The Idaho Risk Evaluation Manual for Petroleum Releases has been revised in conjunction with rule Docket No. 58-0124-1801. Revised sections of the manual have been included for reference purposes.

The full copy of the manual is available at www.deq.idaho.gov.

Idaho
Risk Evaluation Manual for Petroleum Releases

Idaho Department of Environmental Quality
1410 North Hilton
Boise, Idaho 83706

August 2018

Only revised sections of the manual have been included.

BREAK IN CONTINUITY OF SECTIONS

Section 3. Screening Level Evaluation

Data collected during the initial site characterization is typically initially evaluated using screening levels. This evaluation is intended to achieve the following objectives of the screening level evaluation:

- Demonstrate that the site or portions of the site do not pose a threat to human health and hence does not require any further evaluation, and
- Identify areas of the site that need further evaluation.

These objectives are achieved by comparing the maximum site concentrations with the screening level values.

3.1 Screening Levels

The screening levels for the petroleum COI in the Rule have been developed by DEQ and are included in Table 2. The screening levels are risk-based target concentrations developed with the following:

- the assumption that receptors will be residential,
- conservative input parameter values,
- an acceptable target risk of 10^{-6}, and
- a hazard quotient (HQ) of 1.

Specific exposure factors and models used to develop screening levels are presented in Appendices A and E. Screening levels are the lowest target concentrations for the following exposure pathways and ROE for soil, soil vapor, and groundwater.

Specifically, screening levels for soil are the lowest of the following concentrations:

- Surficial and subsurface soil concentrations protective of exposure via groundwater ingestion at maximum contaminant levels (MCLs) or risk-based concentrations at the downgradient edge of the source or
- Subsurface soil concentrations protective of exposure via indoor inhalation of vapors emanating from soil for a residential scenario, or
- Surficial soil concentrations protective of combined ingestion, dermal contact, and outdoor inhalation exposures for a residential scenario.

Screening levels for groundwater are the lowest of the following concentrations:

- MCLs for chemicals that have them or calculated values for ingestion of water in a residential scenario, or
- Groundwater concentrations protective of exposure via indoor inhalation of vapors emanating from groundwater for a residential scenario.

Screening levels for soil vapor are protective of exposure via indoor inhalation of vapors emitted from contaminated soil or groundwater. Screening levels in sub-slab and near-source soil gas are derived by applying attenuation factors of 0.03 to the EPA Regional Screening Levels (RSLs) for both residential and industrial ambient air.

Table 2 lists the screening levels for unrestricted use. For comparison, Table 2 provides the risk-based concentrations in soil and groundwater for all the pathways and ROE listed above. The screening level values incorporated in the Rule are indicated in bold.

Because of the methods and assumptions used in the development of the screening levels and the current limitations of laboratory analytical methods, the calculated screening levels may be lower than the practical quantitation limit reported by a laboratory for selected chemicals. In these situations, site-specific review by DEQ will be required based on the criteria provided in Section 500 of the Rule and Appendix K.

Table 2. Screening Level Concentrations for Soil, Groundwater, and Soil Vapor

	SOIL (mg/kg)			GROUNDWATER (mg/L)		TARGET SUB-SLAB AND NEAR-SOURCE SOIL GAS CONCENTRATIONS (ug/m3)	
						Unrestricted Use	Commercial/ Industrial
CHEMICAL	Vapor Intrusion	Direct Contact	Groundwater Protection	Vapor Intrusion	Ingestion	Vapor Intrusion	Vapor Intrusion
Benzene	0.08	8.3	**0.025**	0.044	**0.005**	**12**	53
Toluene	1300	7930	**6.6**	340	**1**	**170000**	733,333
Ethylbenzene	**0.25**	39	7.4	**0.05**	0.700	**37**	163
Xylenes	**27**	6100	93	**8.7**	10	**3500**	14667
Naphthalene	**0.12**	44	21	**0.07**	0.73	**2.8**	12
MTBE	2.4	340	**0.08**	6.8	**0.04**	**360**	1567
1,2-Dichloroethane	0.02	3.7	**0.013**	0.03	**0.005**	**3.6**	16
Ethylene Dibromide	0.001	0.27	**0.00014**	0.004	**0.00005**	**0.16**	0.67
Acenaphthene	NA	4470	**200**	NA	**2.2**	NA	NA
Anthracene	NA	22300	**3200**	NA	**11**	NA	NA
Benz(a)anthracene	106	1.4	**0.68**	0.60	**0.00022**	0.56	6.67
Benzo(a)pyrene	NA	**0.14**	2.1	NA	**0.0002**	NA	NA
Benzo(b)fluoranthene	NA	**1.4**	2.29	NA	**0.00022**	NA	NA
Benzo(k)fluoranthene	NA	**14**	22.5	NA	**0.0022**	NA	NA
Chrysene	NA	139	**69**	NA	**0.022**	NA	NA
Fluoranthene	NA	2970	**1400**	NA	**1.5**	NA	NA
Fluorene	NA	2970	**240**	NA	**1.5**	NA	NA
Pyrene	NA	2230	**1000**	NA	**1.1**	NA	NA

Values in bold are current screening level values. Screening level values for sub-slab and near-soil gas concentration are equivalent to EPA Regional Screening Levels (EPA, 2018) for residential and industrial ambient air divided by an attenuation factor of 0.03.

NA: not applicable because the chemical does not meet EPA volatility criteria or does not have a Regional Screening Level for ambient air.

BREAK IN CONTINUITY OF SECTIONS

Section 4. Site-Specific Risk Evaluation

Site-specific RE is needed only if the owner/operator chooses not to conduct a screening level evaluation or to use the default screening levels as the remediation standards.

Conducting a site-specific RE requires the completion of several important steps. These include developing an SCM, identifying the chemicals present in environmental media, assessing exposure and exposure pathways, assessing the toxicity of the chemicals present, characterizing human risks, and characterizing the impacts on or risks to the environment. This section describes each of these steps and also provides the suggested format for some of the deliverables (most of which are reports) that assist in developing and documenting the evaluation.

BREAK IN CONTINUITY OF SECTIONS

4.3 Exposure Assessment

The goals of the exposure assessment portion of the RE are to:

- Characterize the physical setting,
- Identify potentially exposed populations,
- Identify complete or potentially complete exposure pathways,
- Estimate exposure concentrations, and
- Estimate petroleum chemical intakes.

The exposure assessment uses much of the data collected in support of and assumptions contained in the SCM (described earlier in section 4.1). A graphical display of the SCM like the sample shown in Figure 2 is helpful for assessing exposure.

BREAK IN CONTINUITY OF SECTIONS

4.3.4 Exposure Point Concentrations

Exposure point concentrations are the average petroleum chemical concentrations to which receptors could be exposed over a specified duration within a specified geographical area. The geographical area about which a receptor moves and within which a receptor contacts contaminated media during the specified exposure duration is termed an exposure unit (EPA, 2001). The exposure unit of all receptors must be considered and described. The exposure unit, or spatial area over which a given receptor is likely to be exposed, must be established for on-site receptors as well as any off-site impacted or potentially impacted receptors and for each exposure pathway or ROE. The same site may have different exposure units for current and future use scenarios.

A detailed discussion of the estimation of exposure point concentrations and the use of exposure units for RE is provided in Appendix I. This appendix describes the sources of uncertainty which affect the estimation of exposure point concentrations, strategies to reduce this uncertainty, and methodologies to evaluate data quality. It also provides guidance on the selection of appropriate data for various ROE and appropriate statistical methods for analysis of available data.

The RE report should clearly identify specific data and methods used to estimate the exposure point concentrations, and provide a rationale for the method and data used. The following information should be provided in a table:

- Media
- ROE/pathway
- Receptor
- Data used
- Method of estimation

Table 3 shows how such a table might be constructed with examples of the type of information that would be supplied.

Table 3. Example Table Describing Derivation of Exposure Point Concentrations

Media	Route of Exposure	Receptor	Data Obtained From	Method
Surficial Soil	Direct Contact	Construction Worker	Unpaved Area	Average
Subsurface Soil	Indoor Inhalation	Commercial Worker	Building Footprint	Maximum
Groundwater	Ingestion	Residential	Source Area	Upper Confidence Limit
Soil Vapor	Indoor Inhalation	Commercial Worker	Sub-slab and near soil gas samples	Maximum

As presented in Table 3, an exposure point concentration is estimated for each complete ROE. Various methods available to estimate the exposure point concentrations are discussed in Appendix I. Use of the maximum concentration as the exposure point concentration is most conservative and also the easiest to calculate when compared with other ways of calculating

exposure point concentration (average, area-weighted average, upper limit of the confidence interval around the mean). Thus, if the risk that is calculated using the maximum concentration is acceptable, considerable computational effort can be avoided.

BREAK IN CONTINUITY OF SECTIONS

4.4 Toxicity Assessment

4.4.1 Chemical-Specific Toxicological Factors

The toxicity of chemicals with carcinogenic adverse health effects is quantified using cancer slope factors (CSF) for oral and dermal ROE, or inhalation unit risk (IUR) for the inhalation route. A CSF is an upper-bound estimate of the probability of a response (developing cancer) per unit intake of a chemical over a lifetime. The IUR is the upper-bound excess cancer risk estimated to result from continuous exposure to a chemical at a concentration of 1 $\mu g/m^3$ in air.

For chemicals that cause noncarcinogenic health effects, toxicity is typically quantified by reference doses (RfD) for oral and dermal ROE, and reference concentrations (RfC) for the inhalation ROE. The RfD is an estimate of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without risk of adverse health effects during a lifetime. Since RfDs are based on oral exposure, they are modified for use in dermal exposure assessment to take account of differences between gastrointestinal and dermal absorption. The RfC is an estimate of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of adverse health effects over a lifetime.

The primary source of information for toxicity factors for the petroleum COI is the EPA RSL tables (RSL) (EPA, 2018) found at:
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

Toxicity factors selected by DEQ for the petroleum COIs are presented in Appendix D.

03. Table 4. Default Toxicity Values for Risk Evaluation.

DEFAULT TOXICITY VALUES FOR RISK EVALUATION							
CHEMICALS	**CAS Number[a]**	**Oral Slope Factor (SF_o) (kg-day/mg)**	**Inhalation Unit Risk (IUR) (ug/m^3)**	**Oral Reference Dose (RfD_o) (mg/kg-day)**	**Inhalation Reference Concentration (RfC) (mg/m^3)**	**Oral RA[b] Factor (RAF_o)**	**Dermal RA Factor (RAF_d)**
Benzene	71-43-2	0.055	7.8E-06	0.004	0.03	1	0
Toluene	108-88-3	NA	NA	0.08	5.0	1	0
Ethylbenzene	100-41-4	0.011	2.5E-06	0.1	1.0	1	0
Total Xylenes	1330-20-7	NA	NA	0.2	0.1	1	0
Naphthalene	91-20-3	NA	3.4E-05	0.02	0.003	1	0.13

MTBE[c]	1634-04-4	0.0018	2.6E-07	NA	3.0	1	0
1,2-Dichloroethane	107-06-2	0.091	2.6E-05	0.006	0.007	1	0
Ethylene Dibromide	106-93-4	2	6.0E-04	0.009	0.009	1	0
Acenaphthene	83-32-9	NA	NA	0.06	NA	1	0.13
Anthracene	120-12-7	NA	NA	0.3	NA	1	0.13
Benz(a)anthracene	56-55-3	0.1	1.1E-04	NA	NA	1	0.13
Benzo(a)pyrene	50-32-8	1	1.1E-03	3.0E-04	NA	1	0.13
Benzo(b)fluoranthene	205-99-2	0.1	1.1E-04	NA	NA	1	0.13
Benzo(k)fluoranthene	207-08-9	0.01	1.1E-04	NA	NA	1	0.13
Chrysene	218-01-9	0.001	1.1E-05	NA	NA	1	0.13
Fluoranthene	206-44-0	NA	NA	0.04	NA	1	0.13
Fluorene	86-73-7	NA	NA	0.04	NA	1	0.13
Pyrene	129-00-0	NA	NA	0.03	NA	1	0.13
Notes:							
a Chemical Abstract Service							
b Relative Absorption							
c Methyl tert-butyl ether							
NA: No data available							
Source of toxicity values is the Regional Screening Level Summary Table (May 2018) found at the U.S. EPA Regional Screening Table website. The website is located at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.							

BREAK IN CONTINUITY OF SECTIONS

4.6 Risk-Based Target Levels

As described in the Risk Characterization section 4.5, if the calculated risk or hazard for all petroleum COIs and complete ROE for identified potential receptors exceeds the Acceptable Target Risk or Hazard Levels and corrective action is required, then risk-based target concentrations (RATLs) to achieve these targets should be calculated. Ingestion of water is not included in this calculation. The procedure used to calculate RATLs requires chemical-specific toxicological factors, receptor-specific exposure factors, fate and transport parameters, physical and chemical properties of the petroleum COIs, and mathematical models. In calculating risk-based target concentrations, all of these factors, properties, and models are typically the same as used for calculations of other risk-based levels.

Target concentrations should be estimated using an allocated risk process that apportions the acceptable target cumulative risk and HI among the different chemical-pathway combinations. The primary goal is to develop target concentrations in all media such that the acceptable target risk levels and hazard levels are met. There is no standard way to apportion the cumulative risk. To develop RATL concentrations, the default option selected by DEQ apportions cumulative risk and HI equally among all contributing petroleum chemical-pathway combinations such that those petroleum chemicals which contribute the greatest proportion of the total risk have the most stringent remediation standards. This methodology is described in detail, with examples, in Appendix D and is implemented in the computational software provided by DEQ to complement this guidance.

If a petroleum COI has toxicity that is based on both carcinogenic and noncarcinogenic effects, the applicable RATL for that chemical should be the lower of the two calculated allowable concentrations.

Site-specific considerations may result in an owner/operator choosing to utilize a different method for calculating target concentrations. For example, at a site having volatile and semi-volatile petroleum COIs contributing to the cumulative risk, the owner/operator may choose a technology that specifically reduces the volatile chemical's concentrations but marginally reduces the concentration of the semi-volatile chemical. A different owner/operator may choose to significantly reduce the concentration of the semi-volatile chemical and marginally reduce the concentration of the volatile chemical. The two strategies will result in different cleanup levels for each chemical; however, both will be acceptable provided cumulative risk meets the acceptable target risk criteria.

4.6.1 Developing RATL Concentrations for Groundwater and Surface Water Protection

For groundwater and surface water protection, target concentrations are calculated using somewhat different procedures, described below.

BREAK IN CONTINUITY OF SECTIONS

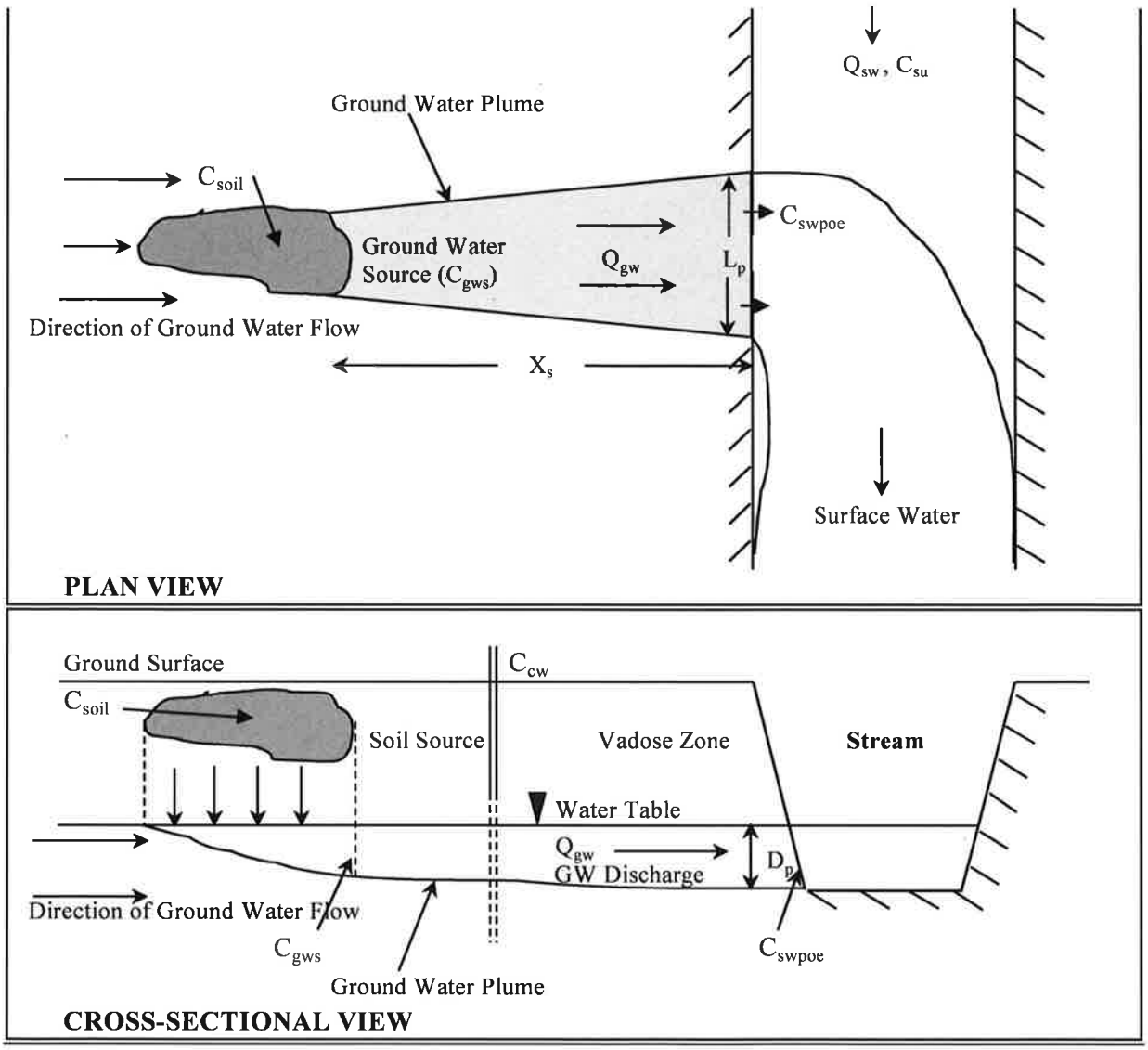
4.6.1.2 Surface Water Protection

Potential impacts to streams and other surface waterbodies from a petroleum release must be evaluated and surface water quality must be protected as per IDAPA 58.01.02 (Water Quality Standards and Wastewater Treatment Requirements). The primary receptors and ROE for potentially impacted surface waters evaluated in the RE process are described in section 4.6.1.2.1. Other ROE, such as contact with contaminated sediments or overland flow discharge, are evaluated on a case-by-case basis.

This section describes the evaluation of potential impacts to surface water via discharge of impacted groundwater to a surface waterbody. A schematic illustrating this exposure pathway is shown in Figure 3. This figure shows the relevant compliance and exposure locations and associated concentrations. Within the RE process, protection of surface waterbodies requires the owner/operator to determine or calculate the applicable surface water standards at the point where groundwater discharges into a surface waterbody (C_{swpoe}). Once the appropriate surface water standard is determined, compliance with the standard may be achieved in a number of ways. These include measuring surface water concentrations at the point of groundwater discharge, measuring groundwater concentrations at the point of discharge into the surface waterbody, or determining appropriate alternate concentrations in other media and at POC locations. Selection of alternate locations may be most appropriate for those sites where contamination has not yet reached a surface waterbody. Alternate concentrations (or RATLs) and POC locations can include:

- Source area soils (C_{soil}), or
- Compliance points in groundwater at different distances between the surface water and the source (C_{cw}) other than the point where groundwater discharges into the surface waterbody.

The owner/operator can back-calculate allowable soil (C_{soil}) and compliance well concentrations (C_{cw}) using dilution attenuation factors (DAFs). Specific equations, combining the Summer's mixing model and the Domenico analytical groundwater transport model, are presented in Appendix E. If measured concentration(s) at the soil source or the compliance well exceeds corresponding allowable concentrations, cleanup to RATL concentrations or performance of a more detailed, site-specific evaluation to refine DAFs are options.



Explanation of Symbols

Q_{sw} = Stream flow upstream of the point of ground water discharge
C_{su} = Concentration upstream of the ground water discharge
Q_{gw} = Impacted ground water discharge into the stream
C_{sw} = Allowable downstream concentration after uniform mixing
C_{swpoe} = Allowable concentration at the point of ground water discharge to the stream
C_{gws} = Allowable concentration in the ground water at the edge of the soil source
C_{soil} = Allowable soil concentration at the source protective of the stream
C_{cw} = Allowable soil concentration in ground water at different distances between the stream and the source
L_p = Width of ground water plume discharging to the stream
D_p = Thickness of ground water plume discharging to the stream
X_s = Distance from the downgradient edge of the ground water source to the stream

Figure 3. Schematic of Leachate Migration from the Soil Source to the Stream

4.6.1.2.1 Surface Water Quality Standards

The allowable concentration at the point of groundwater discharge into the surface water (C_{swpoe}), or the surface water quality standard, depends on the beneficial use designations of the surface waterbody as per IDAPA 58.01.02.100 and criteria assigned to protect those beneficial uses (IDAPA 58.01.02.200-250).

Beneficial uses include:

- Aquatic life: Cold water, salmonid spawning, seasonal cold water, warm water, or modified.
- Recreation: Primary contact or secondary contact.
- Water supply: Domestic, agricultural, or industrial.

Each beneficial use has associated numerical and narrative criteria. Numerical criteria are specified values that are not to be exceeded. For narrative criteria involving toxic substances, concentrations are not specified, but must be low enough to ensure that designated beneficial uses are not impaired. When necessary, development of numeric criteria for toxic substances is governed by IDAPA 58.01.02.210.05.

The allowable concentrations for certain toxic substances associated with these beneficial uses are tabulated in IDAPA 58.01.02.210.01.b.

BREAK IN CONTINUITY OF SECTIONS

4.7 Deliverables

The primary deliverables associated with conducting a site-specific RE typically include an optional work plan for the collection and evaluation of data, an optional data collection report, and the required RE report. In many cases, the results of a data collection effort are combined with the RE report. If the results of the RE report indicate the need for corrective action, a CAP must also be developed and submitted. The contents of CAPs are discussed in Section 5. This section describes the contents of a work plan.

4.7.1 Work Plan

A work plan may be desirable where extensive data collection activities or significant departures from default exposure assumptions or modeling are being proposed.

As appropriate, a work plan to fill identified data gaps may be prepared and submitted to DEQ for review. The amount of detail to be included in the work plan will vary among sites. At sites where a considerable amount of data has already been collected, the work plan may be a brief letter indicating activities to be performed to fill in the data gaps. For a complex or large site, a very detailed work plan, including the SCM, data collection methodology, analysis methods, a data QAPP, and a health and safety plan may need to be developed.

An RE work plan should address each item discussed in sections 4.7.1.1 through 4.7.1.11 as appropriate to the purpose and goals of the RE.

BREAK IN CONTINUITY OF SECTIONS

4.7.1.6 *Toxicity*

The Rule specifies that toxicity values for petroleum chemicals listed in Appendix D must be used in the RE.

If additional chemicals need to be included in the RE, as provided for in Section 100.02 of the Rule, their physical chemical properties and toxicity values should be obtained from the EPA RSL website (EPA, 2018).

APPENDICES

Appendix C: Default Physical and Chemical Properties

Appendix D: Default Toxicity Values

Appendix G: Evaluation of the Vapor Intrusion Pathway

Appendix C: Default Physical and Chemical Properties

Chemicals	CAS Number	Molecular Weight	Water Solubility (milligrams/ liter)	Henry's Law Constant (liters air/ liters water)	Organic Carbon Adsorption Coefficient Koc (milliliters/gram)	Vapor Pressure (millimeters mercury)[a]	Diffusion Coefficient in Air (square centimeters/ second)	Diffusion Coefficient in Water (square centimeters/ second)
Acenaphthene	83-32-9	154.2	3.9	7.5E-03	5027	1.6E-03	0.051	8.3E-06
Anthracene	120-12-7	178.2	0.0434	2.3E-03	16360	2.0E-04	0.039	7.9E-06
Benzene	71-43-2	78.1	1790	2.3E-01	145.8	9.5E+01	0.09	1.0E-05
Benzo(a)anthracene	56-55-3	228.3	0.0094	4.9E-04	176900	1.1E-07	0.051	5.9E-06
Benzo(a)pyrene	50-32-8	252.3	0.0016	1.9E-05	587400	5.5E-09	0.048	5.6E-06
Benzo(b)fluoranthene	205-99-2	252.3	0.0015	2.7E-05	599400	5.0E-07	0.048	5.6E-06
Benzo(k)fluoranthene	207-08-9	252.3	0.0008	2.4E-05	587400	9.6E-11	0.048	5.6E-06
Chrysene	218-01-9	228.3	0.002	2.1E-04	180500	6.3E-09	0.026	6.7E-06
1,2-Dichloroethane	107-06-2	99.0	8600	4.8E-02	40	8.7E+01	0.086	1.1E-05
Ethylbenzene	100-41-4	106.2	169	3.2E-01	446	1.0E+01	0.068	8.5E-06
Ethylene Dibromide	106-93-4	187.9	3910	2.7E-02	40	1.1E+01	0.043	1.0E-05
Fluoranthene	206-44-0	202.3	0.26	3.6E-04	55450	5.0E-06	0.028	7.2E-06
Fluorene	86-73-7	166.2	1.69	3.9E-03	9160	1.0E-04	0.044	7.9E-06
MTBE	1634-04-4	88.2	51000	2.4E-02	12	2.49E+02	0.075	8.6E-06
Naphthalene	91-20-3	128.0	31	1.8E-02	1544	2.3E-01	0.06	8.4E-06
Pyrene	129-00-0	202.3	0.135	4.9E-04	54340	6.9E-07	0.028	7.2E-06
Toluene	108-88-3	92.1	526	2.7E-01	234	2.2E+01	0.078	9.2E-06
Total Xylenes	1330-20-7	106.2	106	2.7E-01	383	8.8 E+00	0.085	9.9E-06

Note: Values for physical and chemical properties (with the exception of vapor pressure) are taken from the U.S. Environmental Protection Agency regional screening levels website (accessed May 2018) chemical specific parameter supporting table.

[a] Values for vapor pressure at 20–25 degrees Celsius were obtained from the *Groundwater Chemicals Desk Reference, Volume 1* by John H. Montgomery and Linda M. Welkom (1991, Lewis Publishers) and the *Groundwater Chemicals Desk Reference, Volume 2* by John H. Montgomery (1991, Lewis Publishers).

Appendix D: Default Toxicity Values

The table below provides a list of the default carcinogenic and noncarcinogenic toxicity factors and oral and dermal relative absorption factors used in the risk evaluation process. All toxicity factor values, oral relative absorption factors, and dermal relative absorption factors for polynuclear aromatic hydrocarbons were obtained from the U.S. Environmental Protection Agency (EPA) regional screening level website and are current as of May 2018:

http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

In their *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* (Part E, Supplemental Guidance for Dermal Risk Assessment), the EPA did not provide dermal relative absorption factors for volatile organic compounds based on the rationale that these compounds would tend to be volatilized from the soil on skin. Based on this rationale, the dermal relative absorption factors for volatile organic compounds is assumed to be zero.

Chemicals	CAS Number	Oral Slope Factor (kg-day/mg)[a]	Unit Inhalation Risk ($\mu g/m^3$)[b]	Oral Reference Dose (mg/kg-day)[c]	Inhalation Reference Concentration (mg/m^3)[d]	Oral Relative Absorption Factor	Dermal Relative Absorption Factor
Acenaphthene	83-32-9	NA	NA	6.0E-2	NA	1	0.13
Anthracene	120-12-7	NA	NA	3.0E-1	NA	1	0.13
Benzene	71-43-2	5.5E-2	7.8E-6	4.0E-3	3.0E-2	1	0
Benzo(a)anthracene	56-55-3	0.1	1.1E-4	NA	NA	1	0.13
Benzo(a)pyrene	50-32-8	1	1.1E-3	0.0003	NA	1	0.13
Benzo(b)fluoranthene	205-99-2	0.1	1.1E-4	NA	NA	1	0.13
Benzo(k)fluoranthene	207-08-9	0.01	1.1E-4	NA	NA	1	0.13
Chrysene	218-01-9	0.001	1.1E-5	NA	NA	1	0.13
1,2-Dichloroethane	107-06-2	9.1E-2	2.6E-5	6.0E-3	7.0E-3	1	0
Ethylbenzene	100-41-4	1.1E-2	2.5E-6	1.0E-1	1.0E0	1	0
Ethylene Dibromide	106-93-4	2.0E0	6.0E-4	9.0E-3	9.0E-3	1	0
Fluoranthene	206-44-0	NA	NA	4.0E-2	NA	1	0.13
Fluorene	86-73-7	NA	NA	4.0E-2	NA	1	0.13
MTBE	1634-04-4	1.8E-3	2.6E-7	NA	3.0E0	1	0
Naphthalene	91-20-3	NA	3.4E-5	2.0E-2	3.0E-3	1	0.13
Pyrene	129-00-0	NA	NA	3.0E-2	NA	1	0.13
Toluene	108-88-3	NA	NA	8.0E-2	5.0E0	1	0
Total Xylenes	1330-20-7	NA	NA	2.0E-1	1.0E-1	1	0

[a] kg-day/mg = kilogram-day per milligram
[b] $\mu g/m^3$ = microgram per cubic meter
[c] mg/kg-day = milligram per kilogram-day
[d] mg/m^3 = milligram per cubic meter

Appendix G: Evaluation of the Vapor Intrusion Pathway

EPA's June, 2015, *Technical Guide for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites, EPA 510-R-15-001* is included as Appendix G.

United States Environmental Protection Agency

EPA 510-R-15-001

Technical Guide For Addressing Petroleum Vapor Intrusion At Leaking Underground Storage Tank Sites

U.S. Environmental Protection Agency
Office of Underground Storage Tanks
Washington, D.C.

June 2015