State of Alaska
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES PROGRAM

Procedures for Calculating Cumulative Risk
September 15, 2016

Adopted by Reference at 18 AAC 75

PROCEDURES FOR CALCULATING CUMULATIVE RISK

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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.

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 $1/10^{th}$ 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 95^{th} percent upper confidence limit (UCL) remaining on-site following cleanup[2]; and

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[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).

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 PCCL 2016 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 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 2016. Levels developed using the risk-based equations in that document 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 can be found 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

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

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. 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 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.

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[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/ipcs/assessment/tef_values.pdf

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

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

Next, if the highest concentration remaining in soil or groundwater exceeds $1/10^{th}$ 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) 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	*Metals as required on a case by case basis* 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)*

* indicates carcinogenic

† Chromium includes both III and VI valances, but only VI is 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 explained in the PCCL 2016. 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 2016 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 2016 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 2016.

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.

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APPENDIX A: WORKSHEET FOR CALCULATING CUMULATIVE RISK

Chemicals of Concern Carcinogens	Exposure Media	Exposure Route	Site Concentration (mg/kg, mg/L or mg/m^3)	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/m^3)**	**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	8210	26600	-	-	-	-
Acenaphthylene	208-96-8	No	4110	13300	-	-	-	-
Acetone	67-64-1	No	123000	-	1.09×10^6	-	-	-
Aldrin	309-00-2	No	4.11	-	-	0.716	-	10.4
Ammonium Perchlorate	7790-98-9	No	95.8	-	-	-	-	-
Anthracene	120-12-7	No	41100	133000	-	-	-	-
Antimony (metallic)	7440-36-0	No	54.8	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	68.4	577	7360	13.5	96.1	3070
Barium	7440-39-3	No	27400	-	245000	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	3.67	11.0	429
Benzaldehyde	100-52-7	No	13700	-	-	3040	-	-
Benzene	71-43-2	No	548	-	154	221	-	17.7
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.367	1.10	4340
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	3.67	11.0	43400
Benzo[g,h,i]perylene	191-24-2	No	4110	13300	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	36.7	110	43400
Benzoic Acid	65-85-0	No	548000	2.31×10^6	-	-	-	-
Benzyl Alcohol	100-51-6	No	13700	57700	-	-	-	-
Beryllium and compounds	7440-41-7	No	274	-	9820	-	-	5510
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	11.1	-	6.34
Bis(2-ethylhexyl)phthalate	117-81-7	No	2740	11500	-	869	3090	5.51×10^6
Bromobenzene	108-86-1	No	1100	-	658	-	-	-
Bromodichloromethane	75-27-4	No	2740	-	-	196	-	5.45
Bromoform	75-25-2	No	2740	-	-	1540	-	438
Bromomethane	74-83-9	No	192	-	16.1	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	4.16	3.58	-	1.87
Butanol, N-	71-36-3	No	13700	-	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	27400	115000	-	6400	22800	-
Butylbenzene, n-	104-51-8	No	6840	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	13700	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	13700	-	-	-	-	-
Cadmium (Diet)	7440-43-9	No	137	1440	4910	-	-	7340
Carbon Disulfide	75-15-0	No	13700	-	1830	-	-	-

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]
Carbon Tetrachloride	56-23-5	No	548	-	320	174	-	14.4
Chlordane	12789-03-6	No	68.4	721	1180	34.8	309	455
Chlordecone (Kepone)	143-50-0	No	41.1	173	-	1.22	4.32	2870
Chloroaniline, p-	106-47-8	No	548	2310	-	60.8	216	-
Chlorobenzene	108-90-7	No	2740	-	424	-	-	-
Chloroform	67-66-3	No	1370	-	494	392	-	5.93
Chloromethane	74-87-3	No	-	-	246	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	11000	35500	-	-	-	-
Chlorophenol, 2-	95-57-8	No	684	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	205000	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	411	-	49100	5.36	-	56.8
Chrysene	218-01-9	Yes	-	-	-	367	1100	434000
Copper	7440-50-8	No	5480	-	-	-	-	-
Cresol, m-	108-39-4	No	6840	28800	2.95×10^8	-	-	-
Cresol, o-	95-48-7	No	6840	28800	2.95×10^8	-	-	-
Cresol, p-	106-44-5	No	13700	57700	2.95×10^8	-	-	-
Cumene	98-82-8	No	13700	-	3040	-	-	-
Cyanide (CN-)[5]	57-12-5	No	82.1	-	116	-	-	-
Cyclohexane	110-82-7	No	-	-	13800	-	-	-
DDD	72-54-8	No	-	-	-	50.7	180	192000
DDE, p,p'-	72-55-9	No	-	-	-	35.8	-	645
DDT	50-29-3	No	68.4	961	-	35.8	424	136000
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.367	1.10	3980
Dibenzofuran	132-64-9	No	137	1920	-	-	-	-
Dibromochloromethane	124-48-1	No	2740	-	-	145	-	-
Dibromoethane, 1,2-	106-93-4	No	1230	-	137	6.08	-	0.685
Dibromomethane (Methylene Bromide)	74-95-3	No	-	-	45.2	-	-	-
Dibutyl Phthalate	84-74-2	No	13700	57700	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	12300	-	2890	-	-	-
Dichlorobenzene, 1,3-	541-73-1	No	12300	-	2470	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	9580	-	10400	2250	-	31.7
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	27.0	96.1	38900
Dichlorodifluoromethane	75-71-8	No	27400	-	220	-	-	-
Dichloroethane, 1,1-	75-34-3	No	27400	-	-	2130	-	69.0
Dichloroethane, 1,2-	107-06-2	No	821	-	57.0	134	-	8.44

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, 1,1-	75-35-4	No	6840	-	517	-	-	-
Dichloroethylene, 1,2-cis-	156-59-2	No	274	-	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	2740	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	411	1730	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	1370	11500	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	12300	-	25.2	338	-	17.0
Dichloropropene, 1,3-	542-75-6	No	4110	-	115	122	-	38.8
Dieldrin	60-57-1	No	6.84	28.8	-	0.760	2.70	2870
Diethyl Phthalate	84-66-2	No	110000	461000	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	2740	11500	-	-	-	-
Dimethylphthalate	131-11-3	No	110000	461000	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	13.7	57.7	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	13.7	57.7	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	13.7	57.7	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	274	1150	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	274	1130	-	39.2	137	149000
Dinitrotoluene, 2,6-	606-20-2	No	41.1	175	-	8.11	29.1	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	274	19200	-	-	-	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	274	12800	-	-	-	-
Dioxane, 1,4-	123-91-1	No	4110	-	3040	122	-	546
Diphenylamine	122-39-4	No	3420	14400	-	-	-	-
Endosulfan	115-29-7	No	821	-	-	-	-	-
Endrin	72-20-8	No	41.1	173	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	28500	-	-	-
Ethylbenzene	100-41-4	No	13700	-	7130	1110	-	76.8
Ethylene Glycol	107-21-1	No	274000	1.15×10^6	1.96×10^8	-	-	-
Fluoranthene	206-44-0	No	5480	17700	-	-	-	-
Fluorene	86-73-7	No	5480	17700	-	-	-	-
Formaldehyde	50-00-0	No	27400	-	2030	-	-	427
Heptachlor	76-44-8	No	68.4	-	-	2.70	-	11.0
Heptachlor Epoxide	1024-57-3	No	1.78	-	-	1.34	-	9.71
Hexachlorobenzene	118-74-1	No	110	-	-	7.60	-	4.45
Hexachlorobutadiene	87-68-3	No	137	-	-	156	-	15.9
Hexachlorocyclohexane, Alpha-	319-84-6	No	1100	4610	-	1.93	6.86	7340
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	6.76	24.0	24900

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]
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	No	41.1	433	-	11.1	98.3	42600
Hexachlorocyclopentadiene	77-47-4	No	821	-	2.05	-	-	-
Hexachloroethane	67-72-1	No	95.8	-	326	304	-	26.6
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	411	11500	-	111	2620	-
Hexane, N-	110-54-3	No	-	-	1540	-	-	-
Hexanone, 2-	591-78-6	No	684	-	845	-	-	-
Hydrazine	302-01-2	No	-	-	5.34	4.06	-	0.978
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	3.67	11.0	43400
Isophorone	78-59-1	No	27400	115000	9.82x 10^8^08	12800	45500	-
Isopropanol	67-63-0	No	274000	-	14500	-	-	-
Mercuric Chloride	7487-94-7	No	41.1	-	147000	-	-	-
Mercury (elemental)	7439-97-6	No	21.9	-	28.3	-	-	-
Methanol	67-56-1	No	274000	-	1.54×10^6	-	-	-
Methoxychlor	72-43-5	No	684	2880	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	82100	-	150000	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	-	-	69200	-	-	-
Methyl Mercury	22967-92-6	No	13.7	-	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	32700	6760	-	1130
Methylene Chloride	75-09-2	Yes	821	-	2710	1340	-	4390
Methylnaphthalene, 1-	90-12-0	No	9580	31100	-	420	1150	-
Methylnaphthalene, 2-	91-57-6	No	548	1770	-	-	-	-
Naphthalene	91-20-3	No	2740	8870	158	-	-	41.8
Nickel Soluble Salts	7440-02-0	No	2740	-	44200	-	-	50800
Nitrobenzene	98-95-3	No	274	-	848	-	-	63.4
Nitroglycerin	55-63-0	No	13.7	57.7	-	716	2540	-
Nitroguanidine	556-88-7	No	13700	57700	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	1.10	-	6.45	0.0526	-	0.112
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	1.74	6.18	6610
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	2480	8830	5.08×10^6
Nitrotoluene, m-	99-08-1	No	13.7	57.7	-	-	-	-
Nitrotoluene, o-	88-72-2	No	123	-	-	55.3	-	-
Nitrotoluene, p-	99-99-0	No	548	2310	-	760	2700	-

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]
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	6840	481000	-	-	-	-
Octyl Phthalate, di-N-	117-84-0	No	1370	5770	-	-	-	-
Pentachlorophenol	87-86-5	No	684	1150	-	30.4	43.2	2.59×10^6
Pentaerythritol tetranitrate (PETN)	78-11-5	No	274	1150	-	3040	10800	-
Perfluorooctane Sulfonate (PFOS)	1763-23-1	No	2.74	11.5	-	-	-	-
Perfluorooctanoic Acid (PFOA)	335-67-1	No	2.74	11.5	-	174	618	-
Phenanthrene	85-01-8	No	4110	13300	-	-	-	-
Phenol	108-95-2	No	41100	173000	9.82×10^7	-	-	-
Phosphorus, White	7723-14-0	No	2.74	-	-	-	-	-
Polychlorinated Biphenyls	1336-36-3	No	-	-	-	6.08	15.4	27.8
Propyl benzene	103-65-1	No	13700	-	8430	-	-	-
Pyrene	129-00-0	No	4110	13300	-	-	-	-
Selenium	7782-49-2	No	684	-	9.82×10^6	-	-	-
Silver	7440-22-4	No	684	-	-	-	-	-
Styrene	100-42-5	No	27400	-	11400	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	0.0000958	0.00135	0.0867	0.0000936	0.00111	0.00154
Tetrachloroethane, 1,1,1,2-	630-20-6	No	4110	-	-	468	-	31.9
Tetrachloroethane, 1,1,2,2-	79-34-5	No	2740	-	-	60.8	-	10.3
Tetrachloroethylene	127-18-4	No	821	-	164	5790	-	424
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	274	177000	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	1.37	-	-	-	-	-
Toluene	108-88-3	No	11000	-	29000	-	-	-
Toxaphene	8001-35-2	No	-	-	-	11.1	39.3	41300
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	4.11×10^6	-	94800	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	110	-	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	1370	-	68.6	420	-	-
Trichloroethane, 1,1,1-	71-55-6	No	274000	-	16700	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	548	-	2.34	213	-	19.7
Trichloroethylene	79-01-6	Yes	68.4	-	7.95	154	-	18.2
Trichlorofluoromethane	75-69-4	No	41100	-	-	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	13700	57700	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	137	577	-	1110	3930	4.26×10^6
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	1370	5770	-	-	-	-
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	1100	4610	-	-	-	-

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]
Trichloropropane, 1,2,3-	96-18-4	Yes	548	-	6.71	0.0893	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	67.2	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	1370	-	-	-	-	-
Tri-n-butyltin	688-73-3	No	41.1	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	4110	91100	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	68.4	901	-	406	4500	-
Vanadium and Compounds	7440-62-2	No	690	-	49100	-	-	-
Vinyl Acetate	108-05-4	No	137000	-	2130	-	-	-
Vinyl Chloride	75-01-4	Yes	411	-	226	0.981	-	2.34
Xylenes	1330-20-7	No	27400	-	729	-	-	-
Zinc and Compounds	7440-66-6	No	41100	-	-	-	-	-

[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] 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	6080	19700	-	-	-	-
Acenaphthylene	208-96-8	No	3040	9860	-	-	-	-
Acetone	67-64-1	No	91300	-	743000	-	-	-
Aldrin	309-00-2	No	3.04	-	-	0.530	-	7.15
Ammonium Perchlorate	7790-98-9	No	71.0	-	-	-	-	-
Anthracene	120-12-7	No	30400	98600	-	-	-	-
Antimony (metallic)	7440-36-0	No	40.6	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	50.7	427	27600	10.0	71.2	11500
Barium	7440-39-3	No	20300	-	919000	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	2.72	8.15	295
Benzaldehyde	100-52-7	No	10100	-	-	2250	-	-
Benzene	71-43-2	No	406	-	105	164	-	12.1
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.272	0.815	16200
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	2.72	8.15	162000
Benzo[g,h,i]perylene	191-24-2	No	3040	9860	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	27.2	81.5	162000
Benzoic Acid	65-85-0	No	406000	1.71×10^6	-	-	-	-
Benzyl Alcohol	100-51-6	No	10100	42700	-	-	-	-
Beryllium and compounds	7440-41-7	No	203	-	36800	-	-	20600
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	8.19	-	4.33
Bis(2-ethylhexyl)phthalate	117-81-7	No	2030	8550	-	644	2290	2.06×10^7
Bromobenzene	108-86-1	No	811	-	450	-	-	-
Bromodichloromethane	75-27-4	No	2030	-	-	145	-	3.73
Bromoform	75-25-2	No	2030	-	-	1140	-	300
Bromomethane	74-83-9	No	142	-	11.0	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	2.85	2.65	-	1.28
Butanol, N-	71-36-3	No	10100	-	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	20300	85500	-	4740	16900	-
Butylbenzene, n-	104-51-8	No	5070	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	10100	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	10100	-	-	-	-	-
Cadmium (Diet)	7440-43-9	No	101	1070	18400	-	-	27500
Carbon Disulfide	75-15-0	No	10100	-	1250	-	-	-

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]
Carbon Tetrachloride	56-23-5	No	406	-	219	129	-	9.81
Chlordane	12789-03-6	No	50.7	534	812	25.7	229	312
Chlordecone (Kepone)	143-50-0	No	30.4	128	-	0.901	3.20	10800
Chloroaniline, p-	106-47-8	No	406	1710	-	45.1	160	-
Chlorobenzene	108-90-7	No	2030	-	290	-	-	-
Chloroform	67-66-3	No	1010	-	338	291	-	4.05
Chloromethane	74-87-3	No	-	-	168	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	8110	26300	-	-	-	-
Chlorophenol, 2-	95-57-8	No	507	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	152000	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	304	-	184000	3.97	-	213
Chrysene	218-01-9	Yes	-	-	-	272	815	1.62×10^6
Copper	7440-50-8	No	4060	-	-	-	-	-
Cresol, m-	108-39-4	No	5070	21400	1.10×10^9	-	-	-
Cresol, o-	95-48-7	No	5070	21400	1.10×10^9	-	-	-
Cresol, p-	106-44-5	No	10100	42700	1.10×10^9	-	-	-
Cumene	98-82-8	No	10100	-	2080	-	-	-
Cyanide (CN-)[5]	57-12-5	No	60.8	-	79.3	-	-	-
Cyclohexane	110-82-7	No	-	-	9440	-	-	-
DDD	72-54-8	No	-	-	-	37.6	133	717000
DDE, p,p'-	72-55-9	No	-	-	-	26.5	-	443
DDT	50-29-3	No	50.7	712	-	26.5	314	510000
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.272	0.815	14900
Dibenzofuran	132-64-9	No	101	1420	-	-	-	-
Dibromochloromethane	124-48-1	No	2030	-	-	107	-	-
Dibromoethane, 1,2-	106-93-4	No	913	-	94.0	4.51	-	0.468
Dibromomethane (Methylene Bromide)	74-95-3	No	-	-	30.9	-	-	-
Dibutyl Phthalate	84-74-2	No	10100	42700	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	9130	-	1970	-	-	-
Dichlorobenzene, 1,3-	541-73-1	No	9130	-	1690	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	7100	-	7090	1670	-	21.7
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	20.0	71.2	146000
Dichlorodifluoromethane	75-71-8	No	20300	-	150	-	-	-
Dichloroethane, 1,1-	75-34-3	No	20300	-	-	1580	-	47.2
Dichloroethane, 1,2-	107-06-2	No	608	-	39.0	99.0	-	5.77

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, 1,1-	75-35-4	No	5070	-	354	-	-	-
Dichloroethylene, 1,2-cis-	156-59-2	No	203	-	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	2030	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	304	1280	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	1010	8550	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	9130	-	17.3	250	-	11.6
Dichloropropene, 1,3-	542-75-6	No	3040	-	78.9	90.1	-	26.6
Dieldrin	60-57-1	No	5.07	21.4	-	0.563	2.00	10800
Diethyl Phthalate	84-66-2	No	81100	342000	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	2030	8550	-	-	-	-
Dimethylphthalate[5]	131-11-3	No	81100	342000	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	10.1	42.7	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	10.1	42.7	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	10.1	42.7	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	203	855	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	203	838	-	29.1	101	556000
Dinitrotoluene, 2,6-	606-20-2	No	30.4	129	-	6.01	21.6	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	203	14200	-	-	-	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	203	9490	-	-	-	-
Dioxane, 1,4-	123-91-1	No	3040	-	2080	90.1	-	374
Diphenylamine	122-39-4	No	2530	10700	-	-	-	-
Endosulfan	115-29-7	No	608	-	-	-	-	-
Endrin	72-20-8	No	30.4	128	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	19500	-	-	-
Ethylbenzene	100-41-4	No	10100	-	4870	819	-	52.5
Ethylene Glycol	107-21-1	No	203000	855000	$7.35x\ 10^8$	-	-	-
Fluoranthene	206-44-0	No	4060	13100	-	-	-	-
Fluorene	86-73-7	No	4060	13100	-	-	-	-
Formaldehyde	50-00-0	No	20300	-	1390	-	-	292
Heptachlor	76-44-8	No	50.7	-	-	2.00	-	7.54
Heptachlor Epoxide	1024-57-3	No	1.32	-	-	0.990	-	6.65
Hexachlorobenzene	118-74-1	No	81.1	-	-	5.63	-	3.04
Hexachlorobutadiene	87-68-3	No	101	-	-	116	-	10.8
Hexachlorocyclohexane, Alpha-	319-84-6	No	811	3420	-	1.43	5.08	27500
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	5.01	17.8	93400

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]
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	No	30.4	320	-	8.19	72.8	160000
Hexachlorocyclopentadiene	77-47-4	No	608	-	1.40	-	-	-
Hexachloroethane	67-72-1	No	71.0	-	223	225	-	18.2
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	304	8550	-	81.9	1940	-
Hexane, N-	110-54-3	No	-	-	1050	-	-	-
Hexanone, 2-	591-78-6	No	507	-	578	-	-	-
Hydrazine	302-01-2	No	-	-	3.65	3.00	-	0.669
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	2.72	8.15	162000
Isophorone	78-59-1	No	20300	85500	3.68×10^9	9490	33700	-
Isopropanol	67-63-0	No	203000	-	9940	-	-	-
Mercuric Chloride	7487-94-7	No	30.4	-	552000	-	-	-
Mercury (elemental)	7439-97-6	No	16.2	-	19.4	-	-	-
Methanol	67-56-1	No	203000	-	1.05×10^6	-	-	-
Methoxychlor	72-43-5	No	507	2140	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	60800	-	103000	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	-	-	47300	-	-	-
Methyl Mercury	22967-92-6	No	10.1	-	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	22300	5010	-	771
Methylene Chloride	75-09-2	Yes	608	-	1850	993	-	3000
Methylnaphthalene, 1-	90-12-0	No	7100	23000	-	311	850	-
Methylnaphthalene, 2-	91-57-6	No	406	1310	-	-	-	-
Naphthalene	91-20-3	No	2030	6570	108	-	-	28.6
Nickel Soluble Salts	7440-02-0	No	2030	-	165000	-	-	190000
Nitrobenzene	98-95-3	No	203	-	580	-	-	43.4
Nitroglycerin	55-63-0	No	10.1	42.7	-	530	1880	-
Nitroguanidine	556-88-7	No	10100	42700	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	0.811	-	4.41	0.0389	-	0.0766
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	1.29	4.58	24700
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	1840	6540	1.90×10^7
Nitrotoluene, m-	99-08-1	No	10.1	42.7	-	-	-	-
Nitrotoluene, o-	88-72-2	No	91.3	-	-	41.0	-	-
Nitrotoluene, p-	99-99-0	No	406	1710	-	563	2000	-

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]
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	5070	356000	-	-	-	-
Octyl Phthalate, di-N-	117-84-0	No	1010	4270	-	-	-	-
Pentachlorophenol	87-86-5	No	507	855	-	22.5	32.0	9.71×10^{6}
Pentaerythritol tetranitrate (PETN)	78-11-5	No	203	855	-	2250	8010	-
Perfluorooctane Sulfonate (PFOS)	1763-23-1	No	2.03	8.55	-	-	-	-
Perfluorooctanoic Acid (PFOA)	335-67-1	No	2.03	8.55	-	129	458	-
Phenanthrene	85-01-8	No	3040	9860	-	-	-	-
Phenol	108-95-2	No	30400	128000	3.68×10^{8}	-	-	-
Phosphorus, White	7723-14-0	No	2.03	-	-	-	-	-
Polychlorinated Biphenyls	1336-36-3	No	-	-	-	4.51	11.4	19.0
Propyl benzene	103-65-1	No	10100	-	5760	-	-	-
Pyrene	129-00-0	No	3040	9860	-	-	-	-
Selenium	7782-49-2	No	507	-	3.68×10^{7}	-	-	-
Silver	7440-22-4	No	507	-	-	-	-	-
Styrene	100-42-5	No	20300	-	7820	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	0.0000710	0.000997	0.0595	0.0000693	0.000821	0.00105
Tetrachloroethane, 1,1,1,2-	630-20-6	No	3040	-	-	347	-	21.8
Tetrachloroethane, 1,1,2,2-	79-34-5	No	2030	-	-	45.1	-	7.07
Tetrachloroethylene	127-18-4	No	608	-	112	4290	-	290
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	203	131000	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	1.01	-	-	-	-	-
Toluene	108-88-3	No	8110	-	19800	-	-	-
Toxaphene	8001-35-2	No	-	-	-	8.19	29.1	155000
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	3.04×10^{6}	-	64800	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	81.1	-	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	1010	-	46.9	311	-	-
Trichloroethane, 1,1,1-	71-55-6	No	203000	-	11400	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	406	-	1.60	158	-	13.5
Trichloroethylene	79-01-6	Yes	50.7	-	5.44	114	-	12.5
Trichlorofluoromethane	75-69-4	No	30400	-	-	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	10100	42700	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	101	427	-	819	2910	1.60×10^{7}

SOIL UNDER 40 INCH ZONE			Non-Carcinogenic (mg/kg)			Carcinogenic (mg/kg)		
Hazardous Substance	CAS Number[1]	Mutagenic[2]	Ingestion[2]	Dermal[3]	Inhalation[4]	Ingestion[2]	Dermal[3]	Inhalation[4]
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	1010	4270	-	-	-	-
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	811	3420	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	406	-	4.59	0.0662	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	45.9	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	1010	-	-	-	-	-
Tri-n-butyltin	688-73-3	No	30.4	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	3040	67500	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	50.7	668	-	300	3340	-
Vanadium and Compounds	7440-62-2	No	511	-	184000	-	-	-
Vinyl Acetate	108-05-4	No	101000	-	1460	-	-	-
Vinyl Chloride	75-01-4	Yes	304	-	155	0.962	-	2.04
Xylenes	1330-20-7	No	20300	-	498	-	-	-
Zinc and Compounds	7440-66-6	No	30400	-	-	-	-	-

[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] 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	4980	16100	-	-	-	-
Acenaphthylene	208-96-8	No	2490	8070	-	-	-	-
Acetone	67-64-1	No	74700	-	530000	-	-	-
Aldrin	309-00-2	No	2.49	-	-	0.434	-	5.10
Ammonium Perchlorate	7790-98-9	No	58.1	-	-	-	-	-
Anthracene	120-12-7	No	24900	80700	-	-	-	-
Antimony (metallic)	7440-36-0	No	33.2	-	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	41.5	350	94700	8.19	58.2	39500
Barium	7440-39-3	No	16600	-	3.16×10^6	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	2.23	6.67	211
Benzaldehyde	100-52-7	No	8300	-	-	1840	-	-
Benzene	71-43-2	No	332	-	74.9	134	-	8.62
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.223	0.667	55800
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	2.23	6.67	558000
Benzo[g,h,i]perylene	191-24-2	No	2490	8070	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	22.3	66.7	558000
Benzoic Acid	65-85-0	No	332000	1.40×10^6	-	-	-	-
Benzyl Alcohol	100-51-6	No	8300	35000	-	-	-	-
Beryllium and compounds	7440-41-7	No	166	-	126000	-	-	70800
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	6.70	-	3.09
Bis(2-ethylhexyl)phthalate	117-81-7	No	1660	6990	-	527	1870	7.08×10^7
Bromobenzene	108-86-1	No	664	-	321	-	-	-
Bromodichloromethane	75-27-4	No	1660	-	-	119	-	2.66
Bromoform	75-25-2	No	1660	-	-	933	-	214
Bromomethane	74-83-9	No	116	-	7.86	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	2.03	2.17	-	0.911
Butanol, N-	71-36-3	No	8300	-	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	16600	69900	-	3880	13800	-
Butylbenzene, n-	104-51-8	No	4150	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	8300	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	8300	-	-	-	-	-
Cadmium (Diet)	7440-43-9	No	83.0	874	63200	-	-	94500
Carbon Disulfide	75-15-0	No	8300	-	894	-	-	-

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]
Carbon Tetrachloride	56-23-5	No	332	-	156	105	-	7.00
Chlordane	12789-03-6	No	41.5	437	579	21.1	187	223
Chlordecone (Kepone)	143-50-0	No	24.9	105	-	0.737	2.62	37000
Chloroaniline, p-	106-47-8	No	332	1400	-	36.9	131	-
Chlorobenzene	108-90-7	No	1660	-	207	-	-	-
Chloroform	67-66-3	No	830	-	241	238	-	2.89
Chloromethane	74-87-3	No	-	-	120	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	6640	21500	-	-	-	-
Chlorophenol, 2-	95-57-8	No	415	-	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	124000	-	-	-	-	-
Chromium(VI)	18540-29-9	Yes	249	-	632000	3.25	-	731
Chrysene	218-01-9	Yes	-	-	-	223	667	5.58×10^6
Copper	7440-50-8	No	3320	-	-	-	-	-
Cresol, m-	108-39-4	No	4150	17500	3.79×10^9	-	-	-
Cresol, o-	95-48-7	No	4150	17500	3.79×10^9	-	-	-
Cresol, p-	106-44-5	No	8300	35000	3.79×10^9	-	-	-
Cumene	98-82-8	No	8300	-	1480	-	-	-
Cyanide (CN-)[5]	57-12-5	No	49.8	-	56.5	-	-	-
Cyclohexane	110-82-7	No	-	-	6730	-	-	-
DDD	72-54-8	No	-	-	-	30.7	109	2.46×10^6
DDE, p,p'-	72-55-9	No	-	-	-	21.7	-	316
DDT	50-29-3	No	41.5	583	-	21.7	257	1.75×10^6
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.223	0.667	51200
Dibenzofuran	132-64-9	No	83.0	1170	-	-	-	-
Dibromochloromethane	124-48-1	No	1660	-	-	87.8	-	-
Dibromoethane, 1,2-	106-93-4	No	747	-	67.0	3.69	-	0.334
Dibromomethane (Methylene Bromide)	74-95-3	No	-	-	22.0	-	-	-
Dibutyl Phthalate	84-74-2	No	8300	35000	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	7470	-	1410	-	-	-
Dichlorobenzene, 1,3-	541-73-1	No	7470	-	1200	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	5810	-	5060	1370	-	15.5
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	16.4	58.2	500000
Dichlorodifluoromethane	75-71-8	No	16600	-	107	-	-	-
Dichloroethane, 1,1-	75-34-3	No	16600	-	-	1290	-	33.7

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]
Dichloroethane, 1,2-	107-06-2	No	498	-	27.8	81.0	-	4.11
Dichloroethylene, 1,1-	75-35-4	No	4150	-	252	-	-	-
Dichloroethylene, 1,2-cis-	156-59-2	No	166	-	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	1660	-	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	249	1050	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	830	6990	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	7470	-	12.3	205	-	8.28
Dichloropropene, 1,3-	542-75-6	No	2490	-	56.2	73.7	-	18.9
Dieldrin	60-57-1	No	4.15	17.5	-	0.461	1.64	37000
Diethyl Phthalate	84-66-2	No	66400	280000	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	1660	6990	-	-	-	-
Dimethylphthalate	131-11-3	No	66400	280000	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	8.30	35.0	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	8.30	35.0	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	8.30	35.0	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	166	699	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	166	685	-	23.8	82.9	1.91×10^{6}
Dinitrotoluene, 2,6-	606-20-2	No	24.9	106	-	4.92	17.6	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	166	11700	-	-	-	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	166	7770	-	-	-	-
Dioxane, 1,4-	123-91-1	No	2490	-	1480	73.7	-	266
Diphenylamine	122-39-4	No	2070	8740	-	-	-	-
Endosulfan	115-29-7	No	498	-	-	-	-	-
Endrin	72-20-8	No	24.9	105	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	13900	-	-	-
Ethylbenzene	100-41-4	No	8300	-	3470	670	-	37.4
Ethylene Glycol	107-21-1	No	166000	699000	2.53×10^{9}	-	-	-
Fluoranthene	206-44-0	No	3320	10800	-	-	-	-
Fluorene	86-73-7	No	3320	10800	-	-	-	-
Formaldehyde	50-00-0	No	16600	-	988	-	-	208
Heptachlor	76-44-8	No	41.5	-	-	1.64	-	5.38
Heptachlor Epoxide	1024-57-3	No	1.08	-	-	0.810	-	4.74
Hexachlorobenzene	118-74-1	No	66.4	-	-	4.61	-	2.17
Hexachlorobutadiene	87-68-3	No	83.0	-	-	94.5	-	7.73
Hexachlorocyclohexane, Alpha-	319-84-6	No	664	2800	-	1.17	4.16	94500

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, Beta-	319-85-7	No	-	-	-	4.10	14.6	321000
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	No	24.9	262	-	6.70	59.6	549000
Hexachlorocyclopentadiene	77-47-4	No	498	-	1.00	-	-	-
Hexachloroethane	67-72-1	No	58.1	-	159	184	-	13.0
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	249	6990	-	67.0	1590	-
Hexane, N-	110-54-3	No	-	-	752	-	-	-
Hexanone, 2-	591-78-6	No	415	-	412	-	-	-
Hydrazine	302-01-2	No	-	-	2.60	2.46	-	0.477
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	2.23	6.67	558000
Isophorone	78-59-1	No	16600	69900	1.26×10^{10}	7760	27600	-
Isopropanol	67-63-0	No	166000	-	7080	-	-	-
Mercuric Chloride	7487-94-7	No	24.9	-	1.89×10^{6}	-	-	-
Mercury (elemental)	7439-97-6	No	13.3	-	13.8	-	-	-
Methanol	67-56-1	No	166000	-	751000	-	-	-
Methoxychlor	72-43-5	No	415	1750	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	49800	-	73300	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	-	-	33700	-	-	-
Methyl Mercury	22967-92-6	No	8.30	-	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	15900	4100	-	550
Methylene Chloride	75-09-2	Yes	498	-	1320	812	-	2140
Methylnaphthalene, 1-	90-12-0	No	5810	18800	-	254	695	-
Methylnaphthalene, 2-	91-57-6	No	332	1080	-	-	-	-
Naphthalene	91-20-3	No	1660	5380	77.3	-	-	20.4
Nickel Soluble Salts	7440-02-0	No	1660	-	568000	-	-	654000
Nitrobenzene	98-95-3	No	166	-	413	-	-	30.9
Nitroglycerin	55-63-0	No	8.30	35.0	-	434	1540	-
Nitroguanidine	556-88-7	No	8300	35000	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	0.664	-	3.14	0.0318	-	0.0546
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	1.05	3.74	85000
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	1500	5350	6.54×10^{7}
Nitrotoluene, m-	99-08-1	No	8.30	35.0	-	-	-	-
Nitrotoluene, o-	88-72-2	No	74.7	-	-	33.5	-	-
Nitrotoluene, p-	99-99-0	No	332	1400	-	461	1640	-

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	4150	291000	-	-	-	-
Octyl Phthalate, di-N-	117-84-0	No	830	3500	-	-	-	-
Pentachlorophenol	87-86-5	No	415	699	-	18.4	26.2	3.33×10^{7}
Pentaerythritol tetranitrate (PETN)	78-11-5	No	166	699	-	1840	6550	-
Perfluorooctane Sulfonate (PFOS)	1763-23-1	No	1.66	6.99	-	-	-	-
Perfluorooctanoic Acid (PFOA)	335-67-1	No	1.66	6.99	-	105	374	-
Phenanthrene	85-01-8	No	2490	8070	-	-	-	-
Phenol	108-95-2	No	24900	105000	1.26×10^{9}	-	-	-
Phosphorus, White	7723-14-0	No	1.66	-	-	-	-	-
Polychlorinated Biphenyls	1336-36-3	No	-	-	-	3.69	9.36	13.6
Propyl benzene	103-65-1	No	8300	-	4110	-	-	-
Pyrene	129-00-0	No	2490	8070	-	-	-	-
Selenium	7782-49-2	No	415	-	1.26×10^{8}	-	-	-
Silver	7440-22-4	No	415	-	-	-	-	-
Styrene	100-42-5	No	16600	-	5580	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	0.0000581	0.000816	0.0425	0.0000567	0.000672	0.000752
Tetrachloroethane, 1,1,1,2-	630-20-6	No	2490	-	-	284	-	15.6
Tetrachloroethane, 1,1,2,2-	79-34-5	No	1660	-	-	36.9	-	5.04
Tetrachloroethylene	127-18-4	No	498	-	79.9	3510	-	207
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	166	108000	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	0.830	-	-	-	-	-
Toluene	108-88-3	No	6640	-	14100	-	-	-
Toxaphene	8001-35-2	No	-	-	-	6.70	23.8	531000
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	2.49×10^{6}	-	46200	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	66.4	-	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	830	-	33.4	254	-	-
Trichloroethane, 1,1,1-	71-55-6	No	166000	-	8160	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	332	-	1.14	129	-	9.59
Trichloroethylene	79-01-6	Yes	41.5	-	3.88	93.1	-	8.89
Trichlorofluoromethane	75-69-4	No	24900	-	-	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	8300	35000	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	83.0	350	-	670	2380	5.49×10^{7}

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]
Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	No	830	3500	-	-	-	-
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	664	2800	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	332	-	3.27	0.0541	-	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	32.7	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	830	-	-	-	-	-
Tri-n-butyltin	688-73-3	No	24.9	-	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	2490	55200	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	41.5	546	-	246	2730	-
Vanadium and Compounds	7440-62-2	No	418	-	632000	-	-	-
Vinyl Acetate	108-05-4	No	83000	-	1040	-	-	-
Vinyl Chloride	75-01-4	Yes	249	-	110	0.945	-	1.69
Xylenes	1330-20-7	No	16600	-	355	-	-	-
Zinc and Compounds	7440-66-6	No	24900	-	-	-	-	-

[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] 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	963	-	-	-	-
Acenaphthylene	208-96-8	No	602	461	-	-	-	-
Acetone	67-64-1	No	18000	4.39×10^6	64400	-	-	-
Aldrin	309-00-2	No	0.602	-	-	0.0458	-	0.0115
Ammonium Perchlorate	7790-98-9	No	14.0	3190	-	-	-	-
Anthracene	120-12-7	No	6020	2500	-	-	-	-
Antimony (metallic)	7440-36-0	No	8.02	273	-	-	-	-
Arsenic, Inorganic	7440-38-2	No	6.02	1370	-	0.519	97.3	-
Barium	7440-39-3	No	4010	63700	-	-	-	-
Benz[a]anthracene	56-55-3	Yes	-	-	-	0.343	-	0.184
Benzaldehyde	100-52-7		2010	49100	-	195	4390	-
Benzene	71-43-2	No	80.2	605	62.6	14.2	98.3	7.20
Benzo[a]pyrene	50-32-8	Yes	-	-	-	0.0343	-	-
Benzo[b]fluoranthene	205-99-2	Yes	-	-	-	0.343	-	-
Benzo[g,h,i]perylene	191-24-2	No	602	-	-	-	-	-
Benzo[k]fluoranthene	207-08-9	Yes	-	-	-	3.43	-	-
Benzoic Acid	65-85-0	No	80200	1.20×10^6	-	-	-	-
Benzyl Alcohol	100-51-6	No	2010	88900	-	-	-	-
Beryllium and compounds	7440-41-7	No	40.1	63.7	-	-	-	-
Bis(2-chloroethyl)ether	111-44-4	No	-	-	-	0.708	27.1	0.170
Bis(2-ethylhexyl)phthalate	117-81-7	No	401	-	-	55.6	-	-
Bromobenzene	108-86-1	No	160	542	125	-	-	-
Bromodichloromethane	75-27-4	No	401	6460	-	12.6	186	1.52
Bromoform	75-25-2	No	401	6230	-	98.6	1410	51.0
Bromomethane	74-83-9	No	28.1	997	10.4	-	-	-
Butadiene, 1,3-	106-99-0	No	-	-	4.17	0.229	1.62	1.87
Butanol, N-	71-36-3	No	2010	100000	-	-	-	-
Butyl Benzyl Phthlate	85-68-7	No	4010	2870	-	410	270	-
Butylbenzene, n-	104-51-8	No	1000	-	-	-	-	-
Butylbenzene, sec-	135-98-8	No	2010	-	-	-	-	-
Butylbenzene, tert-	98-06-6	No	2010	1050	-	-	-	-
Cadmium (Diet)	7440-43-9	No	10.0	114	-	-	-	-
Carbon Disulfide	75-15-0	No	2010	20000	1460	-	-	-

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]
Carbon Tetrachloride	56-23-5	No	80.2	340	209	11.1	43.3	9.36
Chlordane	12789-03-6	No	10.0	1.77	1.46	2.23	0.362	0.562
Chlordecone (Kepone)	143-50-0	No	6.02	5.43	-	0.0779	0.0647	-
Chloroaniline, p-	106-47-8	No	80.2	1320	-	3.90	59.0	-
Chlorobenzene	108-90-7	No	401	1280	104	-	-	-
Chloroform	67-66-3	No	201	2530	204	25.1	292	2.44
Chloromethane	74-87-3	No	-	-	188	-	-	-
Chloronaphthalene, Beta-	91-58-7	No	1600	1400	-	-	-	-
Chlorophenol, 2-	95-57-8	No	100	1020	-	-	-	-
Chromium(III), Insoluble Salts	16065-83-1	No	30100	88700	-	-	-	-
Chromium(VI)	18540-29-9	Yes	60.2	171	-	0.501	1.16	-
Chrysene	218-01-9	Yes	-	-	-	34.3	-	-
Copper	7440-50-8	No	802	182000	-	-	-	-
Cresol, m-	108-39-4	No	1000	12000	-	-	-	-
Cresol, o-	95-48-7	No	1000	12100	-	-	-	-
Cresol, p-	106-44-5	No	2010	24600	-	-	-	-
Cumene	98-82-8	No	2010	1920	834	-	-	-
Cyanide (CN-)	57-12-5	No	12.0	2730	1.67	-	-	-
Cyclohexane	110-82-7	No	-	-	12500	-	-	-
DDD	72-54-8	No	-	-	-	3.25	0.351	-
DDE, p,p'-	72-55-9	No	-	-	-	2.29	-	0.579
DDT	50-29-3	No	10.0	-	-	2.29	-	-
Dibenz[a,h]anthracene	53-70-3	Yes	-	-	-	0.0343	-	-
Dibenzofuran	132-64-9	No	20.1	12.9	-	-	-	-
Dibromochloromethane	124-48-1	No	401	6740	-	9.27	143	-
Dibromoethane, 1,2-	106-93-4	No	180	3600	18.8	0.390	7.14	0.0936
Dibromomethane (Methylene Bromide)	74-95-3	No	-	-	8.34	-	-	-
Dibutyl Phthalate	84-74-2	No	2010	1640	-	-	-	-
Dichlorobenzene, 1,2-	95-50-1	No	1800	2920	417	-	-	-
Dichlorobenzene, 1,3-[5]	541-73-1	No	1800	2500	417	-	-	-
Dichlorobenzene, 1,4-	106-46-7	No	1400	2230	1670	144	211	5.10
Dichlorobenzidine, 3,3'-	91-94-1	No	-	-	-	1.73	4.53	-
Dichlorodifluoromethane	75-71-8	No	4010	38200	209	-	-	-
Dichloroethane, 1,1-	75-34-3	No	4010	58400	-	137	1830	35.1
Dichloroethane, 1,2-	107-06-2	No	120	2820	14.6	8.56	184	2.16

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, 1,1-	75-35-4	No	1000	8540	417	-	-	-
Dichloroethylene, 1,2-cis-	156-59-2	No	40.1	363	-	-	-	-
Dichloroethylene, 1,2-trans-	156-60-5	No	401	3630	-	-	-	-
Dichlorophenol, 2,4-	120-83-2	No	60.2	190	-	-	-	-
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	No	201	1350	-	-	-	-
Dichloropropane, 1,2-	78-87-5	No	1800	21500	8.34	21.6	237	5.62
Dichloropropene, 1,3-	542-75-6	No	602	6560	41.7	7.79	78.2	14.0
Dieldrin	60-57-1	No	1.00	0.614	-	0.0487	0.0274	-
Diethyl Phthalate	84-66-2	No	16000	198000	-	-	-	-
Dimethylphenol, 2,4-	105-67-9	No	401	3110	-	-	-	-
Dimethylphthalate[5]	131-11-3	No	16000	581000	-	-	-	-
Dinitrobenzene, 1,2-	528-29-0	No	2.01	53.3	-	-	-	-
Dinitrobenzene, 1,3-	99-65-0	No	2.01	72.5	-	-	-	-
Dinitrobenzene, 1,4-	100-25-4	No	2.01	75.6	-	-	-	-
Dinitrophenol, 2,4-	51-28-5	No	40.1	1220	-	-	-	-
Dinitrotoluene, 2,4-	121-14-2	No	40.1	749	-	2.51	43.2	-
Dinitrotoluene, 2,6-	606-20-2	No	6.02	93.5	-	0.519	7.42	-
Dinitrotoluene, 2-Amino-4,6-	35572-78-2	No	40.1	1030	-	-	-	-
Dinitrotoluene, 4-Amino-2,6-	19406-51-0	No	40.1	1030	-	-	-	-
Dioxane, 1,4-	123-91-1	No	602	191000	62.6	7.79	2280	11.2
Diphenylamine	122-39-4	No	501	840	-	-	-	-
Endosulfan	115-29-7	No	120	631	-	-	-	-
Endrin	72-20-8	No	6.02	3.68	-	-	-	-
Ethyl Chloride	75-00-3	No	-	-	20900	-	-	-
Ethylbenzene	100-41-4	No	2010	3820	2090	70.8	124	22.5
Ethylene Glycol	107-21-1	No	40100	5.70×10^7	-	-	-	-
Fluoranthene	206-44-0	No	802	-	-	-	-	-
Fluorene	86-73-7	No	802	465	-	-	-	-
Formaldehyde	50-00-0	No	4010	318000	20.5	-	-	4.32
Heptachlor	76-44-8	No	10.0	1.47	-	0.173	0.0233	0.0432
Heptachlor Epoxide	1024-57-3	No	0.261	0.236	-	0.0856	0.0712	0.0216
Hexachlorobenzene	118-74-1	No	16.0	-	-	0.487	-	0.122
Hexachlorobutadiene	87-68-3	No	20.1	9.53	-	9.99	4.36	2.55
Hexachlorocyclohexane, Alpha-	319-84-6	No	160	247	-	0.124	0.175	-
Hexachlorocyclohexane, Beta-	319-85-7	No	-	-	-	0.433	0.613	-

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]
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	No	6.02	9.26	-	0.708	1.00	-
Hexachlorocyclopentadiene	77-47-4	No	120	41.6	0.417	-	-	-
Hexachloroethane	67-72-1	No	14.0	13.7	62.6	19.5	17.5	5.10
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	No	60.2	7960	-	7.08	861	-
Hexane, N-	110-54-3	No	-	-	1460	-	-	-
Hexanone, 2-	591-78-6	No	100	2760	62.6	-	-	-
Hydrazine[7]	302-01-2	No	-	-	0.0626	0.260	1120	0.0115
Indeno[1,2,3-cd]pyrene	193-39-5	Yes	-	-	-	0.343	-	-
Isophorone	78-59-1	No	4010	86500	-	820	16300	-
Isopropanol	67-63-0	No	40100	6.51×10^6	417	-	-	-
Mercuric Chloride	7487-94-7	No	6.02	95.6	-	-	-	-
Mercury (elemental)	7439-97-6	No	3.21	728	0.626	-	-	-
Methanol	67-56-1	No	40100	1.80×10^7	41700	-	-	-
Methoxychlor	72-43-5	No	100	58.7	-	-	-	-
Methyl Ethyl Ketone (2-Butanone)	78-93-3	No	12000	1.46×10^6	10400	-	-	-
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	No	-	-	6260	-	-	-
Methyl Mercury	22967-92-6	No	2.01	455	-	-	-	-
Methyl tert-Butyl Ether (MTBE)	1634-04-4	No	-	-	6260	433	19900	216
Methylene Chloride	75-09-2	Yes	120	3660	1250	125	3470	2030
Methylnaphthalene, 1-	90-12-0	No	1400	1120	-	26.9	19.7	-
Methylnaphthalene, 2-	91-57-6	No	80.2	65.1	-	-	-	-
Naphthalene	91-20-3	No	401	701	6.26	-	-	1.65
Nickel Soluble Salts	7440-02-0	No	401	18200	-	-	-	-
Nitrobenzene	98-95-3	No	40.1	624	18.8	-	-	1.40
Nitroglycerin	55-63-0	No	2.01	86.8	-	45.8	1820	-
Nitroguanidine	556-88-7	No	2010	1.82×10^6	-	-	-	-
Nitrosodimethylamine, N-	62-75-9	Yes	0.160	73.8	0.0834	0.00491	2.00	0.00145
Nitroso-di-N-propylamine, N-	621-64-7	No	-	-	-	0.111	3.53	-
Nitrosodiphenylamine, N-	86-30-6	No	-	-	-	159	523	-
Nitrotoluene, m-	99-08-1	No	2.01	13.6	-	-	-	-
Nitrotoluene, o-	88-72-2	No	18.0	154	-	3.54	27.8	-
Nitrotoluene, p-	99-99-0	No	80.2	617	-	48.7	344	-

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]
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	No	1000	634000	-	-	-	-
Octyl Phthalate, di-N-	117-84-0	No	201	-	-	-	-	-
Pentachlorophenol	87-86-5	No	100	29.3	-	1.95	0.524	-
Pentaerythritol tetranitrate (PETN)	78-11-5	No	40.1	962	-	195	4300	-
Perfluorooctane Sulfonate (PFOS)	1763-23-1	No	0.401	-	-	-	-	-
Perfluorooctanoic Acid (PFOA)	335-67-1	No	0.401	-	-	11.1	-	-
Phenanthrene	85-01-8	No	602	246	-	-	-	-
Phenol	108-95-2	No	6020	141000	-	-	-	-
Phosphorus, White	7723-14-0	No	0.401	91.0	-	-	-	-
Polychlorinated Biphenyls	1336-36-3	No	-	-	-	1.95	-	0.562
Propyl benzene	103-65-1	No	2010	1830	2090	-	-	-
Pyrene	129-00-0	No	602	151	-	-	-	-
Selenium	7782-49-2	No	100	22800	-	-	-	-
Silver	7440-22-4	No	100	1520	-	-	-	-
Styrene	100-42-5	No	4010	10300	2090	-	-	-
TCDD, 2,3,7,8-	1746-01-6	No	0.0000140	-	0.0000834	5.99×10^{-6}	-	1.48×10^{-6}
Tetrachloroethane, 1,1,1,2-	630-20-6	No	602	2390	-	30.0	109	7.59
Tetrachloroethane, 1,1,2,2-	79-34-5	No	401	3640	-	3.90	32.5	0.968
Tetrachloroethylene	127-18-4	No	120	230	83.4	371	653	216
Tetryl (Trinitrophenylmethylnitramine)	479-45-8	No	40.1	2470	-	-	-	-
Thallium (Soluble Salts)	7440-28-0	No	0.201	45.5	-	-	-	-
Toluene	108-88-3	No	1600	5300	10400	-	-	-
Toxaphene	8001-35-2	No	-	-	-	0.708	-	-
Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	No	602000	1.91×10^{6}	62600	-	-	-
Trichlorobenzene, 1,2,3-	87-61-6	No	16.0	12.6	-	-	-	-
Trichlorobenzene, 1,2,4-	120-82-1	No	201	164	4.17	26.9	20.2	-
Trichloroethane, 1,1,1-	71-55-6	No	40100	251000	10400	-	-	-
Trichloroethane, 1,1,2-	79-00-5	No	80.2	1250	0.417	13.7	196	3.51
Trichloroethylene	79-01-6	Yes	10.0	68.9	4.17	11.8	74.5	9.57
Trichlorofluoromethane	75-69-4	No	6020	36400	-	-	-	-
Trichlorophenol, 2,4,5-	95-95-4	No	2010	2890	-	-	-	-
Trichlorophenol, 2,4,6-	88-06-2	No	20.1	30.2	-	70.8	98.1	-

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	201	874	-	-	-	-
Trichlorophenoxypropionic acid, -2,4,5	93-72-1	No	160	362	-	-	-	-
Trichloropropane, 1,2,3-	96-18-4	Yes	80.2	767	0.626	0.00835	0.0728	-
Trimethylbenzene, 1,2,4-	95-63-6	No	-	-	14.6	-	-	-
Trimethylbenzene, 1,3,5-	108-67-8	No	201	277	-	-	-	-
Tri-n-butyltin	688-73-3	No	6.02	9.87	-	-	-	-
Trinitrobenzene, 1,3,5-	99-35-4	No	602	46700	-	-	-	-
Trinitrotoluene, 2,4,6-	118-96-7	No	10.0	448	-	26.0	1070	-
Vanadium and Compounds	7440-62-2	No	101	596	-	-	-	-
Vinyl Acetate	108-05-4	No	20100	1.36×10^6	417	-	-	-
Vinyl Chloride	75-01-4	Yes	60.2	893	209	0.214	2.77	3.35
Xylenes	1330-20-7	No	4010	7530	209	-	-	-
Zinc and Compounds	7440-66-6	No	6020	2.28×10^6	-	-	-	-

[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.

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.