average calculated in accordance with the equations above is greater than 1.0, then additional remediation must be carried out until the level of contaminants remaining in the remediated area have a weighted average calculated in accordance with the equation above less than or equal to one;

b) Divide each individual chemical's remediation objective by the number of chemicals in that specific target organ group that were detected at the site. Each of the contaminant concentrations at the site is then compared to the remediation objectives that have been adjusted to account for this potential additivity. For the noncarcinogenic contaminants listed in Appendix A, Table E, a respective soil remediation objective need be no lower than the respective value listed in Appendix B, Tables A or B.

Section 742.615 Chemical and Site Properties

a) Physical and Chemical Properties of Contaminants

Tier 2 evaluations require information on the physical and chemical properties of the contaminants of concern. The physical and chemical properties used in a Tier 2 evaluation are contained in Appendix C, Table E. If the site has contaminants not included in this table, a person may request the Agency to provide the applicable physical and chemical input values or may propose input values under Subpart I. If a person proposes to apply values other than those in Appendix C, Table E, or those provided by the Agency, the evaluation shall be considered under Tier 3.

b) Soil and Groundwater Parameters

1) A Tier 2 evaluation requires examination of soil and groundwater parameters. The parameters that may be varied, and the conditions under which these parameters are determined as part of Tier 2, are summarized in Appendix C, Tables B and D. If a person proposes to vary site-specific parameters outside of the framework of these tables, the evaluation shall be considered under Tier 3.

2) To determine site-specific physical soil parameters, a minimum of one boring per 0.5 acre of contamination shall be collected. This boring must be deep enough to allow the collection of the required field measurements. The site-specific physical soil parameters must be determined from the portion of the boring representing the stratigraphic unit(s) being evaluated. For example, if evaluating the migration to groundwater portion of the groundwater ingestion exposure route, two samples from the boring will be required:

A) A sample of the predominant soil type for the vadose zone; and

B) A sample of the predominant soil type for the saturated zone.

3) A site-specific SSL dilution factor (used in developing soil remediation objectives based upon the protection of groundwater) may be determined by substituting site information in Equation S22 in Appendix C, Table A. To make this demonstration, a minimum of three (3) monitoring wells shall be used to determine the hydraulic gradient. As an alternative, the default dilution factor value listed in Appendix C, Table B is used. If monitoring wells are used to determine the hydraulic gradient, the soil taken from the borings shall be visually inspected to ensure there are no significant differences in the stratigraphy. If there are similar soil types in the field, one boring shall be used to determine the site-specific physical soil parameters. If there are significant differences, all of the borings shall be evaluated before determining the site-specific physical soil parameters for the site.

4) Not all of the parameters identified in Appendix C, Tables B and D need to be determined on a site-specific basis. A person may choose to collect partial site-specific information and use default values as listed in Appendix C, Tables B and D for the rest of the parameters.

5) Appendix D describes the procedures to be used in determining whether groundwater is Class II.

SUBPART G: TIER 2 SOIL EVALUATION

Section 742.700 Overview

a) Tier 2 remediation objectives are developed through the use of models which allow site-specific data to be considered. Appendix C, Tables A and C list equations that shall be used under a Tier 2 evaluation to calculate soil remediation objectives prescribed by SSL and RBCA models, respectively (see also Appendix C, Illustration A).

b) Appendix C, Table A lists equations that are used under the SSL model (see also Appendix C, Illustration A). The SSL model has equations to evaluate the following human exposure routes:

1) Soil ingestion exposure route;

2) Inhalation exposure route for:

A) Volatiles

B) Fugitive dust; and

3) Migration to groundwater portion of the groundwater ingestion exposure route.

c) Evaluation of the dermal exposure route is not required under the SSL model.

d) Appendix C, Table C lists equations that are used under the RBCA model (see also Appendix C, Illustration A). The RBCA model has equations to evaluate human exposure based on the following:

1) The combined exposure routes of inhalation of vapors and particulates, soil ingestion, and dermal contact with soil;

2) The ambient vapor inhalation (outdoor) route from subsurface soils;

3) Migration to groundwater portion of the groundwater ingestion route; and

4) Groundwater ingestion exposure route.

e) The equations in either Appendix C, Tables A or C may be used to calculate remediation objectives for each contaminant of concern under Tier 2, if the following requirements are met:

1) The Tier 2 soil remediation objectives for the ingestion and inhalation exposure routes shall use the applicable equations from the same approach (i.e., SSL equations in Appendix C, Table C).

2) The equations used to calculate soil remediation objectives for the migration to groundwater portion of the groundwater ingestion exposure route are not dependent on the approach utilized to calculate soil remediation objectives for the other exposure routes. For example, it is acceptable to use the SSL equations for calculating Tier 2 soil remediation objectives for the ingestion and inhalation exposure routes, and the RBCA equations for calculating Tier 2 soil remediation objectives for the migration to groundwater portion of the groundwater ingestion exposure route.

3) Combining equations from Appendix C, Tables A and C to form a new model is not allowed. In addition, Appendix C, Tables A and C must use their own applicable parameters identified in Appendix C, Tables B and D, respectively.

f) In calculating soil remediation objectives for industrial/commercial property use, applicable calculations shall be performed twice: once using industrial/commercial population default values and once using construction worker population default values. The more stringent soil remediation objectives derived from these calculations must be used for further Tier 2 evaluations.

g) Tier 2 datasheets provided by the Agency shall be used to present calculated Tier 2 remediation objectives, if required by the particular program for which remediation is being performed.

h) The RBCA equations which rely on the parameter Soil Water Sorption Coefficient (k_s) can only be used for ionizing organics and inorganics by substituting values for k_s from Appendix C, Tables I and J, respectively. This will also require the determination of a site-specific value for soil pH.

Section 742.705 Parameters for Soil Remediation Objective Equations

a) Appendix C, Tables B and D list the input parameters for the SSL and RBCA equations, respectively. The first column lists each symbol as it is presented in

the equation. The next column defines the parameters. The third column shows the units for the parameters. The fourth column identifies where information on the parameters can be obtained (i.e., field measurement, applicable equation(s), reference source, or default value). The last column identifies how the parameters can be generated. A discussion of each parameter group follows.

b) Default Values

Default values are numerical values specified for use in the Tier 2 equations. The fourth column of Appendix C, Tables B and D denotes if the default values are from the SSL model, RBCA model, or some other source. The last column of Appendix C, Tables B and D lists the numerical values for the default values used in the SSL and RBCA equations, respectively.

c) Site-specific Information

Site-specific information is a parameter measured, obtained, or determined from the site to calculate Tier 2 remediation objectives. The fourth column of Appendix C, Tables B and D identifies those site-specific parameters that may require direct field measurement. For some parameters, numerical default inputs have been provided in the last column of Appendix C, Tables B and D to substitute for site-specific information. In some cases, information on the receptor or soil type is required to select the applicable numerical default inputs. Site-specific information includes:

1) Physical soil parameters identified in Appendix C, Table F. The second column identifies the location where the sample is to be collected. Acceptable methods for measuring or calculating these soil parameters are identified in the last column of Appendix C, Table F.

2) Engineered barriers or institutional controls which can affect the target cancer risk. Subparts J and K describe applicable institutional controls and engineered barriers under a Tier 2 evaluation.

3) Receptor classification (i.e., residential, industrial/commercial, and construction worker populations).

d) Toxicological-specific Information

1) Toxicological-specific information is used to calculate Tier 2 remediation objectives for the following parameters:

A) Oral Chronic Reference Dose (RfD_o, expressed in mg/kg-d)

B) Oral Subchronic Reference Dose (RfD_s, expressed in mg/kg-d, shall be used for construction worker remediation objective calculations)

C) Oral Slope Factor (SF_o, expressed in $(mg/kg\text{-}d)^{-1}$)

D) Inhalation Unit Risk Factor (URF expressed in $(ug/m^3)^{-1}$)

E) Inhalation Chronic Reference Concentration (RfC, expressed in mg/m^3)

F) Inhalation Subchronic Reference Concentration (RfC_s, expressed in mg/m^3, shall be used for construction worker remediation objective calculations)

G) Inhalation Chronic Reference Dose (RfD_i, expressed in mg/kg-d)

H) Inhalation Subchronic Reference Dose (RfD_{is}, expressed in mg/kg-d, shall be used for construction worker remediation objective calculations)

I) Inhalation Slope Factor (SF_i, expressed in $(mg/kg\text{-}d)^{-1}$)

2) Toxicological information can be obtained from IRIS, as incorporated by reference in Section 742.210, or the program under which the remediation is being performed.

e) Chemical-specific Information

Chemical-specific information used to calculate Tier 2 remediation objectives is listed in Appendix C, Table E.

f) Calculations

Calculating numerical values for some parameters requires the use of equations listed in Appendix C, Tables A or C. The parameters that are calculated are listed in Appendix C, Tables B and D.

Section 742.710 SSL Soil Equations

a) This Section sets forth the equations and parameters used to develop Tier 2 soil remediation objectives for the three exposure routes using the SSL approach.

b) Soil Ingestion Exposure Route

1) Equations S1 through S3 form the basis for calculating Tier 2 remediation objectives for the soil ingestion exposure route using the SSL approach. Equation S1 is used to calculate soil remediation objectives for noncarcinogenic contaminants. Equations S2 and S3 are used to calculate soil remediation objectives for carcinogenic contaminants for residential populations and industrial/commercial and construction worker populations, respectively.

2) For Equation S1, the SSL default values cannot be modified with site-specific information.

3) For Equations S2 and S3, the only parameter that can be modified is the target cancer risk. A target cancer risk of more than 1 in 1,000,000 may be used if the applicable exposure routes have been managed through the use of institutional controls. The remaining parameters in Equations S2 and S3 are default values, and the corresponding numerical values in Appendix C, Table B must be used to calculate the Tier 2 SSL ingestion exposure route remediation objectives.

c) Inhalation Exposure Route

1) Equations S4 through S16, S26, and S27 are used to calculate Tier 2 soil remediation objectives for the inhalation exposure route using the SSL approach. To address this exposure route, volatiles must be evaluated separately from fugitive dust using their own equations set forth in subsection (c)(2) and (c)(3) of this Section, respectively.

2) Volatiles

A) Equations S4 through S10 are used to calculate Tier 2 soil remediation objectives for volatile contaminants based on the inhalation exposure route. Equation S4 is used to calculate soil remediation objectives for noncarcinogenic volatile contaminants in soil for residential and industrial/commercial populations. Equation S5 is used to calculate soil remediation objectives for noncarcinogenic volatile contaminants in soil for construction worker populations. Equation S6 is used to calculate soil remediation objectives for carcinogenic volatile contaminants in soil for residential and industrial/commercial populations. Equation S7 is used to calculate soil remediation objectives for carcinogenic volatile contaminants in soil for construction worker populations. Equations S8 through S10, S27, and S28 are used

for calculating numerical values for some of the parameters in Equations S4 through S7.

B) For Equation S4, a numerical value for the Volatilization Factor (VF) can be calculated in accordance with subsection (c)(2)(F) of this Section. The remaining parameters in Equation S4 have either SSL default values listed in Appendix C, Table B or toxicological-specific information (i.e., RfC), which can be obtained from IRIS or requested from the program under which the remediation is being performed.

C) For Equation S5, a numerical value for the Volatilization Factor adjusted for Agitation (VF') can be calculated in accordance with subsection (c)(2)(G) of this Section. The remaining parameters in Equation S5 have either SSL default values listed in Appendix C, Table B or toxicological-specific information (i.e., RfC), which can be obtained from IRIS or requested from the program under which the remediation is being performed.

D) For Equation S6, a numerical value for VF can be calculated in accordance with subsection (c)(2)(F) of this Section. The remaining parameters in Equation S6 have either default values listed in Appendix C, Table B or toxicological-specific information (i.e., URF), which can be obtained from IRIS or requested from the program under which the remediation is being performed.

E) For Equation S7, a numerical value for VF' can be calculated in accordance with subsection (c)(2)(G) of this Section. The remaining parameters in Equation S7 have either default values listed in Appendix C, Table B or toxicological-specific information (i.e., URF), which can be obtained from IRIS or requested from the program under which the remediation is being performed.

F) The VF can be calculated for residential and commercial/industrial populations using one of the following equations based on the information known about the contaminant source and receptor population:

i) Equation S8, in conjunction with Equation S10, is used to calculate VF assuming an infinite source of contamination.

ii) If the area and depth of the contaminant source are known or can be estimated reliably, mass limit considerations may be used to calculate VF using Equation S26.

G) The VF' can be calculated for the construction worker populations using one of the following equations based on the information known about the contaminant source:

i) Equation S9 is used to calculate VF' assuming an infinite source of contamination.

ii) If the area and depth of the contaminant source are known or can be estimated reliably, mass limit considerations may be used to calculate VF' using Equation S27.

3) Fugitive Dust

A) Equations S11 through S16 are used to calculate Tier 2 soil remediation objectives using the SSL fugitive dust model for the inhalation exposure route. Equation S11 is used to calculate soil remediation objectives for noncarcinogenic contaminants in fugitive dust for residential and industrial/commercial populations. Equation S12 is used to calculate soil remediation objectives for noncarcinogenic contaminants in fugitive dust for construction worker populations. Equation S13 is used to calculate soil remediation objectives for carcinogenic contaminants in fugitive dust for residential and industrial/commercial populations. Equation S14 is used to calculate soil remediation objectives for carcinogenic contaminants in fugitive dust for construction worker populations. Equations S15 and S16 are used for calculating numerical quantities for some of the parameters in Equations S11 through S14.

B) For Equation S11, a numerical value can be calculated for the Particulate Emission Factor (PEF) using Equation S15. This equation relies on various input parameters from a variety of sources. The remaining parameters in Equation S11 have either SSL default values listed in Appendix C, Table B or toxicological-specific information (i.e., RfC), which can be obtained from IRIS or requested from the program under which the remediation is being performed.

C) For Equation S12, a numerical value for the Particulate Emission Factor for Construction Worker (PEF') can be calculated using Equation S16. The remaining parameters in Equation S12 have either SSL default values listed in Appendix C, Table B or toxicological-specific information (i.e., RfC), which can be

obtained from IRIS or requested from the program under which the remediation is being performed.

D) For Equation S13, a numerical value for PEF can be calculated using Equation S15. The remaining parameters in Equation S13 have either default values listed in Appendix C, Table B or toxicological-specific information (i.e., URF), which can be obtained from IRIS or requested from the program under which the remediation is being performed.

E) For Equation S14, a numerical value for PEF' can be calculated using Equation S16. The remaining parameters in Equation S14 have either default values listed in Appendix C, Table B or toxicological-specific information (i.e., URF), which can be obtained from IRIS or requested from the program under which the remediation is being performed.

d) Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route

The Tier 2 remediation objective for the migration to groundwater portion of the groundwater ingestion exposure route can be calculated using one of the following equations based on the information known about the contaminant source and receptor population:

1) Equation S17 is used to calculate the remediation objective assuming an infinite source of contamination.

A) The numerical quantities for four parameters in Equation S17, the Target Soil Leachate Concentration (C_w), Soil-Water Partition Coefficient (K_d), Water-Filled Soil Porosity (θ_w), and Air-Filled Soil Porosity (θ_a) are calculated using Equations S18, S19, S20, and S21, respectively. Equations S22, S23, S24, and S25 are also needed to calculate numerical values for Equations S18 and S21.

B) The remaining parameters in Equation S17 are Henry's Law Constant (H'), a chemical specific value listed in Appendix C, Table E and Dry Soil Bulk Density (D_b), a site-specific based value listed in Appendix C, Table B.

C) The default value for GW_{obj} is the Tier 1 groundwater objective. For chemicals for which there is no Tier 1 groundwater remediation objective, the value for GW_{obj} shall be the Health Advisory concentration determined according to the procedures specified in 35 Ill. Adm. Code 620, Subpart F. As an alternative

to using the Tier 1 groundwater remediation objectives or Health Advisories, a target risk for carcinogens greater than 1 in 1,000,000 may be used to calculate GW_{obj} using Equation S23, and a Target Hazard Quotient greater than 1.0 may be used to calculate GW_{obj} using the procedures of Subpart I, if approved institutional controls are in place as may be required in Subpart J.

2) If the area and depth of the contaminant source are known or can be estimated reliably, mass limit considerations may be used to calculate the remediation objective for this exposure route using Equation S28. The parameters in Equation S28 have default values listed in Appendix C, Table B.

Section 742.715 RBCA Soil Equations

a) This Section presents the RBCA model and describes the equations and parameters used to develop Tier 2 soil remediation objectives.

b) Ingestion, Inhalation, and Dermal Contact

1) The two sets of equations in subsection (b)(2) and (b)(3) of this Section shall be used to generate Tier 2 soil remediation objectives for the combined ingestion, inhalation, and dermal contact with soil exposure route.

2) Combined Exposure Routes of Soil Ingestion, Inhalation of Vapors and Particulates, and Dermal Contact with Soil

A) Equations R1 and R2 form the basis for deriving Tier 2 remediation objectives for the set of equations that evaluates the combined exposure routes of soil ingestion, inhalation of vapors and particulates, and dermal contact with soil using the RBCA approach. Equation R1 is used to calculate soil remediation objectives for carcinogenic contaminants. Equation R2 is used to calculate soil remediation objectives for noncarcinogenic contaminants. Soil remediation objectives for the ambient vapor inhalation (outdoor) route from subsurface soils must also be calculated in accordance with the procedures outlined in subsection (b)(3) of this Section and compared to the values generated from Equations R1 or R2. The smaller value (i.e., R1 and R2 compared to R7 and R8, respectively) from these calculations is the Tier 2 soil remediation objective for the combined exposure routes of soil ingestion, inhalation, and dermal contact with soil.

B) In Equation R1, numerical values are calculated for two parameters:

i) The volatilization factor for surficial soils (VF_{ss}) using Equations R3 and R4; and

ii) The volatilization factor for subsurface soils regarding particulates (VF_p) using Equation R5.

C) VF_{ss} uses Equations R3 and R4 to derive a numerical value. Equation R3 requires the use of Equation R6. Both equations must be used to calculate the VF_{ss}. The lowest calculated value from these equations must be substituted into Equation R1.

D) The remaining parameters in Equation R1 have either default values listed in Appendix C, Table D or toxicological-specific information (i.e., SF_o, SF_i), which can be obtained from IRIS or requested from the program under which the remediation is being performed.

E) For Equation R2, the parameters VF_{ss} and VF_p are calculated. The remaining parameters in Equation R2 have either default values listed in Appendix C, Table D or toxicological-specific information (i.e., RfD_o, RfD_i) , which can be obtained from IRIS or requested from the program under which the remediation is being performed.

F) For chemicals other than inorganics which do not have default values for the dermal absorption factor (RAF_d) in Appendix C, Table D, a dermal absorption factor of 0.5 shall be used for Equations R1 and R2. For inorganics, dermal absorption may be disregarded (i.e., $RAF_d = 0$).

3) Ambient Vapor Inhalation (outdoor) route from Subsurface Soils (soil below one meter)

A) Equations R7 and R8 form the basis for deriving Tier 2 remediation objectives for the ambient vapor inhalation (outdoor) route from subsurface soils using the RBCA approach. Equation R7 is used to calculate soil remediation objectives for carcinogenic contaminants. Equation R8 is used to calculate soil remediation objectives for noncarcinogenic contaminants.

B) For Equation R7, the carcinogenic risk-based screening level for air ($RBSL_{air}$) and the volatilization factor for soils below one meter to ambient air (VF_{samb}) have numerical values that are

calculated using Equations R9 and R11, respectively. Both equations rely on input parameters from a variety of sources.

C) The noncarcinogenic risk-based screening level for air ($RBSL_{air}$) and the volatilization factor for soils below one meter to ambient air (VF_{samb}) in Equation R8 have numerical values that can be calculated using Equations R10 and R11, respectively.

c) Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route

1) Equation R12 forms the basis for deriving Tier 2 remediation objectives for the migration to groundwater portion of the groundwater ingestion exposure route using the RBCA approach. The parameters, groundwater at the source (GW_{source}), and Leaching Factor (LF_{sw}) have numerical values that are calculated using Equations R13 and R14, respectively.

2) Equation R13 requires numerical values that are calculated using Equation R15.

3) Equation R14 requires numerical values that are calculated using Equations R21, R22, and R24. For non-ionizing organics, the Soil Water Absorption Coefficient (k_s) shall be calculated using Equation R20. For ionizing organics and inorganics the values for k_s are listed in Appendix C, Tables I and J, respectively. The remaining parameters in Equation R14 are field measurements or default values listed in Appendix C, Table D.

d) The default value for GW_{comp} is the Tier 1 groundwater objective. For chemicals for which there is no Tier 1 groundwater remediation objective, the value for GW_{comp} shall be the Health Advisory concentration determined according to the procedures specified in 35 Ill. Adm. Code 620, Subpart F. As an alternative to using the Tier 1 groundwater remediation objectives or Health Advisories, a target risk for carcinogens greater than 1 in 1,000,000 may be used to calculate GW_{comp} using Equation R25, and a Target Hazard Quotient greater than 1.0 may be used to calculate GW_{comp} using the procedures of Subpart I, if approved institutional controls are in place as may be required in Subpart J.

SUBPART H: TIER 2 GROUNDWATER EVALUATION

Section 742.800 General

If the contaminant concentrations in the groundwater exceed the applicable Tier 1 remediation objectives, a person has the following options:

a) Demonstrate that the groundwater ingestion exposure route is excluded from consideration pursuant to Subpart C;

b) Demonstrate that the groundwater contamination is at or below area background concentrations in accordance with Subpart D and, if necessary, an institutional control restricting usage of the groundwater is in place in accordance with Subpart J;

c) Remediate to Tier 1 remediation objectives;

d) Develop Tier 2 groundwater remediation objectives in accordance with Section 742.805 and remediate to that level, if necessary;

e) Conduct a Tier 3 evaluation in accordance with Subpart I; or

f) Obtain approval from the Board to:

1) Reclassify the groundwater pursuant to 35 Ill. Adm. Code 620.260; or

2) Use an adjusted standard pursuant to Section 28.1 of the Act.

Section 742.805 Tier 2 Groundwater Remediation Objectives

a) To develop a groundwater remediation objective under this Section that exceeds the applicable Tier 1 groundwater remediation objective, a person may request approval from the Agency if the person has performed the following:

1) Identified the horizontal and vertical extent of groundwater for which the Tier 2 groundwater remediation objective is sought;

2) Taken corrective action, to the maximum extent practicable to remove any free product;

3) Using Equation R26 in accordance with Section 742.810, demonstrated that the concentration of any contaminant of concern in groundwater will meet:

A) The applicable Tier 1 groundwater remediation objective at the point of human exposure; or

B) For any contaminant of concern for which there is no Tier 1 groundwater remediation objective, the Health Advisory concentration determined according to the procedures specified in 35 Ill. Adm. Code 620, Subpart F at the point of human exposure. A person may request the Agency to provide these

concentrations or may propose these concentrations under Subpart I.

4) Using Equation R26 in accordance with Section 742.810, demonstrated that the concentration of any contaminant of concern in groundwater within the minimum or maximum setback zone of an existing potable water supply well will meet the applicable Tier 1 groundwater remediation objective;

5) Using Equation R26 in accordance with Section 742.810, demonstrated that the concentration of any contaminant of concern in groundwater discharging into a surface water will meet the applicable surface water quality standard under 35 Ill. Adm. Code 302;

6) Demonstrated that the source of the release is not located within the minimum or maximum setback zone of a potable water supply well nor within a regulated recharge area of a potable water supply well; and

7) If the selected corrective action includes an engineered barrier to minimize migration of contaminant of concern from the soil to the groundwater, demonstrated that the barrier will remain in place for post-remediation land use through an institutional control as set forth in Subpart J.

b) A groundwater remediation objective that exceeds the water solubility of that chemical (refer to Appendix C, Table E for solubility values) is not allowed.

Section 742.810 Calculations to Predict Impacts from Remaining Groundwater Contamination

a) Equation R26 predicts the contaminant concentration along the centerline of a plume emanating from a vertical planar source in the aquifer (dimensions S_w wide and S_d deep). This model accounts for both three-dimensional dispersion (x is the direction of groundwater flow, y is the other horizontal direction, and z is the vertical direction) and biodegradation.

1) The parameters in this equation are:

A) X = distance from the planar source to the location of concern, along the centerline of the plume (i.e., $y=0$, $z=0$)

B) $C_{(x)}$ = the concentration of the contaminant at a distance X from the source, along the centerline of the plume

C) $C_{(source)}$ = the greatest potential concentration of the contaminant of concern in the groundwater at the source of the

contamination, based on the concentrations of contaminants in groundwater due to the release and the projected concentration of the contaminant migrating from the soil to the groundwater. As indicated above, the model assumes a planar source discharging groundwater at a concentration equal to $C_{(source)}$.

D) α_x = dispersivity in the x direction (i.e., Equation R16)

E) α_y = dispersivity in the y direction (i.e., Equation R17)

F) α_z = dispersivity in the z direction (i.e., Equation R18)

G) U = specific discharge (i.e., actual groundwater flow velocity through a porous medium; takes into account the fact that the groundwater actually flows only through the pores of the subsurface materials), where the aquifer hydraulic conductivity (k), the infiltration rate (I), and the total soil porosity (θ_T) must be known (i.e., Equation R19).

H) λ = first order degradation constant obtained from Appendix C, Table E or from measured groundwater data.

I) S_w = width of planar source in the y direction

J) S_d = depth of planar source in the z direction

2) The following parameters are determined through field measurements: U, k, I, θ_T, S_w, S_d.

A) The determination of values for U, k, I, and θ_T can be obtained through the appropriate laboratory and field techniques.

B) From the immediate down-gradient edge of the source of the groundwater contamination values for S_w and S_d shall be determined. S_w is defined as the width of groundwater at the source which exceeds the Tier 1 groundwater remediation objective. S_d is defined as the depth of groundwater at the source which exceeds the Tier 1 groundwater remediation objective.

C) Total soil porosity can also be calculated using Equation R23.

3) The value of $C_{(source)}$ equals the greatest concentration of the contaminant in the groundwater at the source of the contamination.

b) Once values are obtained for all the input parameters identified in subsection (a) of this Section, the contaminant concentration along the centerline of the plume a distance X from the source shall be calculated.

1) To demonstrate that no existing potable water supply well is adversely impacted, X shall be the distance from the down-gradient edge of the source of the contamination at the site to the nearest water supply well. This calculation must show that the contaminant in the groundwater at this location ($C_{(x)}$), does not exceed the applicable Tier 1 groundwater remediation objective or Health Advisory concentration.

2) To demonstrate that no surface water is adversely impacted, X shall be the distance from the down-gradient edge of the source of the contamination at the site to the nearest surface water body. This calculation must show that the contaminant in the groundwater at this location ($C_{(x)}$), does not exceed the applicable surface water quality standard.

SUBPART I: TIER 3 EVALUATION

Section 742.900 Introduction

a) Tier 3 sets forth a flexible framework to develop remediation objectives outside of the requirements of Tiers 1 and 2. Although Tier 1 evaluations and Tier 2 evaluations are not prerequisites to conduct Tier 3 evaluations, data from Tier 1 and Tier 2 can assist in developing remediation objectives under a Tier 3 evaluation.

b) The level of detail required to adequately characterize a site depends on the particular use of Tier 3. Tier 3 can require additional investigative efforts beyond those described in Tier 2 to characterize the physical setting of the site. However, in situations where remedial efforts have simply reached a physical obstruction (e.g., a building), additional investigation may not be necessary for a Tier 3 submittal.

c) Situations that can be considered for a Tier 3 evaluation include, but are not limited to:

1) Modification of parameters not allowed under Tier 2 (e.g., a target hazard quotient greater than 1 is requested);

2) Use of models different from those used in Tier 2;

3) Use of additional site data to improve or confirm predictions of exposed receptors to contaminants of concern;

4) Analysis of site-specific risks using formal risk assessment, probabilistic data analysis, and sophisticated fate and transport models;

5) Requests for site-specific remediation objectives because a "common sense" assessment indicates further remediation is not practical (e.g., the remaining contamination is under a structure such as a permanent building);

6) Incomplete human exposure pathway(s) not excluded under Subpart C;

7) Use of toxicological-specific information not available from the sources listed in Tier 2; and

8) Land uses which are substantially different from the assumed residential or industrial/commercial property uses of a site (e.g., a site will be used for recreation in the future and cannot be evaluated in Tiers 1 or 2).

d) Requests for approval of a Tier 3 evaluation must be submitted to the Agency for review under the program under which remediation is performed. When reviewing a submittal under Tier 3, the Agency shall consider WHETHER THE INTERPRETATIONS AND CONCLUSIONS REACHED ARE SUPPORTED BY THE INFORMATION GATHERED. (Section 58.7(e)(1) of the Act) The Agency shall approve a Tier 3 evaluation if the person submits the information required under this Part and establishes through such information that public health is protected and that specified risks to human health and the environment have been minimized.

Section 742.905 Modifications of Parameters

Any proposed changes to Tier 2 parameters which are not provided for in Tier 2 shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

a) The justification for the modification; and

b) The technical and mathematical basis for the modification.

Section 742.910 Alternative Models

Any proposals for the use of models other than those specified in Tier 2 shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

a) Physical and chemical properties of contaminants of concern;

b) Contaminant movement properties;

c) Contaminant availability to receptors;

d) Receptor exposure to the contaminants of concern;

e) Mathematical and technical justification for the model proposed;

f) A licensed copy of the model shall be provided to the Agency, if the Agency does not have a licensed copy of the model currently available for use; and

g) Demonstration that the models were correctly applied.

Section 742.915 Formal Risk Assessments

A comprehensive site-specific risk assessment shall demonstrate that contaminants of concern at a site do not pose a significant risk to any human receptor. All site-specific risk assessments shall be submitted to the Agency for review and approval. A submittal under this Section shall address the following factors:

a) Whether the risk assessment procedure used is nationally recognized and accepted including, but not limited to, those procedures incorporated by reference in Section 742.210;

b) Whether the site-specific data reflect actual site conditions;

c) The adequacy of the investigation of present and post-remediation exposure routes and risks to receptors identified at the site;

d) The appropriateness of the sampling and analysis;

e) The adequacy and appropriateness of toxicity information;

f) The extent of contamination; and

g) Whether the calculations were accurately performed.

Section 742.920 Impractical Remediation

Any request for site-specific remediation objectives due to impracticality of remediation shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

a) The reason(s) why the remediation is impractical;

b) The extent of contamination;

c) Geology, including soil types;

d) The potential impact to groundwater;

e) Results and locations of sampling events;

f) Map of the area, including all utilities and structures; and

g) Present and post-remediation uses of the area of contamination, including human receptors at risk.

Section 742.925 Exposure Routes

Technical information may demonstrate that there is no actual or potential impact of contaminants of concern to receptors from a particular exposure route. In these instances, a demonstration excluding an exposure route shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

a) A description of the route evaluated;

b) Technical support including a discussion of the natural or man-made barriers to exposure through that route, calculations, and modelling results;

c) Physical and chemical properties of contaminants of concern;

d) Contaminant migration properties;

e) Description of the site and physical site characteristics; and

f) Discussion of the result and possibility of the route becoming active in the future.

Section 742.930 Derivation of Toxicological Data

If toxicological-specific information is not available for one or more contaminants of concern from the sources incorporated by reference in Section 742.210, the derivations of toxicological-specific information shall be submitted for Agency review and approval.

Section 742.935 Agricultural Uses and Ecological Receptors (Reserved)

SUBPART J: INSTITUTIONAL CONTROLS

Section 742.1000 General

a) Any person who develops remediation objectives under this Part based on an industrial/commercial property use or based on engineered barriers under Subpart K shall meet the requirements of this Subpart relative to institutional controls. Institutional controls in accordance with this Subpart must be in place on the property when remediation objectives are based on any of the following assumptions:

1) Industrial/Commercial property use;

2) Target cancer risk greater than 1 in 1,000,000;

3) Target hazard quotient greater than 1;

4) Engineered barrier(s); or

5) Any combination of the above.

b) The Agency shall not approve any remediation objective under this Part that is based on the use of institutional controls unless the person has proposed institutional controls meeting the requirements of this Subpart. A proposal for approval of institutional controls shall provide identification of the selected institutional controls from among the types recognized in this Subpart.

c) The following types of institutional controls are recognized under this Subpart:

1) No Further Remediation Letters;

2) Restrictive covenants and deed restrictions;

3) Negative easements;

4) Ordinances adopted and administered by a unit of local government; and

5) Agreements between a property owner and a highway authority with respect to any contamination remaining under highways.

BOARD NOTE: Definitions in the Illinois Highway Code for "highway authority", "highway", and "right-of-way" are applicable to this Part.

Section 742.1005 No Further Remediation Letters

a) A "No Further Remediation" letter issued by the Agency may be used as an institutional control under this Part if the requirements of this Section are met and the Agency has determined that "no further remediation" is required as to the property(ies) to which the letter is to apply.

b) A request for approval of a "No Further Remediation" letter as an institutional control shall follow the requirements applicable to the remediation program under which the remediation is performed.

c) The recipient of the letter shall submit the letter to the Office of the Recorder or the Registrar of Titles of the county in which the site is located within 45 days of receipt of the letter in such a manner that it forms a permanent part of the chain of title for the site. Proper recording of the "No Further Remediation" letter shall consist of adding the letter and an Environmental Notice form to other public documents that would normally be examined during a title search.

d) A "No Further Remediation" letter shall not become effective until officially recorded in accordance with subsection (c) of this Section. The recipient of the letter shall obtain and submit to the Agency a copy of the letter demonstrating that it has been recorded.

e) At no time shall any site for which land use has been restricted under a "No Further Remediation" letter be used in a manner inconsistent with such land use limitation unless further investigation or remedial action has been conducted that documents the attainment of objectives appropriate for the new land use and a new letter is obtained and recorded in accordance with subsection (c) of this Section.

f) Violation of the terms of a No Further Remediation Letter shall be grounds for voidance of the Letter and the Agency's "No Further Remediation" determination in accordance with the procedures applicable to the remediation program under which the remediation is performed.

Section 742.1010 Restrictive Covenants, Deed Restrictions, and Negative Easements

a) A restrictive covenant, deed restriction, or negative easement may be used as an institutional control under this Part if the requirements of this Section are met and the Agency has determined that "no further remediation" is required as to the property(ies) to which the institutional control is to apply.

b) A request for approval of a restrictive covenant, deed restriction, or negative easement as an acceptable institutional control, shall provide the following:

1) A copy of the restrictive covenant, deed restriction, or negative easement in the form it will be recorded with the Office of the Recorder or Registrar of Titles in the county where the site is located. The restrictive covenant, deed restriction, or negative easement shall reference or incorporate the terms of the "No Further Remediation" determination so as to require any current owners and all successors in interest to meet the

requirements of the "No Further Remediation" determination as a condition of use of the property;

2) A scaled map showing the horizontal extent of contamination above the applicable remediation objectives;

3) Information showing the concentration of contaminants of concern in which the applicable remediation objectives are exceeded;

4) A scaled map showing the legal boundaries of all properties subject to the restrictive covenant, deed restriction, or negative easement under which contamination is located that exceeds the applicable remediation objectives;

5) Information identifying the current owner(s) of each property identified in subsection (b)(4) of this Section; and

6) Authorization by the current owner(s), or person authorized by law to act on behalf of the owner, of each property identified in subsection (b)(5) of this Section to record the restrictive covenant or deed restriction.

c) Any restrictive covenant, deed restriction, or negative easement approved by the Agency pursuant to this Part shall be recorded with the "No Further Remediation" determination in the Office of the Recorder or the Registrar of Titles of the county in which the site is located within 45 days of receipt of the Agency approval in accordance with Section 742.1005(c).

d) An institutional control approved under this Section shall not become effective until officially recorded in accordance with subsection (c) of this Section. The person receiving the approval shall obtain and submit to the Agency a copy of the institutional control demonstrating that is has been recorded.

e) At no time shall any site for which land use has been restricted under an institutional control approved under this Section be used in a manner inconsistent with such land use limitation unless further investigation or remedial action has been conducted that documents the attainment of objectives appropriate for such land use and a new institutional control is approved and recorded in accordance with subsection (c) of this Section.

f) Violation of the terms of an institutional control approved under this Section shall be grounds for voidance of the institutional control and the Agency's "No Further Remediation" determination pursuant to Section 58.10 of the Act.

Section 742.1015 Ordinances

a) An ordinance adopted by a unit of local government that effectively prohibits the use of groundwater as a potable supply of water, except at points of withdrawal by the unit of local government, may be used as an institutional control to meet Section 742.805 if the requirements of this Section are met.

b) A request for approval of a local ordinance as an institutional control shall provide the following:

1) A copy of the ordinance restricting groundwater use certified by the unit of local government in which the site is located, unless the Agency and the unit of local government have entered an agreement under subsection (i) of this Section, in which case the request may alternatively reference the Memorandum of Understanding (MOU). The ordinance must demonstrate that potable use of groundwater from water supply wells is prohibited;

2) A scaled map(s) delineating the areal extent of groundwater contamination (measured or modeled) above the applicable remediation objectives;

3) Information showing the concentration of contaminants of concern in which the applicable remediation objectives are exceeded;

4) A scaled map delineating the boundaries of all properties under which groundwater is located which exceeds the applicable groundwater remediation objectives;

5) Information identifying the current owner(s) of each property identified in subsection (b)(4) of this Section; and

6) A copy of the proposed submission of the information to the current owners identified in subsection (b)(5) of this Section of the information required in subsections (b)(1) through (b)(5) of this Section and proof that the notification required in subsection (c) of this Section has been submitted.

c) Each of the property owners identified in subsection (b)(5) of this Section and the unit of local government must receive written notification from the party desiring to use the institutional control that groundwater remediation objectives have been approved by the Agency. Written proof of this notification shall be submitted to the Agency within 45 days from the date of the Agency "No Further Remediation" letter or determination. The notification shall include:

1) The name and address of the unit of local government;

2) The citation to the ordinance;

3) A description of the property being sent notice by adequate legal description or by reference to a plat showing the boundaries;

4) A statement that the ordinance restricting groundwater use has been used by the Agency in reviewing a request for a groundwater remediation objective;

5) A statement as to the nature of the release and response action with the site name, address, and Agency site number or Illinois inventory identification number; and

6) A statement as to where more information may be obtained regarding the ordinance.

d) Unless the Agency and the unit of local government have entered an agreement under subsection (i) of this Section, the current owner or successors in interest of a site who have received approval of use of an ordinance as an institutional control under this Section shall:

1) Monitor activities of the unit of local government relative to variance requests or changes in the ordinance relative to the use of potable groundwater at properties identified in subsection (b)(4) of this Section; and

2) Notify the Agency of any approved variance requests or ordinance changes within thirty (30) days after the date such action has been approved.

e) The information required in subsections (b)(1) through (b)(6) of this Section and the Agency letter approving the groundwater remediation objective shall be submitted to the unit of local government. Proof that the information has been filed with the unit of local government shall be provided to the Agency.

f) Unless the Agency and the unit of local government have entered an agreement under subsection (i) of this Section, a site owner who has received approval of use of an ordinance as an institutional control under this Section shall record as an institutional control under Section 742.1005 or Section 742.1010, as applicable, the site owner's duties under subsection (d) of this Section to monitor activities of the unit of local government.

g) An institutional control approved under this Section shall not become effective until the site owner's duties under subsection (d) of this Section are officially recorded in accordance with subsection (f) of this Section. The person receiving the approval shall obtain and submit to the Agency a copy of the institutional control demonstrating that it has been recorded.

h) The following shall be grounds for voidance of the ordinance as an institutional control and the Agency's "No Further Remediation" determination:

1) Modification of the ordinance by the unit of local government to allow potable use of groundwater;

2) Approval of a site-specific request, such as a variance, to allow potable use of groundwater at a site identified in subsection (b)(4) of this Section; and

3) Violation of the terms of an institutional control recorded under Section 742.1005 or Section 742.1010.

i) The Agency and a unit of local government may enter a Memorandum of Understanding (MOU) under this Section if the unit of local government has adopted an ordinance that effectively prohibits the use of groundwater as a potable supply of water, except at points of withdrawal by the unit of local government, and if the requirements of this subsection are met. The MOU shall include the following:

1) Identification of the authority of the unit of local government to enter the MOU;

2) Identification of the legal boundaries, or equivalent, under which the ordinance is applicable;

3) A certified copy of the ordinance;

4) A commitment by the unit of local government to notify the Agency of any variance requests or proposed ordinance changes at least thirty (30) days prior to the date the local government is scheduled to take action on the request or proposed change; and

5) A commitment by the unit of local government to maintain a registry of all sites within the unit of local government that have received "No Further Remediation" determinations under this Part.

Section 742.1020 Highway Authority Agreements

a) An agreement with a highway authority may be used as an institutional control where the requirements of this Section are met and the Agency has determined that "no further remediation" is required as to the property(ies) to which the agreement is to apply.

b) As part of the agreement the highway authority shall agree to:

1) Prohibit the use of groundwater under the highway right of way that is contaminated above Tier 1 remediation objectives from the release as a potable supply of water.

2) Limit access to soil contamination under the highway right of way that is contaminated above Tier 1 remediation objectives from the release. Access to soil contamination may be allowed if, during and after any access, public health and the environment are protected.

c) A request for approval of an agreement as an institutional control shall provide the following:

1) A copy of the agreement executed by the highway authority and the owner of the property from which the release occurred;

2) A scaled map delineating the areal extent of soil and groundwater contamination above the applicable Tier 1 remediation objectives;

3) Information showing the concentration of contaminants of concern within the zone in which the applicable Tier 1 remediation objectives are exceeded;

4) A stipulation of the information required by subsection (b) of this Section in the agreement if it is not practical to obtain the information by sampling the highway right-of-way; and

5) Information identifying the current fee owner of the highway right-of-way and highway authority having jurisdiction.

d) Violation of the terms of an Agreement approved by the Agency as an institutional control under this Section shall be grounds for voidance of the Agreement as an institutional control and the Agency's "No Further Remediation" determination.

SUBPART K: ENGINEERED BARRIERS

Section 742.1100 General

a) Any person who develops remediation objectives under this Part based on engineered barriers shall meet the requirements of this Subpart and the requirements of Subpart J relative to institutional controls.

b) The Agency shall not approve any remediation objective under this Part that is based on the use of engineered barriers unless the person has proposed engineered barriers meeting the requirements of this Subpart.

c) The use of engineered barriers can be recognized in calculating remediation objectives only if the engineered barriers are intended for use as part of the final corrective action.

d) Any "No Further Remediation" determination based upon the use of engineered barriers shall require effective maintenance of the engineered barrier. The maintenance requirements shall be included in an institutional control under Subpart J and are to be maintained by the owner of the site. This responsibility shall be transferrable with the property. This institutional control shall address provisions for temporary breaches of the barrier by requiring the following if intrusive construction work is to be performed in which the engineered barrier is to be temporarily breached:

1) The construction workers shall be notified by the site owner/operator in advance of intrusive activities. Such notification shall enumerate the contaminant of concern known to be present; and

2) The site owner/operator shall require construction workers to implement protective measures consistent with good industrial hygiene practice.

e) Failure to maintain an engineered barrier in accordance with the "No Further Remediation" determination shall be grounds for voidance of the determination.

Section 742.1105 Engineered Barrier Requirements

a) Natural attenuation, access controls, and point of use treatment shall not be considered engineered barriers. Engineered barriers may not be used to prevent direct human exposure to groundwater.

b) For purposes of determining remediation objectives under Tier 1, engineered barriers are not recognized.

c) The following engineered barriers are recognized for purposes of calculating remediation objectives that exceed residential remediation objectives:

1) For the migration to groundwater portion of the groundwater ingestion exposure route, the following engineered barriers are recognized:

A) Caps, covering the contaminated media, constructed of compacted clay, asphalt, concrete or other material approved by the Agency; and

B) Permanent structures such as buildings and highways.

2) For the soil ingestion exposure route, the following engineered barriers are recognized:

A) Caps, covering the contaminated media, constructed of compacted clay, asphalt, concrete, or other material approved by the Agency;

B) Permanent structures such as buildings and highways; and

C) Clean soil, covering the contaminated media, that is a minimum of one (1) meter in depth.

3) For the inhalation exposure route, the following engineered barriers are recognized:

A) Caps, covering the contaminated media, constructed of compacted clay, asphalt, concrete, or other material approved by the Agency; and

B) Permanent structures such as buildings and highways.

4) For the ingestion of groundwater exposure route, the following engineered barriers are recognized:

A) Slurry walls; and

B) Hydraulic control of groundwater.

d) Unless otherwise prohibited under Section 742.1100, any other type of engineered barrier may be proposed if it will be as effective as the options listed in subsection (c) of this Section.

Section 742.APPENDIX A: General

TABLE A: Soil Saturation Limits (C_{sat}) for Chemicals Whose Melting Point is Less than 30° C.

Chemical Name	C_{sat} (mg/kg)
Acetone	100,000
Benzene	870
Bis(2-chloroethyl)ether	3,300
Bis(2-ethylhexyl)phthalate	31,000
Bromodichloromethane (Dichlorobromomethane)	3,000
Bromoform	1,900
Butanol	10,000
Butyl benzyl phthalate	930
Carbon disulfide	720
Carbon tetrachloride	1,100
Chlorobenzene (Monochlorobenzene)	680
Chlorodibromomethane (Dibromochloromethane)	1,300
Chloroform	2,900
1,2-Dibromo-3-chloropropane	1,400
1,2-Dibromoethane (Ethylene dibromide)	2,800
Di-n-butyl phthalate	2,300
1,2-Dichlorobenzene (o-Dichlorobenzene)	560
1,1-Dichloroethane	1,700
1,2-Dichloroethane (Ethylene dichloride)	1,800
1,1-Dichloroethylene	1,500
cis-1,2-Dichloroethylene	1,200
trans-1,2-Dichloroethylene	3,100
1,2-Dichloropropane	1,100
1,3-Dichloropropene (1,3-Dichloropropylene, cis + trans)	1,400

Chemical Name	C_{sat} (mg/kg)
Diethyl phthalate	2,000
Di-n-octyl phthalate	10,000
Ethylbenzene	400
Hexachlorocyclopentadiene	2,200
Isophorone	4,600
Methyl bromide (Bromomethane)	3,200
Methylene chloride (Dichloromethane)	2,400
Nitrobenzene	1,000
Styrene	1,500
Tetrachloroethylene (Perchloroethylene)	240
Toluene	650
1,2,4-Trichlorobenzene	3,200
1,1,1-Trichloroethane	1,200
1,1,2-Trichloroethane	1,800
Trichloroethylene	1,300
Vinyl acetate	2,700
Vinyl chloride	1,200
m-Xylene	420
o-Xylene	410
p-Xylene	460
Xylenes (total)	410
Ionizable Organics	
2-Chlorophenol	53,000

Section 742.APPENDIX A: General

TABLE B: Tolerance Factor (K)

Tolerance factors (K) for one-sided normal tolerance intervals with probability level (confidence factor) Y = 0.95 and coverage P = 95%. n = number of samples collected.

n	K	n	K
3	7.655	350	1.787
4	5.145	375	1.782
5	4.202	400	1.777
6	3.707	425	1.773
7	3.399	450	1.769
8	3.188	475	1.766
9	3.031	500	1.763
10	2.911	525	1.760
11	2.815	550	1.757
12	2.736	575	1.754
13	2.670	600	1.752
14	2.614	625	1.750
15	2.566	650	1.748
16	2.523	675	1.746
17	2.486	700	1.744
18	2.543	725	1.742
19	2.423	750	1.740
20	2.396	775	1.739
21	2.371	800	1.737
22	2.350	825	1.736
23	2.329	850	1.734
24	2.309	875	1.733
25	2.292	900	1.732
30	2.220	925	1.731
35	2.166	950	1.729
40	2.126	975	1.728
45	2.092	1000	1.727
50	2.065		
55	2.036		
60	2.017		
65	2.000		
70	1.986		
75	1.972		
100	1.924		
125	1.891		
150	1.868		
175	1.850		
200	1.836		
225	1.824		
250	1.814		
275	1.806		
300	1.799		
325	1.792		

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TABLE C: Coefficients $\{A_{N-I+1}\}$ for W Test of Normality, for N=2(1)50

i/n	2	3	4	5	6	7	8	9	10	
1	0.7071	0.7071	0.6872	0.6646	0.6431	0.6233	0.6052	0.5888	0.5739	
2	---	.0000	.1677	.2413	.2806	.3031	.3164	.3244	.3291	
3	---	---	---	.0000	.0875	.1401	.1743	.1976	.2141	
4	---	---	---	---	---	.0000	.0561	.0947	.1224	
5	---	---	---	---	---	---	---	.0000	.0399	
i/n	11	12	13	14	15	16	17	18	19	20
1	0.5601	0.5475	0.5359	0.5251	0.5150	0.5056	0.4968	0.4886	0.4808	0.4734
2	.3315	.3325	.3325	.3318	.3306	.3290	.3273	.3253	.3232	.3211
3	.2260	.2347	.2412	.2460	.2495	.2521	.2540	.2553	.2561	.2565
4	.1429	.1586	.1707	.1802	.1878	.1939	.1988	.2027	.2059	.2085
5	.0695	.0922	.1099	.1240	.1353	.1447	.1524	.1587	.1641	.1686
6	0.0000	0.0303	0.0539	0.0727	0.0880	0.1005	0.1109	0.1197	0.1271	0.1334
7	---	---	.0000	.0240	.0433	.0593	.0725	.0837	.0932	.1013
8	---	---	---	---	.0000	.0196	.0359	.0496	.0612	.0711
9	---	---	---	---	---	---	.0000	.0163	.0303	.0422
10	---	---	---	---	---	---	---	---	.0000	.0140

i/n	21	22	23	24	25	26	27	28	29	30
1	0.4643	0.4590	0.4542	0.4493	0.4450	0.4407	0.4366	0.4328	0.4291	0.4254
2	.3185	.3156	.3126	.3098	.3069	.3043	.3018	.2992	.2968	.2944
3	.2578	.2571	.2563	.2554	.2543	.2533	.2522	.2510	.2499	.2487
4	.2119	.2131	.2139	.2145	.2148	.2151	.2152	.2151	.2150	.2148
5	.1736	.1764	.1787	.1807	.1822	.1836	.1848	.1857	.1864	.1870
6	0.1399	0.1443	0.1480	0.1512	0.1539	0.1563	0.1584	0.1601	0.1616	0.1630
7	.1092	.1150	.1201	.1245	.1283	.1316	.1346	.1372	.1395	.1415
8	.0804	.0878	.0941	.0997	.1046	.1089	.1128	.1162	.1192	.1219
9	.0530	.0618	.0696	.0764	.0823	.0876	.0923	.0965	.1002	.1036
10	.0263	.0368	.0459	.0539	.0610	.0672	.0728	.0778	.0822	.0862
11	0.0000	0.0122	0.0228	0.0321	0.0403	0.0476	0.0540	0.0598	0.0650	0.0697
12	---	---	.0000	.0107	.0200	.0284	.0358	.0424	.0483	.0537
13	---	---	---	---	.0000	.0094	.0178	.0253	.0320	.0381
14	---	---	---	---	---	---	.0000	.0084	.0159	.0227
15	---	---	---	---	---	---	---	---	.0000	.0076

i/n	31	32	33	34	35	36	37	38	39	40
1	0.4220	0.4188	0.4156	0.4127	0.4096	0.4068	0.4040	0.4015	0.3989	0.3964
2	.2921	.2898	.2876	.2854	.2834	.2813	.2794	.2774	.2755	.2737
3	.2475	.2463	.2451	.2439	.2427	.2415	.2403	.2391	.2380	.2368
4	.2145	.2141	.2137	.2132	.2127	.2121	.2116	.2110	.2104	.2098
5	.1874	.1878	.1880	.1882	.1883	.1883	.1883	.1881	.1880	.1878
i/n	31	32	33	34	35	36	37	38	39	40
6	0.1641	0.1651	0.1660	0.1667	0.1673	0.1678	0.1683	0.1686	0.1689	0.1691
7	.1433	.1449	.1463	.1475	.1487	.1496	.1503	.1513	.1520	.1526
8	.1243	.1265	.1284	.1301	.1317	.1331	.1344	.1356	.1366	.1376
9	.1066	.1093	.1118	.1140	.1160	.1179	.1196	.1211	.1225	.1237
10	.0899	.0931	.0961	.0988	.1013	.1036	.1056	.1075	.1092	.1108
11	0.0739	0.0777	0.0812	0.0844	0.0873	0.0900	0.0924	0.0947	0.0967	0.0986
12	.0585	.0629	.0669	.0706	.0739	.0770	.0798	.0824	.0848	.0870
13	.0435	.0485	.0530	.0572	.0610	.0645	.0677	.0706	.0733	.0759
14	.0289	.0344	.0395	.0441	.0484	.0523	.0559	.0592	.0622	.0651
15	.0144	.0206	.0262	.0314	.0361	.0404	.0444	.0481	.0515	.0546

16	0.0000	0.0068	0.0131	0.0187	0.0239	0.0287	0.0331	0.0372	0.0409	0.0444
17	---	---	.0000	.0062	.0119	.0172	.0220	.0264	.0305	.0343
18	---	---	---	---	.0000	.0057	.0110	.0158	.0203	.0244
19	---	---	---	---	---	---	.0000	.0053	.0101	.0146
20	---	---	---	---	---	---	---	---	.0000	.0049
i/n	41	42	43	44	45	46	47	48	49	50
1	0.3940	0.3917	0.3894	0.3872	0.3850	0.3830	0.3808	0.3789	0.3770	0.3751
2	.2719	.2701	.2684	.2667	.2651	.2635	.2620	.2604	.2589	.2574
3	.2357	.2345	.2334	.2323	.2313	.2302	.2291	.2281	.2271	.2260
4	.2091	.2085	.2078	.2072	.2065	.2058	.2052	.2045	.2038	.2032
5	.1876	.1874	.1871	.1868	.1865	.1862	.1859	.1855	.1851	.1847
i/n	41	42	43	44	45	46	47	48	49	50
6	0.1693	0.1694	0.1695	0.1695	0.1695	0.1695	0.1695	0.1693	0.1692	0.1691
7	.1531	.1535	.1539	.1542	.1545	.1548	.1550	.1551	.1553	.1554
8	.1384	.1392	.1398	.1405	.1410	.1415	.1420	.1423`	.1427	.1430
9	.1249	.1259	.1269	.1278	.1286	.1293	.1300	.1306	.1312	.1317
10	.1123	.1136	.1149	.1160	.1170	.1180	.1189	.1197	.1205	.1212

11	0.1004	0.1020	0.1035	0.1049	0.1062	0.1073	0.1085	0.1095	0.1105	0.1113
12	.0891	.0909	.0927	.0943	.0959	.0972	.0986	.0998	.1010	.1020
13	.0782	.0804	.0824	.0842	.0860	.0876	.0892	.0906	.0919	.0932
14	.0677	.0701	.0724	.0745	.0775	.0785	.0801	.0817	.0832	.0846
15	.0575	.0602	.0628	.0651	.0673	.0694	.0713	.0731	.0748	.0764
16	0.0476	0.0506	0.0534	0.0560	0.0584	0.0607	0.0628	0.0648	0.0667	0.0685
17	.0379	.0411	.0442	.0471	.0497	.0522	.0546	.0568	.0588	.0608
18	.0283	.0318	.0352	.0383	.0412	.0439	.0465	.0489	.0511	.0532
19	.0188	.0227	.0263	.0296	.0328	.0357	.0385	.0411	.0436	.0459
20	.0094	.0136	.0175	.0211	.0245	.0277	.0307	.0335	.0361	.0386
21	0.0000	0.0045	0.0087	0.0126	0.0163	0.0197	0.0229	0.0259	0.0288	0.0314
22	---	---	.0000	.0042	.0081	.0118	.0153	.0185	.0215	.0244
23	---	---	---	---	.0000	.0039	.0076	.0111	.0143	.0174
24	---	---	---	---	---	---	.0000	.0037	.0071	.0104
25	---	---	---	---	---	---	---	---	.0000	.0035

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TABLE D: Percentage Points of the W Test for N=3(1)50

n	0.01	0.05
3	0.753	0.767
4	0.687	0.748
5	0.686	0.762
6	0.713	0.788
7	0.730	0.803
8	0.749	0.818
9	0.764	0.829
10	0.781	0.842
11	0.792	0.850
12	0.805	0.859
13	0.814	0.866
14	0.825	0.874
15	0.835	0.881
16	0.844	0.887
17	0.851	0.892
18	0.858	0.897
19	0.863	0.901
20	0.868	0.905
21	0.873	0.908
22	0.878	0.911
23	0.881	0.914
24	0.884	0.916
25	0.888	0.918
26	0.891	0.920
27	0.894	0.923
28	0.896	0.924
29	0.898	0.926
30	0.900	0.927
31	0.902	0.929
32	0.904	0.930
33	0.906	0.931
34	0.908	0.933
35	0.910	0.934

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TABLE E: SSL Chemicals with Noncarcinogenic Toxic Effects on Specific Target Organs/Organ Systems or Similar Modes of Action

Kidney
Acetone
Cadmium
Chlorobenzene
Dalapon
1,1-Dichloroethane
Di-n-octyl phthalate
Endosulfan
Ethylbenzene
Fluoranthene
Nitrobenzene
Pyrene
Toluene
2,4,5-Trichlorophenol
Vinyl acetate

Liver
Acenaphthene
Acetone
Butylbenzyl phthalate
Chlorobenzene
Di-n-octyl phthalate
Endrin
Ethylbenzene
Fluoranthene
Nitrobenzene
Picloram
Styrene
2,4,5-TP (Silvex)
Toluene
2,4,5-Trichlorophenol

Central Nervous System
Butanol
Cyanide (amendable)
2,4-Dimethylpheno-l
Endrin
Manganese
2-Methylphenol
Mercury
Styrene
Xylenes

Circulatory System
Antimony
Barium
2,4-D
cis-1,2-Dichloroethylene
Nitrobenzene
trans 1,2-Dichloroethylene
2,4-Dimethylphenol
Fluoranthene
Fluorene
Styrene
Zinc

Gastrointestinal System
Endothall
Hexachlorocyclopentadiene
Methyl bromide

Reproductive System
Barium
Boron
Carbon disulfide
2-Chlorophenol
1,2 Dibromo-3-Chloropropane (Inhalation only)
Dinoseb
Methoxychlor
Phenol

Cholinesterase Inhibition
Aldicarb
Carbofuran

Decreased Body Weight Gains and Circulatory System Effects
Atrazine
Simazine

Adrenal Gland
Nitrobenzene

1,2,4-Trichlorobenzene

Respiratory System
1,2-Dichloropropane
Hexachlorocyclopentadiene
Methyl bromide
Vinyl acetate

Immune System
2,4-Dichlorophenol
p-Chloroaniline

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TABLE F: Range of Concentrations of Inorganic Chemicals in Background Soils

Chemical Name	Counties Within Metropolian Statistical Areas[a] (mg/kg)	Counties Outside Metropolitan Statistical Areas (mg/kg)
Aluminum	1,388 - 37,200	2,640 - 23,300
Antimony	0.24 - 8	0.18 - 8.6
Arsenic	1.1 - 24	0.35 - 22.4
Barium	ND[b] (<5) - 1,720	22.4 - 253
Beryllium	0.05 - 9.9	ND (<0.02) - 8.8
Cadmium	ND (<2.5) - 8.2	ND (<0.2) - 5.2
Calcium	813 - 130,000	630 - 184,000
Chromium	ND (<2.14) - 151	4.3 - 37
Cobalt	2.1 - 23	0.9 - 32
Copper	ND (<2.93) - 156	1 - 42
Cyanide	ND (<0.07) - 2.7	ND (<0.06) - 1.2
Iron	5,000 - 80,000	3,200 - 29,100
Lead	4.7 - 647	ND (<7.44) - 270
Magnesium	541 - 74,500	476 - 24,100
Manganese	155 - 5,590	61.5 - 3,710
Mercury	0.02 - 0.99	ND (<0.01) - 1.67

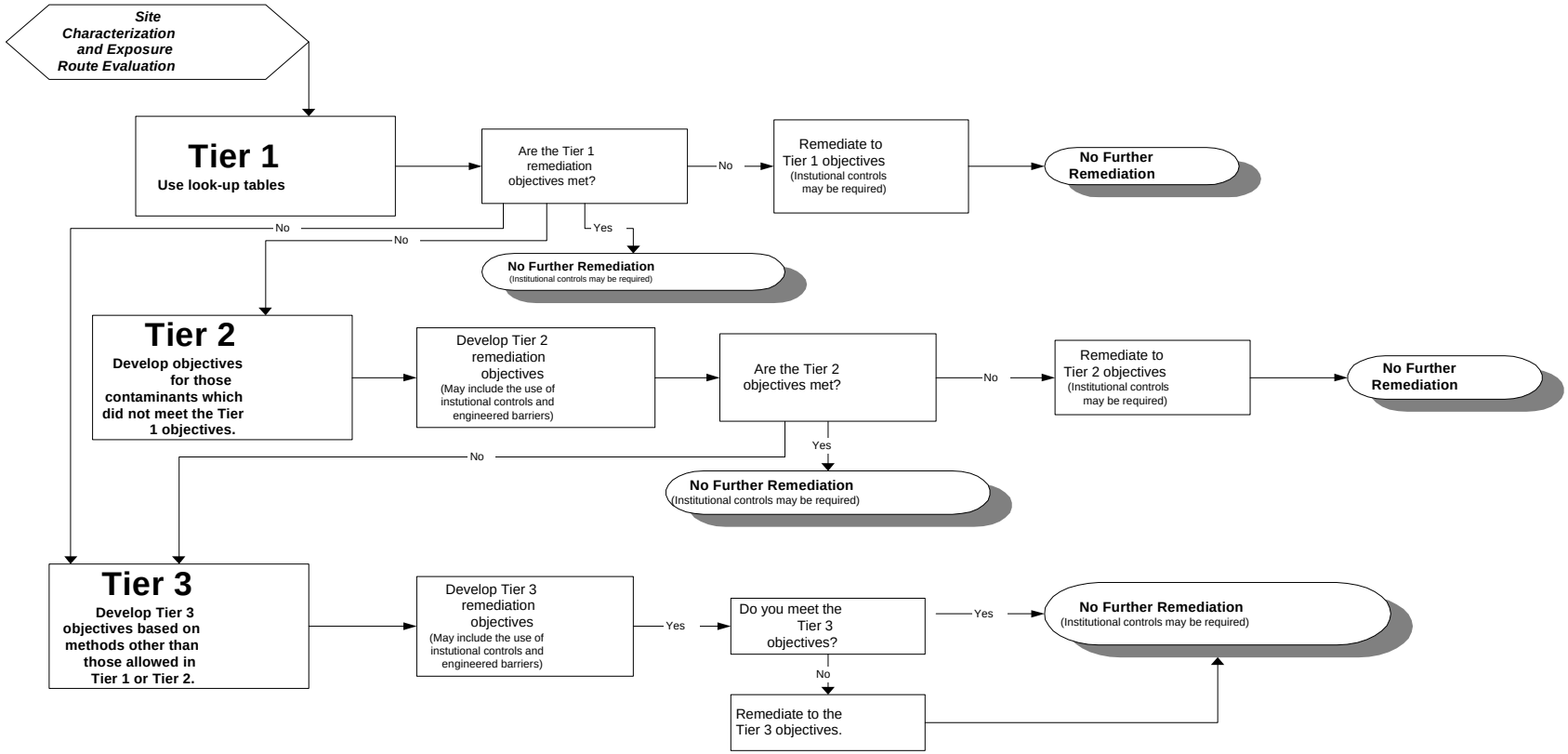
[a]Counties within Metropolitan Statistical Areas: Boone, Champaign, Clinton, Cook, DuPage, Grundy, Henry, Jersey, Kane, Kankakee, Kendall, Lake, Macon, Madison, McHenry, McLean, Menard, Monroe, Peoria, Rock Island, Sangamon, St. Clair, Tazewell, Will, Winnebago, and Woodford.

[b]ND = Below the Detection Limit

Chemical Name	Counties Within Metropolian Statistical Areas[a] (mg/kg)	Counties Outside Metropolitan Statistical Areas (mg/kg)
Nickel	ND (<3.1) - 135	ND (<5) - 34.6
Potassium	270 - 5,820	280 - 5,600
Selenium	ND (,0.12) - 2.6	ND (<0.1) - 1.7
Silver	ND (<0.32) - 5.6	ND (<0.06) - 5.9
Sodium	20.2 - 1,290	14.1 - 7,600
Sulfate	17.6 - 240	10 - 260
Sulfide	ND (<1.00) - 10.1	ND (<1) - 8.8
Thallium	0.02 - 1.6	0.05 - 2.8
Vanadium	ND (<2.5) - 80	6 - 47
Zinc	23 - 798	ND (<5.5) - 400

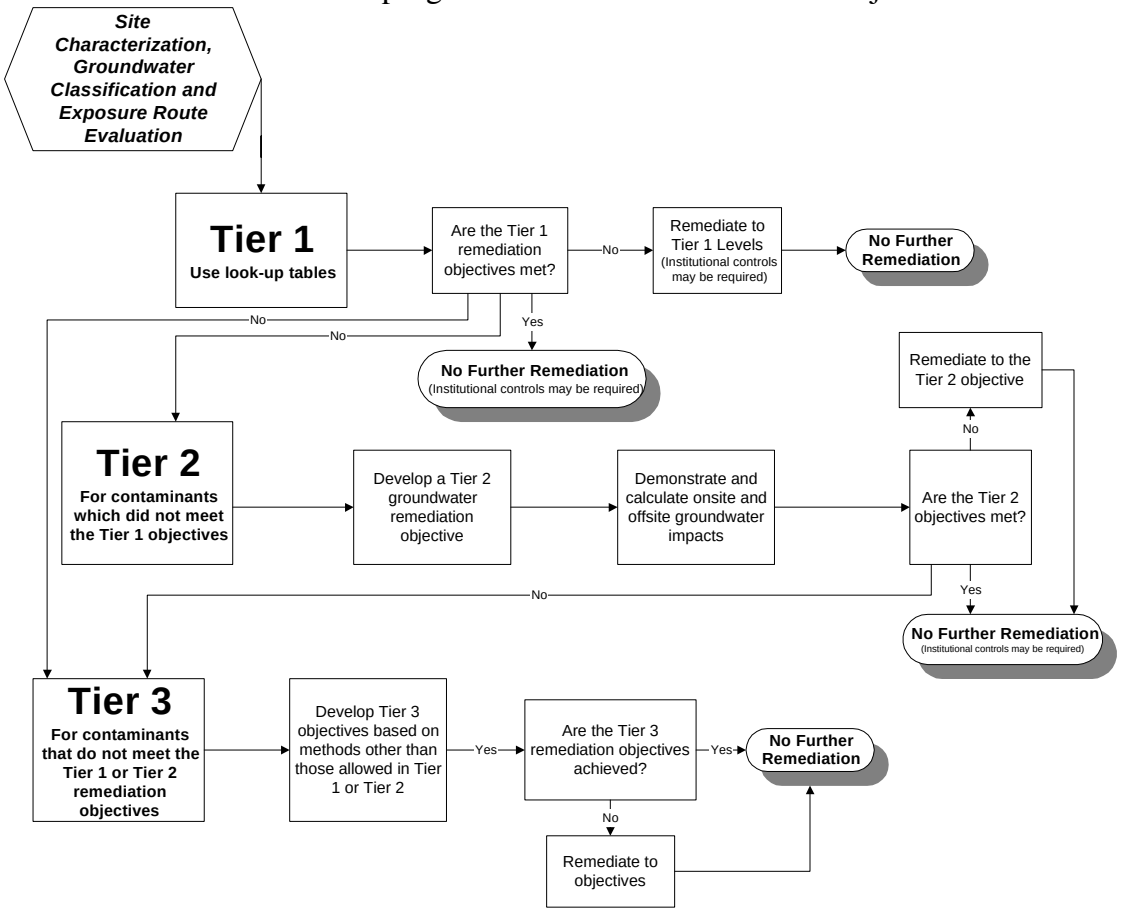
Section 742.APPENDIX A: General

Illustration A: Developing Soil Remediation Objectives Under the Tiered Approach



Section 742.APPENDIX A: General

Illustration B: Developing Groundwater Remediation Objectives Under the Tiered Approach



Section 742.APPENDIX B: Tier 1 Tables and Illustrations

TABLE A: Tier 1 Soil Remediation Objectives[a] for Residential Properties

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
83-32-9	Acenaphthene	4,700[b]	---[c]	570[b]	2,800	*
67-64-1	Acetone	7,800[b]	100,000[d]	16[b]	16	*
15972-60-8	Alachlor[o]	8[e]	---[c]	0.04	0.2	NA
116-06-3	Aldicarb[o]	78[b]	---[c]	0.013	0.07	NA
309-00-2	Aldrin	0.04[e]	3[e]	0.5[e]	2.5	*
120-12-7	Anthracene	23,000[b]	---[c]	12,000[b]	60,000	*
1912-24-9	Atrazine[o]	2700[b]	---[c]	0.066	0.33	NA
71-43-2	Benzene	22[e]	0.8[e]	0.03	0.15	*
56-55-3	Benzo(a)anthracene	0.9[e]	---[c]	2	10	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
205-99-2	Benzo(b)fluoranthene	0.9[e]	---[c]	5	25	*
207-08-9	Benzo(k)fluroanthene	9[e]	---[c]	49	240	*
50-32-8	Benzo(a)pyrene	0.09[e,f]	---[c]	8	80	*
111-44-4	Bis(2-chloroethyl)ether	0.6[e]	0.2[e,f]	0.0004[e,f]	0.0004	0.66
117-81-7	Bis(2-ethylhexyl)phthalate	46[e]	31,000[d]	3,600	31,000[d]	*
75-27-4	Bromodichloromethane (Dichlorobromomethane)	10[e]	3,000[d]	0.6	3	*
75-25-2	Bromoform	81[e]	53[e]	0.8	4	*
71-36-3	Butanol	7,800[b]	10,000[d]	17[b]	17	NA
85-68-7	Butyl benzyl phthalate	16,000[b]	930[d]	930[d]	930[d]	*
86-74-8	Carbazole	32[e]	---[c]	---	---	NA
1563-66-2	Carbofuran[o]	390[b]	---[c]	0.22	1.1	NA
75-15-0	Carbon disulfide	7,800[b]	720[d]	32[b]	160	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
56-23-5	Carbon tetrachloride	5[e]	0.3[e]	0.07	0.35	*
57-74-9	Chlordane	0.5[e]	20[e]	10	50	*
108-90-7	Chlorobenzene (Monochlorobenzene)	1,600[b]	130[b]	1	5	*
124-48-1	Chlorodibromomethane (Dibromochloromethane)	1,400[b]	1,300[d]	0.4	2	*
67-66-3	Chloroform	100[e]	0.3[e]	0.6	3	*
218-01-9	Chrysene	88[e]	---[c]	160	800	*
94-75-7	2,4-D	780[b]	---[c]	1.5	7.7	*
75-99-0	Dalapon	2,300[b]	---[c]	0.85	8.5	1.2
72-54-8	DDD	3[e]	---[c]	16[e]	80	*
72-55-9	DDE	2[e]	---[c]	54[e]	270	*
50-29-3	DDT	2[e]	---[g]	32[e]	160	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
53-70-3	Dibenzo(a,h)anthracene	0.09[e,f]	---[c]	2	10	*
96-12-8	1,2-Dibromo-3-chloropropane	0.46[e]	16[b]	0.002	0.002	*
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.0075[e]	0.24[e]	0.0004	0.004	0.005
84-74-2	Di-n-butyl phthalate	7,800[b]	2,300[d]	2,300[d]	2,300[d]	*
95-50-1	1,2-Dichlorobenzene (o - Dichlorobenzene)	7,000[b]	560[d]	17	85	*
106-46-7	1,4-Dichlorobenzene (p - Dichlorobenzene)	---[c]	---[g]	2	10	*
91-94-1	3,3'-Dichlorobenzidine	1[e]	---[c]	0.007[e,f]	0.035[e]	1.3
75-34-3	1,1-Dichloroethane	7,800[b]	1,300[b]	23[b]	110	*
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	7[e]	0.4[e]	0.02	0.1	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
75-35-4	1,1-Dichloroethylene	630[b]	1,500[d]	0.06	0.3	*
156-59-2	cis-1,2-Dichloroethylene	780[b]	1,200[d]	0.4	1.1	*
156-60-5	trans-1,2-Dichloroethylene	1,600[b]	3,100[d]	0.7	3.5	*
78-97-5	1,2-Dichloropropane	9[e]	15[b]	0.03	1.5	*
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, cis + trans)	4[e]	0.1[e]	0.004[e]	0.02	0.005
60-57-1	Dieldrin[n]	0.04[e]	1[e]	0.004[e]	0.02	*
84-66-2	Diethyl phthalate	63,000[b]	2,000[d]	470[b]	470	*
121-14-2	2,4-Dinitrotoluene	0.9[e]	---[c]	0.0008[e,f]	0.0008	0.013
606-20-2	2,6-Dinitrotoluene	0.9[e]	---[c]	0.0007[e,f]	0.0007	0.0067
117-84-0	Di-n-octyl phthalate	1,600[b]	10,000[d]	10,000[d]	10,000[d]	*
115-29-7	Endosulfan	470[b]	---[c]	18[b]	18	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
145-73-3	Endothall[o]	1,600[b]	---[c]	0.4	0.4	NA
72-20-8	Endrin	23[b]	---[c]	1	5	*
100-41-4	Ethylbenzene	7,800[b]	400[d]	13	19	*
206-44-0	Fluoranthene	3,100[b]	---[c]	4,300[b]	21,000	*
86-73-7	Fluorene	3,100[b]	---[c]	560[b]	2,800	*
76-44-8	Heptachlor	0.1[e]	0.1[e]	23	110	*
1024-57-3	Heptachlor epoxide	0.07[e]	5[e]	0.7	3.5	*
118-74-1	Hexachlorobenzene	0.4[e]	1[e]	2	20	*
319-84-6	alpha-HCH (alpha-BHC)	0.1[e]	0.8[e]	0.0005[e,f]	0.0025	0.002
58-89-9	gamma-HCH (Lindane)[n]	0.5[e]	---[c]	0.009	0.045	*
77-47-4	Hexachlorocyclopentadiene	550[b]	10[b]	400	2,200[d]	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
67-72-1	Hexachloroethane	78[b]	---[c]	0.5[b]	0.5	*
193-39-5	Indeno(1,2,3-c,d)pyrene	0.9[e]	---[c]	14	70	*
78-59-1	Isophorone	15,600[b]	4,600[d]	8[b]	8	*
72-43-5	Methoxychlor	390[b]	---[c]	160	800	*
74-83-9	Methyl bromide (Bromomethane)	110[b]	10[b]	0.2[b]	0.2	*
75-09-2	Methylene chloride (Dichloromethane)	85[e]	13[e]	0.02[e]	0.2	*
91-20-3	Naphthalene	3,100[b]	---[c]	84[b]	130	*
98-95-3	Nitrobenzene	39[b]	92[b]	0.1[b,f]	0.1	0.26
1918-02-1	Picloram[o]	5,500[b]	---[c]	2	20	NA
1336-36-3	Polychlorinated biphenyls (PCBs)[n]	1; 10[h]	---[c,h]	---[h]	---[h]	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
129-00-0	Pyrene	2,300[b]	---[c]	4,200[b]	21,000	*
122-34-9	Simazine[o]	390[b]	---[c]	0.04	0.4	NA
100-42-5	Styrene	16,000[b]	1,500[d]	4	20	*
127-18-4	Tetrachloroethylene (Perchloroethylene)	12[e]	11[e]	0.06	0.3	*
108-88-3	Toluene	16,000[b]	650[d]	12	30	*
8001-35-2	Toxaphene[n]	0.6[e]	89[e]	31	150	*
120-82-1	1,2,4-Trichlorobenzene	780[b]	3,200[b]	5	50	*
71-55-6	1,1,1-Trichloroethane	---[c]	1,200[d]	2	10	*
79-00-5	1,1,2-Trichloroethane	310[b]	1,800[d]	0.02	0.2	*
79-01-6	Trichloroethylene	58[e]	5[e]	0.06	0.3	*
108-05-4	Vinyl acetate	78,000[b]	1,000[b]	170[b]	170	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
75-01-4	Vinyl chloride	0.3[e]	0.03[e]	0.01[f]	0.05	*
108-38-3	m-Xylene	160,000[b]	420[d]	210	210	*
95-47-6	o-Xylene	160,000[b]	410[d]	190	190	*
106-42-3	p-Xylene	160,000[b]	460[d]	200	200	*
1330-20-7	Xylenes (total)	160,000[b]	410[d]	190	190	*
	Ionizable Organics					
65-85-0	Benzoic Acid	310,000[b]	---[c]	400[b,i]	400[i]	*
106-47-8	4-Chloroaniline (p-Chloroaniline)	310[b]	---[c]	0.7[b]	0.7	1.3
95-57-8	2-Chlorophenol	390[b]	53,000[d]	4[b,i]	4[i]	*
120-83-2	2,4-Dichlorophenol	230[b]	---[c]	1[b,i]	1[i]	*
105-67-9	2,4-Dimethylphenol	1,600[b]	---[c]	9[b]	9	*

		Exposure Route-Specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
51-28-5	2,4-Dinitrophenol	160[b]	---[c]	0.3[b,f]	0.3	3.3
88-85-7	Dinoseb[o]	78[b]	---[c]	0.34[b,i]	3.4[i]	*
95-48-7	2-Methylphenol (o - Cresol)	3,900[b]	---[c]	15[b]	15	*
86-30-6	N-Nitrosodiphenylamine	130[e]	---[c]	1[e]	1	*
621-64-7	N-Nitrosodi-n-propylamine	0.09[e,f]	---[c]	0.00005[e,f]	0.00005	0.66
87-86-5	Pentachlorophenol	3[e,j]	---[c]	0.03[f,i]	0.15[i]	2.4
108-95-2	Phenol	47,000[b]	---[c]	100[b]	100	*
93-72-1	2,4,5-TP (Silvex)	630[b]	---[c]	11[i]	55[i]	*
95-95-4	2,4,5-Trichlorophenol	7,800[b]	---[c]	270[b,i]	1,200[i]	*
88-06-2	2,4,6 Trichlorophenol	58[e]	200[e]	0.2[e,f,i]	0.2[i]	0.43

		Exposure Route-specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L) TCLP	Class II (mg/L) TCLP	ADL (mg/kg)
	Inorganics					
7440-36-0	Antimony	31[b]	---[c]	0.006[m]	0.024[m]	*
7440-38-2	Arsenic[l,n]	0.4[e,t]	750[e]	0.05[m]	0.2[m]	*
7440-39-3	Barium	5,500[b]	690,000[b]	2.0[m]	2.0[m]	*
7440-41-7	Beryllium	0.1[e,t]	1,300[e]	0.004[m]	0.5[m]	*
7440-42-8	Boron	7,000[b]	---[c]	2.0[m]	2.0[m]	*
7440-43-9	Cadmium[l,n]	78[b, r]	1,800[e]	0.005[m]	0.05[m]	*
16887-00-6	Chloride	---[c]	---[c]	200[m]	200[m]	*
7440-47-3	Chromium, total	390[b]	270[e]	0.1[m]	1.0[m]	*
16065-83-1	Chromium, ion, trivalent	78,000[b]	---[c]	---[g]	---[g]	*
18540-29-9	Chromium, ion, hexavalent	390[b]	270[e]	---	---	*
7440-48-4	Cobalt	4,700[b]	---[c]	1.0[m]	1.0[m]	*

		Exposure Route-specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L) TCLP	Class II (mg/L) TCLP	ADL (mg/kg)
7440-50-8	Copper[n]	2,900[b]	---[c]	0.65[m]	0.65[m]	*
57-12-5	Cyanide (amenable)	1,600[b]	---[c]	0.2[q]	0.6[q]	*
7782-41-4	Fluoride	4,700[b]	---[c]	4.0[m]	4.0[m]	*
15438-31-0	Iron	---[c]	---[c]	5.0[m]	5.0[m]	*
7439-92-1	Lead	400[k]	---[c]	0.0075[m]	0.1[m]	*
7439-96-5	Manganese	3,900[b]	74,000[b]	0.15[m]	10.0[m]	*
7439-97-6	Mercury[l,n]	23[b,s]	10[b,i]	0.002[m]	0.01[m]	*
7440-02-0	Nickel[l]	1,600[b]	13,000[e]	0.1[m]	2.0[m]	*
14797-55-8	Nitrate as N[p]	130,000[b]	---[c]	10.0[m]	100[m]	*
7782-49-2	Selenium[l,n]	390[b]	---[c]	0.05[m]	0.05[m]	*

		Exposure Route-specific Values for Soils		Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L) TCLP	Class II (mg/L) TCLP	ADL (mg/kg)
7440-22-4	Silver	390[b]	---[c]	0.05[m]	---	*
14808-79-8	Sulfate	---[c]	---[c]	400[m]	400[m]	*
7440-28-0	Thallium	---[c]	---[c]	0.002[m]	0.02[m]	*
7440-62-2	Vanadium	550[b]	---[c]	0.049[m]	---	*
7440-66-6	Zinc[l]	23,000[b]	---[c]	5.0[o]	10[o]	*

"*" indicates that the ADL is less than or equal to the specified cleanup objective.
NA means not available; no PQL or EQL available in USEPA analytical methods.

Chemical Name and Soil Cleanup Objective Notations

[a] Soil cleanup objectives based on human health criteria only.

[b] Calculated values correspond to a target hazard quotient of 1.

[c] No toxicity criteria available for the route of exposure.

[d] Soil saturation concentration (C_{sat}) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.

[e] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[f] Level is at or below Contract Laboratory Program required quantitation limit for Regular Analytical Services (RAS).

[g] Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.

[h] A preliminary goal of 1 ppm has been set for PCBs based on Guidance on Remedial Actions for Superfund Sites with PCB Contamination, EPA/540G-90/007, and on USEPA efforts to manage PCB contamination. See 40 CFR 761.120 - USEPA "PCB Spill Cleanup Policy." This regulation goes on to say that the cleanup goal for an unrestricted area is 10 ppm and 25 ppm for a restricted area, provided both have at least 10 inches of clean cover.

[i] Soil cleanup objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D of this Part.

[j] Ingestion soil cleanup objective adjusted by a factor of 0.5 to account for dermal route.

[k] A preliminary remediation goal of 400 mg/kg has been set for lead based on Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive #9355.4-12.

[l] Potential for soil-plant-human exposure.

[m] Concentration in mg/L determined by the Toxicity Characteristic Leaching Procedure (TCLP). The person conducting the remediation has the option to use TCLP cleanup objectives listed in this Table or the applicable pH-specific soil cleanup objectives listed in Appendix B, Tables C or D of this Part. If the person conducting the remediation wishes to calculate soil cleanup objectives based on background concentrations, this should be done in accordance with Subpart D of this Part.

[n] The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.

[o] For agrichemical facilities, cleanup objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.

[p] For agrichemical facilities, soil cleanup objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the procedures set forth in Subparts D and I of this Part.

[q] For cyanide, the TCLP extraction must be done using water at a pH of 7.0.

r Value based on dietary Reference Dose.

s Value based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7).

t Note that Table value is likely to be less than background concentration for this chemical; screening or remediation concentrations using the procedures of Subpart D of this Part may be more appropriate.

Section 742.APPENDIX B: Tier 1 Tables and Illustrations

Table B: Tier 1 Soil Remediation Objectives[a] for Industrial/Commercial Properties

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
83-32-9	Acenaphthene	120,000[b]	-----[c]	120,000[b]	-----[c]	570[b]	2,800	*
67-64-1	Acetone	200,000[b]	100,000[d]	200,000[b]	100,000[d]	16[b]	16	*
15972-60-8	Alachlor[o]	72[e]	-----[c]	1,600[e]	-----[c]	0.04	0.2	NA
116-06-3	Aldicarb[o]	2,000[b]	-----[c]	200[b]	-----[c]	0.013	0.07	NA
309-00-2	Aldrin	0.3[e]	6.6[e]	6.1[b]	9.3[e]	0.5[e]	2.5	*
120-12-7	Anthracene	610,000[b]	-----[c]	610,000[b]	-----[c]	12,000[b]	60,000	*
1912-24-9	Atrazine[o]	72,000[b]	-----[c]	7,100[b]	-----[c]	0.066	0.33	NA
71-43-2	Benzene	200[e]	1.5[e]	4,300[e]	1.7[e]	0.03	0.15	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
56-55-3	Benzo(a)anthracene	8[e]	-----[c]	170[e]	-----[c]	2	10	*
205-99-2	Benzo(b)fluoranthene	8[e]	-----[c]	170[e]	-----[c]	5	25	*
207-08-9	Benzo(k)fluroanthene	78[e]	-----[c]	1,700[e]	-----[c]	49	240	*
50-32-8	Benzo(a)pyrene	0.8[e]	-----[c]	17[e]	-----[c]	8	80	*
117-81-7	Bis(2-ethylhexyl)phthalate	410[e]	31,000[d]	4,100[b]	31,000[d]	3,600	31,000[d]	*
75-27-4	Bromodichloromethane (Dichlorobromomethane)	92[e]	3,000[d]	2,000[e]	3,000[d]	0.6	3	*
75-25-2	Bromoform	720[e]	100[e]	16,000[e]	140[e]	0.8	4	*
71-36-3	Butanol	200,000[b]	10,000[d]	200,000[b]	10,000[d]	17[b]	17	NA
85-68-7	Butyl benzyl phthalate	410,000[b]	930[d]	410,000[b]	930[d]	930[d]	930[d]	*
86-74-8	Carbazole	290[e]	-----[c]	6,200[e]	-----[c]	-----	-----	NA

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1563-66-2	Carbofuran[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.22	1.1	NA
75-15-0	Carbon disulfide	200,000[b]	720[d]	20,000[b]	9.0[b]	32[b]	160	*
56-23-5	Carbon tetrachloride	44[e]	0.64[e]	410[b]	0.90[e]	0.07	0.35	*
57-74-9	Chlordane	4[e]	38[e]	12[b]	53[e]	10	50	*
108-90-7	Chlorobenzene (Monochlorobenzene)	41,000[b]	210[b]	4,100[b]	1.3[b]	1	5	*
124-48-1	Chlorodibromomethane (Dibromochloromethane)	41,000[b]	1,300[d]	41,000[b]	1,300[d]	0.4	2	*
67-66-3	Chloroform	940[e]	0.54[e]	2,000[b]	0.76[e]	0.6	3	*
218-01-9	Chrysene	780[e]	-----[c]	17,000[e]	-----[e]	160	800	*
94-75-7	2,4-D	20,000[b]	-----[c]	2,000[b]	-----[c]	1.5	7.7	*
75-99-0	Dalapon	61,000[b]	-----[c]	6,100[b]	-----[c]	0.85	8.5	1.2

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
72-54-8	DDD	24[e]	-----[c]	520[e]	-----[c]	16[e]	80	*
72-55-9	DDE	17[e]	-----[c]	370[e]	-----[c]	54[e]	270	*
50-29-3	DDT	17[e]	1,500[e]	100[b]	2,100[e]	32[e]	160	*
53-70-3	Dibenzo(a,h)anthracene	0.8[e]	-----[c]	17[e]	-----[c]	2	10	*
96-12-8	1,2-Dibromo-3-chloropropane	4[e]	17[b]	89[e]	0.11[b]	0.002	0.002	*
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.07[e]	0.32[e]	1.5[e]	0.45[e]	0.0004	0.004	0.005
84-74-2	Di-n-butyl phthalate	200,000[b]	2,300[d]	200,000[b]	2,300[d]	2,300[d]	2,300[d]	*
95-50-1	1,2-Dichlorobenzene (o - Dichlorobenzene)	180,000[b]	560[d]	18,000[b]	340[b]	17	85	*
106-46-7	1,4-Dichlorobenzene (p - Dichlorobenzene)	-----[c]	17,000[b]	-----[c]	350[b]	2	10	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
91-94-1	3,3'-Dichlorobenzidine	13[e]	-----[c]	280[e]	-----[c]	0.007[e,f]	0.035	1.3
75-34-3	1,1-Dichloroethane	200,000[b]	1,700[d]	200,000[b]	140[b]	23[b]	110	*
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	63[e]	0.70[e]	1,400[e]	0.99[e]	0.02	0.1	*
75-35-4	1,1-Dichloroethylene	18,000[b]	-----[c]	1,800[b]	-----[c]	0.06	0.3	*
156-59-2	cis-1,2-Dichloroethylene	20,000[b]	1,200[d]	20,000[b]	1,200[d]	0.4	1.1	*
156-60-5	trans-1,2-Dichloroethylene	41,000[b]	3,100[d]	41,000[b]	3,100[d]	0.7	3.5	*
78-97-5	1,2-Dichloropropane	84[e]	23[b]	1,800[e]	0.50[b]	0.03	1.5	*
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, cis + trans)	33[e]	0.23[e]	610[b]	0.33[e]	0.004[e]	0.02	0.005
60-57-1	Dieldrin[n]	0.4[e]	2.2[e]	7.8[e]	3.1[e]	0.004[e]	0.02	0.0013
84-66-2	Diethyl phthalate	1,000,000[b]	2,000[d]	1,000,000[b]	2,000[d]	470[b]	470	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
121-14-2	2,4-Dinitrotoluene	8.4[e]	-----[c]	180[e]	-----[c]	0.0008[e,f]	0.0008	0.013
606-20-2	2,6-Dinitrotoluene	8.4[e]	-----[c]	180[e]	-----[c]	0.0007[e,f]	0.0007	0.0067
117-84-0	Di-n-octyl phthalate	41,000[e]	10,000[d]	4,100[b]	10,000[d]	10,000[d]	10,000[d]	*
115-29-7	Endosulfan	12,000[e]	-----[c]	1,200[b]	-----[c]	18[b]	18	*
145-73-3	Endothall[o]	41,000[c]	-----[c]	4,100[b]	-----[c]	0.4	0.4	NA
72-20-8	Endrin	610[b]	-----[c]	61[b]	-----[c]	1	5	*
100-41-4	Ethylbenzene	200,000[b]	400[d]	20,000[b]	58[b]	13	19	*
206-44-0	Fluoranthene	82,000[b]	-----[c]	82,000[b]	-----[c]	4,300[b]	21,000	*
86-73-7	Fluorene	82,000[b]	-----[c]	82,000[b]	-----[c]	560[b]	2,800	*
76-44-8	Heptachlor	1[e]	11[e]	28[e]	16[e]	23	110	*
1024-57-3	Heptachlor epoxide	0.6[e]	9.2[e]	2.7[b]	13[e]	0.7	3.5	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
118-74-1	Hexachlorobenzene	4[e]	1.9[e]	78[e]	2.6[e]	2	20	*
319-84-6	alpha-HCH (alpha-BHC)	0.9[e]	1.5[e]	20[e]	2.1[e]	0.0005[e,f]	0.0025	0.002
58-89-9	gamma-HCH (Lindane)[n]	4[e]	-----[c]	96[e]	-----[c]	0.009	0.045	*
77-47-4	Hexachlorocyclopentadiene	14,000[b]	17[b]	14,000[b]	1.1[b]	400	2,200[d]	*
67-72-1	Hexachloroethane	2,000[b]	-----[c]	2,000[b]	-----[c]	0.5[b]	0.5	*
193-39-5	Indeno(1,2,3-c,d)pyrene	8[e]	-----[c]	170[e]	-----[c]	14	70	*
78-59-1	Isophorone	410,000[b]	4,600[d]	410,000[b]	4,600[d]	8[b]	8	*
72-43-5	Methoxychlor	10,000[b]	-----[c]	1,000[b]	-----[c]	160	800	*
74-83-9	Methyl bromide (Bromomethane)	2,900[b]	15[b]	1,000[b]	4.3[b]	0.2[b]	0.2	*
75-09-2	Methylene chloride (Dichloromethane)	760[e]	25[e]	12,000[b]	38[e]	0.02[e]	0.2	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
91-20-3	Naphthalene	82,000[b]	-----[c]	8,200[b]	-----[c]	84[b]	130	*
98-95-3	Nitrobenzene	1,000[b]	150[b]	1,000[b]	10[b]	0.1[b,f]	0.1	0.26
1918-02-1	Picloram[o]	140,000[b]	-----[c]	14,000[b]	-----[c]	2	20	NA
1336-36-3	Polychlorinated biphenyls (PCBs)[n]	1; 10; 25[h]	-----[c,h]	1[h]	-----[c,h]	-----[h]	-----[h]	*
129-00-0	Pyrene	61,000[b]	-----[c]	61,000[b]	-----[c]	4,200[b]	21,000	*
122-34-9	Simazine[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.04	0.4	NA
100-42-5	Styrene	410,000[b]	1,500[d]	41,000[b]	470[b]	4	20	*
127-18-4	Tetrachloroethylene (Perchloroethylene)	110[e]	20[e]	2,400[e]	31[e]	0.06	0.3	*
108-88-3	Toluene	410,000[b]	650[d]	410,000[b]	47[b]	12	30	*
8001-35-2	Toxaphene[n]	5.2[e]	170[e]	110[e]	260[e]	31	150	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
120-82-1	1,2,4-Trichlorobenzene	20,000[b]	3,200[d]	2,000[b]	1,000[b]	5	50	*
71-55-6	1,1,1-Trichloroethane	-----[c]	1,200[d]	-----[c]	1,200[d]	2	10	*
79-00-5	1,1,2-Trichloroethane	8,200[b]	-----[c]	1,200[b]	-----[c]	0.02	0.2	*
79-01-6	Trichloroethylene	520[e]	8.9[e]	1,200[b]	14[e]	0.06	0.3	*
108-05-4	Vinyl acetate	1,000,000[b]	1,600[b]	200,000[b]	11[b]	170[b]	170	*
75-01-4	Vinyl chloride	3[e]	0.31[e]	65[e]	0.47[e]	0.01[f]	0.05	*
108-38-3	m-Xylene	1,000,000	420[d]	410,000[b]	420[d]	210	210	*
95-47-6	o-Xylene	1,000,000	410[d]	410,000[b]	410[d]	190	190	*
106-42-3	p-Xylene	1,000,000	460[d]	410,000[b]	460[d]	200	200	*
1330-20-7	Xylenes (total)	1,000,000[b]	410[d]	410,000[b]	410[d]	190	190	*
65-85-0	Benzoic Acid	1,000,000[b]	-----[c]	820,000[b]	-----[c]	400[b,i]	400[i]	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
	Ionizable Organics							
106-47-8	4 - Chloroaniline (p-Chloroaniline)	8,200[b]	-----[c]	820[b]	-----[c]	0.7[b]	0.7	1.3
95-57-8	2-Chlorophenol	10,000[b]	53,000[d]	10,000[b]	53,000[d]	4[b,i]	4[i]	*
120-83-2	2,4-Dichlorophenol	6,100[b]	-----[c]	610[b]	-----[c]	1[b,i]	1[i]	*
105-67-9	2,4-Dimethylphenol	41,000[b]	-----[c]	41,000[b]	-----[c]	9[b]	9	*
51-28-5	2,4-Dinitrophenol	4,100[b]	-----[c]	410[b]	-----[c]	0.3[b,f,i]	0.3[i]	3.3
88-85-7	Dinoseb[o]	2,000[b]	-----[c]	200[b]	-----[c]	0.34[b,i]	3.4[i]	*
95-48-7	2-Methylphenol (o - Cresol)	100,000[b]	-----[c]	100,000[b]	-----[c]	15[b]	15	*
86-30-6	N-Nitrosodiphenylamine	1,200[e]	-----[c]	25,000[e]	-----[c]	1[e]	1	0.66
621-64-7	N-Nitrosodi-n-propylamine	0.8[e]	-----[c]	18[e]	-----[c]	0.00005[e,f]	0.00005	0.66
87-86-5	Pentachlorophenol	24[e,j]	-----[c]	520[e,j]	-----[c]	0.03[f,i]	0.15[i]	2.4

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
108-95-2	Phenol	1,000,000[b]	-----[c]	120,000[b]	-----[c]	100[b]	100	*
93-72-1	2,4,5-TP (Silvex)	16,000[b]	-----[c]	1,600[b]	-----[c]	11[i]	55[i]	*
95-95-4	2,4,5-Trichlorophenol	200,000[b]	-----[c]	200,000[b]	-----[c]	270[b,i]	1,200[i]	*
88-06-2	2,4,6 Trichlorophenol	520[e]	390[e]	11,000[e]	590[e]	0.2[e,f,i]	0.2[i]	0.43

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	
	Inorganics							
7440-36-0	Antimony	820[b]	-----[c]	82[b]	-----[c]	0.006[m]	0.024[m]	*
7440-38-2	Arsenic[l,n]	3[e,t]	1,200[e]	61[b]	25,000[e]	0.05[m]	0.2[m]	
7440-39-3	Barium	140,000[b]	910,000[b]	14,000[b]	870,000[b]	2.0[m]	2.0[m]	*
7440-41-7	Beryllium	1[e,t]	2,100[e]	29[e]	44,000[e]	0.004[m]	0.5[m]	*
7440-42-8	Boron	180,000[b]	1,000,000	18,000[b]	1,000,000	2.0[m]	2.0[m]	*
7440-43-9	Cadmium[l,n]	2,000[b,r]	2,800[e]	200[b,r]	59,000[e]	0.005[m]	0.05[m]	*
16887-00-6	Chloride	-------[c]	-----[c]	-----[c]	-----[c]	200[m]	200[m]	*
7440-47-3	Chromium, total	10,000[b]	420[e]	4,100[b]	8,800[e]	0.1[m]	1.0[m]	*
16065-83-1	Chromium, ion, trivalent	1,000,000[b]	-----[c]	330,000[b]	-----[c]	-----[g]	-----[g]	*
18540-29-9	Chromium, ion, hexavalent	10,000[b]	420[e]	4,100[b]	8,800[e]	-----	-----	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	
7440-48-4	Cobalt	120,000[b]	-----[c]	12,000[b]	-----[c]	1.0[m]	1.0[m]	*
7440-50-8	Copper[n]	82,000[b]	-----[c]	8,200[b]	-----[c]	0.65[m]	0.65[m]	*
57-12-5	Cyanide (amenable)	41,000[b]	-----[c]	4,100[b]	-----[c]	0.2[q]	0.6[q]	*
7782-41-4	Fluoride	120,000[b]	-----[c]	12,000[b]	-----[c]	4.0[m]	4.0[m]	*
15438-31-0	Iron	-----[c]	-----[c]	-----[c]	-----[c]	5.0[m]	5.0[m]	*
7439-92-1	Lead	400[k]	-----[c]	400[k]	-----[c]	0.0075[m]	0.1[m]	*
7439-96-5	Manganese	100,000[b]	91,000[b]	10,000[b]	8,700[b]	0.15[m]	10.0[m]	*
7439-97-6	Mercury[l,n]	610[b]	540,000[b]	61[b,s]	52,000[b]	0.002[m]	0.01[m]	*
7440-02-0	Nickel[l]	41,000[b]	21,000[e]	4,100[b]	440,000[e]	0.1[m]	2.0[m]	*
14797-55-8	Nitrate as N[p]	1,000,000[b]	-----[c]	330,000[b]	-----[c]	10.0[m]	100[m]	*
7782-49-2	Selenium[l,n]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.05[m]	0.05[m]	*

		Exposure Route-Specific Values for Soils				Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	
7440-22-4	Silver	10,000[b]	-----[c]	1,000[b]	-----[c]	0.05[m]	-----	*
14808-79-8	Sulfate	-----[c]	-----[c]	-----[c]	-----[c]	400[m]	400[m]	*
7440-28-0	Thallium	-----[c]	-----[c]	-----[c]	-----[c]	0.002[m]	0.02[m]	*
7440-62-2	Vanadium	14,000[b]	-----[c]	1,400[b]	-----[c]	0.049[m]	-----	*
7440-66-6	Zinc[l]	610,000[b]	-----[c]	61,000[b]	-----[c]	5.0[o]	10[o]	*

"*" indicates that the ADL is less than or equal to the specified cleanup objective.

NA means Not Available; no PQL or EQL available in USEPA analytical methods.

Chemical Name and Soil Cleanup Objective Notations (2nd, 5th thru 8th Columns)

[a] Soil cleanup objectives based on human health criteria only.

[b] Calculated values correspond to a target hazard quotient of 1.

[c] No toxicity criteria available for this route of exposure.

[d] Soil saturation concentration (C_{sat}) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.

[e] Calculated values correspond to a cancer risk level of 1 in 1,000,000. Site-specific conditions may warrant use of a greater risk level but not to exceed 1 in 10,000.

f Level is at or below Contract Laboratory Program required quantitation limit for Regular Analytical Services (RAS).

g Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.

h A preliminary goal of 1 ppm has been set for PCBs based on Guidance on Remedial Actions for Superfund Sites with PCB Contamination, EPA/540G-90/007, and on USEPA efforts to manage PCB contamination. See 40 CFR 761.120 for USEPA "PCB Spill Cleanup Policy." This regulation goes on to say that the cleanup goal for an unrestricted area is 10 ppm and 25 ppm for a restricted area, provided both have at least 10 inches of clean cover.

I Soil cleanup objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D in this Part.

j Ingestion soil cleanup objective adjusted by a factor of 0.5 to account for dermal route.

k A preliminary remediation goal of 400 mg/kg has been set for lead based on Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive #9355.4-12.

l Potential for soil-plant-human exposure.

m Concentration in mg/L determined by the Toxicity Characteristic Leaching Procedure (TCLP). The person conducting the remediation has the option to use TCLP cleanup objectives listed in this Table or the applicable pH-specific soil cleanup objectives in Appendix B, Tables C or D of this Part. If the person wishes to calculate cleanup objectives based on background concentrations, this should be done in accordance with Subpart D of this Part.

n The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.

o For agrichemical facilities, cleanup objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.

p For agrichemical facilities, soil cleanup objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the located in Subparts D and I of this Part.

q For cyanide, the TCLP extraction must be done using water at a pH of 7.0.

r Value based on dietary Reference Dose.

s Value based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7).

t Note that Table value is likely to be less than background concentration for this chemical; screening or remediation concentrations using the procedures of Subpart D of this Part.

Section 742.APPENDIX B: Tier 1 Tables and Illustrations

Table C: pH Specific Soil Remediation Objectives for Inorganics and Ionizing Organics for the Migration to Groundwater Portion of the Groundwater Ingestion Route (Class I Groundwater)

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.0
Inorganics									
Antimony	5	5	5	5	5	5	5	5	5
Arsenic	25	26	27	28	29	29	29	30	31
Barium	260	490	850	1,200	1,500	1,600	1,700	1,800	2,100
Beryllium	1.1	2.1	3.4	6.6	22	63	140	1,000	8,000
Cadmium	1.0	1.7	2.7	3.7	5.2	7.5	11	59	430
Chromium (+6)	70	62	54	46	40	38	36	32	28
Copper	330	580	2,100	11,000	59,000	130,000	200,000	330,000	330,000
Cyanide	40	40	40	40	40	40	40	40	40
Mercury	0.01	0.01`	0.03	0.15	0.89	2.1	3.3	6.4	8.0
Nickel	20	36	56	76	100	130	180	700	3,800
Selenium	24	17	12	8.8	6.3	5.2	4.5	3.3	2.4
Silver	0.24	0.33	0.62	1.5	4.4	8.5	13	39	110

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.0
Thallium	1.6	1.8	2.0	2.4	2.6	2.8	3.0	3.4	3.8
Vanadium	980	980	980	980	980	980	980	980	980
Zinc	1,000	1,800	2,600	3,600	5,100	6,200	7,500	16,000	53,000
Organics									
Benzoic Acid	440	420	410	400	400	400	400	400	400
2-Chlorophenol	3.5	3.5	3.5	3.5	3.4	3.4	3.4	3.2	2.7
2,4-Dichlorophenol	1.1	1.1	1.1	1.1	1.1	1.0	1.0	0.90	0.72
Dinoseb	8.4	4.5	1.9	0.82	0.43	0.34	0.31	0.27	0.25
Pentachlorophenol	0.54	0.32	0.15	0.07	0.04	0.03	0.02	0.02	0.02
2,4,5-TP (Silvex)	26	16	12	11	11	11	11	11	11
2,4,5-Trichlorophenol	350	340	340	320	280	270	200	110	56
2,4,6-Trichlorophenol	0.37	0.36	0.34	0.26	0.20	0.15	0.13	0.09	0.07

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Table D: pH Specific Soil Remediation Objectives for Inorganics and Ionizing Organics for the Migration to Groundwater Portion of the Groundwater Ingestion Route (Class II Groundwater)

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.0
Inorganics									
Antimony	20	20	20	20	20	20	20	20	20
Arsenic	100	100	100	110	110	120	120	120	120
Barium	260	490	850	1,200	1,500	1,600	1,700	1,800	2,100
Beryllium	140	260	420	820	2,800	7,900	17,000	130,000	1,000,000
Cadmium	10	17	27	37	52	75	110	590	4,300
Chromium (+6)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Copper	330	580	2,100	11,000	59,000	130,000	200,000	330,000	330,000
Cyanide	120	120	120	120	120	120	120	120	120
Mercury	0.05	0.06	0.14	0.75	4.4	10	16	32	40
Nickel	400	730	1,100	1,500	2,000	2,600	3,500	14,000	76,000
Selenium	24	17	12	8.8	6.3	5.2	4.5	3.3	2.4
Thallium	16	18	20	24	26	28	30	34	38
Zinc	2,000	3,600	5,200	7,200	10,000	12,000	15,000	32,000	110,000

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.0
Organics									
Benzoic Acid	440	420	410	400	400	400	400	400	400
2-Chlorophenol	3.5	3.5	3.5	3.5	3.4	3.4	3.4	3.2	2.7
2,4-Dichlorophenol	1.1	1.1	1.1	1.1	1.1	1.0	1.0	0.90	0.72
Dinoseb	84	45	19	8.2	4.3	3.4	3.1	2.7	2.5
Pentachlorophenol	2.7	1.6	0.75	0.33	0.18	0.15	0.12	0.11	0.10
2,4,5-TP (Silvex)	130	79	62	57	55	55	55	55	55
2,4,5-Trichlorophenol	1,700	1,700	1,700	1,600	1,400	1,200	1,000	560	280
2,4,6-Trichlorophenol	0.37	0.36	0.34	0.26	0.20	0.15	0.13	0.09	0.07

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TABLE E: Tier 1 Groundwater Remediation Objectives for the Direct Ingestion of Groundwater Portion of the Groundwater Ingestion Route

		Groundwater Cleanup Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
83-32-9	Acenaphthene	0.42	2.1
67-64-1	Acetone	0.7	0.7
15972-60-8	Alachlor	0.002[c]	0.01[c]
116-06-3	Aldicarb	0.003[c]	0.015[c]
309-00-2	Aldrin	0.00004[a]	0.0002
120-12-7	Anthracene	2.1	10.5
1912-24-9	Atrazine	0.003[c]	0.015[c]
71-43-2	Benzene	0.005[c]	0.025[c]
56-55-3	Benzo(a)anthracene	0.00013[a]	0.00065
205-99-2	Benzo(b)fluoranthene	0.00018[a]	0.0009
207-08-9	Benzo(k)fluroanthene	0.00017[a]	0.00085
50-32-8	Benzo(a)pyrene	0.0002[a,c]	0.002[c]
111-44-4	Bis(2-chloroethyl)ether	0.01[a]	0.01
117-81-7	Bis(2-ethylhexyl)phthalate	0.006[a,c]	0.06[c]
75-27-4	Bromodichloromethane (Dichlorobromomethane)	0.00002[a]	0.0001
75-25-2	Bromoform	0.0002[a]	0.0002
71-36-3	Butanol	0.7	0.7
85-68-7	Butyl benzyl phthalate	1.4	7.0
86-74-8	Carbazole	---	---
1563-66-2	Carbofuran	0.04[c]	0.2[c]
75-15-0	Carbon disulfide	0.7	3.5
56-23-5	Carbon tetrachloride	0.005[c]	0.025[c]
57-74-9	Chlordane	0.002[c]	0.01[c]

CAS No.	Chemical Name	Groundwater Cleanup Objective	
		Class I (mg/L)	Class II (mg/L)
108-90-7	Chlorobenzene (Monochlorobenzene)	0.1[c]	0.5[c]
124-48-1	Chlorodibromomethane (Dibromochloromethane)	0.14	0.14
67-66-3	Chloroform	0.00002[a]	0.0001
218-01-9	Chrysene	0.0015[a]	0.0075
94-75-7	2,4-D	0.07[c]	0.35[c]
75-99-0	Dalapon	0.2[c]	2.0[c]
72-54-8	DDD	0.00011[a]	0.00055
72-55-9	DDE	0.00004[a]	0.0002
50-29-3	DDT	0.00012[a]	0.0006
53-70-3	Dibenzo(a,h)anthracene	0.0003[a]	0.0015
96-12-8	1,2-Dibromo-3-chloropropane	0.0002[c]	0.0002[c]
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.00005[a,c]	0.0005[c]
84-74-2	Di-n-butyl phthalate	0.7	3.5
95-50-1	1,2-Dichlorobenzene (o - Dichlorobenzene)	0.6[c]	1.5[c]
106-46-7	1,4-Dichlorobenzene (p - Dichlorobenzene)	0.075[c]	0.375[c]
91-94-1	3,3'-Dichlorobenzidine	0.02[a]	0.1
75-34-3	1,1-Dichloroethane	0.7	3.5
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	0.005[c]	0.025[c]
75-35-4	1,1-Dichloroethylene[b]	0.007[c]	0.035[c]
156-59-2	cis-1,2-Dichloroethylene	0.07[c]	0.2[c]
156-60-5	trans-1,2-Dichloroethylene	0.1[c]	0.5[c]
78-97-5	1,2-Dichloropropane	0.005[c]	0.025[c]
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, cis + trans)	0.001[a]	0.005

CAS No.	Chemical Name	Groundwater Cleanup Objective	
		Class I (mg/L)	Class II (mg/L)
60-57-1	Dieldrin	0.00002[a]	0.0001
84-66-2	Diethyl phthalate	5.6	5.6
121-14-2	2,4-Dinitrotoluene[a]	0.00002	0.00002
606-20-2	2,6-Dinitrotoluene[a]	0.0001	0.0001
88-85-7	Dinoseb	0.007[c]	0.07[c]
117-84-0	Di-n-octyl phthalate	0.14	0.7
115-29-7	Endosulfan	0.042	0.042
145-73-3	Endothall	0.1[c]	0.1[c]
72-20-8	Endrin	0.002[c]	0.01[c]
100-41-4	Ethylbenzene	0.7[c]	1.0[c]
206-44-0	Fluoranthene	0.28	1.4
86-73-7	Fluorene	0.28	1.4
76-44-8	Heptachlor	0.0004[c]	0.002[c]
1024-57-3	Heptachlor epoxide	0.0002[c]	0.001[c]
118-74-1	Hexachlorobenzene	0.00006[a]	0.0003
319-84-6	alpha-HCH (alpha-BHC)	0.00003[a]	0.00015
58-89-9	gamma-HCH (Lindane)	0.0002[c]	0.001[c]
77-47-4	Hexachlorocyclopentadiene	0.05[c]	0.5[c]
67-72-1	Hexachloroethane	0.007	0.007
193-39-5	Indeno(1,2,3-c,d)pyrene	0.00043[a]	0.00215
78-59-1	Isophorone	1.4	1.4
72-43-5	Methoxychlor	0.04[c]	0.2[c]
74-83-9	Methyl bromide (Bromomethane)	0.0098	0.0098
75-09-2	Methylene chloride (Dichloromethane)	0.005[c]	0.05[c]
91-20-3	Naphthalene[2]	0.025	0.039
98-95-3	Nitrobenzene[2]	0.0035	0.0035

CAS No.	Chemical Name	Groundwater Cleanup Objective	
		Class I (mg/L)	Class II (mg/L)
1918-02-1	Picloram	0.5[c]	5.0[c]
1336-36-3	Polychlorinated biphenyls (PCBs)[n]	0.0005[c]	0.0025[c]
129-00-0	Pyrene	0.21	1.05
122-34-9	Simazine	0.004[c]	0.04[c]
100-42-5	Styrene	0.1[c]	0.5[c]
93-72-1	2,4,5-TP (Silvex)	0.05[c]	0.25[c]
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.005[c]	0.025[c]
108-88-3	Toluene	1.0[c]	2.5[c]
8001-35-2	Toxaphene	0.00[c]	0.015[c]
120-82-1	1,2,4-Trichlorobenzene	0.07[c]	0.7[c]
71-55-6	1,1,1-Trichloroethane[2]	0.2[c]	1.0[c]
79-00-5	1,1,2-Trichloroethane	0.005[c]	0.05[c]
79-01-6	Trichloroethylene	0.005[c]	0.025[c]
108-05-4	Vinyl acetate	7.0	7.0
75-01-4	Vinyl chloride	0.002[c]	0.01[c]
1330-20-7	Xylenes (total)	10.0[c]	10.0[c]
	Ionizable Organics		
65-85-0	Benzoic Acid	28	28
106-47-8	4-Chloroaniline (p-Chloroaniline)	0.028	0.028
95-57-8	2-Chlorophenol	0.035	0.035
120-83-2	2,4-Dichlorophenol	0.021	0.021
105-67-9	2,4-Dimethylphenol	0.14	0.14
51-28-5	2,4-Dinitrophenol	0.014	0.014
95-48-7	2-Methylphenol (o - Cresol)	0.35	0.35
86-30-6	N-Nitrosodiphenylamine	0.01[a]	0.01

CAS No.	Chemical Name	Groundwater Cleanup Objective	
		Class I (mg/L)	Class II (mg/L)
621-64-7	N-Nitrosodi-n-propylamine	0.01[a]	0.01
87-86-5	Pentachlorophenol	0.001[a,c]	0.005[c]
108-95-2	Phenol	0.1[c]	0.1[c]
95-95-4	2,4,5-Trichlorophenol	0.7	3.5
88-06-2	2,4,6 Trichlorophenol	0.0064[a]	0.0064
	Inorganics		
7440-36-0	Antimony	0.006[c]	0.024[c]
7440-38-2	Arsenic	0.05[c]	0.2[c]
7440-39-3	Barium	2.0[c]	2.0[c]
7440-41-7	Beryllium	0.004[c]	0.5[c]
7440-42-8	Boron	2.0[c]	2.0[c]
7440-43-9	Cadmium	0.005[c]	0.05[c]
16887-00-6	Chloride	200[c]	200[c]
7440-47-3	Chromium, total	0.1[c]	1.0[c]
18540-29-9	Chromium, ion, hexavalent	---	---
7440-48-4	Cobalt	1.0[c]	1.0[c]
7440-50-8	Copper	0.65[c]	0.65[c]
57-12-5	Cyanide	0.2[c]	0.6[c]
7782-41-4	Fluoride	4.0[c]	4.0[c]
15438-31-0	Iron	5.0[c]	5.0[c]
7439-92-1	Lead	0.0075[c]	0.1[c]
7439-96-5	Manganese	0.15[c]	10.0[c]
7439-97-6	Mercury	0.002[c]	0.01[c]
7440-02-0	Nickel	0.1[c]	2.0[c]
14797-55-8	Nitrate as N	10.0[c]	100[c]
7782-49-2	Selenium	0.05[c]	0.05[c]
7440-22-4	Silver	0.05[c]	---
14808-79-8	Sulfate	400[c]	400[c]

		Groundwater Cleanup Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
7440-28-0	Thallium	0.002[c]	0.02[c]
7440-62-2	Vanadium[2]	0.049	---
7440-66-6	Zinc	5.0[c]	10[c]

Chemical Name and Groundwater Cleanup Objective Notations

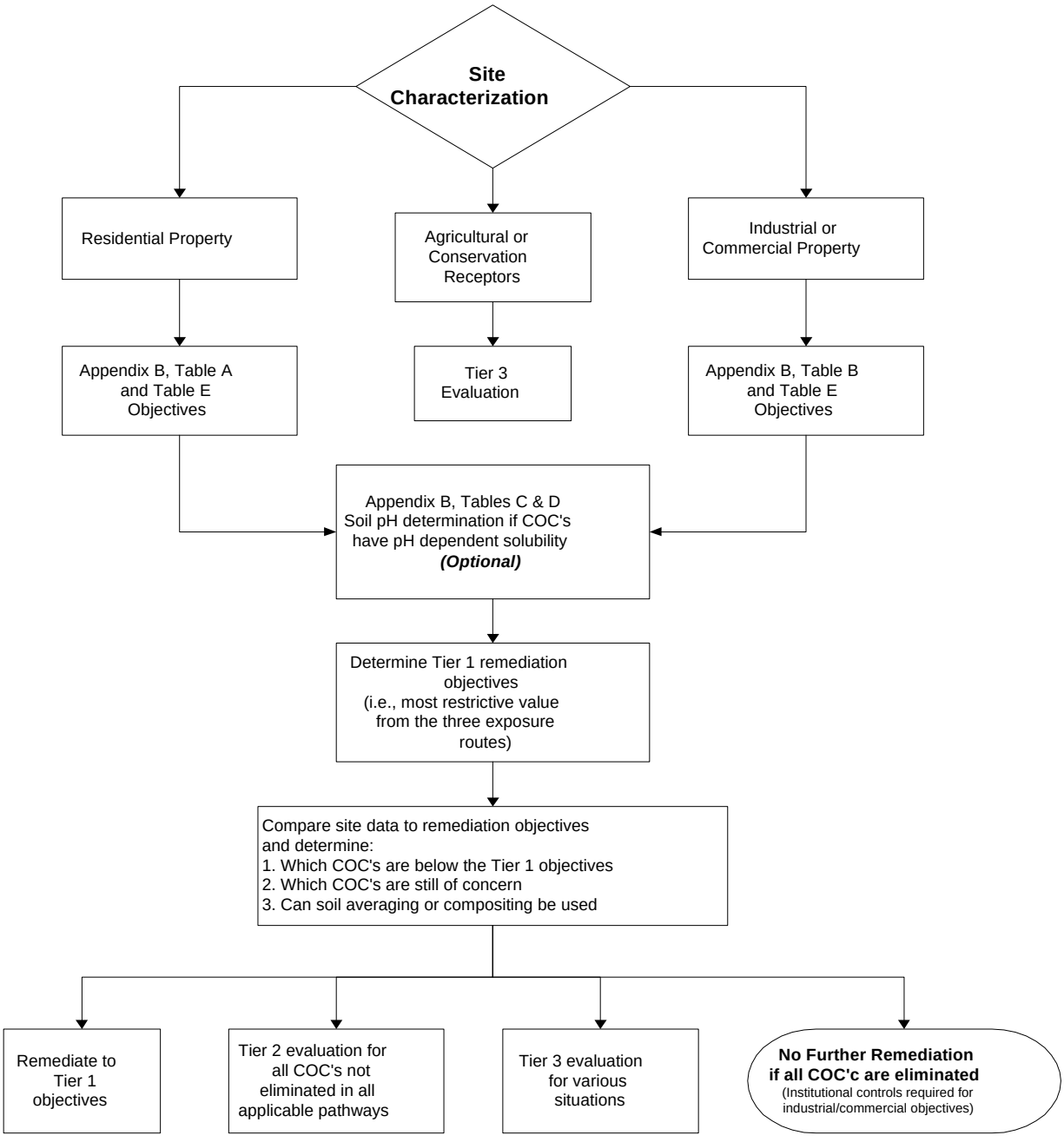
[a] The groundwater Health Advisory concentration is equal to ADL for carcinogens.

[b] Oral Reference Dose and/or Reference Concentration under review by USEPA. Listed values subject to change.

[c] Value listed is also the Groundwater Quality Standard for this chemical pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

Section 742.APPENDIX B: Tier 1 Tables and Illustrations

Illustration A: Tier 1 Evaluation



Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Table A: SSL Equations

Equations for Soil Ingestion Exposure Route	Remediation Objectives for Noncarcinogenic Contaminants (mg/kg)	$\frac{THQ \bullet BW \bullet AT \bullet 365\frac{d}{yr}}{\frac{1}{RfD_O} \bullet 10^{-6}\frac{kg}{mg} \bullet EF \bullet ED \bullet IR_{soil}}$	S1
	Remediation Objectives for Carcinogenic Contaminants - Residential (mg/kg)	$\frac{TR \bullet AT_c \bullet 365\frac{d}{yr}}{SF_o \bullet 10^{-6}\frac{kg}{mg} \bullet EF \bullet IF_{soil-adj}}$	S2
	Remediation Objectives for Carcinogenic Contaminants - Industrial/ Commercial, Construction Worker (mg/kg)	$\frac{TR \bullet BW \bullet AT_c \bullet 365\frac{d}{yr}}{SF_o \bullet 10^{-6}\frac{kg}{mg} \bullet EF \bullet ED \bullet IR_{soil}}$	S3
Equations for Inhalation Exposure Route (Volatiles)	Remediation Objectives for Noncarcinogenic Contaminants - Residential, Industrial/Commercial (mg/kg)	$\frac{THQ \bullet AT \bullet 365\frac{d}{yr}}{EF \bullet ED \bullet \left(\frac{1}{RfC} \bullet \frac{1}{VF}\right)}$	S4

Remediation Objectives for Noncarcinogenic Contaminants - Construction Worker (mg/kg)	$$\frac{THQ \bullet AT \bullet 365\frac{d}{yr}}{EF \bullet ED \bullet \left(\frac{1}{RfC} \bullet \frac{1}{VF'}\right)}$$	S5
Remediation Objectives for Carcinogenic Contaminants - Residential, Industrial/ Commercial (mg/kg)	$$\frac{TR \bullet AT_c \bullet 365\frac{d}{yr}}{URF \bullet 1{,}000\frac{ug}{mg} \bullet EF \bullet ED \bullet \frac{1}{VF}}$$	S6
Remediation Objectives for Carcinogenic Contaminants - Construction Worker (mg/kg)	$$\frac{TR \bullet AT_c \bullet 365\frac{d}{yr}}{URF \bullet 1{,}000\frac{ug}{mg} \bullet EF \bullet ED \bullet \frac{1}{VF'}}$$	S7
Equation for Derivation of the Volatilization Factor - Residential, Industrial/ Commercial, VF (m^3/kg)	$$VF = \frac{Q}{C} \bullet \frac{\left(3.14 \bullet D_A \bullet T\right)^{1/2}}{\left(2 \bullet {}_b \bullet D_A\right)} \bullet 10^{-4}\ \frac{m^2}{cm^2}$$	S8
Equation for Derivation of the Volatilization Factor - Construction Worker, VF′ (m^3/kg)	$$VF' = \frac{VF}{10}$$	S9
Equation for Derivation of Apparent Diffusivity, D_A (cm^2/s)	$$D_A = \frac{\left({}^{3.33}_{a} \bullet D_i \bullet H'\right) + \left({}^{3.33}_{w} \bullet D_w\right)}{\eta^2} \bullet \frac{1}{\left({}_b \bullet K_d\right) + {}_w + \left({}_a \bullet H'\right)}$$	S10

Equations for Inhalation Exposure Route (Fugitive Dusts)	Remediation Objectives for Noncarcinogenic Contaminants - Residential, Industrial/Commercial (mg/kg)	$$\frac{THQ \bullet AT \bullet 365\frac{d}{yr}}{EF \bullet ED \bullet \left(\frac{1}{RfC} \bullet \frac{1}{PEF}\right)}$$	S11
	Remediation Objectives for Noncarcinogenic Contaminants - Construction Worker (mg/kg)	$$\frac{THQ \bullet AT \bullet 365\frac{d}{yr}}{EF \bullet ED \bullet \left(\frac{1}{RfC} \bullet \frac{1}{PEF'}\right)}$$	S12
	Remediation Objectives for Carcinogenic Contaminants - Residential, Industrial/ Commercial (mg/kg)	$$\frac{TR \bullet AT_c \bullet 365\frac{d}{yr}}{URF \bullet 1{,}000\frac{ug}{mg} \bullet EF \bullet ED \bullet \frac{1}{PEF}}$$	S13
	Remediation Objectives for Carcinogenic Contaminants - Construction Worker (mg/kg)	$$\frac{TR \bullet AT_c \bullet 365\frac{d}{yr}}{URF \bullet 1{,}000\frac{ug}{mg} \bullet EF \bullet ED \bullet \frac{1}{PEF'}}$$	S14
	Equation for Derivation of Particulate Emission Factor, PEF (m^3/kg)	$$PEF = \frac{Q}{C} \bullet \frac{3{,}600\frac{s}{hr}}{0.036 \bullet (1-V) \bullet \left(\frac{U_m}{U_t}\right)^3 \bullet F(x)}$$	S15

	Equation for Derivation of Particulate Emission Factor, PEF′ - Construction Worker (m^3/kg)	$PEF' = \frac{PEF}{10}$	S16
Equations for the Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route	Remediation Objective (mg/kg)	$C_w \bullet \left[K_d + \frac{\left({}_w + {}_a \bullet H' \right)}{b} \right]$ NOTE: This equation can only be used if the contaminant of concern is not in the water bearing unit.	S17
	Target Soil Leachate Concentration, C_w (mg/L)	$C_w = DF \bullet GW_{obj}$	S18
	Soil-Water Partition Coefficient, K_d (cm^3/g)	$K_d = K_{oc} \bullet f_{oc}$	S19
	Water-Filled Soil Porosity, θ_w (L_{water}/L_{soil})	${}_w = \bullet \left(\frac{I}{K_s} \right)^{1/(2b+3)}$	S20
	Air-Filled Soil Porosity, θ_a (L_{air}/L_{soil})	$a = - w$	S21
	Dilution Factor, DF (unitless)	$DF = 1 + \frac{K \bullet i \bullet d}{I \bullet L}$	S22

	Groundwater Remediation Objective for Carcinogenic Contaminants, GW_{obj} (mg/L)	$$\frac{TR \bullet BW \bullet AT_c \bullet 365\frac{d}{yr}}{SF_o \bullet IR_w \bullet EF \bullet ED}$$	S23
	Total Soil Porosity, η (L_{pore}/L_{soil})	$$= 1 - \frac{b}{s}$$	S24
	Equation for Estimation of Mixing Zone Depth, d (m)	$$d = \left(0.0112 \bullet L^2\right)^{0.5} + d_a\left[1 - \exp\frac{(-L \bullet I)}{\left(K \bullet i \bullet d_a\right)}\right]$$	S25
Mass-Limit Equations for Inhalation Exposure Route and Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route	Mass-Limit Volatilization Factor for the Inhalation Exposure Route - Residential, Industrial/ Commercial, VF (m^3/kg)	$$VF_{M-L} = \frac{Q}{C} \bullet \frac{\left[T \bullet \left(3.15 \bullet 10^7 \frac{s}{yr}\right)\right]}{b \bullet d_s \bullet 10^6 \frac{g}{mg}}$$ NOTE: This equation may be used when area and depth of contaminant source are known or can be estimated reliably.	S26
	Mass-Limit Volatilization Factor for Inhalation Exposure Route - Construction Worker, VF′ - (m^3/kg)	$$VF'_{M-L} = \frac{VF_{M-L}}{10}$$	S27

	Mass-Limit Remediation Objective for Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route (mg/kg)	$\frac{(C_w \bullet I_{M-L} \bullet ED_{M-L})}{b \bullet d_s}$ NOTE: This equation may be used when area and depth of contaminant source are known or can be estimated reliably.	S28
Equation for Derivation of the Soil Saturation Limit, C_{sat}		$C_{sat} = \frac{S}{b} \bullet [(K_d \bullet \ _b) + \ _w + (H' \bullet \ _a)]$	S29

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Table B: SSL Parameters

Symbol	Parameter	Units	Source	Parameter Value(s)
AT	Averaging Time for Noncarcinogens in Ingestion Equation	yr	SSL	Residential = 6 Industrial/Commercial = 25 Construction Worker = 0.115
AT	Averaging Time for Noncarcinogens in Inhalation Equation	yr	SSL	Residential = 30 Industrial/Commercial = 25 Construction Worker = 0.115
AT_c	Averaging Time for Carcinogens	yr	SSL	70
BW	Body Weight	kg	SSL	Residential = 15, noncarcinogens 70, carcinogens Industrial/Commercial = 70 Construction Worker = 70
C_{sat}	Soil Saturation Concentration	mg/kg	Appendix A, Table A or Equation S29 in Appendix C, Table A	Chemical-Specific or Calculated Value
C_w	Target Soil Leachate Concentration	mg/L	Equation S18 in Appendix C, Table A	Groundwater Standard, Health Advisory, or Calculated Value
d	Mixing Zone Depth	m	SSL or Equation S25 in Appendix C, Table A	2 m or Calculated Value
d_a	Aquifer Thickness	m	Field Measurement	Site-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
d_s	Depth of Source	m	Field Measurement or Estimation	Site-Specific
D_A	Apparent Diffusivity	cm^2/s	Equation S10 in Appendix C, Table A	Calculated Value
D_i	Diffusivity in Air	cm^2/s	Appendix C, Table E	Chemical-Specific
D_w	Diffusivity in Water	cm^2/s	Appendix C, Table E	Chemical-Specific
DF	Dilution Factor	unitless	Equation S22 in Appendix C, Table A	20 or Calculated Value
ED	Exposure Duration for Ingestion of Carcinogens	yr	SSL	Industrial/Commercial = 25 Construction Worker = 1
ED	Exposure Duration for Inhalation of Carcinogens	yr	SSL	Residential = 30 Industrial/Commercial = 25 Construction Worker = 1
ED	Exposure Duration for Ingestion of Noncarcinogens	yr	SSL	Residential = 6 Industrial/Commercial = 25 Construction Worker = 1
ED	Exposure Duration for Inhalation of Noncarcinogens	yr	SSL	Residential = 30 Industrial/Commercial = 25 Construction Worker = 1
ED	Exposure Duration for the Direct Ingestion of Groundwater	yr	-------	Residential = 30 Industrial/Commercial = 25 Construction Worker = 1

Symbol	Parameter	Units	Source	Parameter Value(s)
ED_{M-L}	Exposure Duration for Migration to Groundwater Mass-Limit Equation S29	yr	SSL	70
EF	Exposure Frequency	d/yr	SSL	Residential = 350 Industrial/Commercial = 250 Construction Worker = 30
F(x)	Function dependent on U_m/U_t	unitless	SSL	0.194
f_{oc}	Organic Carbon Content of Soil	g/g	SSL or Field Measurement (See Appendix C, Table F)	Surface Soil = 0.006 Subsurface soil = 0.002, or Site-Specific
GW_{obj}	Groundwater Cleanup Objective	mg/L	Appendix B, Table E, 35 IAC 620.Subpart F, or Equation S23 in Appendix C, Table A	Chemical-Specific or Calculated
H'	Henry's Law Constant	unitless	Appendix C, Table E	Chemical-Specific
i	Hydraulic Gradient	m/m	Field Measurement (See Appendix C, Table F)	Site-Specific
I	Infiltration Rate	m/yr	SSL	0.3
I_{M-L}	Infiltration Rate for Migration to Groundwater Mass-Limit Equation S29	m/yr	SSL	0.18

Symbol	Parameter	Units	Source	Parameter Value(s)
$IF_{soil-adj}$ (residential)	Age Adjusted Soil Ingestion Factor for Carcinogens	(mg-yr)/(kg-d)	SSL	Residential = 114
IR_{soil}	Soil Ingestion Rate	mg/d	SSL	Residential = 200 Industrial/Commercial = 50 Construction Worker = 480
IR_W	Daily Water Ingestion Rate	L/d	-------	Residential = 2 Industrial/Commercial = 1
K	Aquifer Hydraulic Conductivity	m/yr	Field Measurement (See Appendix C, Table F)	Site-Specific
K_d	Soil-Water Partition Coefficient	cm^3/g or L/kg	Equation S19 in Appendix C, Table A	Calculated Value
K_{oc}	Organic Carbon Partition Coefficient	cm^3/g or L/kg	Appendix C, Table E	Chemical-Specific
K_s	Saturated Hydraulic Conductivity	m/yr	Appendix C, Table K Appendix C, Illustration C	Site-Specific
L	Source Length Parallel to Groundwater Flow	m	Field Measurement	Site-Specific
PEF	Particulate Emission 10^{-4} to 10^{-6} Factor	m^3/kg	SSL or Equation S15 in Appendix C, Table A	$1.42 \bullet 10^9$ or Site-Specific
PEF′	Particulate Emission Factor adjusted for Agitation (construction worker)	m^3/kg	Equation S16 in Appendix C, Table A	$9.53 \bullet 10^7$ or Site-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
Q/C	Inverse of the mean concentration at the center of a square source (used in VF and PEF equations)	$(g/m^2\text{-}s)/(kg/m^3)$	SSL or Appendix C, Table H	Residential = 68.81 Industrial/Commercial = 85.81 Construction Worker = 85.81
RfC	Inhalation Reference Concentration	mg/m^3	IEPA (IRIS/HEAST[a])	Toxicological-Specific (Note: for Construction Workers use subchronic reference concentrations)
RfD_o	Oral Reference Dose	mg/(kg-d)	IEPA (IRIS/HEAST[a])	Toxicological-Specific (Note: for Construction Worker use subchronic reference doses)
S	Solubility in Water	mg/L	Appendix C, Table E	Chemical-Specific
SF_o	Oral Slope Factor	$(mg/kg\text{-}d)^{-1}$	IEPA (IRIS/HEAST[a])	Toxicological-Specific
T	Exposure Interval	s	SSL	Residential = $9.5 \bullet 10^8$ Industrial/Commercial = $7.9 \bullet 10^8$ Construction Worker = 3.6×10^6
THQ	Target Hazard Quotient	unitless	SSL	1
TR	Target Cancer Risk	unitless	SSL	Residential = 10^{-4} to 10^{-6} Industrial/Commercial = 10^{-4} to 10^{-6} Construction Worker = 10^{-4} to 10^{-6}
U_m	Mean Annual Windspeed	m/s	SSL	4.69
URF	Inhalation Unit Risk Factor	$(ug/m^3)^{-1}$	IEPA (IRIS/HEAST[a])	Toxicological-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
U_t	Equivalent Threshold Value of Windspeed at 7 m	m/s	SSL	11.32
V	Fraction of Vegetative Cover	unitless	SSL or Field Measurement	0.5 or Site-Specific
VF	Volatilization Factor	m^3/kg	Equation S8 in Appendix C, Table A	Calculated Value
VF′	Volatilization Factor adjusted for Agitation	m^3/kg	Equation S9 in Appendix C, Table A	Calculated Value
VF_{M-L}	Mass-Limit Volatilization Factor	m^3/kg	Equation S26 in Appendix C, Table A	Calculated Value
VF'_{M-L}	Mass-Limit Volatilization Factor adjusted for Agitation	m^3/kg	Equation S27 in Appendix C, Table A	Calculated Value
η	Total Soil Porosity	L_{pore}/L_{soil}	SSL or Equation S24 in Appendix C, Table A	0.43, or Gravel = 0.25 Sand = 0.32 Silt = 0.40 Clay = 0.36, or Calculated Value

Symbol	Parameter	Units	Source	Parameter Value(s)
θ_a	Air-Filled Soil Porosity	L_{air}/L_{soil}	SSL or Equation S21 in Appendix C, Table A	Surface Soil (top 1 meter) = 0.28 Subsurface Soil (below 1 meter) = 0.13, or Gravel = 0.05 Sand = 0.14 Silt - 0.24 Clay = 0.19, or Calculated Value
θ_w	Water-Filled Soil Porosity	L_{water}/L_{soil}	SSL or Equation S20 in Appendix C, Table A	Surface Soil (top 1 meter) = 0.15 Subsurface Soil (below 1 meter) = 0.30, or Gravel = 0.20 Sand = 0.18 Silt = 0.16 Clay = 0.17, or Calculated Value
ρ_b	Dry Soil Bulk Density	kg/L	SSL or Field Measurement (See Appendix C, Table F)	1.5, or Gravel = 2.0 Sand = 1.8 Silt = 1.6 Clay = 1.7, or Site-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
ρ_s	Soil Particle Density	g/cm^3	SSL or Field Measurement (See Appendix C, Table F)	2.65, or Surface Soil (top 1 meter) = 2.63 Subsurface Soil (below 1 meter) = 2.65, or Site-Specific
ρ_w	Water Density	g/cm^3	SSL	1
1/(2b+3)	Exponential in Equation S20	unitless	Appendix C, Table K Appendix C, Illustration	Site-Specific

a HEAST = Health Effects Assessment Summary Tables. USEPA, Office of Solid Waste and Emergency Resp onse. EPA/SQO/R-95/036. Updated Quarterly.

Section 742.Appendix C: Tier 2 Tables and Illustrations

Table C: RBCA Equations

Equations for the combined exposures routes of soil ingestion	Remediation Objectives for Carcinogenic Contaminants (mg/kg)	$$\frac{TR \bullet BW \bullet AT_C \bullet 365\frac{d}{yr}}{EF \bullet ED \bullet \left\{\left[SF_o \bullet 10^{-6}\frac{kg}{mg} \bullet \left(\left(IR_{soil} \bullet RAF_o\right)+\left(SA \bullet M \bullet RAF_d\right)\right)\right]+\left[SF_i \bullet IR_{air} \bullet \left(VF_{ss}+VF_p\right)\right]\right\}}$$	R1
inhalation of vapors and particulates, and dermal contact with soil	Remediation Objectives for Non-carcinogenic Contaminants (mg/kg)	$$\frac{THQ \bullet BW \bullet AT_n \bullet 365\frac{d}{yr}}{EF \bullet ED \bullet \left[\frac{10^{-6}\frac{kg}{mg}\left[\left(IR_{soil} \bullet RAF_o\right)+\left(SA \bullet M \bullet RAF_d\right)\right]}{RfD_o}+\frac{IR_{air} \bullet \left(VF_{ss}+VF_p\right)}{RfD_i}\right]}$$	R2
	Volatilization Factor for Surficial Soils, VF_{ss} (kg/m^3) Whichever is less between R3 and R4	$$VF_{ss}=\frac{2 \bullet W \bullet \_\__s \bullet 10^3\frac{cm^3 \cdot kg}{m^3 \cdot g}}{U_{air} \bullet \_\__{air}} \bullet \sqrt{\frac{D_s^{eff} \bullet H'}{\bullet\left[\_\__{ws}+\left(k_s \bullet \_\__s\right)+\left(H' \bullet \_\__{as}\right)\right] \bullet}}$$	R3
		$$VF_{ss}=\frac{W \bullet \_\__s \bullet d \bullet 10^3\frac{cm^3 \cdot kg}{m^3 \cdot g}}{U_{air} \bullet \_\__{air} \bullet}$$	R4

	Volatilization Factor for Surficial Soils Regarding Particulates, VF_p (kg/m^3)	$$VF_p = \frac{P_e \bullet W \bullet 10^3 \frac{cm^3 \cdot kg}{m^3 \cdot g}}{U_{air} \bullet \quad_{air}}$$	R5
	Effective Diffusion Coefficient in Soil Based on Vapor-Phase Concentration D_s^{eff} (cm^2/s)	$$D_s^{eff} = \frac{D^{air} \bullet \quad_{as}^{3.33}}{\quad_{T}^{2}} + \frac{D^{water} \bullet \quad_{ws}^{3.33}}{H' \bullet \quad_{T}^{2}}$$	R6
Equations for the ambient vapor inhalation (outdoor) route from subsurface soils	Remediation Objectives for Carcinogenic Contaminants (mg/kg)	$$\frac{RBSL_{air} \bullet 10^{-3}}{VF_{samb}}$$	R7
	Remediation Objectives for Non-carcinogenic Contaminants (mg/kg)	$$\frac{RBSL_{air} \bullet 10^{-3}}{VF_{samb}}$$	R8

	Carcinogenic Risk-Based Screening Level for Air, $RBSL_{air}$ (ug/m^3)	$$RBSL_{air} = \frac{TR \bullet BW \bullet AT_c \bullet 365 \frac{d}{yr} \bullet 10^3 \frac{ug}{mg}}{SF_i \bullet IR_{air} \bullet EF \bullet ED}$$	R9
	Noncarcinogenic Risk-Based Screening Level for Air, $RBSL_{air}$ (ug/m^3)	$$RBSL_{air} = \frac{THQ \bullet RfD_i \bullet BW \bullet AT_n \bullet 365 \frac{d}{yr} \bullet 10^3 \frac{ug}{mg}}{IR_{air} \bullet EF \bullet ED}$$	R10
	Volatilization Factor - Subsurface Soil to Ambient Air, VF_{samb} (mg/m^3)/(mg/kg_{soil})	$$VF_{samb} = \frac{H' \bullet \ _s \bullet 10^3 \frac{cm^3 \cdot kg}{m^3 \cdot g}}{\left[\ _{ws} + \left(k_s \bullet \ _s\right) + \left(H' \bullet \ _{as}\right)\right] \bullet \left[1 + \frac{\left(U_{air} \bullet \ _{air} \bullet L_s\right)}{\left(D_s^{eff} \bullet W\right)}\right]}$$	R11

Equations for the Migration to Groundwater Portion of the Groundwater Ingestion Exposure Route	Remediation Objective (mg/kg)	$\frac{GW_{source}}{LF_{sw}}$ Note: This equation can only be used if the contaminant of concern is not in the water bearing unit.	R12
	Groundwater at the source, GW_{source} (mg/L)	$GW_{source} = \frac{GW_{comp}}{C_{(x)} / C_{source}}$	R13
	Leaching Factor, LF_{sw} $(mg/L_{water})/(mg/kg_{soil})$	$LF_{sw} = \frac{{}_{s} \bullet \frac{cm^3 \cdot kg}{L \cdot g}}{\left[{}_{ws} + \left(k_s \bullet {}_{s}\right) + \left(H' \bullet {}_{as}\right)\right] \bullet \left[1 + \frac{\left(U_{gw} \bullet {}_{gw}\right)}{\left(I \bullet W\right)}\right] \bullet 365 \frac{d}{yr}}$	R14
	Steady-State Attenuation Along the Centerline of a Dissolved Plume, $C_{(x)}/C_{source}$	$C_{(x)} / C_{source} = \exp\left[\left(\frac{X}{2 {}_{x}}\right) \bullet \left(1 - \sqrt{1 + \frac{4 \bullet {}_{x}}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{{}_{y} \bullet X}}\right] \bullet erf\left[\frac{S_d}{4 \bullet \sqrt{{}_{z} \bullet X}}\right]$	R15
	Longitudinal Dispersivity, α_x (cm)	${}_{x} = 0.10 \bullet X$	R16

Transverse Dispersivity, α_y (cm)	$_y = \frac{x}{3}$	R17
Vertical Dispersivity, α_z (cm)	$_z = \frac{x}{20}$	R18
Specific Discharge, U (cm/d)	$U = \frac{K \bullet i}{_T}$	R19
Soil-Water Sorption Coefficient, k_s	$k_s = K_{oc} \bullet f_{oc}$	R20
Volumetric Air Content in Vadose Zone Soils, θ_{as} (cm^3_{air}/cm^3_{soil})	$_{as} = _T + \frac{(w \bullet _s)}{_w}$	R21
Volumetric Water Content in Vadose Zone Soils, θ_{ws} (cm^3_{water}/cm^3_{soil})	$_{ws} = \frac{w \bullet _s}{_w}$	R22
Total Soil Porosity, θ_T (cm^3/cm^3_{soil})	$_T = _{as} + _{ws}$	R23

	Groundwater Darcy Velocity, U_{gw} (cm/s)	$U_{gw} = K \bullet i$	R24
Equations for the Groundwater Ingestion Exposure Route	Remediation Objective for Carcinogenic Contaminants (mg/L)	$\frac{TR \bullet BW \bullet AT_c \bullet 365 \frac{d}{yr}}{SF_o \bullet IR_w \bullet EF \bullet ED}$	R25
	Dissolved Hydrocarbon Concentration along Centerline, $C_{(x)}$ (g/cm^3_{water})	$C_{(x)} = C_{source} \bullet \exp\left[\left(\frac{X}{2\ x}\right) \bullet \left(1 - \sqrt{1 + \frac{4 \bullet x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{y \bullet X}}\right] \bullet erf\left[\frac{S_d}{4 \bullet \sqrt{z \bullet X}}\right]$ NOTE: 1. This equation does not predict the contaminant flow within bedrock. 2. If this value of the First Order Degradation Constant (λ) is not readily available, then set $1 - \sqrt{1 + 4 \bullet \ _x}$ to equal a value of "1"	R26

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Table D: RBCA Parameters

Symbol	Parameter	Units	Source	Parameter Value(s)
AT_c	Averaging Time for Carcinogens	yr	RBCA	70
AT_n	Averaging Time for Noncarcinogens	yr	RBCA	Residential = 30 Industrial/Commercial = 25 Construction Worker = 0.115
BW	Adult Body Weight	kg	RBCA	70
C_{source}	Concentration of Contaminant in Groundwater at the Source.	mg/L	Field Measurement	Site-Specific
$C_{(x)}$	Concentration of Contaminant in Groundwater at Distance X from the source	mg/L	Equation R26 in Appendix C, Table C	Calculated Value
$C_{(x)}/C_{source}$	Steady-State Attenuation Along the Centerline of a Dissolved Plume	unitless	Equation R15 in Appendix C, Table C	Calculated Value
d	Lower Depth of Surficial Soil Zone	cm	Field Measurement	100 or Site-Specific (not to exceed 100)

Symbol	Parameter	Units	Source	Parameter Value(s)
D^{air}	Diffusion Coefficient in Air	cm^2/s	Appendix C, Table E	Chemical-Specific
D^{water}	Diffusion Coefficient in Water	cm^2/s	Appendix C, Table E	Chemical-Specific
D_s^{eff}	Effective Diffusion Coefficient in Soil Based on Vapor-Phase Concentration	cm^2/s	Equation R6 in Appendix C, Table C	Calculated Value
ED	Exposure Duration	yr	RBCA	Residential = 30 Industrial/Commercial = 25 Construction Worker = 1
EF	Exposure Frequency	d/yr	RBCA	Residential = 350 Industrial/Commercial = 250 Construction Worker = 30
erf	Error Function	unitless	Appendix C, Table G	Mathematical Function
f_{oc}	Organic Carbon Content of Soil	g/g	RBCA or Field Measurement (See Appendix C, Table F)	Surface Soil = 0.006 Subsurface Soil = 0.002 or Site-Specific
GW_{comp}	Groundwater Objective at the Compliance Point	mg/L	Appendix B, Table E, 35 IAC 620.Subpart F, or Equation R25 in Appendix C, Table C	Site-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
GW_{source}	Groundwater Concentration at the Source	mg/L	Equation R13 in Appendix C, Table C	Calculated Value
H'	Henry's Law Constant	cm^3_{water}/cm^3_{air}	Appendix C, Table E	Chemical-Specific
i	Hydraulic Gradient	cm/cm (unitless)	Field Measurement (See Appendix C, Table F)	Site-Specific
I	Infiltration Rate	cm/yr	RBCA	30
IR_{air}	Daily Outdoor Inhalation Rate	m^3/d	RBCA	20
IR_{soil}	Soil Ingestion Rate	mg/d	RBCA	Residential = 100 Industrial/Commercial = 50 Construction Worker = 480
IR_w	Daily Water Ingestion Rate	L/d	RBCA	Residential = 2 Industrial/Commercial = 1
K	Aquifer Hydraulic Conductivity	cm/d	Field Measurement (See Appendix C, Table F)	Site-Specific
K_{oc}	Organic Carbon Partition Coefficient	cm^3/g or L/kg	Appendix C, Table E	Chemical-Specific
k_s	Soil Water Sorption Coefficient	(cm^3_{water}/ cm^3_{soil})	Equation R20 in Appendix C,Table C	Calculated Value
L_s	Depth to Subsurface Soil Sources	cm	RBCA	10

Symbol	Parameter	Units	Source	Parameter Value(s)
LF_{sw}	Leaching Factor	$(mg/L_{water})/(mg/kg_{soil})$	Equation R14 in Appendix C, Table C	Calculated Value
M	Soil to Skin Adherence Factor	mg/cm^2	RBCA	0.5
Pe	Particulate Emission Rate	g/cm^2-s	RBCA	$6.9 \quad 10^{-14}$
RAF_d	Dermal Relative Absorption Factor	unitless	RBCA	0.5
RAF_d (PNAs)	Dermal Relative Absorption Factor	unitless	RBCA	0.05
RAF_d (inorganics)	Dermal Relative Absorption Factor	unitless	RBCA	0
RAF_o	Oral Relative Absorption Factor	unitless	RBCA	1.0
$RBSL_{air}$	Carcinogenic Risk-Based Screening Level for Air	ug/m^3	Equation R9 in Appendix C, Table C	Chemical-, Media-, and Exposure Route-Specific
$RBSL_{air}$	Noncarcinogenic Risk-Based Screening Level for Air	ug/m^3	Equations R10 in Appendix C, Table C	Chemical-, Media-, and Exposure Route-Specific
RfD_i	Inhalation Reference Dose	mg/kg-d	IEPA (IRIS/HEAST[a])	Toxicological-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
RfD_o	Oral Reference Dose	mg/(kg-d)	IEPA (IRIS/HEAST[a])	Toxicological-Specific (Note: for Construction Worker use subchronic reference doses)
SA	Skin Surface Area	cm^2/d	RBCA	3,160
S_d	Source Width Perpendicular to Groundwater Flow Direction in Vertical Plane	cm	Field Measurement	For Migration to Groundwater Route: Use 200 or Site-Specific For Groundwater cleanup objective: Use Site-Specific
S_w	Source Width Perpendicular to Groundwater Flow Direction in Horizontal Plane	cm	Field Measurement	Site-Specific
SF_i	Inhalation Cancer Slope Factor	$(mg/kg-d)^{-1}$	IEPA (IRIS/HEAST[a])	Toxicological-Specific
SF_o	Oral Slope Factor	$(mg/kg-d)^{-1}$	IEPA (IRIS/HEAST[a])	Toxicological-Specific
THQ	Target Hazard Quotient	unitless	RBCA	1
TR	Target Cancer Risk	unitless	RBCA	Residential = 10^{-4} to 10^{-6} Industrial/Commercial = 10^{-4} to 10^{-6} Construction Worker = 10^{-4} to 10^{-6}

Symbol	Parameter	Units	Source	Parameter Value(s)
U	Specific Discharge	cm/d	Equation R19 in Appendix C, Table C	Calculated Value
U_{air}	Average Wind Speed Above Ground Surface in Ambient Mixing Zone	cm/s	RBCA	225
U_{gw}	Groundwater Darcy Velocity	cm/yr	Equation R24 in Appendix C, Table C	Calculated Value
VF_p	Volatilization Factor for Surficial Soils Regarding Particulates	kg/m^3	Equation R5 in Appendix C, Table C	Calculated Value
VF_{samb}	Volatilization Factor (Subsurface Soils to Ambient Air)	$(mg/m^3_{air})/(mg/kg_{soil})$ or kg/m^3	Equation R11 in Appendix C, Table C	Calculated Value
VF_{ss}	Volatilization Factor for Surficial Soils	kg/m^3	Use Equations R3 and R4 in Appendix C, Table C	Calculated Value from Equation R3 or R4 (whichever is less)
W	Width of Source Area Parallel to Direction to Wind or Groundwater Movement	cm	Field Measurement	Site-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
w	Average Soil Moisture Content	g_{water}/g_{soil}	RBCA or Field Measurement (See Appendix C, Table F)	0.1, or Surface Soil (top 1 meter) = 0.1 Subsurface Soil (below 1 meter) = 0.2, or Site-Specific
X	Distance along the Centerline of the Groundwater Plume Emanating from a Source. The x direction is the direction of groundwater flow	cm	Field Measurement	Site-Specific
α_x	Longitudinal Dispersitivity	cm	Equation R16 in Appendix C, Table C	Calculated Value
α_y	Transverse Dispersitivity	cm	Equation R17 in Appendix C, Table C	Calculated Value
α_z	Vertical Dispersitivity	cm	Equation R18 in Appendix C, Table C	Calculated Value
δ_{air}	Ambient Air Mixing Zone Height	cm	RBCA	200
δ_{gw}	Groundwater Mixing Zone Thickness	cm	RBCA	200

Symbol	Parameter	Units	Source	Parameter Value(s)
θ_{as}	Volumetric Air Content in Vadose Zone Soils	cm^3_{air}/cm^3_{soil}	RBCA or Equation R21 in Appendix C, Table C	Surface Soil (top 1 meter) = 0.28 Subsurface Soil (below 1 meter)= 0.13, or Gravel = 0.05 Sand = 0.14 Silt = 0.16 Clay = 0.17, or Calculated Value
θ_{ws}	Volumetric Water Content in Vadose Zone Soils	cm^3_{water}/cm^3_{soil}	RBCA or Equation R22 in Appendix C, Table C	Surface Soil (top 1 meter) = 0.15 Subsurface Soil (below 1 meter) = 0.30, or Gravel = 0.20 Sand = 0.18 Silt = 0.16 Clay = 0.17, or Calculated Value

Symbol	Parameter	Units	Source	Parameter Value(s)
θ_T	Total Soil Porosity	cm^3/cm^3_{soil}	RBCA or Equation R23 in Appendix C, Table C	0.43, or Gravel = 0.25 Sand = 0.32 Silt = 0.40 Clay = 0.36, or Calculated Value
λ	First Order Degradation Constant	d^{-1}	Appendix C, Table E	Chemical-Specific
π	pi			3.1416
ρ_s	Soil Bulk Density	g/cm^3	RBCA or Field Measurement (See Appendix C, Table F)	1.5, or Gravel = 2.0 Sand = 1.8 Silt = 1.6 Clay = 1.7, or Site-Specific
ρ_w	Water Density	g/cm^3	RBCA	1
τ	Averaging Time for Vapor Flux	s	RBCA	9.46×10^8

[a] HEAST = Health Effects Assessment Summary Tables. USEPA, Office of Solid Waste and Emergency Response. EPA/540/R-95/036. Updated Quarterly.

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Table E: Default Physical and Chemical Parameters

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
Neutral Organics							
83-32-9	Acenaphthene	4.24	0.0421	7.69E-6	0.00636	7,080	0.0034
67-64-1	Acetone	1,000,000	0.124	1.14E-5	0.00159	0.575	0.0495
15972-60-8	Alachlor	242	0.0198	5.69E-6	0.00000132	394	No Data
116-06-3	Aldicarb	6,000	0.0305	7.19E-6	0.0000000574	12	0.00109
309-00-2	Aldrin	0.18	0.0132	4.86E-6	0.00697	2,450,000	0.00059
120-12-7	Anthracene	0.0434	0.0324	7.74E-6	0.00267	29,500	0.00075
1912-24-9	Atrazine	70	0.0258	6.69E-6	0.00000005	451	No Data
71-43-2	Benzene	1,750	0.088	9.80E-6	0.228	58.9	0.0009

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
56-55-3	Benzo(a)anthracene	0.0094	0.0510	9.00E-6	0.000137	398,000	0.00051
205-99-2	Benzo(b)fluoranthene	0.0015	0.0226	5.56E-6	0.00455	1,230,000	0.00057
207-08-9	Benzo(k)fluoranthene	0.0008	0.0226	5.56E-6	0.000034	1,230,000	0.00016
65-85-0	Benzoic Acid	3,500	0.0536	7.97E-6	0.0000631	0.600	No Data
50-32-8	Benzo(a)pyrene	0.00162	0.043	9.00E-6	0.0000463	1,020,000	0.00065
111-44-4	Bis(2-chloroethyl)ether	17,200	0.0692	7.53E-6	0.000738	15.5	0.0019
117-81-7	Bis(2-ethylhexyl)phthalate	0.34	0.0351	3.66E-6	0.00000418	15,100,000	0.0018
75-27-4	Bromodichloromethane	6,740	0.0298	1.06E-5	0.0656	55.0	No Data
75-25-2	Bromoform	3,100	0.0149	1.03E-5	0.0219	87.1	0.0019
71-36-3	Butanol	74,000	0.0800	9.30E-6	0.000361	6.92	0.01283
85-68-7	Butyl Benzyl Phthalate	2.69	0.0174	4.83E-6	0.0000517	57,500	0.00385
86-74-8	Carbazole	7.48	0.0390	7.03E-6	0.000000626	3,390	No Data

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
1563-66-2	Carbofuran	320	0.0249	6.63E-6	.00377	37	No Data
75-15-0	Carbon Disulfide	1,190	0.104	1.00E-5	1.24	45.7	No Data
56-23-5	Carbon Tetrachloride	793	0.0780	8.80E-6	1.25	174	0.0019
57-74-9	Chlordane	0.056	0.0118	4.37E-6	0.00199	120,000	0.00025
106-47-8	p-Chloroaniline	5,300	0.0483	1.01E-5	0.0000136	66.1	No Data
108-09-7	Chlorobenzene	472	0.0730	8.70E-6	0.152	219	0.0023
124-48-1	Chlorodibromomethane	2,600	0.0196	1.05E-5	0.0321	63.1	0.00385
67-66-3	Chloroform	7,920	0.104	1.00E-5	0.15	39.8	0.00039
95-57-8	2-Chlorophenol	22,000	0.0501	9.46E-6	0.016	388	No Data
218-01-9	Chrysene	0.0016	0.0248	6.21E-6	0.00388	398,000	0.00035
94-75-7	2,4-D	680	0.0231	7.31E-6	0.00000041	451	0.00385
72-54-8	4,4'-DDD	0.09	0.0169	4.76E-6	0.000164	1,000,000	0.000062

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
72-55-9	4,4'-DDE	0.12	0.0144	5.87E-6	0.000861	4,470,000	0.000062
50-29-3	4,4'-DDT	0.025	0.0137	4.95E-6	0.000332	2,630,000	0.000062
75-99-0	Dalapon	900,000	0.0414	9.46E-6	0.00000264	5.8	0.005775
53-70-3	Dibenzo(a,h)anthracene	0.00249	0.0202	5.18E-6	0.00000603	3,800,000	0.00037
96-12-8	1,2-Dibromo-3-chloropropane	1,200	0.0212	7.02E-6	0.00615	182	0.001925
106-93-4	1,2-Dibromoethane	4,200	0.0287	8.06E-6	0.0303	93	0.005775
84-74-2	Di-n-butyl Phthalate	11.2	0.0438	7.86E-6	0.0000000385	33,900	0.03013
95-50-1	1,2-Dichlorobenzene	156	0.0690	7.90E-6	0.0779	617	0.0019
106-46-7	1,4-Dichlorobenzene	73.8	0.0690	7.90E-6	0.0996	617	0.0019
91-94-1	3,3-Dichlorobenzidine	3.11	0.0194	6.74E-6	0.000000164	724	0.0019

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
75-34-3	1,1-Dichloroethane	5,060	0.0742	1.05E-5	0.23	31.6	0.0019
107-06-2	1,2-Dichloroethane	8,520	0.104	9.90E-6	0.0401	17.4	0.0019
75-35-4	1,1-Dichloroethylene	2,250	0.0900	1.04E-5	1.07	58.9	0.0053
156-59-2	cis-1,2-Dichloroethylene	3,500	0.0736	1.13E-5	0.167	35.5	0.00024
156-60-5	trans-1,2-Dichloroethylene	6,300	0.0707	1.19E-5	0.385	52.5	0.00024
120-83-2	2,4-Dichlorophenol	4,500	0.0346	8.77E-6	0.00013	147	0.00027
78-87-5	1,2-Dichloropropane	2,800	0.0782	8.73E-6	0.115	43.7	0.00027
542-75-6	1,3-Dichloropropylene (cis + trans)	2,800	0.0626	1.00E-5	0.726	45.7	0.061
60-57-1	Dieldrin	0.195	0.0125	4.74E-6	0.000619	21,400	0.00032
84-66-2	Diethyl Phthalate	1,080	0.0256	6.35E-6	0.0000185	288	0.00619
105-67-9	2,4-Dimethylphenol	7,870	0.0584	8.69E-6	0.000082	209	0.0495
51-28-5	2,4-Dinitrophenol	2,790	0.0273	9.06E-6	0.0000182	0.01	0.00132

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
121-14-2	2,4-Dinitrotoluene	270	0.203	7.06E-6	0.0000038	95.5	0.00192
606-20-2	2,6-Dinitrotoluene	182	0.0327	7.26E-6	0.0000306	69.2	0.00192
88-85-7	Dinoseb	52	0.0215	6.62E-6	0.0000189	1,120	0.002817
117-84-0	Di-n-octyl Phthalate	0.02	0.0151	3.58E-6	0.00274	83,200,000	0.0019
115-29-7	Endosulfan	0.51	0.0115	4.55E-6	0.000459	2,140	0.07629
145-73-3	Endothall	21,000	0.0291	8.07E-6	0.0000000107	0.29	No Data
72-20-8	Endrin	0.25	0.0125	4.74E-6	0.000308	12,300	0.00032
100-41-4	Ethylbenzene	169	0.0750	7.80E-6	0.323	363	0.003
206-44-0	Fluoranthene	0.206	0.0302	6.35E-6	0.00066	107,000	0.00019
86-73-7	Fluorene	1.98	0.0363	7.88E-6	0.00261	13,800	0.000691
76-44-8	Heptachlor	0.18	0.0112	5.69E-6	0.024	1,410,000	0.13
1024-57-3	Heptachlor epoxide	0.2	0.0132	4.23E-6	0.00039	83,200	0.00063

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
118-74-1	Hexachlorobenzene	6.2	0.0542	5.91E-6	0.0541	55,000	0.00017
319-84-6	alpha-HCH (alpha-BHC)	2.0	0.0142	7.34E-6	0.000435	1,230	0.0025
58-89-9	gamma-HCH (Lindane)	6.8	0.0142	7.34E-6	0.000574	1,070	0.0029
77-47-4	Hexachlorocyclo-pentadiene	1.8	0.0161	7.21E-6	1.11	200,000	0.012
67-72-1	Hexachloroethane	50	0.0025	6.80E-6	0.159	1,780	0.00192
193-39-5	Indeno(1,2,3-c,d)pyrene	0.000022	0.0190	5.66E-6	0.0000656	3,470,000	0.00047
78-59-1	Isophorone	12,000	0.0623	6.76E-6	0.000272	46.8	0.01238
7439-97-6	Mercury	---	0.0307	6.30E-6	0.467	---	No Data
72-43-5	Methoxychlor	0.045	0.0156	4.46E-6	0.000648	97,700	0.0019
74-83-9	Methyl Bromide	15,200	0.0728	1.21E-5	0.256	10.5	0.01824
75-09-2	Methylene Chloride	13,000	0.101	1.17E-5	0.0898	11.7	0.012
95-48-7	2-Methylphenol	26,000	0.0740	8.30E-6	0.0000492	91.2	0.0495

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
91-20-3	Naphthalene	31.0	0.0590	7.50E-6	0.0198	2,000	0.0027
98-95-3	Nitrobenzene	2,090	0.0760	8.60E-6	0.000984	64.6	0.00176
86-30-6	N-Nitrosodiphenylamine	35.1	0.0312	6.35E-6	0.000205	1,290	0.01
621-64-7	N-Nitrosodi-n-propylamine	9,890	0.0545	8.17E-6	0.0000923	24.0	0.0019
87-86-5	Pentachlorophenol	1,950	0.0560	6.10E-6	0.000001	592	0.00045
108-95-2	Phenol	82,800	0.0820	9.10E-6	0.0000163	28.8	0.099
1918-02-1	Picloram	430	0.0255	5.28E-6	0.00000000166	1.98	No Data
1336-36-3	Polychlorinated biphenyls (PCBs)	0.7	-------[a]	-------[a]	-------[a]	309,000	No Data
129-00-0	Pyrene	0.135	0.0272	7.24E-6	0.000451	105,000	0.00018
122-34-9	Simazine	5	0.027	7.36E-6	0.0000000133	133	No Data
100-42-5	Styrene	310	0.0710	8.00E-6	0.113	776	0.0033
93-72-1	2,4,5-TP (Silvex)	31	0.0194	5.83E-6	0.0000000032	5,440	No Data

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
127-18-4	Tetrachloroethylene	200	0.0720	8.20E-6	0.754	155	0.00096
108-88-3	Toluene	526	0.0870	8.60E-6	0.272	182	0.011
8001-35-2	Toxaphene	0.74	0.0116	4.34E-6	0.000246	257,000	No Data
120-82-1	1,2,4-Trichlorobenzene	300	0.0300	8.23E-6	0.0582	1,780	0.0019
71-55-6	1,1,1-Trichloroethane	1,330	0.0780	8.80E-6	0.705	110	0.0013
79-00-5	1,1,2-Trichloroethane	4,420	0.0780	8.80E-6	0.0374	50.1	0.00095
79-01-6	Trichloroethylene	1,100	0.0790	9.10E-6	0.422	166	0.00042
95-95-4	2,4,5-Trichlorophenol	1,200	0.0291	7.03E-6	0.000178	1,600	0.00038
88-06-2	2,4,6-Trichlorophenol	800	0.0318	6.25E-6	0.000319	381	0.00038
108-05-4	Vinyl Acetate	20,000	0.0850	9.20E-6	0.021	5.25	No Data
57-01-4	Vinyl Chloride	2,760	0.106	1.23E--6	1.11	18.6	0.00024
108-38-3	m-Xylene	161	0.070	7.80E-6	0.301	407	0.0019

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (Di) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})
95-47-6	o-Xylene	178	0.087	1.00E-5	0.213	363	0.0019
106-42-3	p-Xylene	185	0.0769	8.44E-6	0.314	389	0.0019
1330-20-7	Xylenes (total)	186	0.0720		0.25	260	0.0019

Chemical Abstracts Service (CAS) registry number. This number in the format xxx-xx-x, is unique for each chemical and allows efficient searching on computerized data bases.

[a]Soil Remediation objectives are determined pursuant to 40 CFR 761.120, as incorporated by reference at Section 732.104 (the USEPA "PCB Spill Cleanup Policy"), for most sites; persons remediating sites should consult with BOL if calculation of Tier 2 soil remediation objectives is desired.

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Table F: Methods for Determining Physical Soil Parameters

Methods for Determining Physical Soil Parameters		
Parameter	Sampling Location[a]	Method
ρ_b (soil bulk density)	Surface	ASTM - D 1556-90 Sand Cone Method[b]
		ASTM - D 2167-94 Rubber Balloon Method[b]
		ASTM - D 2922-91 Nuclear Method[b]
	Subsurface	ASTM - D 2937-94 Drive Cylinder Method[b]
ρ_s (soil particle density)	Surface or Subsurface	ASTM - D 854-92 Specific Gravity of Soil[b]
w (moisture content)	Surface or Subsurface	ASTM - D 4959-89 (Reapproved 1994) Standard[b]
		ASTM - D 4643-93 Microwave Oven[b]
		ASTM - D2216-92 Laboratory Determination[b]
		ASTM - D3017-88 (Reapproved 1993) Nuclear Method[b]
		Equivalent USEPA Method (e.g., sample preparation procedures described in methods 3541 or 3550)
f_{oc} (organic carbon content)	Surface or Subsurface	Nelson and Sommers (1982)
		ASTM - D 2974-87 (Reapproved 1995) Moisture, Ash, and Organic Matter[b]
		USEPA Method 9060A Total Organic Content

Methods for Determining Physical Soil Parameters		
Parameter	Sampling Location[a]	Method
η or θ_T (total soil porosity)	Surface or Subsurface (calculated)	$\eta = 1 - \rho_b/\rho_s$ $\theta_T = \theta_{as} + \theta_{ws}$
θ_a or θ_{as} (air-filled soil porosity)	Surface or Subsurface (calculated)	$\eta - [(w \bullet \rho_b)/\rho_w]$
θ_w or θ_{ws} (water-filled soil porosity)	Surface or Subsurface (calculated)	$(w \bullet \rho_b)/\rho_w$
K (hydraulic conductivity)	Surface or Subsurface	ASTM - D 5084-90 Flexible Wall Permeameter
		Pump Test
		Slug Test
i (hydraulic gradient)	Surface or Subsurface	Field Measurement

[a] This is the location where the sample is collected
[b] As incorporated by reference in Section 742.120.

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Table G: Error Function (erf)

$$erf(\ ) = \frac{2}{\sqrt{\ }} \int_0 e^{-\ ^2} d$$

	erf (β)
0	0
0.05	0.056372
0.1	0.112463
0.15	0.167996
0.2	0.222703
0.25	0.276326
0.3	0.328627
0.35	0.379382
0.4	0.428392
0.45	0.475482
0.5	0.520500
0.55	0.563323
0.6	0.603856
0.65	0.642029
0.7	0.677801
0.75	0.711156
0.8	0.742101
0.85	0.770668
0.9	0.796908
0.95	0.820891
1.0	0.842701
1.1	0.880205
1.2	0.910314
1.3	0.934008
1.4	0.952285
1.5	0.966105
1.6	0.976348
1.7	0.983790
1.8	0.989091
1.9	0.992790
2.0	0.995322
2.1	0.997021
2.2	0.998137
2.3	0.998857
2.4	0.999311
2.5	0.999593
2.6	0.999764
2.7	0.999866
2.8	0.999925
2.9	0.999959
3.0	0.999978

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Table H: Q/C Values by Source Area

Source (Acres)	Area Q/C Value (g/m^2-s per kg/m^3)
0.5	97.78
1	85.81
2	76.08
5	65.75
10	59.16
30	50.60

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

TABLE I: Values to be Substituted for k_s when Evaluating Ionizing Organics as a Function of pH

pH	Benzoic Acid	2-Chloro-phenol	2,4-Dichloro-phenol	2,4-Dinitro-phenol	Pentachlorlo-phenol	2,3,4,5-Tetra-chlorophenol	2,3,4,6-Tetra-chlorophenol	2,4,5-Trichloro-phenol	2,4,6-Trichloro-phenol
4.9	5.54E+00	3.98E+02	1.59E+02	2.94E-02	9.05E+03	1.73E+04	4.45E+03	2.37E+03	1.04E+03
5.0	4.64E+00	3.98E+02	1.59E+02	2.55E-02	7.96E+03	1.72E+04	4.15E+03	2.36E+03	1.03E+03
5.1	3.88E+00	3.98E+02	1.59E+02	2.23E-02	6.83E+03	1.70E+04	3.83E+03	2.36E+03	1.02E+03
5.2	3.25E+00	3.98E+02	1.59E+02	1.98E-02	5.97E+03	1.67E+04	3.49E+03	2.35E+03	1.01E+03
5.3	2.72E+00	3.98E+02	1.59E+02	1.78E-02	5.10E+03	1.65E+04	3.14E+03	2.34E+03	9.99E+02
5.4	2.29E+00	3.98E+02	1.58E+02	1.62E-02	4.32E+03	1.61E+04	2.79E+03	2.33E+03	9.82E+02
5.5	1.94E+00	3.97E+02	1.58E+02	1.50E-02	3.65E+03	1.57E+04	2.45E+03	2.32E+03	9.62E+02
5.6	1.65E+00	3.97E+02	1.58E+02	1.40E-02	3.07E+03	1.52E+04	2.13E+03	2.31E+03	9.38E+02
5.7	1.42E+00	3.97E+02	1.58E+02	1.32E-02	2.58E+03	1.47E+04	1.83E+03	2.29E+03	9.10E+02
5.8	1.24E+00	3.97E+02	1.58E+02	1.25E-02	2.18E+03	1.40E+04	1.56E+03	2.27E+03	8.77E+02
5.9	1.09E+00	3.97E+02	1.57E+02	1.20E-02	1.84E+03	1.32E+04	1.32E+03	2.24E+03	8.39E+02
6.0	9.69E-01	3.96E+02	1.57E+02	1.16E-02	1.56E+03	1.24E+04	1.11E+03	2.21E+03	7.96E+02
6.1	8.75E-01	3.96E+02	1.57E+02	1.13E-02	1.33E+03	1.15E+04	9.27E+02	2.17E+03	7.48E+02
6.2	7.99E-01	3.96E+02	1.56E+02	1.10E-02	1.15E+03	1.05E+04	7.75E+02	2.12E+03	6.97E+02
6.3	7.36E-01	3.95E+02	1.55E+02	1.08E-02	9.98E+02	9.51E+03	6.47E+02	2.06E+03	6.44E+02

pH	Benzoic Acid	2-Chloro-phenol	2,4-Dichloro-phenol	2,4-Dinitro-phenol	Pentachlorlo-phenol	2,3,4,5-Tetra-chlorophenol	2,3,4,6-Tetra-chlorophenol	2,4,5-Trichloro-phenol	2,4,6-Trichloro-phenol
6.4	6.89E-01	3.94E+02	1.54E+02	1.06E-02	8.77E+02	8.48E+03	5.42E+02	1.99E+03	5.89E+02
6.5	6.51E-01	3.93E+02	1.53E+02	1.05E-02	7.81E+02	7.47E+03	4.55E+02	1.91E+03	5.33E+02
6.6	6.20E-01	3.92E+02	1.52E+02	1.04E-02	7.03E+02	6.49E+03	3.84E+02	1.82E+03	4.80E+02
6.7	5.95E-01	3.90E+02	1.50E+02	1.03E-02	6.40E+02	5.58E+03	3.27E+02	1.71E+03	4.29E+02
6.8	5.76E-01	3.88E+02	1.47E+02	1.02E-02	5.92E+02	4.74E+03	2.80E+02	1.60E+03	3.81E+02
6.9	5.60E-01	3.86E+02	1.45E+02	1.02E-02	5.52E+02	3.99E+03	2.42E+02	1.47E+03	3.38E+02
7.0	5.47E-01	3.83E+02	1.41E+02	1.02E-02	5.21E+02	3.33E+03	2.13E+02	1.34E+03	3.00E+02
7.1	5.38E-01	3.79E+02	1.38E+02	1.02E-02	4.96E+02	2.76E+03	1.88E+02	1.21E+03	2.67E+02
7.2	5.32E-01	3.75E+02	1.33E+02	1.01E-02	4.76E+02	2.28E+03	1.69E+02	1.07E+03	2.39E+02
7.3	5.25E-01	3.69E+02	1.28E+02	1.01E-02	4.61E+02	1.87E+03	1.53E+02	9.43E+02	2.15E+02
7.4	5.19E-01	3.62E+02	1.21E+02	1.01E-02	4.47E+02	1.53E+03	1.41E+02	8.19E+02	1.95E+02
7.5	5.16E-01	3.54E+02	1.14E+02	1.01E-02	4.37E+02	1.25E+03	1.31E+02	7.03E+02	1.78E+02
7.6	5.13E-01	3.44E+02	1.07E+02	1.01E-02	4.29E+02	1.02E+03	1.23E+02	5.99E+02	1.64E+02
7.7	5.09E-01	3.33E+02	9.84E+01	1.00E-02	4.23E+02	8.31E+02	1.17E+02	5.07E+02	1.53E+02
7.8	5.06E-01	3.19E+02	8.97E+01	1.00E-02	4.18E+02	6.79E+02	1.13E+02	4.26E+02	1.44E+02
7.9	5.06E-01	3.04E+02	8.07E+01	1.00E-02	4.14E+02	5.56E+02	1.08E+02	3.57E+02	1.37E+02
8.0	5.06E-01	2.86E+02	7.17E+01	1.00E-02	4.10E+02	4.58E+02	1.05E+02	2.98E+02	1.31E+02

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

TABLE J: Values to be Substituted for k_s when Evaluating Inorganics as a Function of pH[a]

pH	As	Ba	Be	Cd	Cr (+3)	Cr (+6)	Hg	Ni	Ag	Se	Tl	Zn
4.9	2.5E+01	1.1E+01	2.3E+01	1.5E+01	1.2E+03	3.1E+01	4.0E-02	1.6E+01	1.0E-01	1.8E+01	4.4E+01	1.6E+01
5.0	2.5E+01	1.2E+01	2.6E+01	1.7E+01	1.9E+03	3.1E+01	6.0E-02	1.8E+01	1.3E-01	1.7E+01	4.5E+01	1.8E+01
5.1	2.5E+01	1.4E+01	2.8E+01	1.9E+01	3.0E+03	3.0E+01	9.0E-02	2.0E+01	1.6E-01	1.6E+01	4.6E+01	1.9E+01
5.2	2.6E+01	1.5E+01	3.1E+01	2.1E+01	4.9E+03	2.9E+01	1.4E-01	2.2E+01	2.1E-01	1.5E+01	4.7E+01	2.1E+01
5.3	2.6E+01	1.7E+01	3.5E+01	2.3E+01	8.1E+03	2.8E+01	2.0E-01	2.4E+01	2.6E-01	1.4E+01	4.8E+01	2.3E+01
5.4	2.6E+01	1.9E+01	3.8E+01	2.5E+01	1.3E+04	2.7E+01	3.0E-01	2.6E+01	3.3E-01	1.3E+01	5.0E+01	2.5E+01
5.5	2.6E+01	2.1E+01	4.2E+01	2.7E+01	2.1E+04	2.7E+01	4.6E-01	2.8E+01	4.2E-01	1.2E+01	5.1E+01	2.6E+01
5.6	2.6E+01	2.2E+01	4.7E+01	2.9E+01	3.5E+04	2.6E+01	6.9E-01	3.0E+01	5.3E-01	1.1E+01	5.2E+01	2.8E+01
5.7	2.7E+01	2.4E+01	5.3E+01	3.1E+01	5.5E+04	2.5E+01	1.0E-00	3.2E+01	6.7E-01	1.1E+01	5.4E+01	3.0E+01
5.8	2.7E+01	2.6E+01	6.0E+01	3.3E+01	8.7E+04	2.5E+01	1.6E-00	3.4E+01	8.4E-01	9.8E+00	5.5E+01	3.2E+01
5.9	2.7E+01	2.8E+01	6.9E+01	3.5E+01	1.3E+05	2.4E+01	2.3E-00	3.6E+01	1.1E+00	9.2E+00	5.6E+01	3.4E+01
6.0	2.7E+01	3.0E+01	8.2E+01	3.7E+01	2.0E+05	2.3E+01	3.5E-00	3.8E+01	1.3E+00	8.6E+00	5.8E+01	3.6E+01
6.1	2.7E+01	3.1E+01	9.9E+01	4.0E+01	3.0E+05	2.3E+01	5.1E-00	4.0E+01	1.7E+00	8.0E+00	5.9E+01	3.9E+01
6.2	2.8E+01	3.3E+01	1.2E+02	4.2E+01	4.2E+05	2.2E+01	7.5E-00	4.2E+01	2.1E+00	7.5E+00	6.1E+01	4.2E+01
6.3	2.8E+01	3.5E+01	1.6E+02	4.4E+01	5.8E+05	2.2E+01	1.1E+01	4.5E+01	2.7E+00	7.0E+00	6.2E+01	4.4E+01
6.4	2.8E+01	3.6E+01	2.1E+02	4.8E+01	7.7E+05	2.1E+01	1.6E+01	4.7E+01	3.4E+00	6.5E+00	6.4E+01	4.7E+01
6.5	2.8E+01	3.7E+01	2.8E+02	5.2E+01	9.9E+05	2.0E+01	2.2E+01	5.0E+01	4.2E+00	6.1E+00	6.6E+01	5.1E+01
6.6	2.8E+01	3.9E+01	3.9E+02	5.7E+01	1.2E+06	2.0E+01	3.0E+01	5.4E+01	5.3E+00	5.7E+00	6.7E+01	5.4E+01

pH	As	Ba	Be	Cd	Cr (+3)	Cr (+6)	Hg	Ni	Ag	Se	Tl	Zn
6.7	2.9E+01	4.0E+01	5.5E+02	6.4E+01	1.5E+06	1.9E+01	4.0E+01	5.8E+01	6.6E+00	5.3E+00	6.9E+01	5.8E+01
6.8	2.9E+01	4.1E+01	7.9E+02	7.5E+01	1.8E+06	1.9E+01	5.2E+01	6.5E+01	8.3E+00	5.0E+00	7.1E+01	6.2E+01
6.9	2.9E+01	4.2E+01	1.1E+03	9.1E+01	2.1E+06	1.8E+01	6.6E+01	7.4E+01	1.0E+01	4.7E+00	7.3E+01	6.8E+01
7.0	2.9E+01	4.2E+01	1.7E+03	1.1E+02	2.5E+06	1.8E+01	8.2E+01	8.8E+01	1.3E+01	4.3E+00	7.4E+01	7.5E+01
7.1	2.9E+01	4.3E+01	2.5E+03	1.5E+02	2.8E+06	1.7E+01	9.9E+01	1.1E+02	1.6E+01	4.1E+00	7.6E+01	8.3E+01
7.2	3.0E+01	4.4E+01	3.8E+03	2.0E+02	3.1E+06	1.7E+01	1.2E+02	1.4E+02	2.0E+01	3.8E+00	7.8E+01	9.5E+01
7.3	3.0E+01	4.4E+01	5.7E+03	2.8E+02	3.4E+06	1.6E+01	1.3E+02	1.8E+02	2.5E+01	3.5E+00	8.0E+01	1.1E+02
7.4	3.0E+01	4.5E+01	8.6E+03	4.0E+02	3.7E+06	1.6E+01	1.5E+02	2.5E+02	3.1E+01	3.3E+00	8.2E+01	1.3E+02
7.5	3.0E+01	4.6E+01	1.3E+04	5.9E+02	3.9E+06	1.6E+01	1.6E+02	3.5E+02	3.9E+01	3.1E+00	8.5E+01	1.6E+02
7.6	3.1E+01	4.6E+01	2.0E+04	8.7E+02	4.1E+06	1.5E+01	1.7E+02	4.9E+02	4.8E+01	2.9E+00	8.7E+01	1.9E+02
7.7	3.1E+01	4.7E+01	3.0E+04	1.3E+03	4.2E+06	1.5E+01	1.8E+02	7.0E+02	5.9E+01	2.7E+00	8.9E+01	2.4E+02
7.8	3.1E+01	4.9E+01	4.6E+04	1.9E+03	4.3E+06	1.4E+01	1.9E+02	9.9E+02	7.3E+01	2.5E+00	9.1E+01	3.1E+02
7.9	3.1E+01	5.0E+01	6.9E+04	2.9E+03	4.3E+06	1.4E+01	1.9E+02	1.4E+03	8.9E+01	2.4E+00	9.4E+01	4.0E+02
8.0	3.1E+01	5.2E+01	1.0E+05	4.3E+03	4.3E+06	1.4E+01	2.0E+02	1.9E+03	1.1E+02	2.2E+00	9.6E+01	5.3E+02

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

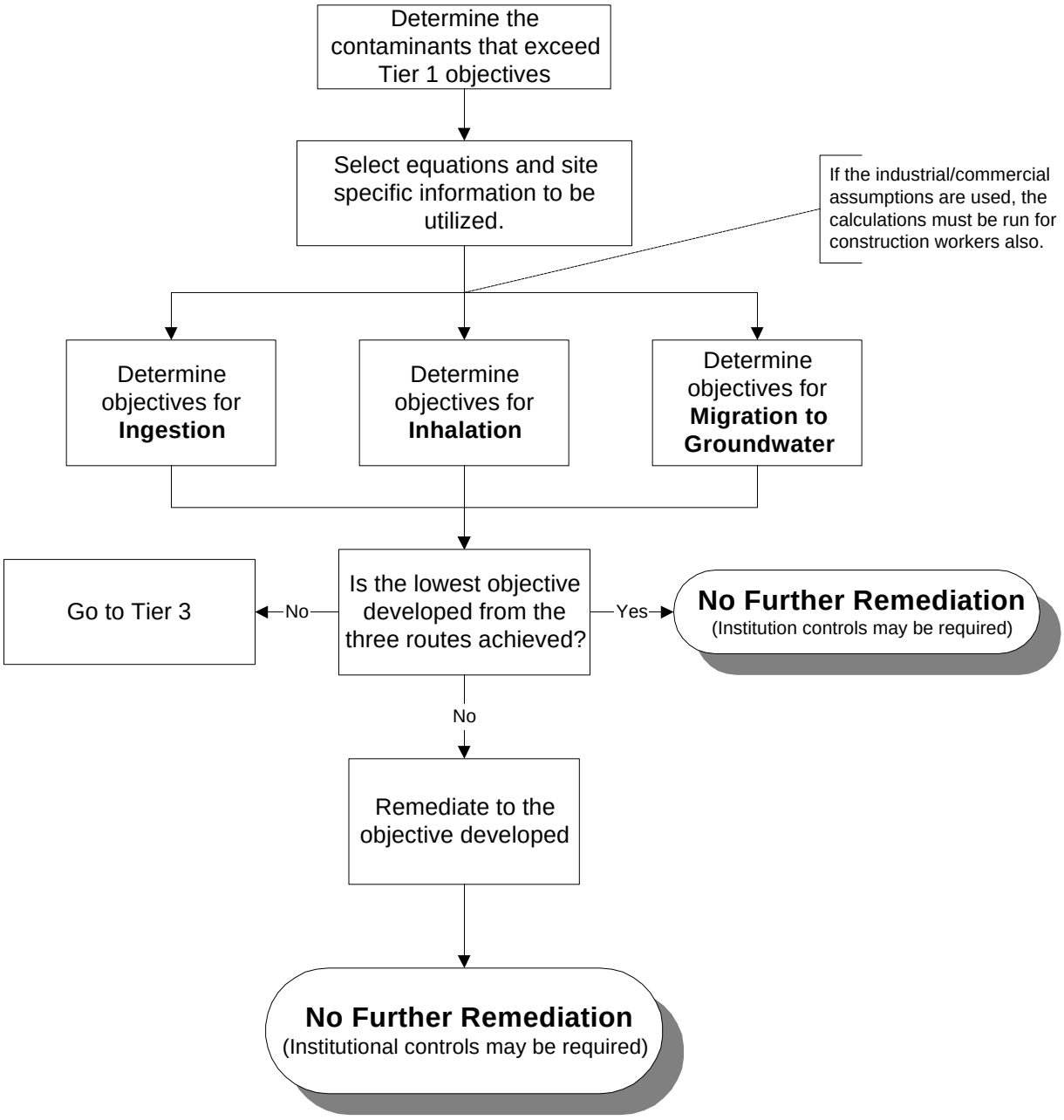
TABLE K: Parameter Estimates for Calculating Water-Filled Soil Porosity (θ_w)

Soil Texture[a]	K_s	$1/(2B+3)$
Sand	1,830	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

[a] The appropriate texture classification is determined by a particle size analysis by ASTM D2488-93 as incorporated by reference in Section 742.210 and the U.S. Department of Agriculture Soil Textural Triangle shown in Appendix C, Illustration C.

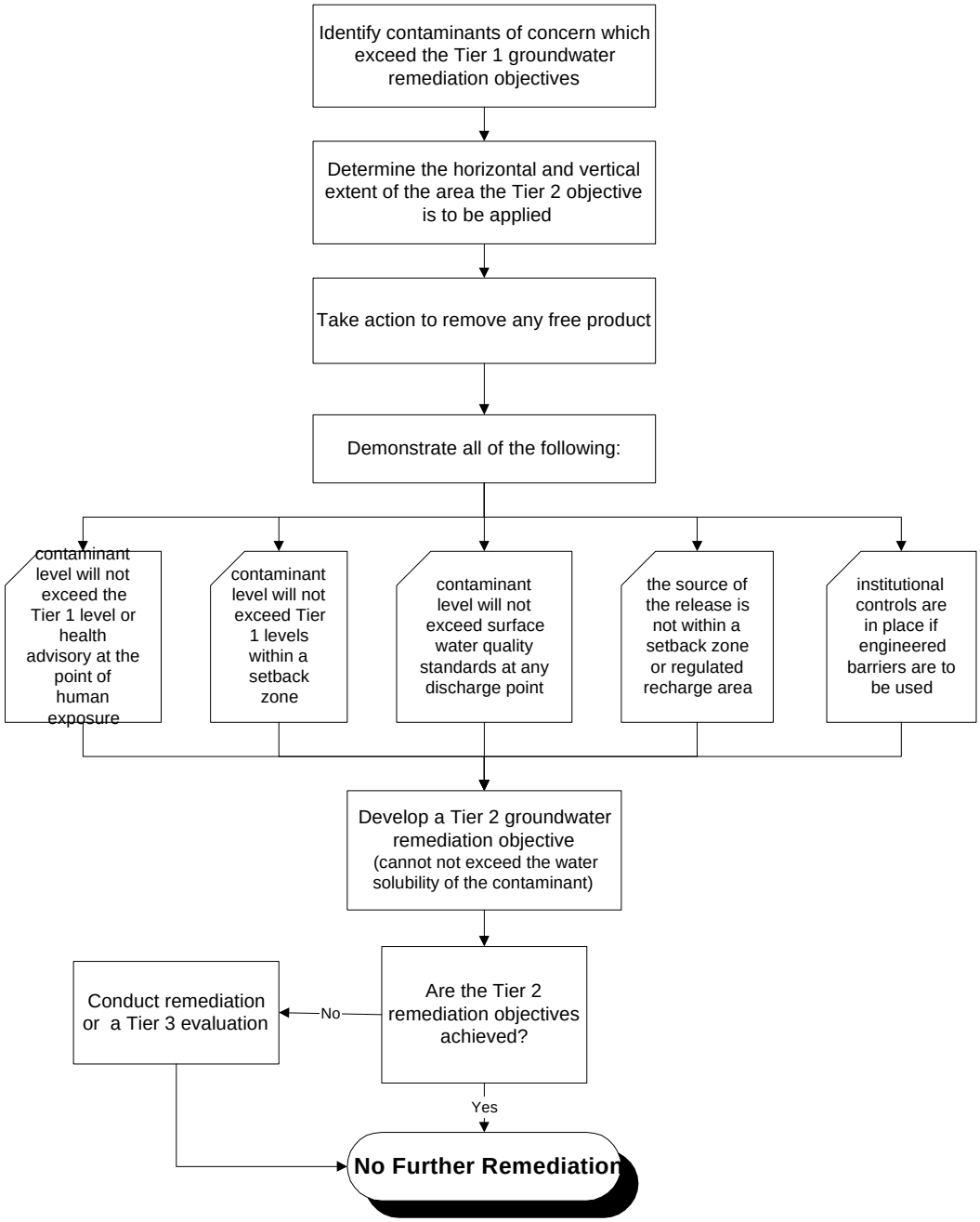
Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Illustration A: Tier 2 Evaluation for Soil



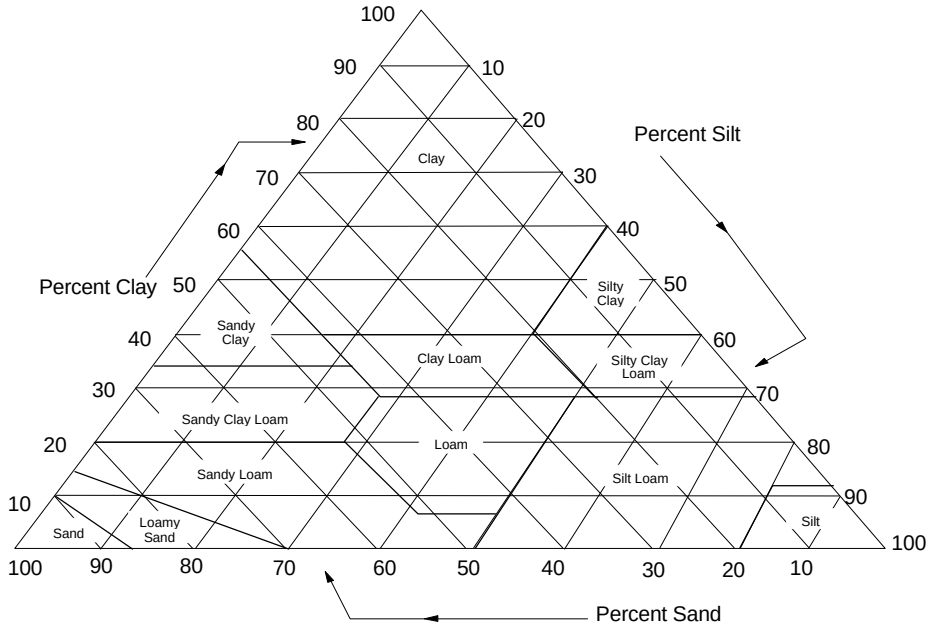
Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Illustration B: Tier 2 Evaluation for Groundwater



Section 742.APPENDIX C: Tier 2 Tables and Illustrations

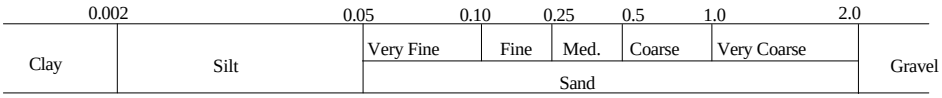
Illustration C: U.S. Department of Agriculture Soil Texture Classification



Criteria Used with the Field Method for Determining Soil Texture Classes

Criterion	Sand	Sandy loam	Loam	Slit loam	Clay loam	Clay
1. Individual grains visible to eye	Yes	Yes	Some	Few	No	No
2. Stability of dry clods	Do not form	Do not form	Easily broken	Moderately easily broken	Hard and stable	Very hard and stable
3. Stability of wet clods	Unstable	Slightyl stable	Moderately stable	Stable	Very stable	Very stable
4. Stability of "ribbon" when wet soil rubbed between thumb and fingers	Does not form	Does not form	Does not form	Broken appearance	Thin, will break	Very long, flexible

Particle Size, mm



Section 742.APPENDIX D: Procedures for Determination of Class II Groundwater

The following is a procedure to demonstrate that groundwater beneath a site does not meet the Class I criteria set forth in 35 Ill. Adm. Code 620.210 and therefore, need only meet the Class II groundwater quality standards. Groundwater is classified in 35 Ill. Adm. Code 620 as a Class II, general resource groundwater when it:

1) Does not meet the provisions of 35 Ill. Adm. Code 620.230 (Class III) or 35 Ill. Adm. Code 620.240 (Class IV); (Determining whether the groundwater is Class III or Class IV is relatively straight forward, as is the requirement to determine if the groundwater has previously been classified as Class II groundwater by the Illinois Pollution Control Board (Board).) or,

2) Has been found by the Board to be a Class II groundwater, pursuant to the petition procedures set forth in 35 Ill. Adm. Code 620.260; (if a continuous zone containing groundwater begins within 10 feet of the ground surface and extends greater than ten feet below the ground surface it will not be considered a Class II groundwater if an additional criterion is met under 35 Ill. Adm. Code 620.210, in this case it would be considered Class I groundwater. Although it may be possible, it is unrealistic to try to designate two distinct classes of groundwater within the same saturated hydrogeologic unit. But, if the person conducting the remediation can demonstrate that by cleaning the groundwater within ten feet of the surface to Class II specifications will not degrade the groundwater greater than 10 feet below the ground surface above Class I standards, the Agency may approve both Class I and II standards in accordance with the location of the groundwater.) or,

3) Is located less than ten feet below the ground surface; or,

4) Does not meet the provisions of 35 Ill. Adm. Code 620.210, which is further discussed in paragraphs (A) through (D) below.

Initially, the sources of information listed below should be considered to determine the appropriate classification of groundwater:

1) Published data concerning regional and local geologic and hydrogeologic conditions (i.e. geologic surveys, former site investigations, etc.).

2) The locations of all potable water wells located within one mile of the site with the logs and/or dates of well completion attached.

3) Available data on-site boring logs which characterize the geology from ground surface to the first saturated unit or, if a perched zone is present, the first saturated unit below the perched zone.

If after collecting and reviewing the above information the groundwater is clearly not a Class II groundwater and one still wishes to pursue classification as Class II groundwater, further investigation including site-specific information must be utilized to make a determination that the groundwater is subject to the Class II standards. If the site geology or hydrogeologic properties pass all criteria listed below, the groundwater is a Class II groundwater. The information requirements listed describe the minimum documentation which should be provided to the Agency.

A) Groundwater cannot be located within the minimum setback of a well which serves as a potable water supply and to the bottom of such well;

The minimum setback zone of a well extends from the land surface to the bottom of the well as determined by the screen depth. This establishes a three-dimensional zone of protection around the well.

Section 14 of the Environmental Protection Act (Act) established setback requirements for potable water supply wells and potential sources/routes of contamination. Unless regulatory relief consistent with this Section of the Act has been sought and received, no new sources/routes may be located within 200 feet of a potable water supply well or 400 feet of a vulnerable community water supply well. Further, the converse of this statement also applies (e.g., no new potable water supply well may locate within 200 feet of a current or future source/route). A 400 foot separation is required for a vulnerable community water supply well. In addition, a community water supply may establish maximum setback zones of up to 1,000 feet around the wells. This may cause further siting restrictions for new activities as well as require technology controls under 35 Ill. Adm. Code 615/616 for existing and new activities.

This requirement may be satisfied by the submission of a scaled map delineating the site and all potable water wells located within a one mile radius from the unit(s) of concern. The Illinois State Water Survey and/or the Division of Public Water Supplies of the Agency should be contacted, as well as other appropriate state and federal entities, to obtain this information. A copy of the state or federal agency's response to an information inquiry should be included with the information submitted by the person conducting the remediation. Also, a visual inspection of the area within 200 feet of the unit(s) of concern should be conducted when possible to detect unplugged private wells.

B) Formations beneath the site cannot consist of unconsolidated sand, gravel, or sand and gravel which is 5 feet or more in thickness and that contains 12 percent or less in fines (i.e. fines which pass through a No. 200 sieve tested according to ASTM Standard Practice D2488-93);

This criterion is specific to the type of formations listed. If a zone of saturation fails this Class II criterion, Class II may still apply pursuant to D below.

This criterion may be satisfied by the submission of, at a minimum, one site-specific, continuously sampled boring log which clearly identifies the saturated interval from

which a representative sample was obtained. Sieve test analysis should be conducted on several samples from each saturated interval which is at least five feet in thickness and composed of sand-sized grains or greater. In addition, the person conducting the remediation should submit the sieve data sheet, plot, and a scaled map which identifies the location of each boring.

C) Formations beneath the site cannot consist of sandstone which is 10 feet or more in thickness, or fractured carbonate which is 15 feet or more in thickness; or

This requirement may be satisfied by the submission of, at a minimum, one site-specific, continuously sampled boring log with a description of the geologic material present. This boring log should extend from the ground surface to a depth which is 10 feet into the uppermost water-bearing unit subject to Class I standards or bedrock, whichever is shallower. The boring(s) should be continuously sampled and located on a scaled site map. A representative sample, as used previously, is a sample obtained from each distinctive saturated unit within the boring. Also, a literature search of regional and local geologic conditions should be conducted with the results submitted to the Agency.

D) Class II shall not include any geologic material which is shown capable of either of the following:

- Sustained groundwater yield, from up to a 12 inch borehole, of 150 gallons per day or more from a thickness of 15 feet or less; or

  This requirement may be satisfied by the submission of continuously sampled boring logs which demonstrate aquifer thickness. In addition, as-built well construction diagrams should also be submitted to the Agency for review. Furthermore, a pump test or equivalent must be conducted to determine the yield of the geologic material. Methodology, assumptions, and any calculations performed should also be submitted to meet this requirement. If the aquifer geometry and transmissivity have been obtained through a site-specific field investigation, an analytical solution may be used to estimate well yield. The person conducting the remediation must demonstrate the appropriateness of an analytical solution to estimate well yield versus an actual field test. Well yield should be determined for either confined or unconfined conditions.

  The pump test should consider some minimum pumping rate during the test; the following criteria should be used:

  i) If all areas within 200 feet of the site have access to a water main to provide drinking water from a public water supply system, then a minimum pumping rate of 4 gallons per minute should be used when performing this test.

ii) If all areas within 200 feet of the site do not have access to a water main to provide drinking water from a public water supply system, then a minimum pumping rate of 0.5 gallons per minute should be used when performing this test.

- Hydraulic conductivity of 1 x 10^{-4} cm/sec or greater using one of the following test methods or its equivalent:

  This requirement may be satisfied by performing field and/or lab tests such as a permeameter, slug test, and/or pump test.

  An appropriate method of evaluation should be chosen based on the type of wells, the length of time over which data may need to be collected and, if known, the characteristics of the targeted aquifer. Such methods and the suggested information to be submitted to the Agency are outlined below and shall include at least one of the following:

  i) Permeameter

  If this method is chosen, samples of unconsolidated materials should be left in the field-sampling tubes which then become the permeameter sample chamber. Proceeding in this manner should allow as little disruption to the sample as possible. Unconsolidated samples should not be repacked into the sample chamber. An outline of the laboratory test method used and a description of the steps followed (including any calculations) should be submitted to the Agency for review.

  ii) Slug tests

  This information to be submitted to the Agency should include a description of the slug test method utilized and a discussion of the procedures followed during the tests, including any calculations performed.

  A significant drawback to performing a slug test is that it is heavily dependent on a high-quality intake. If a well point is clogged or corroded, measured values may be inaccurate. Also, if a well is developed by surging or backwashing prior to testing, the measured values may reflect increased conductivities in the artificially included gravel pack around the intake. If slug tests are chosen, a sufficient number of tests should be run to ensure that representative measures of hydraulic conductivities have been obtained and that lateral variations at various depths are documented.

  iii) Pump tests

Preliminary or short-term drawdown tests should be performed initially to assess the appropriate pumping rate for the constant-rate tests. Several methods and/or equations may be used in evaluating data generated from pump tests such as Theis, Hantush-0Jacob, Hvorslev and/or Theim equations. The method(s) of evaluation selected should be provided to the Agency with justification for their use, (explanations of any assumptions made and examples of all calculations performed along with a description of the physical tests performed including the type of pump used.)

NOTE: It may be beneficial to use laboratory evaluation methods to further support results of field tests; however, field methods provide the best definition of the hydraulic conductivity in most cases. The most appropriate method to determine hydraulic conductivity for most sites will be the pump test, provided proper evaluation of the data obtained from the test is utilized. Pump tests provide in-situ measurements that are averaged over a large aquifer volume and are preferred since they are able to characterize a greater portion of the subsurface compared to the other aquifer tests. Slug tests provide in-situ values representative of a small volume of porous media in the immediate vicinity of a piezometer tip, providing point values only, and may be more appropriate in very low-permeability materials in which conductivity is too small to conduct a pump test.

IT IS SO ORDERED.

I, Dorothy M. Gunn, Clerk of the Illinois Pollution Control Board, hereby certify that the above opinion and order was adopted on the ____ day of _____, 1996, by a vote of _____.

_____
Dorothy M. Gunn, Clerk
Illinois Pollution Control Board