

SUBJECT: Air Phase Hydrocarbon Vapor Intrusion Screening Values

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Air Phase Petroleum Hydrocarbon (APH) Vapor Intrusion Screening Table 1

APH Chemical	DEQ/EPA RSL Screen (µg/m³)*		Background	C/nc
	Residential	Industrial		
1,2-Dichloroethane (DCA)**	0.12	0.53	0.23	C**
Aliphatic (C5-C8)	73	310	94	nc
Aliphatic (C9-C12)	21	88	44	nc
Aromatic (C9-C10)	5.2	22		nc
Benzene	0.40	1.8	1.3	C**
Ethylbenzene	1.3	5.5	1.1	C*
Ethylene dibromide (EDB)	0.0052	0.023		C
MTBE	12	53		C*
Naphthalene	0.092	0.40	0.39	C**
Toluene	520	2200		nc
Xylenes (mix of m,p- & o-)	10	44		nc

C= carcinogen value derived the screening level

n/c = non carcinogen value derived the screening level

**= where nc SL < 10X ca SL

* = where: nc SL < 100X ca SL

APH Screening Level Uses:

The Air-Phase Petroleum Hydrocarbon Vapor Intrusion (APH VI) Screening Level Table is designed as a simple screening tool to determine if vapor intrusion exceeds generic risk-based screening levels at sites with ONLY petroleum contamination. This table is not meant to be used with solvent sites or mixed waste sites containing a combination of petroleum and other sources as those screening levels are not given in this table. The petroleum screening levels can be used at other sites as long as all other compounds are properly represented and adjusted for in the Tier 2 analysis (solvent/mixed waste sites are not specifically addressed in this memo). The compounds in Table 1 were selected as they are the most common compounds detected in indoor air as a result of petroleum releases that pose a risk to human health. Screening levels for additional petroleum compounds, not shown in the table above, can be found using U.S. Environmental Protection Agency (EPA) Regional Screening Level (RSL) hazard quotient (HQ) 0.1 table, indoor air screening levels for the appropriate receptor.

Summary of Table 1 screening levels (Tier 1):

For Table 1, indoor air residential and commercial/industrial screening levels, the EPARSL calculator (EPA, 2024) was used at the RSL Target Hazard Quotient (THQ) 0.1 and Target Risk (TR) 1E-06 risk level. Screening levels were rounded to two significant numbers, consistent with the EPA RSL tables. On the user provided input page https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, lifetime in years was modified from the EPA default of 70 to 78 to be consistent with DEQ defaults (DEQ, 2024). Toxicity values (RfC and RfD) for the petroleum fractions were from Montana DEQ’s Risk-Based Corrective Action Guidance for Petroleum Releases (DEQ, 2024). All other toxicity values were EPA RSL default values.

- Where background based upon the Typical Indoor Air Concentrations of Volatile Organic Compounds in Non-Smoking Montana Residences Not Impacted by Vapor Intrusion (DEQ, 2012) is higher than the screening level, orange cells, the background number applies.
- If the release is diesel or waste oil and VI is a potential pathway, other compounds such as polycyclic aromatic hydrocarbons (PAHs) and 1- and 2-methylnaphthalene may need to be added to the vapor intrusion (VI) analysis.

How to calculate Tier 2 screening levels:

The same process applies to APH as is outlined in RBCA, 4.2.1 (DEQ, 2024).

The carcinogenic Tier-1 APH screening levels in Table 1 were developed with a TR of 1E-06, which means that “one person out of 1 million persons assumed to be exposed under similar conditions could develop cancer as a result of lifetime exposure to one or more potential carcinogens” (EPA, 2020 chapter 4: <https://www.epa.gov/sites/default/files/2020-09/documents/chap4.pdf>).

To calculate the noncarcinogenic screening levels for Table 1, a THQ of 0.1 was used, which is the potential for non-cancer health hazards to occur from exposure to a chemical with non-cancer health guidelines, or more specifically, the ratio of an exposure level for a specific time period over a reference concentration (RfC) for that chemical at a similar exposure period.

Tier I APH screening levels are derived to allow exposure to 10 compounds, either 10 non-carcinogens, represented in Table 1 as nc or 10 carcinogens, represented in Table 1 as C. Once a site is fully investigated, the same calculation used for Tier 2 soil RBSLs may be used to calculate a site-specific indoor air concentrations protective of human health at the cumulative carcinogenic risk level of 1E-05 and a cumulative non-carcinogenic Hazard Index (HI; sum of HQs) risk level.

$$\text{Tier 2 RBSL}_n = \text{Tier 1 RBSL}_n \times \left(\frac{10}{\# \text{ of non - Carcinogenic Exceedances}} \right)$$

$$\text{Tier 2 RBSL}_c = \text{Tier 1 RBSL}_c \times \left(\frac{10}{\# \text{ of Carcinogenic Exceedances}} \right)$$

Tier 3 adjustments:

The HI may be summed according to major health effects and the target organs or systems (US EPA, 1989a). It is important to sum the HQs for each common effect to ensure no segregated HI exceeds 1. This process is referred to as “segregating the HIs.”

The process is as follows:

- Generate a HQ for each chemical
- Assign each chemical to one or more target organs based upon information found in the toxicity references included in the EPA Toxicity Hierarchy (EPA, 2003).
- Sum the individual HQs for each chemical assigned to each organ or organ system to generate an HI for that target organ or system.
- If any HI exceeds 1, then there is an unacceptable risk for non-carcinogenic health effects.

Tier 3 adjustments can be made on soil, air, or soil gas screening levels. Adjustments are not allowed for water quality standards. DEQ does not sum the HI across various media (exposure pathways). DEQ recommends a risk assessor or toxicologist perform the segregated HI calculation (Tier 3 analyses).

Changes from last APH Screening table:

1,3 butadiene was deleted from the standard APH suite. 1,3 butadiene is highly volatile and primarily associated with combustion and cannot generally be tied back to a release (cannot be detected in soil or in water) and it breaks down quickly in air (ATSDR, 2012).

The fraction RfCs have been updated and screening levels recalculated.

The calculator portion of the APH tool was deleted and any Tier 3 calculations should be done on a case-by-case basis with the assistance of a toxicologist or risk assessor.

References:

ATSDR, 2012. Toxicological Profile for 1,3-Butadiene. September. Available at <https://www.atsdr.cdc.gov/ToxProfiles/tp28-c6.pdf>.

DEQ, 2012. Typical Indoor Air Concentrations of Volatile Organic Compounds in Non-Smoking Montana Residences Not Impacted by Vapor Intrusion, A Montana Indoor Air Quality Investigation, August. Available at https://deq.mt.gov/Files/Land/StateSuperfund/Documents/VI_guide/CompleteIndoorVOCReport.pdf.

DEQ, 2021. Montana Vapor Intrusion Guide. September. Available at https://deq.mt.gov/Files/Land/StateSuperFund/Documents/VI_Guide/MontanaVI_Guide_FINAL.pdf.

DEQ, 2024. Risk-Based Corrective Action Guidance for Petroleum Releases, Final. February. Available at https://deq.mt.gov/files/Land/StateSuperFund/Documents/rbca/Update/Final%20RBCA%202024%20Update_Compiled%20PDF.pdf.

U.S. EPA. 1989a. 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, D.C. December.

U.S. EPA, 2003. Human Health Toxicity Values in Superfund Risk Assessments. December. Available at <https://www.epa.gov/risk/human-health-toxicity-values-superfund-risk-assessments>.

U.S. EPA, 2020. RCRA Delisting Technical Support Document, July. Available at <https://www.epa.gov/sites/default/files/2020-09/documents/chap4.pdf>.

U.S. EPA. 2024. Regional Screening Level (RSL) Calculator available at https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search.