

Appendix B

DIRECT CONTACT TECHNICAL SUPPORT DOCUMENT

DIRECT CONTACT

This portion of Appendix B explains the methods Montana Department of Environmental Quality (DEQ) used to develop direct contact risk-based screening levels (RBSLs) for Tier 1 of the risk-based corrective action (RBCA) process. The appendix is made up of tables and spreadsheets used to develop the RBSLs. The following is a brief explanation of these tables and spreadsheets. Data sources are provided in the spreadsheets and a reference list is provided at the end of this appendix. DEQ chose conservative parameters to develop RBSLs applicable to a wide variety of sites.

Table 1 provides a compilation of the chemical specific information used to develop the RBSLs and the actual direct contact RBSLs calculated for each compound. DEQ chose toxicity values based upon the December 5, 2003 EPA OSWER Directive 9285.7-53, which provides a hierarchy of human health values recommended for risk assessments (EPA, December 2003). For the petroleum fractions, DEQ obtained toxicity values for ingestion and dermal exposure from the Massachusetts Department of Environmental Protection (MADEP) November 2003 Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH /APH Methodology. (Volatile Petroleum Hydrocarbons = VPH, Extractable Petroleum Hydrocarbons = EPH, and Air-Phase Hydrocarbons). For petroleum fraction toxicity via inhalation, DEQ uses the EPA September 2009 Provisional Peer-Reviewed Toxicity Values for Complex Mixtures of Aliphatic and Aromatic Hydrocarbons (EPA, September 2009).

The columns in Table 1 that depict the oral reference dose (RfDo)/oral slope factor (SFo) and the reference concentration (RfC)/inhalation unit risk (IUR) depict either the non-cancer or the cancer value depending upon which provides for the more conservative RBSL. DEQ relied upon the United States Environmental Protection Agency (EPA) Regional Screening Levels (RSL) Tables (EPA, November 2017) for this determination. For naphthalene, both the RfC and the IUR are provided. RBSLs for residential and commercial exposure are based upon naphthalene carcinogenicity via inhalation. The RBSL for construction exposure is based upon non-carcinogenic risk via ingestion, inhalation, and dermal exposure.

The Volatilization Factors spreadsheet was used to calculate volatilization factor for the volatile fraction using the method provided in the EPA RSL User's Guide (EPA, November 2017). Volatile chemicals are defined as those chemicals having a Henry's Law constant greater than 10^{-5} (atm-m³/mol) and a molecular weight less than 200 g/mole as defined in EPA, November 2017. Data sources are provided at the end of the spreadsheets. DEQ used the EPA RSL Calculator (EPA, November 2017) as the source of the volatilization factors for the target analytes, like benzene.

The Age-Adjusted Factors spreadsheet was used to calculate age-adjusted factors for the soil ingestion and dermal contact exposure routes using the method provided in the EPA, November 2017. These age-adjusted factors, as well as the other exposure parameters included in the spreadsheets are based upon those included in the EPA February 2014 Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors (EPA, February 2014) and in some cases the EPA October 2011 Exposure Factors Handbook.

The Residential Scenario: Carcinogens spreadsheet was used to calculate RBSLs for residential exposure to carcinogens using the methods provided in EPA, November 2017. These RBSLs are

based on a target risk of 1×10^{-6} , providing some assurance that overall site risks will not exceed 1×10^{-5} , and are applied to the top 2 feet of soil at sites where the current and reasonably expected future usage is residential.

The Residential Scenario: Non-carcinogens spreadsheet was used to calculate RBSLs for residential exposure to non-carcinogens using the methods provided in EPA, November 2017, EPA, September 2008, the MADEP Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of the MADEP VPH/EPH Approach, Final Policy (October 31, 2002). These RBSLs are based on a target hazard quotient of 0.125 for each compound. There are eight possible non-carcinogens, including the non-target fractions, present in either gasoline or diesel. Therefore, a hazard quotient of 0.125 provides some assurance that the overall hazard index for a site will not exceed 1. These RBSLs are applied to the top 2 feet of soil at sites where the current and reasonably expected future usage is residential.

The Commercial Scenario: Carcinogens spreadsheet was used to calculate RBSLs for a commercial worker's exposure to carcinogens using the methods provided in EPA, November 2017. These RBSLs are based on a target risk of 1×10^{-6} , providing some assurance that overall site risks will not exceed 1×10^{-5} , and are applied to the top 2 feet of soil at sites where the current and reasonably expected future usage is commercial or industrial.

The Commercial Scenario: Non-carcinogens spreadsheet was used to calculate RBSLs for a commercial worker's exposure to non-carcinogens using the methods provided in EPA, November 2017 and MADEP, October 2002. These RBSLs are based on a target hazard quotient of 0.125 for each compound. There are eight possible non-carcinogens, including the non-target fractions, present in either gasoline or diesel. Therefore, a hazard quotient of 0.125 provides some assurance that the overall hazard index for a site will not exceed 1. The RBSLs are applied to the top 2 feet of soil at sites where the current and reasonably expected future usage is commercial or industrial.

The Construction Scenario: Carcinogens spreadsheet was used to calculate RBSLs for a construction worker's exposure to carcinogens using the methods provided in EPA, November 2017. These RBSLs are based on a target risk of 1×10^{-6} , providing some assurance that overall site risks will not exceed 1×10^{-5} and are applied to soil greater than 2 feet below the ground surface at all sites where there is a potential for utility installation, pipe repair, or other excavation in the future.

The Construction Scenario: Non-carcinogens spreadsheet was used to calculate RBSLs for a construction worker's exposure to non-carcinogens using the methods provided in EPA, November 2017 and MADEP, October 2002. These RBSLs are based on a target hazard quotient of 0.125 for each compound. There are eight possible non-carcinogens, including the non-target fractions, present in either gasoline or diesel. Therefore, a hazard quotient of 0.125 provides some assurance that the overall hazard index for a site will not exceed 1. The RBSLs may be applied to soil greater than 2 feet below the ground surface at all sites where there is a potential for utility installation, pipe repair, or other excavation in the future.

The Water Quality Guidelines for Non-Target Analytes spreadsheet was used to calculate RBSLs for non-target analytes in water using the methods provided in the EPA Drinking Water Regulations and Health Advisories (EPA, October 1996) and MADEP, October 2002.

REFERENCES

- United States Environmental Protection Agency (EPA), October 1996. Drinking Water Regulations and Health Advisories.
- EPA, December 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
- EPA, December 2003. OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments.
- EPA, July 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final.
- EPA, September 2009. Provisional Peer-Reviewed Toxicity Values (PPRTV) for Complex Mixtures of Aliphatic and Aromatic Hydrocarbons.
- EPA, October 2011. Exposure Factors Handbook.
- EPA, February 2014. Human Health Evaluation Manual Supplemental Guidance: Update of Standard Default Exposure Factors.
- EPA, November 2017. Regional Screening Levels User's Guide, Calculator, and Tables.
- Integrated Risk Information System (IRIS) EPA, January 2017. EPA's Integrated Risk Information System (IRIS) – January 2017 search for current toxicity values.
- Massachusetts Department of Environmental Protection (MADEP), October 2002. Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MADEP VPH/EPH Approach Public Comment Draft.
- Massachusetts Department of Environmental Protection (MADEP), November 2003. Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology.

TABLE 1: Chemicals Included in RBCA											
Compound	MW (g/mol)	Henry's Law Constant (dimensionless)	VF (m³/kg)	RAF oral (unitless)	RAF dermal (unitless)	RAF water (unitless)	Effect*	RfDo mg/kg-d or SFo kg-d/mg	Oral Toxicity Reference	RfC mg/m³ or IUR m³/μg	Inhalation Toxicity Reference
For Gasoline											
C5-C8 Aliphatics	93	54	1,189	1	1	1	n	4.0E-02	MADEP 2003	6.0E-01	PPRTV 2009
C9-C12 Aliphatics	149	65	7,176	1	0.5	1	n	1.0E-01	MADEP 2003	1.0E-01	PPRTV 2009
C9-C10 Aromatics	120	69	NA	1	0.5	0.91	n	3.0E-02	MADEP 2003	1.0E-01	PPRTV 2009
MTBE	88.15	0.02	4,900	1	0	1	c	1.8E-03	EPA 2017	2.6E-07	EPA 2017
Benzene	78.1	0.23	3,540	1	0	1	c	5.5E-02	IRIS 2018	7.8E-06	IRIS 2018
Toluene	92.14	0.27	4,290	1	0	1	n	8.0E-02	IRIS 2018	5.0E+00	IRIS 2018
Ethylbenzene	106.16	0.32	5,670	1	0	1	c	1.1E-02	EPA 2017	2.5E-06	IRIS 2018
Xylenes	106.16	0.27	5,740	1	0	1	n	2.0E-01	IRIS 2018	1.0E-01	IRIS 2018
Naphthalene**	128.16	0.02	46,300	1	0.13	1	n/c	2.0E-02	IRIS 2018	3E-03/3.4E-05	EPA 2017
Lead Scavengers											
1,2-Dibromoethane (EDB)	187.88	0.03	8,640	1	0	1	c	2.0E+00	IRIS 2018	6.0E-04	IRIS 2018
1,2-Dichloroethane (DCA)	98.96	0.05	4,570	1	0	1	c	9.1E-02	IRIS 2018	2.6E-05	IRIS 2018
For Diesel and Heavy Compounds											
C9-C18 Aliphatics	170	0.33	11,092	1	0.5	1	n	1.0E-01	MADEP 2003	1.0E-01	PPRTV 2009
C19-C36 Aliphatics	NA	NA	NA	1	0.1	1	n	3.0E+00	PPRTV 2009	NA	PPRTV 2009
C11-C22 Aromatics	150	0.03	NA	0.36	0.1	0.91	n	3.0E-02	MADEP 2003	1.0E-01	PPRTV 2009
Acenaphthene	152.2	7.50E-03	141,000	1	0.13	1	n	6.0E-02	IRIS 2018	NA	IRIS 2018
Anthracene	178.24	2.30E-03	523,000	1	0.13	1	n	3.0E-01	IRIS 2018	NA	IRIS 2018
Benzo(a)anthracene	228.3	4.90E-04	4,410,000	1	0.13	1	c	1.0E-01	EPA 2017	6.0E-05	EPA 2017
Benzo(a)pyrene	252.32	1.90E-05	NA	1	0.13	1	c	1.0E+00	IRIS 2018	6.0E-04	EPA 2017
Benzo(b)fluoranthene	252.32	2.70E-05	NA	1	0.13	1	c	1.0E-01	EPA 2017	6.0E-05	EPA 2017
Benzo(k)fluoranthene	252.32	2.40E-05	NA	1	0.13	1	c	1.0E-02	EPA 2017	6.0E-06	EPA 2017
Chrysene	228.3	2.10E-04	NA	1	0.13	1	c	1.0E-03	EPA 2017	6.0E-07	EPA 2017
Dibenzo(a,h)anthracene	278.35	5.80E-06	NA	1	0.13	1	c	1.0E+00	EPA 2017	6.0E-04	EPA 2017
Fluoranthene	202.26	3.60E-04	NA	1	0.13	1	n	4.0E-02	IRIS 2018	NA	IRIS 2018
Fluorene	166.22	3.90E-03	281,000	1	0.13	1	n	4.0E-02	IRIS 2018	NA	IRIS 2018
Indeno(1,2,3-cd)pyrene	276.34	1.40E-05	NA	1	0.13	1	c	1.0E-01	EPA 2017	6.0E-05	EPA 2017
Naphthalene**	128.16	0.02	46,300	1	0.13	1	n/c	2.0E-02	IRIS 2018	3E-03/3.4E-05	EPA 2017
1-Methylnaphthalene	142.2	0.021	58,600	1	0.13	1	c	2.9E-02	PPRTV 2008	NA	EPA 2017
2-Methylnaphthalene	142.2	0.021	58,000	1	0.13	1	n	4.0E-03	IRIS 2018	NA	EPA 2017
Pyrene	202.25	4.90E-04	2,380,000	1	0.13	1	n	3.0E-02	IRIS 2018	NA	IRIS 2018

Particulate Emission Factor (PEF) = 1.36E+09 (1359344438) m3/kg (EPA, May 2016)

*For compounds with both non-carcinogenic and carcinogenic effects, the more conservative of the two was chosen.

**The inhalation unit risk and the reference concentration are provided for naphthalene. RBSLs for residential and commercial exposure are based upon naphthalene carcinogenicity via inhalation

construction exposure is based upon non-carcinogenic risk via ingestion, dermal, and inhalation.

MW = molecular weight

g/mol = grams per mole

VF = volatilization factor

m^3/kg = cubic meter per kilogram

RAF = relative absorption factor

RfDo = oral reference dose

mg/kg-d = milligram per kilogram-day

SFo = oral slope factor

kg-d/mg = kilogram-day per milligram

RfC = reference concentration

mg/m^3 = milligrams per cubic meter

IUR = inhalation unit risk

$\text{m}^3/\mu\text{g}$ = cubic meter per microgram

Res. = residential

Comm. = commercial/industrial

Cons. = construction

MADEP = Massachusetts Department of Environmental Quality

EPA = U.S. Environmental Protection Agency

PPRTV = Provisional Peer Reviewed Toxicity Value

IRIS = Integrated Risk Information System

EPA Volatilization Factor (EPA, May 2016)	
$VF = [(Q/C) * ((3.14 * Da * T)^{(1/2)}) / (2 * db * Da) * 10^{-4}]$	
$Da = ((Pa^{(1/3)} * Di * H + Pw^{(1/3)} * Dw) / n^2) / (db * Kd + Pw + Pa * H)$	
C5-C8 ALIPHATICS	
VF = volatilization factor (m ³ /kg) calculated	1189
Q/C = inverse of the mean conc. at center of square source (g/m ² -s per kg/m ³)	68.18
pi = 3.14	3.14
Da = apparent diffusivity (cm ² /s) calculated	0.0094
Pa = air-filled soil porosity (Lair/Lsoil)	0.28
Di = diffusivity in air (cm ² /s) chemical specific	0.08
H = dimensionless Henry's law constant chemical specific	54
Pw = water-filled soil porosity (Lwater/Lsoil)	0.15
Dw = diffusivity in water (cm ² /s) chemical specific	1.00E-05
n = total soil porosity (Lpore/Lsoil)	0.43
db = dry soil bulk density (g/cm ³)	1.50E+00
Kd = soil-water partition coefficient (Koc*foc; cm ³ /g) calculated	13.59
Koc = soil organic carbon-water partition coefficient (cm ³ /g) chemical specific	2265
foc = organic carbon content of soil (g/g)	0.006
T = exposure interval (s)	8.20E+08
10 ⁻⁴ = conversion factor (m ² /cm ²)	1.00E-04
C9-C12 ALIPHATICS	
VF = volatilization factor (m ³ /kg) calculated	7176
Q/C = inverse of the mean conc. at center of square source (g/m ² -s per kg/m ³)	68.18
pi = 3.14	3.14
Da = apparent diffusivity (cm ² /s) calculated	0.00026
Pa = air-filled soil porosity (Lair/Lsoil)	0.28
Di = diffusivity in air (cm ² /s) chemical specific	0.07
H = dimensionless Henry's law constant chemical specific	65
Pw = water-filled soil porosity (Lwater/Lsoil)	0.15
Dw = diffusivity in water (cm ² /s) chemical specific	1.00E-05
n = total soil porosity (Lpore/Lsoil)	0.43
db = dry soil bulk density (g/cm ³)	1.5
Kd = soil-water partition coefficient (Koc*foc; cm ³ /g) calculated	900
Koc = soil organic carbon-water partition coefficient (cm ³ /g) chemical specific	1.50E+05
foc = organic carbon content of soil (g/g)	0.006
T = exposure interval (s)	8.20E+08
10 ⁻⁴ = conversion factor (m ² /cm ²)	1.00E-04
C9-C18 ALIPHATICS	
VF = volatilization factor (m ³ /kg) calculated	11092
Q/C = inverse of the mean conc. at center of square source (g/m ² -s per kg/m ³)	68.18
pi = 3.14	3.14
Da = apparent diffusivity (cm ² /s) calculated	0.000035
Pa = air-filled soil porosity (Lair/Lsoil)	0.28
Di = diffusivity in air (cm ² /s) chemical specific	0.07
H = dimensionless Henry's law constant chemical specific	69
Pw = water-filled soil porosity (Lwater/Lsoil)	0.15
Dw = diffusivity in water (cm ² /s) chemical specific	5.00E-06
n = total soil porosity (Lpore/Lsoil)	0.43
db = dry soil bulk density (g/cm ³)	1.5
Kd = soil-water partition coefficient (Koc*foc; cm ³ /g) calculated	4080
Koc = soil organic carbon-water partition coefficient (cm ³ /g) chemical specific	6.80E+05
foc = organic carbon content of soil (g/g)	0.006
T = exposure interval (s)	
10 ⁻⁴ = conversion factor (m ² /cm ²)	1.00E-04
* The following are the sources of the data used to calculate the volatilization factors:	
All non-chemical specific data and the chemical specific data for the target analytes: EPA, May 2016	
Chemical specific data for the non-target analytes except for Dw: MADEP, October 2002	

Soil Ingestion Factor (EPA Regional Screening Levels tables)

$$IFSadj = EDc * IRSc / BWc + (EDtot - EDc) * IRSa / BWa$$

Parameters	Values
IFSadj (Age-adjusted soil ingestion factor - mg*yr/kg*day)	105
EDc (Child exposure duration - yr; EPA, February 2014)	6
IRSc (Child soil ingestion rate - mg/day; EPA, February 2014)	200
BWc (Child body weight - kg; EPA, February 2014)	15
EDtot (Total exposure duration - yr; EPA, February 2014)	26
IRSa (Adult soil ingestion rate - mg/day; EPA, February 2014)	100
BWa (Adult body weight - kg; EPA, February 2014)	80

Mutagenic Soil Ingestion Factor (EPA Regional Screening Levels tables)

$$IFSMadj = ED0-2 * IRSc * 10 / BWc + ED2-6 * IRSc * 3 / BWc + ED6-16 * IRSc * 3 / BWa + ED16-30 * IRSc * 1 / BWa$$

Parameters	Values
IFSadj (Mutagenic age-adjusted soil ingestion factor - mg*yr/kg*day)	477
ED0-2 (0-2 year exposure duration - yr; EPA, November 2012)	2
ED2-6 (2-6 year exposure duration - yr; EPA, November 2012)	4
ED6-16 (6-16 year exposure duration - yr; EPA, November 2012)	10
ED16-26 (16-26 year exposure duration - yr; EPA, February 2014)	10
IRSc (Child soil ingestion rate - mg/day; EPA, February 2014)	200
BWc (Child body weight - kg; EPA, February 2014)	15
IRSa (Adult soil ingestion rate - mg/day; EPA, February 2014)	100
BWa (Adult body weight - kg; EPA, February 2014)	80

Mutagenic Soil Inhalation Factor (EPA Regional Screening Levels tables)

$$MIFadj = (ED0-2 * 10) + (ED2-6 * 3) + (ED6-16 * 3) + (ED16-30 * 1)$$

Parameters	Values
MIFadj (Mutagenic age-adjusted inhalation factor - yr)	72
ED0-2 (0-2 year exposure duration - yr; EPA, November 2012)	2
ED2-6 (2-6 year exposure duration - yr; EPA, November 2012)	4
ED6-16 (6-16 year exposure duration - yr; EPA, November 2012)	10
ED16-26 (16-26 year exposure duration - yr; EPA, February 2014)	10

Dermal Factor (EPA Regional Screening Levels tables)

$$DFSadj = EDc * Sac * AFc / BWc + (EDtot - EDc) * Saa * AFa / BWa$$

Parameters	Values
DFSadj (Age-adjusted dermal factor - mg*yr/kg*day)	295
EDc (Child exposure duration - yr; EPA, February 2014)	6
SAc (Child surface area - cm ² /day; EPA, February 2014)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, February 2014)	0.2
BWc (Child body weight - kg; EPA, February 2014)	15
EDtot (Total exposure duration - yr; EPA, February 2014)	26
SAA (Adult surface area - cm ² /day; EPA, February 2014)	6032
AFa (Adult adherence factor - mg/cm ² ; EPA, February 2014)	0.07
BWa (Adult body weight - kg; EPA, February 2014)	80

Mutagenic Dermal Factor (EPA Regional Screening Levels tables)

$$DFSMadj = ED0-2 * AFc * SAc * 10 / BWc + ED2-6 * AFc * SAc * 3 / BWc + ED16-30 * AFa * SAA * 1 / BWa$$

Parameters	Values
DFSMadj (Age-adjusted soil ingestion factor - mg*yr/kg*day)	1224
ED0-2 (0-2 year exposure duration - yr; EPA, November 2012)	2
ED2-6 (2-6 year exposure duration - yr; EPA, November 2012)	4
ED6-16 (6-16 year exposure duration - yr; EPA, November 2012)	10
ED16-26 (16-26 year exposure duration - yr; EPA, February 2014)	10
SAC (Child surface area - cm ² /day; EPA, February 2014)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, February 2014)	0.2
BWc (Child body weight - kg; EPA, February 2014)	15
SAA (Adult surface area - cm ² /day; EPA, February 2014)	6032
AFa (Adult adherence factor - mg/cm ² ; EPA, February 2014)	0.07
BWa (Adult body weight - kg; EPA, February 2014)	80

RESIDENTIAL SCENARIO
CARCINOGENS

May 2018

Cancer Risk Formula (with volatilization factor):

$$Cs = [(TR*AT)/(EF*((Sfo*RAFo*CF*IFSadj)+(IUR*CFi*(1/VF+1/PEF)*ED*ETres)+(Sfo*RAFd*CF*DFSadj)))]$$

BENZENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	1.3
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	5.50E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSadj (Age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	105
IUR (Chemical specific - kg-day/mg; IRIS, EPA, January 2018)	7.80E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	3540
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ED (Exposure duration - yr; EPA, November 2017)	26
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
DFSadj (Age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	295

ETHYLBENZENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	6.4
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.10E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSadj (Age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	105
IUR (Chemical specific - kg-day/mg; IRIS, EPA, November 2017)	2.50E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	5670
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ED (Exposure duration - yr; EPA, November 2017)	26
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
DFSadj (Age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	295

RESIDENTIAL SCENARIO
CARCINOGENS

May 2018

MTBE	
Parameters	Values
Cs (Soil concentration - mg/kg)	52
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.80E-03
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSadj (Age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	105
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	2.60E-07
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	4900
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ED (Exposure duration - yr; EPA, November 2017)	26
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
DFSadj (Age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	295

1,2-DIBROMOETHANE	
Parameters	Values
Cs (Soil concentration - mg/kg)	0.040
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	2.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSadj (Age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	105
IUR (Chemical specific - kg-day/mg; IRIS, EPA, January 2018)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	8640
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ED (Exposure duration - yr; EPA, November 2017)	26
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
DFSadj (Age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	295

1,2-DICHLOROETHANE	
Parameters	Values
Cs (Soil concentration - mg/kg)	0.52
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	9.10E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSadj (Age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	105
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	2.60E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	4570
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ED (Exposure duration - yr; EPA, November 2017)	26
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
DFSadj (Age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	295

NAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	4.3
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	3.40E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	46300
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ED (Exposure duration - yr; EPA, November 2017)	26
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1

Mutagenic Mode of Action Cancer Risk Formula (without volatilization factor):

$$Cs = [(TR*AT)/(EF*((SFo*RAFo*CF*IFSMadj)+(IUR*CFi*(1/PEF)*MIFadj*ETres)+(SFo*RAFd*CF*DFMadj)))]$$

BENZ(A)ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	1.28
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSMadj (Mutagenic age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	477
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
MIFadj (Mutagenic age-adjusted inhalation factor - yr; EPA, February 2014)	72
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
DFSMadj (Mutagenic age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	1224

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CARCINOGENS

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BENZO(A)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	0.128
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	1.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSMadj (Mutagenic age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	477
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
MIFadj (Mutagenic age-adjusted inhalation factor - yr; EPA, February 2014)	72
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0.13
DFSMadj (Mutagenic age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	1224

BENZO(B)FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	1.28
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSMadj (Mutagenic age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	477
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
MIFadj (Mutagenic age-adjusted inhalation factor - yr; EPA, February 2014)	72
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
DFSMadj (Mutagenic age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	1224

BENZO(K)FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	12.8
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSMadj (Mutagenic age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	477
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
MIFadj (Mutagenic age-adjusted inhalation factor - yr; EPA, February 2014)	72
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
DFSMadj (Mutagenic age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	1224

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DIBENZO(A,H)ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	0.128
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSMadj (Mutagenic age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	477
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
MIFadj (Mutagenic age-adjusted inhalation factor - yr; EPA, February 2014)	72
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
DFSMadj (Mutagenic age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	1224

CHRYSENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	128
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-03
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSMadj (Mutagenic age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	477
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-07
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
MIFadj (Mutagenic age-adjusted inhalation factor - yr; EPA, February 2014)	72
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
DFSMadj (Mutagenic age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	1224

INDENO(1,2,3-CD)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	1.28
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSMadj (Mutagenic age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	477
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0.E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
MIFadj (Mutagenic age-adjusted inhalation factor - yr; EPA, February 2014)	72
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
DFSMadj (Mutagenic age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	1224

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CARCINOGENS

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Cancer Risk Formula (without inhalation):

$$Cs = [(TR*AT)/(EF*((Sfo*RAFo*CF*IFSadj)+(Sfo*RAFd*CF*DFSadj)))]$$

1-METHYLNAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	20
TR (Target cancer risk - Arsenic example representing total risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	350
Sfo (Chemical specific oral cancer slope factor - kg-day/mg; PPRTV, 2008)	2.90E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0.E-06
IFSadj (Age-adjusted soil ingestion factor - mg-yr/kg-day; EPA, February 2014)	105
ED (Exposure duration - yr; EPA, November 2017)	26
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
DFSadj (Age-adjusted soil dermal factor - mg-yr/kg-day; EPA, February 2014)	295

RESIDENTIAL SCENARIO
NON-CARCINOGENS

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Non-cancer Risk Formula (with volatilization factor):

$$Cs = [(THQ*AT)/(ED*EF*((1/RfDo*RAFo*CF*IRSc)/BWc)+(1/RfC*ETres*(1/PEF+1/VF)))+(1/RfDo*CF*R$$

C5-C8 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	52
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2003)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	6.00E-01
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	1189
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2003)	1
SAc (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

C9-C12 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	77
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2003)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	1.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.00E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	1.00E-01
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	7176
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2003)	0.5
SAc (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

NAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	16
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	2.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	3.00E-03
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	46300
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAc (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

C9-C18 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	109
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2003)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	1.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	1.00E-01
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	11092
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2003)	0.5
SAc (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

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TOLUENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	611
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	8.00E-02
CF (Conversion factor - kg/mg; EPA, December 1991)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, August 1997)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	5.00E+00
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	4290
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAc (Child surface area - cm ² /day; EPA, February 2015)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, February 2015)	0.2

XYLENES	
Parameters	Values
Cs (Soil concentration - mg/kg)	72
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	2.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	1.00E-01
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	5740
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAc (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

RESIDENTIAL SCENARIO
NON-CARCINOGENS

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Non-cancer Risk Formula (with inhalation but without volatilization factor):

$$Cs = [(THQ*AT)/(ED*EF*((1/RfDo*RAFo*CF*IRSc)/BWc)+(1/RfC*ETres*(1/PEF)))+(1/RfDo*CF*RAFd*SAc)]$$

C9-C10 AROMATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	134
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2003)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	1.00E-01
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2003)	0.5
SAc (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

C11-C22 AROMATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	491
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2003)	0.36
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	1.00E-01
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2003)	0.1
SAc (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

BENZO(A)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	3.00E-04
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	2.00E-06
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2003)	0.1
SAC (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2242
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	3.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July, 2004)	0.13
SAC (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

ACENAPHTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	448
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	6.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAC (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

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NON-CARCINOGENS

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FLUORENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	299
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAC (Child surface area - cm ² /day; EPA, February 2014)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	299
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAC (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	224
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAC (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

2-METHYLNAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	30
THQ (Target hazard quotient)	0.125
BWc (Child body weight - kg; EPA, November 2017)	15
AT (Averaging time - day; EPA, November 2017)	2190
ED (Exposure duration - yr; EPA, November 2017)	6
EF (Exposure frequency - day/yr; EPA, November 2017)	350
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-03
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSc (Child soil ingestion rate - mg soil/day; EPA, November 2017)	200
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAC (Child surface area - cm ² /day; EPA, November 2017)	2373
AFc (Child adherence factor - mg/cm ² ; EPA, November 2017)	0.2

COMMERCIAL SCENARIO
CARCINOGENS

May 2018

Cancer Risk Formula (with volatilization factor):

$$Cs = [(TR*AT)/(EF*ED*((SFO*RAFo*CF*IRSa)/BWa)+(IUR*CFi*(1/VF+1/PEF)*ETcom))+((SFO*RAFd*CF*S$$

BENZENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	5.7
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	5.50E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	7.80E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	3,540
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

ETHYLBENZENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	28
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	1.10E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	2.50E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	5,670
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
CARCINOGENS

May 2018

MTBE	
Parameters	Values
Cs (Soil concentration - mg/kg)	228
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	1.80E-03
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	2.60E-07
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	4,900
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

1,2-DIBROMOETHANE	
Parameters	Values
Cs (Soil concentration - mg/kg)	0.18
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	2.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	8,640
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
CARCINOGENS

May 2018

1,2-DICHLOROETHANE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2.3
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	9.10E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	2.60E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	4,570
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

NAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	19
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; EPA, November 2017)	250
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	3.40E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	46,300
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ED (Total exposure duration - yr; EPA, November 2017)	25
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33

COMMERCIAL SCENARIO
CARCINOGENS

May 2018

Cancer Risk Formula (without volatilization factor):

$$Cs = [(TR*AT)/(EF*ED*((SFO*RAFo*CF*IRSa)/BWa)+(IUR*CFi*(1/PEF)*ETcom))+((SFO*RAFd*CF*SAA*AI$$

BENZ(A)ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	23.5
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

BENZO(A)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2.35
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	1.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36.E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
CARCINOGENS

May 2018

BENZO(B)FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	23.5
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

BENZO(K)FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	235
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
CARCINOGENS

May 2018

DIBENZO(A,H)ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2.35
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

CHRYSENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2351
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-03
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-07
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
CARCINOGENS

May 2018

INDENO(1,2,3-CD)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	23.5
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
ED (Exposure duration - yr; EPA, November 2017)	25
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

Cancer Risk Formula (without inhalation):

$$Cs = [(TR*AT)/(EF*ED*((SFo*RAFo*CF*IRSa)/BWa)+((SFo*RAFd*CF*SAa*AFa)/BWa))]$$

1-METHYLNAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	81
TR (Target cancer risk - Arsenic example representing total risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; EPA, November 2017)	250
SFo (Chemical specific oral cancer slope factor - kg-day/mg; PPRTV, 2008)	2.90E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
ED (Exposure duration - yr; EPA, November 2017)	25
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
NON-CARCINOGENS

May 2018

Non-cancer Risk Formula (with volatilization factor):

$$Cs = [(THQ*AT)/(ED*EF*((1/RfDo*RAFo*CF*IRSa)/BWa)+(1/RfC*ETcom*(1/PEF+1/VF)))+(1/RfDo*CF*$$

C5-C8 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	289
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV, 2009)	6.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	1189
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	1
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

C9-C12 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	362
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	1.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV, 2009)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	7176
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	0.5
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
NON-CARCINOGENS

May 2018

NAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	73
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	2.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	3.00E-03
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	46300
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

C9-C18 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	538
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	1.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV, 2009)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	11092
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	0.5
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
NON-CARCINOGENS

May 2018

TOLUENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	5856
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	8.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	5.00E+00
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	4290
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAA (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

XYLENES	
Parameters	Values
Cs (Soil concentration - mg/kg)	311
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	2.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	5740
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAA (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
NON-CARCINOGENS

May 2018

Non-cancer Risk Formula (with inhalation but without volatilization factor):

$$Cs = [(THQ*AT)/(ED*EF*((1/RfDo*RAFo*CF*IRSa)/BWa)+(1/RfC*ETcom*(1/PEF)))+(1/RfDo*CF*RAFd$$

C9-C10 AROMATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	1406
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV, 2009)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	0.5
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

C11-C22 AROMATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	5592
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	0.36
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV, 2009)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	0.1
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
NON-CARCINOGENS

May 2018

BENZO(A)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	28
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	3.00E-04
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	2.00E-06
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	28254
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	3.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

ACENAPHTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	5651
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	6.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
NON-CARCINOGENS

May 2018

FLUORENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	3767
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	3,767
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2,825
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

COMMERCIAL SCENARIO
NON-CARCINOGENS

May 2018

2-METHYLNAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	377
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	9125
ED (Exposure duration - yr; EPA, November 2017)	25
EF (Exposure frequency - day/yr; EPA, November 2017)	250
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-03
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	100
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.12

CONSTRUCTION SCENARIO
CARCINOGENS

May 2018

Cancer Risk Formula (with volatilization factor):

$$Cs = [(TR*AT)/(EF*ED*((SFO*RAFo*CF*IRSa)/BWa)+(IUR*CFi*(1/VF+1/PEF)*ETcom))+((SFO*RAFd*CF*SAA*AFa)/BWa)]$$

BENZENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	239
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	5.50E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	7.80E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	3540
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

ETHYLBENZENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	1323
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	1.10E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	2.50E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	6500
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
CARCINOGENS

May 2018

MTBE	
Parameters	Values
Cs (Soil concentration - mg/kg)	8877
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	1.80E-03
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	2.60E-07
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	4700
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

1,2-DIBROMOETHANE	
Parameters	Values
Cs (Soil concentration - mg/kg)	7.8
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	2.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	9500
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
CARCINOGENS

May 2018

1,2-DICHLOROETHANE	
Parameters	Values
Cs (Soil concentration - mg/kg)	111
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	9.10E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	2.60E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	5100
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

NAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	1094
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
EF (Exposure frequency - day/yr; DEQ 2015)	124
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	3.40E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	54000
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ED (Exposure duration - yr; DEQ 2015)	1
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33

CONSTRUCTION SCENARIO
CARCINOGENS

May 2018

Cancer Risk Formula (without volatilization factor):

$$Cs = [(TR*AT)/(EF*ED*((SFO*RAFo*CF*IRSa)/BWa)+(IUR*CFi*(1/PEF)*ETcom))+((SFO*RAFd*CF*SAA*AFa)/BWa)]$$

BENZ(A)ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	393
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

BENZO(A)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	39.3
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; IRIS, January 2018)	1.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, January 2018)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
CARCINOGENS

May 2018

BENZO(B)FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	393
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

BENZO(K)FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	3928
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; IRIS, November 2017)	6.00E-06
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
CARCINOGENS

May 2018

DIBENZO(A,H)ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	39.3
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E+00
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-04
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CHRYSENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	39284
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-03
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-07
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
CARCINOGENS

May 2018

INDENO(1,2,3-CD)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	393
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; EPA, November 2017)	1.00E-01
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
IUR (Chemical specific - kg-day/mg; EPA, November 2017)	6.00E-05
CFi (Inhalation conversion factor - µg/mg; EPA, November 2017)	1.0E+03
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

Cancer Risk Formula (without Inhalation):

$$Cs = [(TR*AT)/(EF*ED*((SFo*RAFo*CF*IRSa)/BWa)+((SFo*RAFd*CF*SAA*AFa)/BWa))]$$

1-METHYLNAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	1355
TR (Target cancer risk)	1.E-06
AT (Averaging time - day; EPA, October 2011)	28470
BWa (Adult body weight - kg; EPA, November 2017)	80
EF (Exposure frequency - day/yr; DEQ 2015)	124
ED (Exposure duration - yr; DEQ 2015)	1
SFo (Chemical specific oral cancer slope factor - kg-day/mg; PPRTV, 2008)	2.90E-02
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² ; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
NON-CARCINOGENS

May 2018

Non-cancer Risk Formula (with volatilization factor):

$$Cs = [(THQ*AT)/(ED*EF*((1/RfDo*RAFo*CF*IRSa)/BWa)+(1/RfC*ETcom*(1/PEF+1/VF)))+(1/RfDo*CF*RAF$$

C5-C8 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	408
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	6.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	1189
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	1
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

C9-C12 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	643
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	1.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	7,176
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	0.5
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
NON-CARCINOGENS

May 2018

NAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	137
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	2.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	3.00E-03
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	46,300
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

C9-C18 ALIPHATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	902
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	1.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	11,092
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	0.5
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
NON-CARCINOGENS

May 2018

TOLUENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	5483
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	8.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	5.00E+00
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	4,290
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

XYLENES	
Parameters	Values
Cs (Soil concentration - mg/kg)	612
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	2.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; IRIS, January 2018)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
VF (Volatilization factor - m ³ /kg; EPA, November 2017)	5,740
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, July 2004)	0
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
NON-CARCINOGENS

May 2018

Non-cancer Risk Formula (with inhalation but without volatilization factor):

$$Cs = [(THQ*AT)/(ED*EF*((1/RfDo*RAFo*CF*IRSa)/BWA)+(1/RfC*ETcom*(1/PEF)))+(1/RfDo*CF*RAFd*SAa$$

C9-C10 AROMATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	1028
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	0.5
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

C11-C22 AROMATICS	
Parameters	Values
Cs (Soil concentration - mg/kg)	3931
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	0.36
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	1.00E-01
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; MADEP, October 2002)	0.1
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
NON-CARCINOGENS

May 2018

BENZO(A)PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	34
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; MADEP, October 2002)	0.36
RfDo (Chemical specific oral reference dose - mg/kg-day; MADEP, November 2003)	3.00E-04
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RfC (Chemical specific inhalation reference concentration - mg/m ³ ; PPRTV 2009)	2.00E-06
ETcom (Commercial exposure time - 8 hr/day*1 day/24 hr; EPA, November 2017)	0.33
PEF (Particulate emission factor - m ³ /kg; EPA, November 2017)	1.36E+09
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

ANTHRACENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	18887
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	3.00E-01
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

ACENAPHTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	3777
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	6.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAA (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
NON-CARCINOGENS

May 2018

FLUORENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2518
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

FLUORANTHENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	2,518
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

PYRENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	1,898
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	3.00E-02
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3470
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

CONSTRUCTION SCENARIO
NON-CARCINOGENS

May 2018

2-METHYLNAPHTHALENE	
Parameters	Values
Cs (Soil concentration - mg/kg)	252
THQ (Target hazard quotient)	0.125
BWa (Adult body weight - kg; EPA, November 2017)	80
AT (Averaging time - day; EPA, November 2017)	365
ED (Exposure duration - yr; DEQ 2015)	1
EF (Exposure frequency - day/yr; DEQ 2015)	124
RAFo (Chemical specific oral relative absorption factor - unitless; EPA, November 2017)	1
RfDo (Chemical specific oral reference dose - mg/kg-day; IRIS, January 2018)	4.00E-03
CF (Conversion factor - kg/mg; EPA, November 2017)	1.0E-06
IRSa (Adult soil ingestion rate - mg soil/day; EPA, November 2017)	330
RAFd (Chemical specific dermal relative absorption factor - unitless; EPA, November 2017)	0.13
SAa (Adult surface area - cm ² /day; EPA, November 2017)	3527
AFa (Adult adherence factor - mg/cm ² ; EPA, November 2017)	0.3

WATER QUALITY GUIDELINES FOR NON-TARGET ANALYTES

May 2018

This spreadsheet calculates the concentrations of non-target petroleum compounds in water which result in a hazard quotient of 1 based on ingestion &, for volatile fractions, inhalation.

Non-Carcinogenic Risk Formula (EPA, November 2017):

$$C_w = [(THQ * AT * CF) / (ED * EF * ((RAFw * IRw / RfDo) / BWa) + (VF * ETres / RfC))]$$

C5-C8 ALIPHATICS	
Parameters	Values
Cw (Water concentration - µg/L)	646
THQ (Target hazard quotient - unitless)	1
BW (Body weight - kg; (EPA, November 2017))	80
AT (Averaging time - day (DEQ, May 2017))	10950
CF (Conversion factor - µg/mg; November 2017)	1000
ED (Exposure duration - yr (DEQ, May 2017))	30
EF (Exposure frequency - day/yr (EPA, November 2017))	350
RAFw (Chemical specific water relative absorption factor - unitless; MADEP, October 2002)	1
IRw (Ingestion rate - L/day; (EPA, November 2017))	2.5
RfDo (Oral reference dose - mg/kg/day (MADEP, November 2003))	0.04
VF (Andelman volatilization factor - L/m ³ (EPA, November 2017)	0.5
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	1
RfC (Inhalation reference concentration - mg/m ³ (IRIS, PPRTV, 2009))	0.6

C9-C12 ALIPHATICS	
Parameters	Values
Cw (Water concentration - µg/L)	1,391
THQ (Target hazard quotient - unitless)	1
BW (Body weight - kg; (EPA, November 2017))	80
AT (Averaging time - day (DEQ, May 2017))	10950
CF (Conversion factor - µg/mg; November 2017)	1000
ED (Exposure duration - yr (DEQ, May 2017))	30
EF (Exposure frequency - day/yr (EPA, November 2017))	365
RAFw (Chemical specific water relative absorption factor - unitless; MADEP, October 2002)	1
IRw (Ingestion rate - L/day; (EPA, November 2017))	2.5
RfDo (Oral reference dose - mg/kg/day (MADEP, November 2003))	0.1
VF (Volatilization factor - L/m ³ (EPA, November 2017 (K*0.5 L/m ³))	0.5
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	13
RfC (Inhalation reference concentration - mg/m ³ (IRIS, PPRTV, 2009))	0.2

C9-C18 ALIPHATICS	
Parameters	Values
Cw (Water concentration - µg/L)	1,391
THQ (Target hazard quotient - unitless)	1
BW (Body weight - kg; (EPA, November 2017))	80
AT (Averaging time - day (DEQ, May 2017))	10950
CF (Conversion factor - µg/mg; November 2017)	1000
ED (Exposure duration - yr (DEQ, May 2017))	30
EF (Exposure frequency - day/yr (EPA, November 2017))	365
RAFw (Chemical specific water relative absorption factor - unitless; MADEP, October 2002)	1
IRw (Ingestion rate - L/day; (EPA, November 2017))	2.5
RfDo (Oral reference dose - mg/kg/day (MADEP, November 2003))	0.1
VF (Volatilization factor - L/m ³ (EPA, November 2017 (K*0.5 L/m ³))	0.5
ETres (Residential exposure time - 24 hr/day*1 day/24 hr; EPA, November 2017)	13
RfC (Inhalation reference concentration - mg/m ³ (IRIS, PPRTV, 2009))	0.2

C9-C10 AROMATICS	
Parameters	Values
Cw (Water concentration - µg/L)	1,055
THQ (Target hazard quotient - unitless)	1
BW (Body weight - kg; (EPA, November 2017))	80
AT (Averaging time - day (DEQ, May 2017))	10950
CF (Conversion factor - µg/mg; November 2017)	1000
ED (Exposure duration - yr (DEQ, May 2017))	30
EF (Exposure frequency - day/yr (EPA, November 2017))	365
RAFw (Chemical specific water relative absorption factor - unitless; MADEP, October 2002)	0.91
IRw (Ingestion rate - L/day; (EPA, November 2017))	2.5
RfDo (Oral reference dose - mg/kg/day (MADEP, November 2003))	0.03

C11-C22 AROMATICS	
Parameters	Values
Cw (Water concentration - µg/L)	1,055
THQ (Target hazard quotient - unitless)	1
BW (Body weight - kg; (EPA, November 2017))	80
AT (Averaging time - day (DEQ, May 2017))	10950
CF (Conversion factor - µg/mg; November 2017)	1000
ED (Exposure duration - yr (DEQ, May 2017))	30
EF (Exposure frequency - day/yr (EPA, November 2017))	365
RAFw (Chemical specific water relative absorption factor - unitless; MADEP, October 2002)	0.91
IRw (Ingestion rate - L/day; (EPA, November 2017))	2.5
RfDo (Oral reference dose - mg/kg/day (MADEP, November 2003))	0.03

C19-C36 ALIPHATICS	
Parameters	Values
Cw (Water concentration - µg/L)	96,000
Beneficial use ceiling (µg/L)	1,000
THQ (Target hazard quotient - unitless)	1
BW (Body weight - kg; (EPA, November 2017))	80
AT (Averaging time - day (DEQ, May 2017))	10950
CF (Conversion factor - µg/mg; November 2017)	1000
ED (Exposure duration - yr (DEQ, May 2017))	30
EF (Exposure frequency - day/yr (EPA, November 2017))	365
RAFw (Chemical specific water relative absorption factor - unitless; MADEP, October 2002)	1
IRw (Ingestion rate - L/day; (EPA, November 2017))	2.5
RfDo (Oral reference dose - mg/kg/day (PPRTV, September 2009))	3

DEQ, May 2017; Montana Circular DEQ-7

EPA, November 2017; EPA Regional Screening Levels User's Guide and Tables

MADEP, October 2002; Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MADEP VPH/EPH Approach

MADEP, November 2003; Updated Petroleum Hydrocarbon Fraction Toxicity Values for the VPH/EPH/APH Methodology