State of Alaska
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES PROGRAM

Procedures for Calculating Cumulative Risk

May 15, 2016

Adopted by Reference at 18 AAC 75

PROCEDURES FOR CALCULATING CUMULATIVE RISK

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 CARCINOGENS 1
1.2 MUTAGENS 1
1.3 NONCARCINOGENS 2

2.0 CALCULATING CUMULATIVE RISK 2

1. WHEN TO PERFORM THE CUMULATIVE RISK ANALYSIS 2
2. PROCEDURES 2

3.0 CUMULATIVE RISK AND GROUNDWATER 4

4.0 CUMULATIVE RISK UNDER METHOD FOUR 4

5.0 CHEMICALS WITH SPECIAL CONSIDERATIONS 5

5.1 PCBS 5
5.2 DIOXINS 5
5.3 LEAD 5
5.4 CHEMICALS NOT FOUND IN ADEC TABLES 6
5.5 NATURALLY OCCURRING COMPOUNDS 6
5.6 PETROLEUM HYDROCARBONS 6

6.0 CUMULATIVE RISK CALCULATIONS FOR METHOD THREE 8

7.0 ADDITIONAL PATHWAYS TO INVESTIGATE 8

8.0 ROUNDING IN CUMULATIVE RISK 8

9.0 ECOLOGICAL RECEPTORS 8

REFERENCES 10

APPENDIX A: WORKSHEET FOR CALCULATING CUMULATIVE RISK 11

APPENDIX B: HUMAN HEALTH RISK BASED CONCENTRATIONS 12

SOIL ARCTIC ZONE 13

SOIL UNDER 40 INCH ZONE 19

SOIL OVER 40 INCH ZONE 25

GROUNDWATER 31

APPENDIX C: HIERARCHY OF TOXICITY SOURCES AND MCLS 37

1.0 INTRODUCTION

The Alaska Department of Environmental Conservation (DEC) has developed rules at 18 AAC 75, Article 3 that detail the extent of cleanup required at contaminated sites in order to adequately protect human health, safety, and welfare and the environment. Included in these rules as well as the regulations for underground storage tanks at 18 AAC 78, is the requirement for ensuring that contaminants at a site do not exceed cumulative risk thresholds for carcinogenic and noncarcinogenic compounds, accounting for exposure to multiple contaminants across multiple pathways. This document describes the procedures for calculating that cumulative risk.

Under 18 AAC 75.325(g) or 18 AAC 78.600(d), a responsible party must ensure that contaminants remaining onsite do not exceed the cumulative risk standard of 1 in 100,000 excess lifetime cancer risk across all exposure pathways for carcinogens and a hazard index of not more than one, reported to one significant figure, across all exposure pathways for noncarcinogens, regardless of whether the cleanup levels established for the site are under method two, three, or four.

ADEC utilizes a sum-of-ratios approach for calculating cumulative risk. The approach is carried out in two separate calculations; one calculation for carcinogenic effects and one for noncarcinogenic effects. Separating risk quantification in this way is necessary due to differences between the two types of effects. For carcinogens, risk is evaluated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (USEPA, 1989). Within the carcinogenic category additional adjustments are incorporated if the chemical is considered to have a mutagenic mode of action. For noncarcinogens, risks are based on exposure over a threshold that is likely to be without effects. The calculations are then incorporated into a ratio approach and summed to quantify the cumulative risk. These procedures are for cumulative risk only and do not substitute for a baseline risk assessment.

Some compounds can cause both types of effects and are included in both cumulative risk calculations. For example, aldrin causes both carcinogenic and noncarcinogenic effects from soil exposure through the human health pathway. The cleanup level in Table B1 corresponds with the carcinogenic effect because it occurs at a lower concentration than does the noncarcinogenic effect.

1.1 Carcinogens

As stated in the preceding section, carcinogenic risk is estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogenic compound. Under 18 AAC 75.990(12), ADEC defines a carcinogen as "…a substance that meets the criteria of the descriptors "Carcinogenic to Humans" or "Likely to Be Carcinogenic to Humans" according to EPA's *Guidelines for Carcinogen Risk Assessment*, EPA/630/P-03/001F (USEPA, 2005).

Cumulative carcinogenic risk is the summation of all risks from each exposure pathway and exposure route. The cumulative carcinogenic risk equation is shown in Section 2.2. Unless demonstrated otherwise, cancer risks resulting from exposure to two or more carcinogens are assumed to be additive. The cumulative carcinogenic risk equation assumes that there are no synergistic or antagonistic chemical interactions.

1.2 Mutagens

Some of the carcinogenic compounds listed in Tables B1 and C operate by a mutagenic mode of action for carcinogenesis. Some chemicals with a mutagenic mode of action, which would be expected to cause irreversible changes to DNA, are suspected to exhibit a greater effect in early-life versus later-life exposure. Cancer risk to children in the context of EPA's cancer guidelines (USEPA, 2005) includes both early-life exposures that may result in the occurrence of cancer during childhood and early-life exposures that may contribute to cancers later in life. In keeping with this guidance, mutagenic cancer risk is calculated separately, and the mutagen vinyl chloride and trichloroethylene has a unique set of equations. However, when calculating cumulative risk,

mutagens are included with carcinogens. Consult the Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, EPA/630/R-03/003F, March 2005 for further information (User's Guide, EPA Regional Screening Levels, 2015).

1.3 Noncarcinogens

Under 18 AAC 75.990(69), ADEC defines a noncarcinogen as "…a hazardous substance with adverse health effects on humans other than cancer." The noncarcinogenic risk is represented by a hazard quotient (HQ), which is calculated from the ratio of estimated intake of a chemical to the estimated intake at which there are no observed adverse effects. The hazard index (HI) is the summation of all of the HQs for all pathways and exposure routes that affect the same target organ or system endpoint.

For noncarcinogens, the health threats resulting from exposure to two or more hazardous substances with similar types of toxic response are assumed to be additive. However, many noncarcinogens have varying toxic effects and therefore assuming that these effects are additive may not be valid. Noncarcinogenic compounds affect different target organs or systems by different mechanisms of toxicity. To accurately assess the possible effects of noncarcinogenic compounds, the HI can be segregated by target organ or system endpoint and mechanism of toxicity consistent with EPA's *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A) – Interim Final* (USEPA, 1989), *Guidelines for the Health Risk Assessment of Chemical Mixtures* (USEPA, 1986), and *Supplemental Guidance for Conducting Health Risk Assessment of Chemical Mixtures* (USEPA, 2000). Since the mechanism of toxicity is not well understood for many compounds, the department will evaluate segregation of the HI by target organ or system endpoint.

2.0 CALCULATING CUMULATIVE RISK

Cumulative risk is defined as the sum of risks resulting from multiple sources and pathways via which humans are exposed. When more than one hazardous substance is present at a site or multiple exposure pathways exist, the cleanup levels in Table B1 of 18 AAC 75.341 and Table C of 18 AAC 75.345 (hereinafter "Table B1"and "Table C") may need to be adjusted downward. The cumulative cancer risk remaining at the site when cleanup is completed must not exceed 1 in 100,000 (1×10^{-5}) unless otherwise approved by ADEC, and must not exceed the cumulative noncarcinogenic risk standard at a hazard index (HI) of one, reported to one significant figure.

1. When to Perform the Cumulative Risk Analysis

The cumulative risk standard must be met upon completion of site cleanup work, but the department advises that responsible parties be cognizant early on of potential cumulative risk issues to allow adjustments to the scope of the cleanup and avoid remobilization to the site post-cleanup. Therefore, it may be prudent to calculate cumulative risk as soon as adequate and representative data is available. The department does not require that gasoline, diesel and residual range petroleum hydrocarbon fractions (see both Table B2 of 18 AAC 75.341 and Table C) be included in cumulative risk calculations, since selected individual compounds from the fractions are accounted for in Table B1 and Table C. However the risk may be underestimated since each fraction can consist of several other compounds not accounted for. See section 5.6 for more information.

2. Procedures

The process for calculating cumulative risk is as follows:

1. Determine which compounds are considered chemicals of potential concern (COPCs) for inclusion in the calculation of cumulative risk. These chemicals will correspond to a HQ of 0.1 or cancer risk of 1×10^{-6} for the residential exposure scenario. COPCs can be determined using the maximum soil concentration of each contaminant at the site that exceeds $1/10^{th}$ of

the human health levels in Table B1 for the applicable climate zone.[1] For groundwater, the maximum concentration is compared against 1/10th of the cleanup levels in Table C (see Section 3.0 for addressing cumulative risk in groundwater). If no chemicals at the site exceed the 1/10th threshold for either media, or only petroleum range contamination is present, cumulative risk does not need to be calculated for the site. For help on how to evaluate compounds not listed in ADEC tables, see Section 5.4.

Please note that some chemicals listed in Tables B1 and C are capped at saturation or solubility levels that are lower than the actual risk-based value. Using the 1/10th threshold may not adversely influence the calculation; however, adjustments may be needed for saturation or solubility-capped chemicals if several are COPCs at the site. The adjustments can be made to correspond to a HQ of 0.1 or cancer risk of 1×10^{-6} with ADEC cumulative risk tools. Please consult with ADEC staff for assistance in calculating the values.

2. When COPCs are present, develop a conceptual site model (CSM) that shows all of the complete exposure pathways at the site. A CSM should include the source of contamination, release/transport mechanisms, contact media (i.e. soil, air, or groundwater), exposure route (i.e., dermal contact, inhalation, ingestion) and receptor (i.e. current/future resident, subsistence user, or biota). For more information on developing a CSM, refer to the department's Guidance on Developing Conceptual Site Models (ADEC, 2010).

3. Using the worksheet example in Appendix A, record the following information for each contaminant:

    a) whether the contaminant is considered a carcinogen, noncarcinogen, or both (if it is a mutagen, record it as a carcinogen);
    b) the exposure media (soil, groundwater, air)
    c) exposure route (ingestion, inhalation of volatiles and/or particulates, dermal contact)
    d) maximum concentration or the mean soil concentration at the 95th percent upper confidence limit (UCL) remaining on-site following cleanup[2]; and
    e) the corresponding risk-based concentration (RBC) in Appendix B for soil or groundwater.

    RBCs correspond to the concentration in soil that would cause an adverse effect through the inhalation, ingestion, or dermal contact routes of exposure. RBCs are calculated using the equations presented in ADEC's *Procedures for Calculating Cleanup Levels* (PCCL 2015) and take into account default exposure and soil/aquifer data as well as toxicological data specific to the compound of interest. The RBCs differ from Table B1 and Table C in that individual exposure pathways are shown rather than individual exposure pathways are shown rather than the cumulative risk from the respective media listed in the Tables. . Also, some cleanup levels in Table B1 are capped at the soil saturation concentration and therefore may equate to a lifetime cancer risk or HI that is lower than the department standard.
4. For each carcinogen, risk is calculated by dividing the maximum site concentration or the mean of the 95 UCL remaining on-site by the applicable RBC and multiplying by the risk

[1] 1/10 of the cleanup level corresponds to a HQ of 0.1 and cancer risk of 10E-6.

[2] To employ the mean soil concentration at the 95% UCL under 18 AAC 75.380(c)(1), the department must approve an appropriate statistical method. As stated above, for groundwater, the site concentration is the maximum concentration, as described in 18 AAC 75.380(c)(2).

management level of 1×10^{-5}. Cumulative carcinogenic risk is the summation of all the risks from each exposure pathway and exposure route. The equation is as follows:

$$Cumulative\ Carcinogenic\ Risk = \left[\left(\frac{conc_x}{RBC_x}\right) + \left(\frac{conc_y}{RBC_y}\right) + \left(\frac{conc_z}{RBC_z}\right) \ldots\right] \times 10^{-5}$$

5. For each noncarcinogen, the hazard quotient (HQ) is calculated by dividing the site concentration remaining on-site by the applicable RBC and multiplying by the risk management level of 1. The hazard index (HI) is the summation of all HQs across all pathways that are affecting the same target organ or system endpoint. The equation is as follows:

$$Hazard\ Index = \left[\left(\frac{conc_x}{RBC_x}\right) + \left(\frac{conc_y}{RBC_y}\right) + \left(\frac{conc_z}{RBC_z}\right) \ldots\right] \times 1$$

Soil cleanup levels through methods two and three address ingestion of soil, inhalation of volatile chemicals and chemical particulates from soil in outdoor ambient air, and dermal contact with soil. Cleanup levels for groundwater at Table C address ingestion of groundwater, dermal contact with groundwater, and inhalation of volatiles from groundwater.

All other pathways that are shown to be complete based on the site-specific CSM should be investigated. These include indoor air from vapor intrusion as well as consumption of wild foods or exposure as a result of other site uses. The vapor intrusion pathway can be addressed through a site-specific analysis following ADEC's Vapor Intrusion Guidance (2012), while other pathways can be addressed through a method four risk assessment.

The RBCs for compounds not listed in Tables B1 and C and for compounds where alternative cleanup levels under method three are proposed, must be calculated on a site-specific basis using ADEC's Risk Assessment Procedures Manual (RAPM) 2015.

3.0 CUMULATIVE RISK AND GROUNDWATER

Unless it is shown that the groundwater at the site is not used or could not potentially be used for human consumption, it should be assumed that these groundwater pathways are complete. Therefore, chemicals found in groundwater at one-tenth of the Table C values need to be included in the cumulative risk calculations.

Table C values were developed using ADEC's PCCL 2015. Levels developed using the risk-based equations in the PCCL are based on an HQ of 1 or a lifetime excess cancer risk of 1×10^{-5} for ingestion of groundwater, inhalation of volatiles from groundwater and dermal contact with groundwater. The RBCs associated with the three groundwater exposure pathways are shown in Appendix B.

4.0 CUMULATIVE RISK UNDER METHOD FOUR

When conducting a method four risk assessment, compounds found at levels that correspond to greater than the risk based benchmarks of 1×10^{-6} risk or HQ of 0.1 will be retained for further analysis and are therefore included in the cumulative risk calculations. See ADEC's RAPM 2015 for more information.

5.0 CHEMICALS WITH SPECIAL CONSIDERATIONS

The following sections detail procedures for incorporating PCBs, dioxins, and lead in cumulative risk calculations. For additional information and assistance with these compounds please contact ADEC's risk assessor.

5.1 PCBs

Polychlorinated biphenyls (PCBs) are included in cumulative risk calculations although the cleanup levels are determined on a site-specific basis, based on land use, or through a site-specific risk assessment. If separate congener or Aroclor concentrations are present, the appropriate toxicological data can be used to calculate cancer risk. At the time of this document, EPA's *Integrated Risk Information System* (IRIS) had individual assessments for seven different Aroclors: 1016, 1221, 1232, 1242, 1248, 1254 and 1260.[3] In addition IRIS has individual assessments for a handful of specific congeners. If PCBs are presented as a total concentration, the most conservative cancer slope factor and reference dose should be used.

5.2 Dioxins

Risks from dioxins are calculated based on a 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalent (TEQ) approach and should be included in cumulative risk calculations. Toxicity equivalency factors (TEFs) are used to compare the relative toxicity of individual dioxin-like compounds to the more toxic TCDD. Included in this calculation are dioxins, furans, and dioxin-like PCBs. The TEQ approach is based on the assumption that dioxin and dioxin-like compounds act through the same mechanism of toxicity. The TEF for TCDD is equal to one, whereas the TEF values for all other dioxins and dioxin-like compounds are equal to less than one. The TEQ is defined as the product of the concentration of an individual dioxin-like compound (Ci) and the corresponding TEF for that compound (TEFi). The total TEQ is the sum of the TEQ for each of the congeners in a given mixture.

$$Total\ TEQ = \sum(Ci \times TEFi)$$

Once the total TEQ is calculated, this value can be compared to the dioxin slope factor and the risk can be calculated. The most current toxicological data and TEFs should be used when calculating risk to dioxins. As of July 2015, the World Health Organization remains the leading recommended approach for TEFs.[4]

5.3 Lead

Lead contamination in soil or groundwater is not included in cumulative risk calculations. EPA found it inappropriate to apply a reference dose or cancer slope factor to lead (IRIS, 1988). The residential lead soil cleanup level in Table B1 is based on the Integrated Exposure Uptake Biokinetic (IEUBK) model. Soil cleanup levels for lead are site-specific, based on land use, and groundwater cleanup levels are presented in Table C. In addition, an alternative cleanup level may be proposed under a site-specific risk assessment.

Lead cleanup levels are based on land use; for residential land use, the soil cleanup level is 400 mg/kg. For commercial or industrial land use as applied in 18 AAC 75.340(e)(3), the soil cleanup level is 800 mg/kg. As part of a site-specific risk assessment conducted according to the RAPM 2015, approved exposure models may be used to evaluate exposure to a child resident or an adult

---

[3] Available at: http://www.epa.gov/IRIS/

[4] World Health Organization. 2005. International Programme on Chemical Safety, Toxicity equivalent factors for dioxins, furans, and dioxin-like PCBs. Available at: http://www.who.int/foodsafety/chem/tef_update/en/index.html

worker. A responsible person may also propose an alternative cleanup level based on a chemical speciation of the lead present at the site, under a site-specific risk assessment. For soils contaminated with lead more than 15 feet below ground surface, lead cleanup levels will be determined on a site-specific basis.

5.4 Chemicals Not Found in ADEC Tables

To evaluate cumulative risk from a chemical for which no ADEC regulatory criteria is available, the first step is to consult the EPA Regional Screening Levels (RSL) table (available at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm) and compare the site concentration with the listed screening level for residential receptors. If it exceeds the value listed, which equates to a noncarcinogenic risk at HQ= 0.1 and cancer risk at 1×10^{-6} then consult with ADEC staff to calculate a method two cleanup level using the process outlined in the RAPM 2015. Toxicity and chemical data specific to the compound of concern will be needed. Toxicity data can be obtained from EPA's IRIS, EPA's *Provisional Peer Reviewed Toxicity Values (PPRTVs)*[5], or another accepted source (see Appendix C). Chemical data can be obtained from an accepted chemistry source such as the Risk Assessment Information System (RAIS).[6] When compounds are not listed in ADEC and RSL tables please consult with ADEC staff.

Next, if the highest concentration remaining in soil or groundwater exceeds 1/10th of the calculated value, proceed with the steps as described in Section 2.2 of these procedures, including evaluating complete exposure pathways and comparing with the route-specific RBC(s) developed as part of the cleanup criteria calculations and validated by ADEC.

5.5 Naturally Occurring Compounds

DEC recommends the use of the U.S. Environmental Protection Agency's *Guidance for Comparing Background and Chemical Concentrations in Soil for Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Sites* (USEPA, 2002), for determining if compounds found on site are attributable to background levels. If a chemical found at the site is shown to be solely attributable to naturally occurring background concentrations, then the chemical is not included in the cumulative risk calculations.

5.6 Petroleum Hydrocarbons

Each petroleum fraction is a mixture of many different chemicals. The Total Petroleum Hydrocarbon Criteria Working Group identified indicator contaminants to represent the toxicity of the petroleum fractions. Individual risks for each petroleum fraction are then calculated based on these indicator compounds (listed in the table below). In order to accomplish this, analytical data for these compounds must be collected at sites with petroleum contamination. If these indicator compounds are not present at greater than 1/10 of the cleanup level in Tables B1 and C, then no further assessment of cumulative risk is required; however site cleanup levels for petroleum fractions still must be met.

INDICATOR COMPOUNDS FOR PETROLEUM CONTAMINATED SITES	
Volatiles (BTEX)	*Metals as required on a case by case basis*

[5] Available at: http://hhpprtv.ornl.gov/
[6] Available at: http://rais.ornl.gov/

Benzene* Toluene Ethylbenzene* Total xylenes *Polynuclear Aromatic Hydrocarbons (PAHs)* - Acenaphthene Acenaphthylene Anthracene Benzo(a)anthracene* Benzo(b)fluroranthene* Benzo(k)fluoranthene* Benzo(g,h,i)perylene Benzo(a)pyrene* Chrysene * Dibenzo(a,h)anthracene* Fluoranthene Fluorene Indeno(1,2,3-cd)pyrene* Naphthalene* Phenanthrene Pyrene	Arsenic* Barium Cadmium Chromium Lead Nickel Vanadium *Others as needed on a case by case basis* Ethylene dibromide (EDB)* 1,2-dichloroethane (EDC)* Methyl tert-butyl ether (MTBE)* Volatile organic compounds (VOCs)*

* = carcinogenic

The carcinogenic risk of petroleum can be adequately evaluated by determining the risk from carcinogenic indicator compounds. Using the same rationale, noncarcinogenic effects of petroleum can be evaluated by calculating the HI for the indicator contaminants listed in Tables B1 and C. Therefore, the department believes that calculating cumulative risk for the indicator contaminants, in addition to other contaminants on-site, is protective of the cumulative risk to petroleum exposure, provided that site cleanup levels for the petroleum fractions are also met.

The department understands that there are petroleum constituents that will not be captured using this method. For many of these constituents the toxicity of the compounds has not yet been determined or there is minimal risk due to exposure. Petroleum is a chemical mixture. Under the *Guidelines for the Health Risk Assessment of Chemical Mixtures* (USEPA, 1986), the most preferred method for evaluating the risk to chemical mixtures is to use toxicological data for the mixture itself. Many mixtures have different toxicological properties than their constituents. The best available method for assessing risk to petroleum mixtures is to use a surrogate approach to determine cumulative risk. This is done by developing reference doses for each carbon range and then summing the HQs to produce the HI as explain in the PCCL 2015. However, at this time, there is not enough toxicological data available to calculate risk from the full petroleum fractions. Mixtures in petroleum fractions vary by product type and refining process and are altered further by weathering in the environment.

In light of this level of uncertainty, the PCCL 2015 attempts to compensate for the unknown risk from the six aromatic and aliphatic fractions by adopting conservative percentages for the composition of each fraction within each petroleum range (gasoline range organics, diesel range organics, and residual range organics); therefore the fractions are not included in the cumulative risk calculations where the petroleum indicator compounds are used. See Section 6.10 of the PCCL 2015 for more information. The department continues to investigate this issue with the goal of decreasing the uncertainty for risk with a scientifically accurate approach to quantifying the full risk from the petroleum fractions.

6.0 CUMULATIVE RISK CALCULATIONS FOR METHOD THREE

If alternative cleanup levels have been developed under method three, the carcinogenic risk or HQ from each constituent and the cumulative risk are calculated in the same fashion as described in Section 2.2. The site concentration following cleanup is divided by the RBC and the quotient is multiplied by the target risk standard. When using method three cleanup levels with site-specific data, the RBCs in Appendix B cannot be used; instead the same site-specific parameters must be used to produce the method three RBCs. See ADEC's PCCL 2015.

7.0 ADDITIONAL PATHWAYS TO INVESTIGATE

Upon completion of the CSM evaluation, exposure pathways other than those accounted for in Tables B1, B2 and C may be found to be complete. Such exposure pathways may include the indoor air vapor pathway, consumption of cultivated or wild foods at the site, and exposures based on recreational use. Vapor intrusion may be addressed through a site-specific analysis using ADEC's Vapor Intrusion Guidance (2012), while other pathways will require a method four risk assessment. Tables B1, B2 and C include the following exposure routes for soil: dermal contact, ingestion, and inhalation of volatiles and particulates from ambient air; and include the following exposure routes for groundwater: dermal contact, ingestion, and inhalation of volatiles. All completed pathways must be included in cumulative risk calculations including those pathways not addressed in Tables B1 and C.

8.0 ROUNDING IN CUMULATIVE RISK

Under 18 AAC 75.325(g) or 18 AAC 78.600(d), a responsible person must ensure that, after completing site cleanup using methods two or three, the risk from hazardous substances does not exceed a cumulative carcinogenic risk standard of 1 in 100,000 across all exposure pathways and a cumulative noncarcinogenic risk standard at a hazard index of 1, rounded to one significant figure, for all exposure pathways. Similarly, under 18 AAC 75.325(h), a responsible person proposing an alternative cleanup level for soil or groundwater based on a site-specific risk assessment under method four must ensure that the risk from hazardous substances does not exceed the cumulative carcinogenic risk standard of 1 in 100,000 across all exposure pathways and the cumulative noncarcinogenic risk standard at a hazard index of 1 for all exposure pathways.

Both cumulative risk summations for the incremental lifetime cancer risk and the HI should be expressed using one significant figure. The risk for an individual exposure pathway for a chemical, either the cancer risk or the hazard quotient should be shown to two significant figures. These then would be rounded to one significant figure after calculating the cumulative risk.

Standard rounding procedures must be adhered to such that:

Starting from the left most significant digit, move to the right until you have as many digits as you are allowed to keep. Then look to the immediate right and note the number present. If the number to the right is a 5, 6, 7, 8, or 9, round the last significant digit up one. If the number to the right is a 4, 3, 2, 1, or 0, keep the last significant digit the same. Therefore, the rounding procedures and cumulative risk standards are consistent between methods two, three, and four.

9.0 ECOLOGICAL RECEPTORS

The noncarcinogenic HI is calculated for ecological receptors. The ecological noncarcinogenic risk management level is set at a HI of 1. Carcinogens are not considered to be of concern for ecological receptors. The HI is the sum of HQs across multiple exposure routes and exposure pathways. The HQ is calculated by dividing the dose by a risk-based ecological benchmark.

$$HI = \Sigma Dose \div Benchmark$$

If the HI exceeds 1, the individual HQs should be retained for further evaluation. See ADEC's RAPM 2015 for additional information.

REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2002. *Oil and Hazardous Substances Pollution Control Regulations 18AAC 75, Articles 3 and 9*.

ADEC. 2015. *Procedures for Calculating Cleanup Levels*. Contaminated Sites Program.

ADEC. 2015. *Risk Assessment Procedures Manual*. Contaminated Sites Remediation Program.

Total Petroleum Hydrocarbon Criteria Working Group. 1997. *Volume 4, Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons (TPH)*. Amherst Scientific Publishers, Amherst, MA.

United States Environmental Protection Agency (USEPA). 1997. *Health Effects Assessment Summary Tables: FY 1997 Update*. EPA/540/R-97-036. Office of Emergency and Remedial Response, Washington, DC.

USEPA. 1996. *Soil Screening Guidance: Technical Background Document*. EPA/540/R-95/128. Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1996. *Soil Screening Guidance: User's Guide*. 9355.4-23. Office of Solid Waste and Emergency Response, Washington DC.

USEPA. 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)*. EPA/540/1-89/002. Office of Emergency and Remedial Response, Washington, DC.

USEPA. 1988. *Integrated Risk Information System: Lead and Compounds (Inorganic). http://www.epa.gov/iris/subst/0277.htm*. Office of Research and Development, Washington, DC.

USEPA. 1986. *Guidelines for the Health Risk Assessment of Chemical Mixtures*. EPA/630/R-98/002. Office of Research and Development, Washington, DC.

APPENDIX A: WORKSHEET FOR CALCULATING CUMULATIVE RISK

Chemicals of Concern Carcinogens	Exposure Media	Exposure Route	Site Concentration (mg/kg, mg/L or mg/m³)	RBC	Conc÷RBC
$Cumulative\ Carcinogenic\ Risk = \left[\left(\frac{conc_x}{RBC_x}\right) + \left(\frac{conc_y}{RBC_y}\right) + \left(\frac{conc_z}{RBC_z}\right) \ldots\right] \times 10^{-5}$				**Σ (Conc÷RBC) × 10^{-5}**	Total

Chemicals of Concern Noncarcinogens	Exposure Media	Exposure Route	Site Concentration (mg/kg, mg/L or mg/m³)	RBC	Conc÷RBC
$Cumulative\ Noncarcinogenic\ Risk = \left[\left(\frac{conc_x}{RBC_x}\right) + \left(\frac{conc_y}{RBC_y}\right) + \left(\frac{conc_z}{RBC_z}\right) \ldots\right] \times 1$				**Σ (Conc÷RBC) X 1**	Total

mg/kg = milligrams per kilogram
mg/L – milligrams per liter
RBC = risk based concentration

_____
Site Name

APPENDIX B: HUMAN HEALTH RISK BASED CONCENTRATIONS

SOIL ARCTIC ZONE

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Acenaphthene	83-32-9	No	8200	27000	-	-	-	-
Acenaphthylene[5]	208-96-8	No	4100	13000	-	-	-	-
Acetone	67-64-1	No	1.2×10^5	-	1.1×10^6 (6)	-	-	-
Aldrin	309-00-2	No	4.1	-	-	0.72	-	10
Ammonium Perchlorate	7790-98-9	No	96	-	-	-	-	-
Anthracene	120-12-7	No	41000	1.3×10^5	-	-	-	-
Antimony (metallic)	7440-36-0	No	55	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	68	580	40000	14	96	17000
Barium	7440-39-3	No	27000	-	1.3×10^6 (6)	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	3.7	11	430
Benzaldehyde	100-52-7	No	14000	-	-	-	-	-
Benzene	71-43-2	No	550	-	150	220	-	18
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.37	1.1	24000
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	3.7	11	2.4×10^5
Benzo[g,h,i]perylene[5]	191-24-2	No	4100	13000	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	37	110	2.4×10^5
Benzoic Acid	65-85-0	No	5.5×10^5	2.3×10^6 (6)	-	-	-	-
Benzyl Alcohol	100-51-6	No	14000	58000	-	-	-	-
Beryllium and compounds	7440-41-7	No	270	-	54000	-	-	30000
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	11	-	6.3
Bis(2-ethylhexyl)phthalate	117-81-7	No	2700	12000	-	870	3100	3.0×10^7 (6)
Bromobenzene	108-86-1	No	1100	-	660	-	-	-
Bromodichloromethane	75-27-4	No	2700	-	-	200	-	5.4
Bromoform	75-25-2	No	2700	-	-	1500	-	440
Bromomethane	74-83-9	No	190	-	16	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	4.2	3.6	-	1.9
Butanol, N-	71-36-3	No	14000	-	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	27000	1.2×10^5	-	6400	23000	-
Butylbenzene, n-	104-51-8	No	6800	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	14000	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	14000	-	-	-	-	-
Cadmium (Diet)	7440-43-9	No	140	1400	27000	-	-	40000
Carbon Disulfide	75-15-0	No	14000	-	1800	-	-	-
Carbon Tetrachloride	56-23-5	No	550	-	320	170	-	14

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Chlordane	12789-03-6	No	68	720	700	35	310	270
Chlordecone (Kepone)	143-50-0	No	41	170	-	1.2	4.3	16000
Chloroaniline, p-	106-47-8	No	550	2300	-	61	220	-
Chlorobenzene	108-90-7	No	2700	-	420	-	-	-
Chloroform	67-66-3	No	1400	-	490	390	-	5.9
Chloromethane	74-87-3	No	-	-	250	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	11000	35000	-	-	-	-
Chlorophenol, 2-	95-57-8	No	680	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	2.1×10^5	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	410	-	2.7×10^5	5.4	-	310
Chrysene	218-01-9	Yes	-	-	-	370	1100	2.4×10^6 (6)
Copper	7440-50-8	No	5500	-	-	-	-	-
Cresol, m-	108-39-4	No	6800	29000	1.6×10^9 (6)	-	-	-
Cresol, o-	95-48-7	No	6800	29000	1.6×10^9 (6)	-	-	-
Cresol, p-	106-44-5	No	14000	58000	1.6×10^9 (6)	-	-	-
Cumene	98-82-8	No	14000	-	3000	-	-	-
Cyanide (CN-)[7]	57-12-5	No	82	-	7.6	-	-	-
Cyclohexane	110-82-7	No	-	-	14000	-	-	-
DDD	72-54-8	No	-	-	-	51	180	1.0×10^6 (6)
DDE, p,p'-	72-55-9	No	-	-	-	36	-	650
DDT	50-29-3	No	68	960	-	36	420	7.4×10^5
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.37	1.1	22000
Dibenzofuran	132-64-9	No	140	1900	-	-	-	-
Dibromochloromethane	124-48-1	No	2700	-	-	140	-	15
Dibromoethane, 1,2-	106-93-4	No	1200	-	140	6.1	-	0.69
Dibromomethane (Methylene Bromide)	74-95-3	No	1400	-	45	-	-	-
Dibutyl Phthalate	84-74-2	No	14000	58000	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	12000	-	2900	-	-	-
Dichlorobenzene, 1,3-[5]	541-73-1	No	12000	-	2500	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	9600	-	10000	2300	-	32
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	27	96	2.1×10^5
Dichlorodifluoromethane	75-71-8	No	27000	-	220	-	-	-
Dichloroethane, 1,1-	75-34-3	No	27000	-		2100	-	69
Dichloroethane, 1,2-	107-06-2	No	820	-	57	130	-	8.4
Dichloroethylene, 1,1-	75-35-4	No	6800	-	520	-	-	-

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Dichloroethylene, 1,2-cis-	156-59-2	No	270	-	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	2700	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	410	1700	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	1400	12000	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	12000	-	25	340	-	17
Dichloropropene, 1,3-	542-75-6	No	4100	-	120	120	-	39
Dieldrin	60-57-1	No	6.8	29	-	0.76	2.7	16000
Diethyl Phthalate	84-66-2	No	1.1×10^5	4.6×10^5	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	2700	12000	-	-	-	-
Dimethylphthalate[5]	131-11-3	No	1.1×10^5	4.6×10^5	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	14	58	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	14	58	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	14	58	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	270	1200	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	270	1100	-	39	140	8.1×10^5
Dinitrotoluene, 2,6-	606-20-2	No	41	170	-	8.1	29	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	270	19000	-	-	-	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	270	13000	-	-	-	-
Dioxane, 1,4-	123-91-1	No	4100	-	3000	120	-	550
Diphenylamine	122-39-4	No	3400	14000	-	-	-	-
Endosulfan	115-29-7	No	820	-	-	-	-	-
Endrin	72-20-8	No	41	170	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	29000	-	-	-
Ethylbenzene	100-41-4	No	14000	-	7100	1100	-	77
Ethylene Glycol	107-21-1	No	2.7×10^5	1.2×10^6 (6)	1.1×10^9 (6)	-	-	-
Fluoranthene	206-44-0	No	5500	18000	-	-	-	-
Fluorene	86-73-7	No	5500	18000	-	-	-	-
Formaldehyde	50-00-0	No	27000	-	2000	-	-	430
Heptachlor	76-44-8	No	68	-	-	2.7	-	11
Heptachlor Epoxide	1024-57-3	No	1.8	-	-	1.3	-	9.7
Hexachlorobenzene	118-74-1	No	110	-	-	7.6	-	4.4
Hexachlorobutadiene	87-68-3	No	140	-	-	160	-	16
Hexachlorocyclohexane, Alpha-	319-84-6	No	1100	4600	-	1.9	6.9	40000
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	6.8	24	1.4×10^5
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	No	41	430	-	11	98	2.3×10^5

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Hexachlorocyclopentadiene	77-47-4	No	820	-	2.1	-	-	-
Hexachloroethane	67-72-1	No	96	-	330	300	-	27
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	410	12000	-	110	2600	-
Hexane, N-	110-54-3	No	8200	-	1500	-	-	-
Hexanone, 2-	591-78-6	No	680	-	850	-	-	-
Hydrazine[7]	302-01-2	No	-	-	5.3	4.1	-	0.98
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	3.7	11	2.4×10^5
Isophorone	78-59-1	No	27000	1.2×10^5	5.4×10^9 (6)	13000	46000	-
Isopropanol	67-63-0	No	2.7×10^5	-	15000	-	-	-
Lead and Compounds	7439-92-1	No	-	-	-	-	-	-
Mercuric Chloride[5]	7487-94-7	No	41	-	8.0×10^5	-	-	-
Mercury (elemental)	7439-97-6	No	22	-	25	-	-	-
Methanol	67-56-1	No	2.7×10^5	-	1.5×10^6 (6)	-	-	-
Methoxychlor	72-43-5	No	680	2900	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	82000	-	1.5×10^5	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	11000	-	69000	-	-	-
Methyl Mercury	22967-92-6	No	14	-	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	33000	6800	-	1100
Methylene Chloride	75-09-2	Yes	820	-	2700	1300	-	4400
Methylnaphthalene, 1-	90-12-0	No	9600	31000	-	420	1100	-
Methylnaphthalene, 2-	91-57-6	No	550	1800	-	-	-	-
Naphthalene	91-20-3	No	2700	8900	160	-	-	42
Nickel Soluble Salts	7440-02-0	No	2700	-	2.4×10^5	-	-	2.8×10^5
Nitrobenzene	98-95-3	No	270	-	850	-	-	63
Nitroglycerin	55-63-0	No	14	58	-	720	2500	-
Nitroguanidine	556-88-7	No	14000	58000	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	1.1	-	6.4	0.053	-	0.11
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	1.7	6.2	36000
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	2500	8800	2.8×10^7 (6)
Nitrotoluene, m-	99-08-1	No	14	58	-	-	-	-
Nitrotoluene, o-	88-72-2	No	120	-	-	55	-	-
Nitrotoluene, p-	99-99-0	No	550	2300	-	760	2700	-
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	6800	4.8×10^5	-	-	-	-

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Octyl Phthalate, di-N-	117-84-0	No	1400	5800	-	-	-	-
Pentachlorophenol	87-86-5	No	680	1200	-	30	43	1.4×10^{7} (6)
Pentaerythritol tetranitrate (PETN)	78-11-5	No	270	1200	-	3000	11000	-
Perfluorooctane Sulphonic Acid (PFOS)[5]	1763-23-1	No	4.1	-	-	-	-	-
Perfluorooctanoic Acid (PFOA)[5]	335-67-1	No	2.7	-	-	170	-	-
Phenanthrene[5]	85-01-8	No	4100	13000	-	-	-	-
Phenol	108-95-2	No	41000	1.7×10^{5}	5.4×10^{8} (6)	-	-	-
Phosphorus, White	7723-14-0	No	2.7	-	-	-	-	-
Polychlorinated Biphenyls	1336-36-3	No	-	-	-	6.1	15	41
Propyl benzene	103-65-1	No	14000	-	8400	-	-	-
Pyrene	129-00-0	No	4100	13000	-	-	-	-
Selenium	7782-49-2	No	680	-	5.4×10^{7} (6)	-	-	-
Silver	7440-22-4	No	680	-	-	-	-	-
Styrene	100-42-5	No	27000	-	11000	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	9.6×10^{-5}	0.0013	0.087	9.4×10^{-5}	0.0011	0.0015
Tetrachloroethane, 1,1,1,2-	630-20-6	No	4100	-	-	470	-	32
Tetrachloroethane, 1,1,2,2-	79-34-5	No	2700	-	-	61	-	10
Tetrachloroethylene	127-18-4	No	820	-	160	5800	-	420
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	270	1.8×10^{5}	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	1.4	-	-	-	-	-
Toluene	108-88-3	No	11000	-	29000	-	-	-
Toxaphene	8001-35-2	No	-	-	-	11	39	2.3×10^{5}
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	4.1×10^{6} (6)	-	95000	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	110	-	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	1400	-	69	420	-	-
Trichloroethane, 1,1,1-	71-55-6	No	2.7×10^{5}	-	17000	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	550	-	2.3	210	-	20
Trichloroethylene	79-01-6	Yes	68	-	8.0	150	-	18
Trichlorofluoromethane	75-69-4	No	41000	-	1800	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	14000	58000	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	140	580	-	1100	3900	2.3×10^{7} (6)
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	1400	5800	-	-	-	-

SOIL ARCTIC ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	1100	4600	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	550	-	6.7	0.089	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	67	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	1400	-	-	-	-	-
Tri-n-butyltin	688-73-3	No	41	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	4100	91000	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	68	900	-	410	4500	-
Vanadium and Compounds	7440-62-2	No	690	-	2.7×10^5	-	-	-
Vinyl Acetate	108-05-4	No	1.4×10^5	-	2100	-	-	-
Vinyl Chloride	75-01-4	Yes	410	-	230	0.98	-	2.3
Xylenes	1330-20-7	No	27000	-	820	-	-	-
Zinc and Compounds	7440-66-6	No	41000	-	-	-	-	-

[1] "CAS Number" means the Chemical Abstract Service (CAS) registry number uniquely assigned to chemicals by the American Chemical Society and recorded in the CAS Registry System
[2] "Ingestion" means a potential pathway of exposure to hazardous substances through direct consumption of the soil.
[3] "Dermal" means a potential pathway of exposure to hazardous substances through physical contact with the soil
[4] "Inhalation" means a potential pathway to volatile organic hazardous substances in the soil through volatilization.
[5] Where one or more toxicological values were unavailable, toxicity values from surrogate compounds or other sources were used as follows:

(A) pyrene is a toxicity surrogate for acenaphthylene, benzo(g,h,i) perylene, and phenanthrene;
(B) 1,2-dichlorobenzene is a toxicity surrogate for 1,3-dichlorobenzene;
(C) diethylphthalate is a toxicity surrogate for dimethylphthalate;
(D) EPA's November 20, 2009 Soil Screening Levels for Perfluorooctonoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS); and
(E) elemental mercury is a toxicity surrogate for mercuric chloride.

[6] The calculated value exceeds the theoretical maximum value of one million parts per million
[7] Cyanide expressed as free, or physiologically available cyanide

SOIL UNDER 40 INCH ZONE

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Acenaphthene	83-32-9	No	6100	20000	-	-	-	-
Acenaphthylene[5]	208-96-8	No	3000	9900	-	-	-	-
Acetone	67-64-1	No	91000	-	7.4×10^5	-	-	-
Aldrin	309-00-2	No	3.0	-	-	0.53	-	7.2
Ammonium Perchlorate	7790-98-9	No	71	-	-	-	-	-
Anthracene	120-12-7	No	30000	99000	-	-	-	-
Antimony (metallic)	7440-36-0	No	41	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	51	430	28000	10	71	12000
Barium	7440-39-3	No	20000	-	9.2×10^5	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	2.7	8.1	300
Benzaldehyde	100-52-7	No	10000	-	-	-	-	-
Benzene	71-43-2	No	410	-	110	160	-	12
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.27	0.81	16000
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	2.7	8.1	1.6×10^5
Benzo[g,h,i]perylene[5]	191-24-2	No	3000	9900	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	27	81	1.6×10^5
Benzoic Acid	65-85-0	No	4.1×10^5	1.7×10^6 (6)	-	-	-	-
Benzyl Alcohol	100-51-6	No	10000	43000	-	-	-	-
Beryllium and compounds	7440-41-7	No	200	-	37000	-	-	21000
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	8.2	-	4.3
Bis(2-ethylhexyl)phthalate	117-81-7	No	2000	8500	-	640	2300	2.1×10^7 (6)
Bromobenzene	108-86-1	No	810	-	450	-	-	-
Bromodichloromethane	75-27-4	No	2000	-	-	150	-	3.7
Bromoform	75-25-2	No	2000	-	-	1100	-	300
Bromomethane	74-83-9	No	140	-	11	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	2.8	2.7	-	1.3
Butanol, N-	71-36-3	No	10000	-	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	20000	85000	-	4700	17000	-
Butylbenzene, n-	104-51-8	No	5100	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	10000	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	10000	-	-	-	-	-
Cadmium (Diet)	7440-43-9	No	100	1100	18000	-	-	27000
Carbon Disulfide	75-15-0	No	10000	-	1300	-	-	-
Carbon Tetrachloride	56-23-5	No	410	-	220	130	-	9.8

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Chlordane	12789-03-6	No	51	530	480	26	230	180
Chlordecone (Kepone)	143-50-0	No	30	130	-	0.90	3.2	11000
Chloroaniline, p-	106-47-8	No	410	1700	-	45	160	-
Chlorobenzene	108-90-7	No	2000	-	290	-	-	-
Chloroform	67-66-3	No	1000	-	340	290	-	4.1
Chloromethane	74-87-3	No	-	-	170	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	8100	26000	-	-	-	-
Chlorophenol, 2-	95-57-8	No	510	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	1.5×10^5	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	300	-	1.8×10^5	4.0	-	210
Chrysene	218-01-9	Yes	-	-	-	270	810	1.6×10^6 (6)
Copper	7440-50-8	No	4100	-	-	-	-	-
Cresol, m-	108-39-4	No	5100	21000	1.1×10^9 (6)	-	-	-
Cresol, o-	95-48-7	No	5100	21000	1.1×10^9 (6)	-	-	-
Cresol, p-	106-44-5	No	10000	43000	1.1×10^9 (6)	-	-	-
Cumene	98-82-8	No	10000	-	2100	-	-	-
Cyanide (CN-)[7]	57-12-5	No	61	-	5.2	-	-	-
Cyclohexane	110-82-7	No	-	-	9400	-	-	-
DDD	72-54-8	No	-	-	-	38	130	7.2×10^5
DDE, p,p'-	72-55-9	No	-	-	-	27	-	440
DDT	50-29-3	No	51	710	-	27	310	5.1×10^5
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.27	0.81	15000
Dibenzofuran	132-64-9	No	100	1400	-	-	-	-
Dibromochloromethane	124-48-1	No	2000	-	-	110	-	10
Dibromoethane, 1,2-	106-93-4	No	910	-	94	4.5	-	0.47
Dibromomethane (Methylene Bromide)	74-95-3	No	1000	-	31	-	-	-
Dibutyl Phthalate	84-74-2	No	10000	43000	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	9100	-	2000	-	-	-
Dichlorobenzene, 1,3-[5]	541-73-1	No	9100	-	1700	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	7100	-	7100	1700	-	22
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	20	71	1.5×10^5
Dichlorodifluoromethane	75-71-8	No	20000	-	150	-	-	-
Dichloroethane, 1,1-	75-34-3	No	20000	-	-	1600	-	47
Dichloroethane, 1,2-	107-06-2	No	610	-	39	99	-	5.8
Dichloroethylene, 1,1-	75-35-4	No	5100	-	350	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Dichloroethylene, 1,2-cis-	156-59-2	No	200	-	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	2000	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	300	1300	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	1000	8500	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	9100	-	17	250	-	12
Dichloropropene, 1,3-	542-75-6	No	3000	-	79	90	-	27
Dieldrin	60-57-1	No	5.1	21	-	0.56	2.0	11000
Diethyl Phthalate	84-66-2	No	81000	3.4×10^5	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	2000	8500	-	-	-	-
Dimethylphthalate[5]	131-11-3	No	81000	3.4×10^5	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	10	43	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	10	43	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	10	43	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	200	850	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	200	840	-	29	100	5.6×10^5
Dinitrotoluene, 2,6-	606-20-2	No	30	130	-	6.0	22	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	200	14000	-	-	-	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	200	9500	-	-	-	-
Dioxane, 1,4-	123-91-1	No	3000	-	2100	90	-	370
Diphenylamine	122-39-4	No	2500	11000	-	-	-	-
Endosulfan	115-29-7	No	610	-	-	-	-	-
Endrin	72-20-8	No	30	130	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	20000	-	-	-
Ethylbenzene	100-41-4	No	10000	-	4900	820	-	52
Ethylene Glycol	107-21-1	No	2.0×10^5	8.5×10^5	7.4×10^8 (6)	-	-	-
Fluoranthene	206-44-0	No	4100	13000	-	-	-	-
Fluorene	86-73-7	No	4100	13000	-	-	-	-
Formaldehyde	50-00-0	No	20000	-	1400	-	-	290
Heptachlor	76-44-8	No	51	-	-	2.0	-	7.5
Heptachlor Epoxide	1024-57-3	No	1.3	-	-	0.99	-	6.6
Hexachlorobenzene	118-74-1	No	81	-	-	5.6	-	3.0
Hexachlorobutadiene	87-68-3	No	100	-	-	120	-	11
Hexachlorocyclohexane, Alpha-	319-84-6	No	810	3400	-	1.4	5.1	27000
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	5.0	18	93000
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	No	30	320	-	8.2	73	1.6×10^5

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Hexachlorocyclopentadiene	77-47-4	No	610	-	1.4	-	-	-
Hexachloroethane	67-72-1	No	71	-	220	230	-	18
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	300	8500	-	82	1900	-
Hexane, N-	110-54-3	No	6100	-	1100	-	-	-
Hexanone, 2-	591-78-6	No	510	-	580	-	-	-
Hydrazine[7]	302-01-2	No	-	-	3.7	3.0	-	0.67
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	2.7	8.1	1.6×10^5
Isophorone	78-59-1	No	20000	85000	3.7×10^9 (6)	9500	34000	-
Isopropanol	67-63-0	No	2.0×10^5	-	9900	-	-	-
Lead and Compounds	7439-92-1	No	-	-	-	-	-	-
Mercuric Chloride[5]	7487-94-7	No	30	-	5.5×10^5	-	-	-
Mercury (elemental)	7439-97-6	No	16	-	17	-	-	-
Methanol	67-56-1	No	2.0×10^5	-	1.1×10^6 (6)	-	-	-
Methoxychlor	72-43-5	No	510	2100	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	61000	-	1.0×10^5	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	8100	-	47000	-	-	-
Methyl Mercury	22967-92-6	No	10	-	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	22000	5000	-	770
Methylene Chloride	75-09-2	Yes	610	-	1900	990	-	3000
Methylnaphthalene, 1-	90-12-0	No	7100	23000	-	310	850	-
Methylnaphthalene, 2-	91-57-6	No	410	1300	-	-	-	-
Naphthalene	91-20-3	No	2000	6600	110	-	-	29
Nickel Soluble Salts	7440-02-0	No	2000	-	1.7×10^5	-	-	1.9×10^5
Nitrobenzene	98-95-3	No	200	-	580	-	-	43
Nitroglycerin	55-63-0	No	10	43	-	530	1900	-
Nitroguanidine	556-88-7	No	10000	43000	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	0.81	-	4.4	0.039	-	0.077
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	1.3	4.6	25000
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	1800	6500	1.9×10^7 (6)
Nitrotoluene, m-	99-08-1	No	10	43	-	-	-	-
Nitrotoluene, o-	88-72-2	No	91	-	-	41	-	-
Nitrotoluene, p-	99-99-0	No	410	1700	-	560	2000	-
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	5100	3.6×10^5	-	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Octyl Phthalate, di-N-	117-84-0	No	1000	4300	-	-	-	-
Pentachlorophenol	87-86-5	No	510	850	-	23	32	9.7×10^{6} (6)
Pentaerythritol tetranitrate (PETN)	78-11-5	No	200	850	-	2300	8000	-
Perfluorooctane Sulphonic Acid (PFOS)[5]	1763-23-1	No	3.0	-	-	-	-	-
Perfluorooctanoic Acid (PFOA)[5]	335-67-1	No	2.0	-	-	130	-	-
Phenanthrene[5]	85-01-8	No	3000	9900	-	-	-	-
Phenol	108-95-2	No	30000	1.3×10^{5}	3.7×10^{8} (6)	-	-	-
Phosphorus, White	7723-14-0	No	2.0	-	-	-	-	-
Polychlorinated Biphenyls	1336-36-3	No	-	-	-	4.5	11	28
Propyl benzene	103-65-1	No	10000	-	5800	-	-	-
Pyrene	129-00-0	No	3000	9900	-	-	-	-
Selenium	7782-49-2	No	510	-	3.7×10^{7} (6)	-	-	-
Silver	7440-22-4	No	510	-	-	-	-	-
Styrene	100-42-5	No	20000	-	7800	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	7.1×10^{-5}	0.00100	0.060	6.9×10^{-5}	0.00082	0.0011
Tetrachloroethane, 1,1,1,2-	630-20-6	No	3000	-	-	350	-	22
Tetrachloroethane, 1,1,2,2-	79-34-5	No	2000	-	-	45	-	7.1
Tetrachloroethylene	127-18-4	No	610	-	110	4300	-	290
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	200	1.3×10^{5}	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	1.00	-	-	-	-	-
Toluene	108-88-3	No	8100	-	20000	-	-	-
Toxaphene	8001-35-2	No	-	-	-	8.2	29	1.5×10^{5}
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	3.0×10^{6} (6)	-	65000	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	81	-	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	1000	-	47	310	-	-
Trichloroethane, 1,1,1-	71-55-6	No	2.0×10^{5}	-	11000	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	410	-	1.6	160	-	13
Trichloroethylene	79-01-6	Yes	51	-	5.4	110	-	12
Trichlorofluoromethane	75-69-4	No	30000	-	1200	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	10000	43000	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	100	430	-	820	2900	1.6×10^{7} (6)
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	1000	4300	-	-	-	-

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	810	3400	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	410	-	4.6	0.066	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	46	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	1000	-	-	-	-	-
Tri-n-butyltin	688-73-3	No	30	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	3000	67000	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	51	670	-	300	3300	-
Vanadium and Compounds	7440-62-2	No	510	-	1.8×10^5	-	-	-
Vinyl Acetate	108-05-4	No	1.0×10^5	-	1500	-	-	-
Vinyl Chloride	75-01-4	Yes	300	-	150	0.96	-	2.0
Xylenes	1330-20-7	No	20000	-	560	-	-	-
Zinc and Compounds	7440-66-6	No	30000	-	-	-	-	-

[1] "CAS Number" means the Chemical Abstract Service (CAS) registry number uniquely assigned to chemicals by the American Chemical Society and recorded in the CAS Registry System
[2] "Ingestion" means a potential pathway of exposure to hazardous substances through direct consumption of the soil.
[3] "Dermal" means a potential pathway of exposure to hazardous substances through physical contact with the soil
[4] "Inhalation" means a potential pathway to volatile organic hazardous substances in the soil through volatilization.
[5] Where one or more toxicological values were unavailable, toxicity values from surrogate compounds or other sources were used as follows:

(A) pyrene is a toxicity surrogate for acenaphthylene, benzo(g,h,i) perylene, and phenanthrene;
(B) 1,2-dichlorobenzene is a toxicity surrogate for 1,3-dichlorobenzene;
(C) diethylphthalate is a toxicity surrogate for dimethylphthalate;
(D) EPA's November 20, 2009 Soil Screening Levels for Perfluorooctonoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS); and
(E) elemental mercury is a toxicity surrogate for mercuric chloride.

[6] The calculated value exceeds the theoretical maximum value of one million parts per million
[7] Cyanide expressed as free, or physiologically available cyanide

SOIL OVER 40 INCH ZONE

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Acenaphthene	83-32-9	No	5000	16000	-	-	-	-
Acenaphthylene[5]	208-96-8	No	2500	8100	-	-	-	-
Acetone	67-64-1	No	75000	-	5.7×10^5	-	-	-
Aldrin	309-00-2	No	2.5	-	-	0.43	-	5.5
Ammonium Perchlorate	7790-98-9	No	58	-	-	-	-	-
Anthracene	120-12-7	No	25000	81000	-	-	-	-
Antimony (metallic)	7440-36-0	No	33	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	41	350	21000	8.2	58	8900
Barium	7440-39-3	No	17000	-	7.1×10^5	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	2.2	6.7	230
Benzaldehyde	100-52-7	No	8300	-	-	-	-	-
Benzene	71-43-2	No	330	-	81	130	-	9.3
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.22	0.67	13000
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	2.2	6.7	1.3×10^5
Benzo[g,h,i]perylene[5]	191-24-2	No	2500	8100	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	22	67	1.3×10^5
Benzoic Acid	65-85-0	No	3.3×10^5	1.4×10^6 (6)	-	-	-	-
Benzyl Alcohol	100-51-6	No	8300	35000	-	-	-	-
Beryllium and compounds	7440-41-7	No	170	-	28000	-	-	16000
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	6.7	-	3.3
Bis(2-ethylhexyl)phthalate	117-81-7	No	1700	7000	-	530	1900	1.6×10^7 (6)
Bromobenzene	108-86-1	No	660	-	350	-	-	-
Bromodichloromethane	75-27-4	No	1700	-	-	120	-	2.9
Bromoform	75-25-2	No	1700	-	-	930	-	230
Bromomethane	74-83-9	No	120	-	8.5	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	2.2	2.2	-	0.99
Butanol, N-	71-36-3	No	8300	-	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	17000	70000	-	3900	14000	-
Butylbenzene, n-	104-51-8	No	4100	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	8300	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	8300	-	-	-	-	-
Cadmium (Diet)	7440-43-9	No	83	870	14000	-	-	21000
Carbon Disulfide	75-15-0	No	8300	-	970	-	-	-
Carbon Tetrachloride	56-23-5	No	330	-	170	110	-	7.6

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Chlordane	12789-03-6	No	41	440	370	21	190	140
Chlordecone (Kepone)	143-50-0	No	25	100	-	0.74	2.6	8300
Chloroaniline, p-	106-47-8	No	330	1400	-	37	130	-
Chlorobenzene	108-90-7	No	1700	-	220	-	-	-
Chloroform	67-66-3	No	830	-	260	240	-	3.1
Chloromethane	74-87-3	No	-	-	130	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	6600	22000	-	-	-	-
Chlorophenol, 2-	95-57-8	No	410	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	1.2×10^5	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	250	-	1.4×10^5	3.2	-	160
Chrysene	218-01-9	Yes	-	-	-	220	670	1.3×10^6 (6)
Copper	7440-50-8	No	3300	-	-	-	-	-
Cresol, m-	108-39-4	No	4100	17000	8.5×10^8 (6)	-	-	-
Cresol, o-	95-48-7	No	4100	17000	8.5×10^8 (6)	-	-	-
Cresol, p-	106-44-5	No	8300	35000	8.5×10^8 (6)	-	-	-
Cumene	98-82-8	No	8300	-	1600	-	-	-
Cyanide (CN-)[7]	57-12-5	No	50	-	4.0	-	-	-
Cyclohexane	110-82-7	No	-	-	7300	-	-	-
DDD	72-54-8	No	-	-	-	31	110	5.5×10^5
DDE, p,p'-	72-55-9	No	-	-	-	22	-	340
DDT	50-29-3	No	41	580	-	22	260	3.9×10^5
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.22	0.67	11000
Dibenzofuran	132-64-9	No	83	1200	-	-	-	-
Dibromochloromethane	124-48-1	No	1700	-	-	88	-	7.7
Dibromoethane, 1,2-	106-93-4	No	750	-	72	3.7	-	0.36
Dibromomethane (Methylene Bromide)	74-95-3	No	830	-	24	-	-	-
Dibutyl Phthalate	84-74-2	No	8300	35000	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	7500	-	1500	-	-	-
Dichlorobenzene, 1,3-[5]	541-73-1	No	7500	-	1300	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	5800	-	5500	1400	-	17
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	16	58	1.1×10^5
Dichlorodifluoromethane	75-71-8	No	17000	-	120	-	-	-
Dichloroethane, 1,1-	75-34-3	No	17000	-	-	1300	-	36
Dichloroethane, 1,2-	107-06-2	No	500	-	30	81	-	4.4

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Dichloroethylene, 1,1-	75-35-4	No	4100	-	270	-	-	-
Dichloroethylene, 1,2-cis-	156-59-2	No	170	-	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	1700	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	250	1000	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	830	7000	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	7500	-	13	200	-	9.0
Dichloropropene, 1,3-	542-75-6	No	2500	-	61	74	-	20
Dieldrin	60-57-1	No	4.1	17	-	0.46	1.6	8300
Diethyl Phthalate	84-66-2	No	66000	2.8×10^5	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	1700	7000	-	-	-	-
Dimethylphthalate[5]	131-11-3	No	66000	2.8×10^5	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	8.3	35	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	8.3	35	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	8.3	35	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	170	700	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	170	690	-	24	83	4.3×10^5
Dinitrotoluene, 2,6-	606-20-2	No	25	110	-	4.9	18	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	170	12000	-	-	-	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	170	7800	-	-	-	-
Dioxane, 1,4-	123-91-1	No	2500	-	1600	74	-	290
Diphenylamine	122-39-4	No	2100	8700	-	-	-	-
Endosulfan	115-29-7	No	500	-	-	-	-	-
Endrin	72-20-8	No	25	100	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	15000	-	-	-
Ethylbenzene	100-41-4	No	8300	-	3800	670	-	40
Ethylene Glycol	107-21-1	No	1.7×10^5	7.0×10^5	5.7×10^8 (6)	-	-	-
Fluoranthene	206-44-0	No	3300	11000	-	-	-	-
Fluorene	86-73-7	No	3300	11000	-	-	-	-
Formaldehyde	50-00-0	No	17000	-	1100	-	-	230
Heptachlor	76-44-8	No	41	-	-	1.6	-	5.8
Heptachlor Epoxide	1024-57-3	No	1.1	-	-	0.81	-	5.1
Hexachlorobenzene	118-74-1	No	66	-	-	4.6	-	2.3
Hexachlorobutadiene	87-68-3	No	83	-	-	95	-	8.4
Hexachlorocyclohexane, Alpha-	319-84-6	No	660	2800	-	1.2	4.2	21000
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	4.1	15	72000

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Hexachlorocyclohexane, Gamma-(Lindane)	58-89-9	No	25	260	-	6.7	60	1.2×10^5
Hexachlorocyclopentadiene	77-47-4	No	500	-	1.1	-	-	-
Hexachloroethane	67-72-1	No	58	-	170	180	-	14
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	250	7000	-	67	1600	-
Hexane, N-	110-54-3	No	5000	-	810	-	-	-
Hexanone, 2-	591-78-6	No	410	-	450	-	-	-
Hydrazine[7]	302-01-2	No	-	-	2.8	2.5	-	0.52
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	2.2	6.7	1.3×10^5
Isophorone	78-59-1	No	17000	70000	2.8×10^9 (6)	7800	28000	-
Isopropanol	67-63-0	No	1.7×10^5	-	7700	-	-	-
Lead and Compounds	7439-92-1	No	-	-	-	-	-	-
Mercuric Chloride[5]	7487-94-7	No	25	-	4.2×10^5	-	-	-
Mercury (elemental)	7439-97-6	No	13	-	13	-	-	-
Methanol	67-56-1	No	1.7×10^5	-	8.1×10^5	-	-	-
Methoxychlor	72-43-5	No	410	1700	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	50000	-	79000	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	6600	-	36000	-	-	-
Methyl Mercury	22967-92-6	No	8.3	-	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	17000	4100	-	590
Methylene Chloride	75-09-2	Yes	500	-	1400	810	-	2300
Methylnaphthalene, 1-	90-12-0	No	5800	19000	-	250	700	-
Methylnaphthalene, 2-	91-57-6	No	330	1100	-	-	-	-
Naphthalene	91-20-3	No	1700	5400	84	-	-	22
Nickel Soluble Salts	7440-02-0	No	1700	-	1.3×10^5	-	-	1.5×10^5
Nitrobenzene	98-95-3	No	170	-	450	-	-	33
Nitroglycerin	55-63-0	No	8.3	35	-	430	1500	-
Nitroguanidine	556-88-7	No	8300	35000	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	0.66	-	3.4	0.032	-	0.059
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	1.1	3.7	19000
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	1500	5300	1.5×10^7 (6)
Nitrotoluene, m-	99-08-1	No	8.3	35	-	-	-	-
Nitrotoluene, o-	88-72-2	No	75	-	-	34	-	-
Nitrotoluene, p-	99-99-0	No	330	1400	-	460	1600	-

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	4100	2.9×10^5	-	-	-	-
Octyl Phthalate, di-N-	117-84-0	No	830	3500	-	-	-	-
Pentachlorophenol	87-86-5	No	410	700	-	18	26	7.5×10^6 (6)
Pentaerythritol tetranitrate (PETN)	78-11-5	No	170	700	-	1800	6600	-
Perfluorooctane Sulphonic Acid (PFOS)[5]	1763-23-1	No	2.5	-	-	-	-	-
Perfluorooctanoic Acid (PFOA)[5]	335-67-1	No	1.7	-	-	110	-	-
Phenanthrene[5]	85-01-8	No	2500	8100	-	-	-	-
Phenol	108-95-2	No	25000	1.0×10^5	2.8×10^8 (6)	-	-	-
Phosphorus, White	7723-14-0	No	1.7	-	-	-	-	-
Polychlorinated Biphenyls	1336-36-3	No	-	-	-	3.7	9.4	22
Propyl benzene	103-65-1	No	8300	-	4400	-	-	-
Pyrene	129-00-0	No	2500	8100	-	-	-	-
Selenium	7782-49-2	No	410	-	2.8×10^7 (6)	-	-	-
Silver	7440-22-4	No	410	-	-	-	-	-
Styrene	100-42-5	No	17000	-	6000	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	5.8×10^{-5}	0.00082	0.046	5.7×10^{-5}	0.00067	0.00081
Tetrachloroethane, 1,1,1,2-	630-20-6	No	2500	-	-	280	-	17
Tetrachloroethane, 1,1,2,2-	79-34-5	No		-	-	37	-	5.5
Tetrachloroethylene	127-18-4	No	500	-	86	3500	-	220
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	170	1.1×10^5	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	0.83	-	-	-	-	-
Toluene	108-88-3	No	6600	-	15000	-	-	-
Toxaphene	8001-35-2	No	-	-	-	6.7	24	1.2×10^5
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	2.5×10^6 (6)	-	50000	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	66	-	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	830	-	36	250	-	-
Trichloroethane, 1,1,1-	71-55-6	No	1.7×10^5	-	8800	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	330	-	1.2	130	-	10
Trichloroethylene	79-01-6	Yes	41	-	4.2	93	-	9.6
Trichlorofluoromethane	75-69-4	No	25000	-	930	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	8300	35000	-	-	-	-

SOIL OVER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Trichlorophenol, 2,4,6-	88-06-2	No	83	350	-	670	2400	1.2×10^{7} [(6)]
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	830	3500	-	-	-	-
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	660	2800	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	330	-	3.5	0.054	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	35	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	830	-	-	-	-	-
Tri-n-butyltin	688-73-3	No	25	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	2500	55000	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	41	550	-	250	2700	-
Vanadium and Compounds	7440-62-2	No	420	-	1.4×10^{5}	-	-	-
Vinyl Acetate	108-05-4	No	83000	-	1100	-	-	-
Vinyl Chloride	75-01-4	Yes	250	-	120	0.95	-	1.8
Xylenes	1330-20-7	No	17000	-	430	-	-	-
Zinc and Compounds	7440-66-6	No	25000	-	-	-	-	-

[1] "CAS Number" means the Chemical Abstract Service (CAS) registry number uniquely assigned to chemicals by the American Chemical Society and recorded in the CAS Registry System
[2] "Ingestion" means a potential pathway of exposure to hazardous substances through direct consumption of the soil.
[3] "Dermal" means a potential pathway of exposure to hazardous substances through physical contact with the soil
[4] "Inhalation" means a potential pathway to volatile organic hazardous substances in the soil through volatilization.
[5] Where one or more toxicological values were unavailable, toxicity values from surrogate compounds or other sources were used as follows:

(A) pyrene is a toxicity surrogate for acenaphthylene, benzo(g,h,i) perylene, and phenanthrene;
(B) 1,2-dichlorobenzene is a toxicity surrogate for 1,3-dichlorobenzene;
(C) diethylphthalate is a toxicity surrogate for dimethylphthalate;
(D) EPA's November 20, 2009 Soil Screening Levels for Perfluorooctonoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS); and
(E) elemental mercury is a toxicity surrogate for mercuric chloride.

[6] The calculated value exceeds the theoretical maximum value of one million parts per million
[7] Cyanide expressed as free, or physiologically available cyanide

GROUNDWATER

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Acenaphthene	83-32-9	No	1200	960	-	-	-	-
Acenaphthylene[5]	208-96-8	No	600	460	-	-	-	-
Acetone	67-64-1	No	18000	4.4×10^6 (6)	64000	-	-	-
Aldrin	309-00-2	No	0.60	-	-	0.046	-	0.011
Ammonium Perchlorate	7790-98-9	No	14	3200	-	-	-	-
Anthracene	120-12-7	No	6000	2500	-	-	-	-
Antimony (metallic)	7440-36-0	No	8.0	270	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	6.0	1400	-	0.52	93	-
Barium	7440-39-3	No	4000	64000	-	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	0.34	-	0.18
Benzaldehyde	100-52-7		2000	49000	-	-	-	-
Benzene	71-43-2	No	80	600	63	14	94	7.2
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.034	-	-
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	0.34	-	-
Benzo[g,h,i]perylene[5]	191-24-2	No	600	-	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	3.4	-	-
Benzoic Acid	65-85-0	No	80000	1.2×10^6 (6)	-	-	-	-
Benzyl Alcohol	100-51-6	No	2000	89000	-	-	-	-
Beryllium and compounds	7440-41-7	No	40	64	-	-	-	-
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	0.71	26	0.17
Bis(2-ethylhexyl)phthalate	117-81-7	No	400	-	-	56	-	-
Bromobenzene	108-86-1	No	160	540	130	-	-	-
Bromodichloromethane	75-27-4	No	400	6400	-	13	180	1.5
Bromoform	75-25-2	No	400	6200	-	99	1400	51
Bromomethane	74-83-9	No	28	1000	10	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	4.2	0.23	1.6	1.9
Butanol, N-	71-36-3	No	2000	1.0×10^5	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	4000	2900	-	410	260	-
Butylbenzene, n-	104-51-8	No	1000	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	2000	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	2000	1100	-	-	-	-
Cadmium (Diet)	7440-43-9	No	10	110	-	-	-	-
Carbon Disulfide	75-15-0	No	2000	20000	1500	-	-	-
Carbon Tetrachloride	56-23-5	No	80	340	210	11	42	9.4

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Chlordane	12789-03-6	No	10	-	1.5	2.2	-	0.56
Chlordecone (Kepone)	143-50-0	No	6.0	5.4	-	0.078	0.062	-
Chloroaniline, p-	106-47-8	No	80	1300	-	3.9	57	-
Chlorobenzene	108-90-7	No	400	1300	100	-	-	-
Chloroform	67-66-3	No	200	2500	200	25	280	2.4
Chloromethane	74-87-3	No	-	-	190	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	1600	1400	-	-	-	-
Chlorophenol, 2-	95-57-8	No	100	1000	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	30000	89000	-	-	-	-
Chromium(VI)	18540-29-9	Yes	60	170	-	0.50	1.1	-
Chrysene	218-01-9	Yes	-	-	-	34	-	-
Copper	7440-50-8	No	800	1.8×10^5	-	-	-	-
Cresol, m-	108-39-4	No	1000	12000	-	-	-	-
Cresol, o-	95-48-7	No	1000	12000	-	-	-	-
Cresol, p-	106-44-5	No	2000	25000	-	-	-	-
Cumene	98-82-8	No	2000	1900	830	-	-	-
Cyanide (CN-)	57-12-5	No	12	2700	1.7	-	-	-
Cyclohexane	110-82-7	No	-	-	13000	-	-	-
DDD	72-54-8	No	-	-	-	3.2	0.34	-
DDE, p,p'-	72-55-9	No	-	-	-	2.3	-	0.58
DDT	50-29-3	No	10	-	-	2.3	-	-
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.034	-	-
Dibenzofuran	132-64-9	No	20	13	-	-	-	-
Dibromochloromethane	124-48-1	No	400	6700	-	9.3	140	2.1
Dibromoethane, 1,2-	106-93-4	No	180	3600	19	0.39	6.9	0.094
Dibromomethane (Methylene Bromide)	74-95-3	No	200	5400	8.3	-	-	-
Dibutyl Phthalate	84-74-2	No	2000	1600	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	1800	2900	420	-	-	-
Dichlorobenzene, 1,3-[5]	541-73-1	No	1800	2500	420	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	1400	2200	1700	140	200	5.1
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	1.7	4.3	-
Dichlorodifluoromethane	75-71-8	No	4000	38000	210	-	-	-
Dichloroethane, 1,1-	75-34-3	No	4000	58000	-	140	1800	35
Dichloroethane, 1,2-	107-06-2	No	120	2800	15	8.6	180	2.2
Dichloroethylene, 1,1-	75-35-4	No	1000	8500	420	-	-	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Dichloroethylene, 1,2-cis-	156-59-2	No	40	360	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	400	3600	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	60	190	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	200	1300	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	1800	21000	8.3	22	230	5.6
Dichloropropene, 1,3-	542-75-6	No	600	6500	42	7.8	75	14
Dieldrin	60-57-1	No	1.00	0.61	-	0.049	0.026	-
Diethyl Phthalate	84-66-2	No	16000	2.0×10^5	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	400	3100	-	-	-	-
Dimethylphthalate[5]	131-11-3	No	16000	5.8×10^5	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	2.0	53	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	2.0	72	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	2.0	75	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	40	1200	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	40	750	-	2.5	41	-
Dinitrotoluene, 2,6-	606-20-2	No	6.0	93	-	0.52	7.1	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	40	1000	-	-	-	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	40	1000	-	-	-	-
Dioxane, 1,4-	123-91-1	No	600	1.9×10^5	63	7.8	2200	11
Diphenylamine	122-39-4	No	500	840	-	-	-	-
Endosulfan	115-29-7	No	120	630	-	-	-	-
Endrin	72-20-8	No	6.0	3.7	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	21000	-	-	-
Ethylbenzene	100-41-4	No	2000	3800	2100	71	120	22
Ethylene Glycol	107-21-1	No	40000	5.7×10^7 (6)	-	-	-	-
Fluoranthene	206-44-0	No	800	-	-	-	-	-
Fluorene	86-73-7	No	800	460	-	-	-	-
Formaldehyde	50-00-0	No	4000	3.2×10^5	20	-	-	4.3
Heptachlor	76-44-8	No	10	1.5	-	0.17	0.022	0.043
Heptachlor Epoxide	1024-57-3	No	0.26	0.24	-	0.086	0.068	0.022
Hexachlorobenzene	118-74-1	No	16	-	-	0.49	-	0.12
Hexachlorobutadiene	87-68-3	No	20	9.5	-	10	4.2	2.6
Hexachlorocyclohexane, Alpha-	319-84-6	No	160	250	-	0.12	0.17	-
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	0.43	0.59	-
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	No	6.0	9.2	-	0.71	0.96	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Hexachlorocyclopentadiene	77-47-4	No	120	42	0.42	-	-	-
Hexachloroethane	67-72-1	No	14	14	63	19	17	5.1
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	60	7900	-	7.1	830	-
Hexane, N-	110-54-3	No	1200	640	1500	-	-	-
Hexanone, 2-	591-78-6	No	100	2700	63	-	-	-
Hydrazine[7]	302-01-2	No	-	-	0.063	0.26	1100	0.011
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	0.34	-	-
Isophorone	78-59-1	No	4000	86000	-	820	16000	-
Isopropanol	67-63-0	No	40000	6.5×10^6 (6)	420	-	-	-
Lead and Compounds	7439-92-1	No	-	-	-	-	-	-
Mercuric Chloride[5]	7487-94-7	No	6.0	95	-	-	-	-
Mercury (elemental)	7439-97-6	No	3.2	730	0.63	-	-	-
Methanol	67-56-1	No	40000	1.8×10^7 (6)	42000	-	-	-
Methoxychlor	72-43-5	No	100	59	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	12000	1.5×10^6 (6)	10000	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	1600	49000	6300	-	-	-
Methyl Mercury	22967-92-6	No	2.0	450	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	6300	430	19000	220
Methylene Chloride	75-09-2	Yes	120	3700	1300	130	3400	2000
Methylnaphthalene, 1-	90-12-0	No	1400	1100	-	27	19	-
Methylnaphthalene, 2-	91-57-6	No	80	65	-	-	-	-
Naphthalene	91-20-3	No	400	700	6.3	-	-	1.7
Nickel Soluble Salts	7440-02-0	No	400	18000	-	-	-	-
Nitrobenzene	98-95-3	No	40	620	19	-	-	1.4
Nitroglycerin	55-63-0	No	2.0	87	-	46	1800	-
Nitroguanidine	556-88-7	No	2000	1.8×10^6 (6)	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	0.16	74	0.083	0.0049	1.9	0.0014
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	0.11	3.4	-
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	160	500	-
Nitrotoluene, m-	99-08-1	No	2.0	14	-	-	-	-
Nitrotoluene, o-	88-72-2	No	18	150	-	3.5	27	-
Nitrotoluene, p-	99-99-0	No	80	620	-	49	330	-
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	1000	6.3×10^5	-	-	-	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Octyl Phthalate, di-N-	117-84-0	No	200	-	-	-	-	-
Pentachlorophenol	87-86-5	No	100	29	-	1.9	0.50	-
Pentaerythritol tetranitrate (PETN)	78-11-5	No	40	960	-	190	4100	-
Perfluorooctane Sulphonic Acid (PFOS)[5]	1763-23-1	No	0.60	-	-	-	-	-
Perfluorooctanoic Acid (PFOA)[5]	335-67-1	No	0.40	-	-	11	-	-
Phenanthrene[5]	85-01-8	No	600	250	-	-	-	-
Phenol	108-95-2	No	6000	1.4×10^{5}	-	-	-	-
Phosphorus, White	7723-14-0	No	0.40	91	-	-	-	-
Polychlorinated Biphenyls	1336-36-3	No	-	-	-	1.9	-	0.56
Propyl benzene	103-65-1	No	2000	1800	2100	-	-	-
Pyrene	129-00-0	No	600	150	-	-	-	-
Selenium	7782-49-2	No	100	23000	-	-	-	-
Silver	7440-22-4	No	100	1500	-	-	-	-
Styrene	100-42-5	No	4000	10000	2100	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	1.4×10^{-5}	-	8.3×10^{-5}	6.0×10^{-6}	-	1.5×10^{-6}
Tetrachloroethane, 1,1,1,2-	630-20-6	No	600	2400	-	30	100	7.6
Tetrachloroethane, 1,1,2,2-	79-34-5	No	400	3600	-	3.9	31	0.97
Tetrachloroethylene	127-18-4	No	120	230	83	370	630	220
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	40	2500	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	0.20	45	-	-	-	-
Toluene	108-88-3	No	1600	5300	10000	-	-	-
Toxaphene	8001-35-2	No	-	-	-	0.71	0.19	-
Tributyltin	56573-85-4	No	-	-	-	-	-	-
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	6.0×10^{5}	1.9×10^{6} (6)	63000	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	16	13	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	200	160	4.2	27	19	-
Trichloroethane, 1,1,1-	71-55-6	No	40000	2.5×10^{5}	10000	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	80	1300	0.42	14	190	3.5
Trichloroethylene	79-01-6	Yes	10	69	4.2	12	72	9.6
Trichlorofluoromethane	75-69-4	No	6000	36000	1500	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	2000	2900	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	20	30	-	71	94	-

GROUNDWATER			Non-Carcinogenic (µg/L)			Carcinogenic (µg/L)		
Hazardous Substance	CAS Number[1]	Mutagenic?	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	200	870	-	-	-	-
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	160	360	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	80	770	0.63	0.0084	0.071	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	15	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	200	280	-	-	-	-
Tri-n-butyltin	688-73-3	No	6.0	9.8	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	600	47000	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	10	450	-	26	1000	-
Vanadium and Compounds	7440-62-2	No	100	600	-	-	-	-
Vinyl Acetate	108-05-4	No	20000	1.4×10^6 (6)	420	-	-	-
Vinyl Chloride	75-01-4	Yes	60	890	210	0.21	2.7	3.4
Xylenes	1330-20-7	No	4000	7500	210	-	-	-
Zinc and Compounds	7440-66-6	No	6000	2.3×10^6 (6)	-	-	-	-

[1] "CAS Number" means the Chemical Abstract Service (CAS) registry number uniquely assigned to chemicals by the American Chemical Society and recorded in the CAS Registry System
[2] "Ingestion" means a potential pathway of exposure to hazardous substances through direct consumption of the soil.
[3] "Dermal" means a potential pathway of exposure to hazardous substances through physical contact with the soil
[4] "Inhalation" means a potential pathway to volatile organic hazardous substances in the soil through volatilization.
[5] Where one or more toxicological values were unavailable, toxicity values from surrogate compounds or other sources were used as follows:

(A) pyrene is a toxicity surrogate for acenaphthylene, benzo(g,h,i) perylene, and phenanthrene;
(B) 1,2-dichlorobenzene is a toxicity surrogate for 1,3-dichlorobenzene;
(C) diethylphthalate is a toxicity surrogate for dimethylphthalate;
(D EPA's November 20, 2009 Soil Screening Levels for Perfluorooctonoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS); and
(E) elemental mercury is a toxicity surrogate for mercuric chloride.

[6] The calculated value exceeds the theoretical maximum value of one million parts per million

APPENDIX C: HIERARCHY OF TOXICITY SOURCES AND MCLS

Hierarchy of Toxicity Sources and MCLs
Alaska Department of Environmental Conservation
Division of Spill Prevention and Response
Contaminated Sites Program

Tier I Source = IRIS- Integrated Risk Information System
IRIS is EPA's data base containing qualitative and quantitative information on the human health effects that may result from exposure to chemical substances in the environment. The toxicity values listed in IRIS are considered to be validated and have undergone rigorous peer review. The completion of IRIS assessments is a multi-step process:

1) EPA Develops and Completes a draft IRIS Toxicological Review (Duration 345 Days)
2) Internal EPA Review (Duration 60 days)
3) EPA Initiates Interagency Science Consultation on Draft IRIS Toxicological Review (Duration 45 days)
4) EPA Initiates Independent External Peer Review of Draft IRIS Toxicological Review, Public Review and Comment on Draft IRIS Toxicological Review, and Holds a Public Listening Session (Duration 105 days)
5) EPA Revises IRIS Toxicological Review and Develops IRIS Summary (Duration 60 days)
6) (A) Internal EPA Review of Final IRIS Toxicological Review and IRIS Summary (Duration 45 days)
   (B) EPA-led Interagency Science Discussion (Duration 45 days – concurrent with Step 6A.)
7) EPA Completion of IRIS Toxicological Review and IRIS Summary (Duration 30 days)

Tier II Source = PPRTV- Provisional Peer Reviewed Toxicity Values
The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by the EPA's Superfund program for use in site specific risk assessments. However, the PPRTVs are developed in a shorter period of time and although these assessments undergo external peer review, their development does not include Agency and interagency review as is done with the IRIS assessments. Furthermore, their development typically includes a limited evaluation of information on mode of action, other toxicological end points, and other information that provides a better understanding of the toxicology of these chemicals. Often, the amount of relevant information on the toxicity of these chemicals is less because fewer studies have been conducted and reported. However, the PPRTVs are generally the best quantification of the dose-response scientific data that is available at the time they are developed because the PPRTVs utilize current information and methodologies.

Tier III Source = Other Toxicity Values
Tier 3 includes additional EPA/non-EPA sources of toxicity information. Chemicals that have not been through a rigorous IRIS process or requested for PPRTV listing can contain toxicity recommend values from other sources. Priority should be given to sources of information that are most current, peer reviewed, transparent and publicly available. The quality of these values can vary widely and depends on the depth of the toxicity data base, the scientific quality and rigor of the underlying risk assessment and the scope of peer review. Some available values, such as Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Level (MRLs) and California Environmental Protection Agency (Cal EPA) criteria, have undergone an extensive literature review,

a rigorous data analysis using current guidance and methods to derive a toxicity value, and have been thoroughly peer reviewed. It should be noted that ATSDR MRLs are limited to non-cancer effects only. At the other end of the spectrum, there may be chemicals with no values and little or no available toxicity information, or outdated studies which are no longer consistent with current methodologies and practices.

Maximum Contaminant Levels (MCLs) are standards that are set by the United States EPA for drinking water quality. An MCL is the legal threshold limit on the amount of a substance that is allowed in public water systems under the Safe Drinking Water Act. To set a MCL for a contaminant, EPA first determines how much of the contaminant may be present with no adverse health effects based on the information from hierarchy of toxicity listed above. This level is called the Maximum Contaminant Level Goal (MCLG). MCLGs are non-enforceable public health goals. The legally enforced MCL is then set as close as possible to the MCLG. The MCL for a contaminant may be higher than the MCLG because of difficulties in measuring small quantities of a contaminant, a lack of available treatment technologies, or if EPA determines that the costs of treatment would outweigh the public health benefits of a lower MCL. In the last case, EPA will set the MCL to balance the cost of treatment with the public health benefits.

The EPA guidance for establishing an MCL states that "MCLs are enforceable standards and are to be set as close to the maximum contaminant level goals (MCLGs) (Health Goals) as is feasible and are based upon treatment technologies, costs (affordability) and other feasibility factors, such as availability of analytical methods, treatment technology and costs for achieving various levels of removal." The process of determining an MCL only starts with an evaluation of the adverse effects caused by the chemical in question and the doses needed to cause such effects. Finally, only a very small percentage of environmental contaminants have an established MCL.