# Preliminary Cleanup Level Workbook
# Supplemental Information

This supplemental information paper provides background information and instructions for using the Preliminary Cleanup Level (PCUL) workbook. PCULs apply to upland MTCA sites in Ecology's Northwest Region that have environmental transport pathways to surface water. The PCULs cover transport pathways to surface water as well as additional pathways not related to surface water to support complete MTCA cleanup actions.

***The PCUL document is not intended to be used to establish discharge limits for permitted or unpermitted discharges at any site or water quality criteria for any surface water body.***

A version of the PCUL workbook specific to the Lower Duwamish Waterway (LDW) site is posted on Ecology's LDW website[1]. This version includes sediment cleanup levels (CULs) and remedial action levels (RALs) from EPA's (2014) record of decision (ROD) for the LDW. This version of the workbook can be modified for marine sites outside the LDW by eliminating the CULs and RALs specific to the LDW and making additional modifications from site-specific parameter values to default parameter values. Ask Priscilla Tomlinson or Kim Wooten for assistance in modifying the PCUL workbook for marine sites outside the LDW.

There is also a version of the PCUL workbook specific to the South Lake Union (SLU) area, which includes freshwater sediment and surface water. Ask Priscilla Tomlinson to access this version. The SLU version of the workbook is generic and can be used at any freshwater site.

The PCUL document implements the technical approach in an Ecology (2016a) policy memo regarding ground water CULs for the LDW by expanding it to more chemicals and additional transport pathways and by updating applicable or relevant and appropriate requirements (ARARs). The policy memo provides detailed discussions of the following issues that are not repeated here:

- Beneficial uses of the LDW
- Applicability of state and federal WQC for conventional parameters
- Rationale for using Method B CULs
- Descriptions of literature references used to estimate water concentrations protective of aquatic life.

The PCULs are calculated consistent with the Model Toxics Control Act (MTCA, 173-340 WAC), the Sediment Management Standards (SMS, 173-204 WAC), and guidance associated with both of these regulations.

The PCUL workbook has undergone quality assurance checks. Nevertheless, users are advised to perform their own quality assurance checks. Please notify Priscilla Tomlinson at priscilla.tomlinson@ecy.wa.gov or 425-324-0732 if potential errors are identified.

[1] https://apps.ecology.wa.gov/cleanupsearch/site/1643#site-documents.

## Purpose of PCULs

The PCULs in the workbook are intended to be used for two purposes during the cleanup process:

- Remedial investigation: Initial screening of environmental chemical concentrations to identify chemicals and transport and exposure pathways of concern
- Feasibility study and cleanup action plan (CAP): Starting point for developing final, site-specific CULs and remediation levels (RELs, WAC 173-340-355).

The comparison of site contaminant concentrations to PCULs may be used to identify chemicals of potential concern (COPCs). In addition, if environmental concentrations of a chemical in a receiving medium do not exceed its PCUL for that medium, these data may be used to support an empirical demonstration that the applicable transport pathway is not occurring. Additional information concerning length of time the contamination has been present and anticipated future site conditions must also be considered in the empirical demonstration per WAC 173-340-747(9) and Implementation Memo 15 (Ecology 2016b).

For example, ground water concentrations in compliance with the ground water PCUL for a specific chemical could support a proposal to eliminate the leaching pathway from the soil PCUL for that chemical. Similarly, sediment concentrations in compliance with the sediment PCUL could support a proposal to eliminate protection of sediment from the ground water PCUL for that chemical. The Ecology cleanup project manager (site manager) will determine whether an empirical demonstration has been met.

The PCUL document should be the starting point for developing final CULs for LDW sites. Final CULs may be different from PCULs for reasons including, but not necessarily limited to, the following:

- Commercial or industrial land use (soil or air only)
- Exclusion from the terrestrial ecological evaluation (TEE) or qualification to use the simplified TEE
- Elimination of a transport pathway due to an empirical demonstration
- Consideration of natural attenuation during environmental transport
- Availability of biological data that over-ride the results of chemical testing (e.g., whole effluent toxicity test, benthic toxicity bioassay)
- Use of site-specific modeling (e.g., Reible sediment model, site-specific modeling of ground water transport)
- Adjustments based on practical quantitation limits (PQLs)
- Adjustments to consider additive noncancer hazards and cancer risks due to multiple chemicals and multiple exposure pathways.

Some of these issues are discussed later in this document.

## Contents of Workbook

PCULs are calculated for a variety of environmental transport and exposure pathways. Soil PCULs are labeled SL-1 through SL-10; ground water PCULs are labeled GW-1 through GW-5; air PCULs are labeled AR-1; and soil gas PCULs are labeled SG-1. A full list is provided below.

The environmental transport pathways to surface water that are addressed in the PCUL document include the following (Figure 1):

- Transport of contaminated ground water to surface water (GW-2)
- Partitioning of ground water contamination to sediment (GW-3)
- Leaching of soil contaminants to potable ground water from the vadose zone (SL-2) or the saturated zone (SL-5)
- Leaching of soil contaminants from the vadose zone (SL-3) or the saturated zone (SL-6) to ground water followed by transport to surface water
- Leaching of soil contaminants from the vadose zone (SL-4) or the saturated zone (SL-7) to ground water followed by partitioning to sediment
- Erosion of contaminated soil directly to sediment (SL-8)
- Transport of soil into a storm water pipe that outfalls to the river (SL-8)
- Infiltration of soil (SL-8) or ground water (GW-2) into a storm water pipe that outfalls to the river.

Liquid and solid materials in a storm drain system are regulated by the Water Quality Program via their permitting process, not by the Toxics Cleanup Program. The PCUL document does not address the water portion of the surface runoff pathway, either the flow that directly enters a waterbody or the flow that enters a storm drain with an outfall to the waterbody. However, if soil is protective of the leaching pathway (SL-2 through SL-7), it is expected that the water in surface runoff will be protective of the waterbody.

Similarly, the solid materials in a storm drain with an outfall to a waterbody are not addressed by the PCUL document. However, if soil is protective of bank erosion (SL-8), it is expected that any soil entering the storm drain system will be protective of the waterbody. Other pathways for contaminant transport to the waterbody, such as atmospheric deposition or spills directly to the waterbody, should be discussed with the site manager.

The PCUL document includes the following media and pathways that do not directly involve a waterbody:

- Upland soil contamination (SL-1 and SL-9)
- Ground water contamination in a potable aquifer (GW-1)
- Intrusion of soil vapors (SG-1) or vapors from ground water (GW-4) into a building.

The environmental exposure pathways and potential receptors addressed in the PCUL document include the following (Figure 2):

| Medium | Exposure Pathway | Human Receptors | Ecological Receptors |
|---|---|---|---|
| Soil | Direct contact | SL-1 | SL-9 (terrestrial) |
| Ground water | Potable use | GW-1 | -- |

| Medium | Exposure Pathway | Human Receptors | Ecological Receptors |
|---|---|---|---|
| Air | Inhalation | AR-1 | -- |
| Surface water | Direct contact | -- | GW-2 (aquatic) |
| | Seafood consumption | GW-2 | -- |
| Sediment | Direct contact | GW-3 | GW-3 (benthic) |
| | Seafood consumption | GW-3 | GW-3 (higher trophic level) |

The most stringent PCULs are identified for residential land use. PCULs for industrial land use are also available and may be substituted if the site manager agrees that a site qualifies for industrial land use. The CULs for many chemicals are dominated by the leaching pathway; these CULs are not expected to be affected by land use.

The following individual PCULs are provided in the workbook.

| PCUL Number | PCUL Name |
|---|---|
| SL-1 | Direct contact under unrestricted land use |
| SL-2 | Vadose zone protection of drinking water |
| SL-3 | Vadose zone protection of surface water via ground water |
| SL-4 | Vadose zone protection of sediment via ground water |
| SL-5 | Saturated zone protection of drinking water |
| SL-6 | Saturated zone protection of surface water via ground water |
| SL-7 | Saturated zone protection of sediment via ground water |
| SL-8 | Protection of sediment via soil erosion |
| SL-9 | Site-specific TEE for unrestricted land use |
| SL-10 | Natural background concentration |
| GW-1 | Drinking water |
| GW-2 | Protection of surface water |
| GW-3 | Protection of sediment |
| GW-4 | Protection of indoor air |
| GW-5 | Natural background concentration |
| AR-1 | Air cleanup level |
| SG-1 | Soil gas screening level for protection of indoor air |

The workbook contains the following groups of pages that contain sets of related information. In the freshwater version, some page names have the suffix ‘FW’ because they contain information specific to fresh surface water or sediment and must be distinguished in the master workbook from pages with information specific to marine surface water and sediment.

| Category | Page | Contents |
|---|---|---|
| -- | Mod | History of modifications |
| Media Summaries | SL, SL-FW | Most conservative soil PCULs |
| | GW, GW-FW | Most conservative ground water PCULs |
| | Sed, SedFW | Sediment PCULs and, in the LDW version, CULs and RALs from the LDW ROD |
| | AR | PCULs for air and soil gas |

| Category | Page | Contents |
|---|---|---|
| Background Information | Chem | Chemical names, CAS numbers, and synonyms |
| | Param | Chemical and toxicological parameters |
| | Eqtn | Equations for calculating PCULs and non-chemical-specific parameter values for input to equations |
| Soil Calculation Support | SL-Det | Equation values for soil contact, table values for the TEE, and the TSCA[2] ARAR value for PCBs |
| | SL-Eq | Calculations for MTCA Equations 740-1, 740-2, 745-1, and 745-2 (soil contact) |
| | Leach, LeachFW | Calculations for MTCA Equation 747-1 (soil leaching to ground water) |
| Ground Water Calculation Support | PW | ARARs and MTCA equation values for potable water and ground water screening levels for vapor intrusion |
| | SW, SW-FW | ARARs for surface water and MTCA equation values for ingestion of fish |
| | GW-Eq | Calculations for MTCA Equations 720-1 and 720-2 (drinking water) and 730-1 and 730-2 (surface water) |
| | Partit, PartitFW | Calculations for modified MTCA Equation 747-1, used to model partitioning between ground water and sediment |
| | VI | Calculations for ground water screening levels for protection of indoor air |
| Sediment Calculation Support | SedDet, SedDetFW | Individual inputs for sediment PCULs, including background, PQLs, benthic criteria, direct contact PCULs, and bioaccumulative PCULs |
| | Sed-Eq, Sed-EqFW | Calculations for SMS Equations 9-1 and 9-2 for three sediment contact scenarios |
| | SedMMA, SedMMA-FW | Calculations for sediment contact scenarios with considerations for mutagenic mode of action |
| Air Calculation Support | AR-Det | Equation values for air cleanup levels and soil gas screening levels |
| | AR-Eq | Calculations for MTCA Equations 750-1 and 750-2 (air inhalation) |

Detailed notes on individual chemicals and on the contents of each page are provided in Tables 1 and 2, respectively. Table 3 provides definitions of acronyms. Within the workbook, when the value for an individual chemical is obtained from a different source or represents a different endpoint from the other chemicals in the same column, this is explained in a comment inserted into the cell.

[2] CUL is for self-implementing cleanups, consistent with Method A.

The PCULs in the workbook are calculated using ARARs; the equations in MTCA, SMS, and associated guidance; input parameters describing exposure or transport; and, for some chemicals, literature values for aquatic toxicity. The LDW version includes some site-specific parameter values (see Assumptions Specific to the LDW). Such parameters should be reset to default values for marine sites outside the LDW. The SLU version includes only default parameter values.

PCUL values are not copied directly from Ecology's Cleanup Levels and Risk Calculation (CLARC) website but are calculated within the workbook. Some PCULs differ from the values presented in CLARC due to either site-specific assumptions or slight differences in rounding.

The chemicals included in the workbook are those that are commonly analyzed at MTCA sites. The chemical list does not imply that these are the only chemicals that should be analyzed at MTCA sites. All chemicals listed in CLARC that are suspected of being present based on-site history should be analyzed. If a detected analyte is not listed in the PCUL workbook, request Ecology to develop PCULs for the analyte. The site manager must approve PCULs for chemicals not listed in the workbook.

On the soil and ground water summary pages (SL and GW), the most stringent PCUL is identified from among multiple pathway specific PCULs. If the most stringent PCUL falls below the natural background concentration, it is adjusted up to the natural background concentration. To address the possibility that one or more pathways are not applicable at a site, a column is provided for the user to define a PCUL that excludes one or more pathways listed on the summary page. PCULs in the workbook are not adjusted for PQLs (see Practical Quantitation Limits).

On the far-right side of some pages is a matrix showing the basis for the most stringent PCUL for informational purposes. For example, the most stringent PCUL might be based on an ARAR, an adjusted ARAR, a value calculated using a Method B equation, a value calculated using the three-phase model, or natural background.

PCULs do not contain information related to point of compliance. For information on this topic, refer to the applicable sections of MTCA and SMS. Points of compliance must be approved by the site manager.

The PCUL workbook is a living document. Updates to parameters or criteria are incorporated into periodic revisions.

## Assumptions Specific to the LDW

The LDW version of the workbook includes the following site-specific information:

- The receiving surface water and sediments are marine, and the surface water is nonpotable.
- The fish consumption rate is 97.5 grams/day[3], based on the LDW human health risk assessment (LDWG 2010).

[3] Note that the state water quality criteria for human health are based on a fish consumption rate of 175 g/day. The

- The scenarios for human contact with sediment are from the LDW human health risk assessment (LDWG 2010).
- Sediment natural background levels for total PCB congeners, total PCB toxicity equivalents (TEQ), total dioxin/furan TEQ, arsenic, and total cPAH TEQ are from the ROD.
- The natural background concentration of arsenic in ground water is based on Ecology (2022a) for the Puget Sound Basin.
- Soil natural background levels for metals are from Ecology (1994) for the Puget Sound region.
- Ground water PCULs for protection of sediment are calculated using a modified version of the MTCA three-phase model (Equations 747-1 and 747-2), using LDW-specific parameter values for fraction organic carbon, porosity, and particle density (Ecology 2016a). Site-specific modeling approaches may be proposed to the site manager.

## Cautions on Modifications to the Workbook

***The user of this workbook is advised to exercise caution when making changes*** because of the possibility of introducing errors. Always check the source of cell contents before editing a cell. The following workbook features should be considered before making any changes.

Many cells contain formulas linking to other cells or other pages within the workbook. For example, values on the media summary pages (SL, GW, Sed, and AR) are linked to the media detail pages (e.g., SL-Det, PW, SW, SedDet, and AR-Det). Many of the values on the detail pages are linked to the various equation calculation pages (e.g., SL-Eq, GW-Eq, SedEq, VI, Leach, and Partit), which in turn link to the chemical-specific parameters page (Param) and the equations page (Eqtn).

Chemicals are listed in the same order on each page. Do not move chemicals from one row to another on any of the pages. Changes to the lists of chemicals on one page could result in confusion and potentially incorrect linkage among pages. New chemicals may be added, but care must be exercised to insert each chemical in the same order on all pages.

If changes are made to input parameters used in equations, these changes should be made to cells without formulas in the 'Param' page or the 'Eqtn' page. If the modification is made to the correct cell, the modification will be propagated correctly throughout the workbook.

The site manager will determine whether modifications to the workbook are warranted. All changes made to the workbook must be accompanied by a complete explanation of what was changed and why the change was appropriate.

## Adjustments to ARARs

WQC and maximum contaminant levels (MCLs) constitute ARARs under MTCA. The site manager will determine whether ground water at a site is considered potable and thus subject to MCLs. ARARs are evaluated in the workbook to determine if any adjustments are required

evaluation of the protectiveness of these ARARs is discussed under Adjustments to ARARs.

according to WAC 173-340-720(7)(b) and -730(5)(b). The adjustments discussed in this section pertain to individual ARARs. PCULs are not adjusted to account for multiple chemicals or multiple exposure pathways; such adjustments should be performed when developing final CULs for the feasibility study or CAP.

The derivation of the ground water PCUL for protection of potable water (GW-1) involves identifying MCLs and calculating ground water CULs per MTCA Equations 720-1 and 720-2 using the toxicity values in the CLARC database (Figure 3). If the ratio of the minimum MCL to the Equation 720-1 value does not exceed 1, then the hazard quotient associated with the MCL does not exceed 1 and the MCL constitutes the PCUL. If the ratio exceeds 1, the MCL is adjusted down to the Equation 720-1 value to achieve a hazard quotient of 1 and this constitutes the PCUL for noncancer effects.

If the ratio of the minimum MCL to the Equation 720-2 value does not exceed 10, then the cancer risk associated with the MCL does not exceed $1x10^{-5}$ and the MCL constitutes the PCUL. If the ratio exceeds 10, the MCL is adjusted down to 10 times the Equation 720-2 value to achieve a cancer risk of $1x10^{-5}$ and this constitutes the PCUL for cancer effects. The minimum of the PCULs for noncancer and cancer effects is the PCUL for potable groundwater.

If an MCL is available but no oral toxicity values are available to evaluate it (e.g., lead), the MCL is used as the PCUL. If no MCL is available but an oral toxicity value is available, the minimum of the values from Equations 720-1 and 720-2 is used as the PCUL. If a chemical has no toxicity values and no MCL, there is no PCUL for potable water.

Similarly, the derivation of the ground water PCUL for protection of surface water (GW-2) involves identifying WQC and calculating ground water CULs per MTCA Equations 730-1 and 730-2 using the toxicity values in the CLARC database (Figure 4)[4]. Similar ratios are calculated and adjustments made, if needed, as described above for MCLs. The fish consumption rate in Equations 730-1 and 730-2 is adjusted to 97.5 g/day and the fish diet fraction[5] is adjusted to 1 (Ecology 2016a), consistent with both the LDW ROD and common tribal fish consumption patterns. For all sites outside the LDW that lie within the usual and accustomated fishing area for one or more tribes, consult the tribes on the appropriate fish consumption rate.

For ease of calculation, the literature values for protection of aquatic life are included in the determination of minimum WQC, though they are not actually ARARs because they are not promulgated regulations. This placement of the literature values is unlikely to affect the final PCULs.

[4] A small number of State or Federal WQC require adjustment because of differences in toxicity values used between TCP and WQP. TCP uses the toxicity values from IRIS and EPA's regional screening levels workbook, developed for Superfund cleanup work. WQP generally uses the toxicity values from EPA's Clean Water Act Section 304(a) criteria documents for the National Recommended WQC.

[5] Proportion of the total fish diet obtained from the affected waterbody.

## Notes on Specific Parameters

### Chemical Properties

Values for chemical properties (e.g., Kow, Hcc, BCF) are obtained from Ecology's CLARC database. PCULs that are dependent on chemical properties (e.g., leaching) are not calculated for chemicals without chemical property values in CLARC.

### Dermal Absorption and Dermal Toxicity Values

MTCA specifies within the rule default values for dermal absorption (ABS) and the gastrointestinal absorption conversion factor (GI or GIABS) used to calculate dermal toxicity values. The default values may not be updated without a rule amendment. SMS specifies default values for ABS and GI in the SCUM guidance, which is typically updated every two years. Currently, the default values used by MTCA to calculate soil contact PCULs and by SMS to calculate sediment contact PCULs are not the same for many chemicals. Parameter values are provided for both MTCA and SMS, as noted in the column headings on the 'Param' page.

The MTCA parameter values for ABS and GI are not currently used because it is not necessary to evaluate the dermal pathway when using default Method B or Method C soil contact PCULs (WAC 173-340-740(3)(c)(iii)). The parameter values are provided in case an evaluation of the dermal pathway is triggered by modifying parameter values in Equations 740-1 and 740-2, or Equations 745-1 and 745-2, such that the soil contact PCULs are increased significantly. Chemical-specific parameter values were obtained from CLARC.

The SMS parameter values for ABS and GI are used currently because sediment contact PCULs automatically include the dermal pathway. Chemical-specific parameter values were obtained from SCUM Appendix K. If an SVOC, pesticide, or herbicide was not listed in Appendix K, ABS was assumed to be 0.1. If a VOC was not listed, ABS was assumed to be 0. ABS values for PFAS and TPH were assumed to be 0.1, except for fresh gasoline which was assumed to be 0. GI values for all chemicals not listed in Appendix K were assumed to be 1.

### Practical Quantitation Limits

If a final CUL needs to be adjusted to a PQL, the PQL must be approved by the site manager. Because PQLs can vary depending on the analytical method, instrumentation, and site conditions, the workbook does not provide PQLs for soil, ground water, or air. However it is necessary to have sediment PQLs to allow calculation of sediment PCULs for bioaccumulative chemicals. The process for developing sediment PCULs is explained below in Sediment PCULs.

Sediment PQLs are from the Sediment Cleanup User's Manual (SCUM) Tables 11-1 and D-1 and represent mid-range values. The values in Table 11-1 are derived by eliminating the minimum and maximum values reported in a survey of accredited laboratories and taking the median of the remaining values. Sediment PQL data are reported for additional chemicals in Table D-1, but the amount of data available was considered insufficient to derive median values so average values are reported instead. For some chemicals in Table D-1, PQL values are

available from only one or two laboratories. The average PQLs in Table D-1 are associated with a much higher level of uncertainty than the median values in Table 11-1.

### Natural Background Concentrations

Natural background concentrations are provided for soil, ground water, and sediment where available. Potentially liable parties (PLPs) may propose natural background concentrations for additional chemicals per WAC 173-340-709.

Natural soil background concentrations are based on the 90$^{th}$ percentile, the 80$^{th}$ percentile, or four times the median of the data set of natural background concentrations, depending on the shape of the distribution. In Ecology's (1994) background soil evaluation, non-detected values in the data sets were replaced with half the detection limits.

Natural sediment background concentrations for most chemicals are based on the upper 90 percent tolerance limit on the 90$^{th}$ percentile (90/90 UTL) of the background data set, as reported in Table 10-1 of SCUM. Non-detected values in the background data sets were handled using the Kaplan-Meier approach.

The natural background concentration of arsenic in groundwater (8 µg/L) is based on the 90/90 UTL of the data set for the Puget Sound region (Ecology 2022a). Natural background concentrations for Island County (13.3 µg/L) or parts of Snohomish County (13.6 µg/L) may be substituted where appropriate.

In the LDW version of the workbook, the natural sediment background values for total PCB congeners, total dioxin/furan TEQ, and arsenic are taken from the ROD to be consistent with EPA's sediment cleanup. The values in the ROD are based on the upper 95 percent confidence limit (95UCL) on the mean of the background data set.

### Washington State Water Quality Criteria for Human Health

The ground water PCUL for protection of surface water (GW-2) considers State and Federal WQC for protection of aquatic life and humans consuming fish and shellfish. The State WQC for protection of human health (Ecology 2016c) are shown in the column titled 'WA State WQC, Human Health, Consumption of Organisms'. EPA partially approved and partially disapproved of the Washington State WQC for human health. EPA's WQC for Washington State, referred to as the Washington Toxics Rule, are in the column titled 'WA Toxics Rule, Protection of Human Health, Consumption of Organisms'. The minimum ARAR for surface water considers the values in both of these columns, as well as values from the National Recommended Water Quality Criteria (NRWQC) for protection of human health and values from the State and NRWQC for protection of aquatic life.

### Water Quality Criteria for Aquatic Life

Water quality criteria for protection of aquatic life are available for many chemicals from EPA and Washington State. When aquatic life criteria are not available, the following literature

sources may be used to estimate concentrations protective of aquatic life [WAC 173-340-730(3)(b)(ii)]:

- Risk Assessment Information System (University of Tennessee 2013)
- NOAA (2008) screening quick reference tables (SQuiRT)
- Verbruggen et al. (2008)
- De Rooij et al. (2004)
- EPA's EcoTox database.

Values from these literature sources have been included for some commonly encountered chemicals (Ecology 2016a), but not for all chemicals in the PCUL workbook. The site manager will determine whether these or other literature sources should be consulted for other chemicals without aquatic life criteria.

### Sediment PCULs

In the SLU version of the workbook, sediment PCULs are developed according to Ecology's guidance for freshwater sediment in SCUM. These sediment PCULs may be used at any freshwater sediment site.

In the LDW version of the workbook, the minimum sediment CULs in the ROD are the preferred values for the sediment PCULs. For chemicals not listed in the ROD, the sediment PCULs are developed consistent with the SCUM guidance for lower tier sediment cleanup objectives (SCOs) for marine sediments (Figure 5). SMS cleanup screening levels (CSLs, also referred to as upper tier) and the RALs in the ROD are also provided. The CSLs and RALs are not used for developing PCULs but are provided for potential use when developing site-specific CULs or RELs.

The LDW ROD lists six different CULs and 13 different RALs covering four different remedial action objectives and multiple depth horizons. All of the CULs and RALs are provided in the PCUL workbook. The minimum CULs are used for developing PCULs. For some sites, the site manager may determine that the minimum CULs are not applicable. In these cases, the applicable CULs or RALs can be identified in a user-defined sediment PCUL column.

To develop PCULs for marine sites outside the LDW, multiple adjustments must be made to the LDW version of the workbook. The CULs and RALs from the ROD should be eliminated from the 'SedDet' page. Site-specific values for sediment parameters on the 'Eqtn' page should be adjusted back to default values. Additional adjustments are also needed. Please contact Priscilla Tomlinson to develop PCULs for marine sites outside the LDW.

Some of the benthic criteria for marine sediment are expressed in terms of organic carbon (OC) normalized concentrations. OC normalized criteria are not comparable to sediment CULs expressed in dry weight. Groundwater-sediment partitioning cannot be calculated using OC normalized values. For chemicals with OC normalized benthic criteria, the lowest apparent effects thresholds (LAET) values, which are expressed as dry weight, are used for calculating groundwater PCULs to protect sediment. However, when presenting the benthic criteria for these chemicals in the feasibility study and CAP, the OC normalized form should be used, as shown on the Sed and SedFW pages.

Chapter 9 of SCUM provides two methods for establishing sediment CULs for bioaccumulative chemicals. If data for sediment and aquatic tissue concentrations are available, a site-specific biota-to-sediment accumulation factor (BSAF) can be determined. This method requires a large level of effort. In many cases, the sediment CUL calculated using a site-specific BSAF is below the natural background concentration or the PQL. Thus, a simpler approach is to set the sediment CUL to the maximum of natural background and the PQL. The PCUL workbook is designed on a generic basis, so the simplified background/PQL approach is used. If site-specific BSAFs are developed, site-specific sediment PCULs can be hand-entered in the columns for upper and lower tier risk-based concentrations for bioaccumulatives on the 'Sed' or 'SedFW' page.

For the SLU version of the workbook, a chemical is considered bioaccumulative if it occurs on either of the following lists of bioaccumulative chemicals:

- Persistent bioaccumulative toxins (WAC 173-333-310) (43 analytes)
- Primary (List 1) and candidate (List 2) bioaccumulative contaminants of concern (DMMP 2018) (24 analytes).

Due to overlap between the two lists, a total of 59 analytes are identified as bioaccumulative chemicals.

In the LDW version of the workbook, a chemical is considered bioaccumulative if it occurs on either of the two lists of bioaccumulative chemicals shown above ***and*** there is evidence that the chemical is present in LDW seafood at concentrations of potential concern. Chemicals present in LDW seafood at levels of potential concern are identified from the following two lists:

- Chemicals of concern (COCs) for human consumption of seafood from the LDW (LDWG 2010, Table B.7-1) (18 analytes)
- COCs for higher trophic level receptors in the LDW (LDWG 2010, Table A.8-1) (5 analytes).

Due to overlap between the two lists, a total of 21 analytes are identified as present in LDW seafood at levels of potential concern.

The following analytes are identified as bioaccumulative in the LDW version of the workbook because they fit both criteria (bioaccumulative chemicals ***and*** present in LDW tissues at levels of potential concern):

- Total PCB Aroclors, total PCB congeners, and total PCB TEQ
- 2,3,7,8-TCDD and total dioxin/furan TEQ
- Arsenic and mercury
- Tributyltin
- Carcinogenic PAH TEQ
- Hexachlorobenzene and pentachlorophenol
- Aldrin, all forms of chlordane, total DDTs, 4,4'-DDT, dieldrin, heptachlor, and heptachlor epoxide.

The list of bioaccumulative chemicals in the SLU version of the workbook is longer.

The SCO (lower tier) concentration for a bioaccumulative chemical is set to the higher of natural background and the PQL. The CSL (upper tier) concentration for a bioaccumulative chemical is set to the higher of regional background and the PQL. If neither a background concentration nor a numerical PQL value is available, the sediment PCUL is indicated as the text entry "PQL".

When the sediment PCUL for a chemical is listed as the text entry "PQL" rather than a numerical value, it is not possible for the workbook to calculate numerical ground water or soil PCULs for protection of sediment. In these cases, the ground water and soil PCULs are listed as "TBD" (to be determined). Until a numerical sediment PQL is entered, the workbook will ignore non-numerical entries when identifying the most stringent soil and ground water PCULs. If a numerical sediment PQL is entered in the 'PQL' column on the 'Sed' or 'SedFW' page, all of the downstream calculations will self-populate throughout the workbook.

### *Additional Details for Identification of Bioaccumulative Chemicals in LDW*

LDWG (2010) eliminated some of the chemicals identified as COCs in their human health and ecological risk assessments from the final list of indicator chemicals based on considerations of frequency of detection, frequency of exceedance, analytical interference, and contribution to overall risk. For the reasons discussed below, Ecology assumed that all of the chemicals on LDWG's lists of COCs are potentially present in LDW seafood.

Although bis(2-ethylhexyl)phthalate (BEHP) and pentachlorophenol are listed as COCs for human consumption of seafood in RI Table B.7-1, LDWG eliminated them from the list of indicator chemicals (i.e., risk drivers) for human health because of small contribution to overall risk and low frequency of detection. LDWG eliminated tributyltin and vanadium as indicator chemicals because the associated hazard quotients are only slightly above 1 for only one seafood consumption scenario. LDWG eliminated eleven organochlorine pesticides for three reasons: low contribution to overall risk; analytical interference due to high PCB concentrations in the samples that likely biased the pesticide results high; and, in some cases, low frequency of detection. Each of these issues could manifest differently on the small scale of individual upland cleanup sites, so Ecology did not eliminate any of these chemicals from consideration as being potentially present in LDW seafood. However, BEHP, vanadium, and three of the pesticides are not present on the lists of bioaccumulative chemicals and so are not treated as bioaccumulative for that reason.

The higher trophic level species evaluated in LDWG's ecological risk assessment included crabs, great blue herons, ospreys, river otters, and harbor seals. Chemical exposures for these receptors are dominated by their seafood diets. Total PCB exposures to crabs and otters exceeded their lowest observed adverse effect levels (LOAELs) and LDWG retained total PCBs as an indicator chemical for ecological receptors. PCB TEQ, arsenic, mercury, and zinc exposures exceeded the no observed adverse effect levels for crabs, otters, or osprey. LDWG eliminated these chemicals as risk drivers because exposures did not exceed the LOAELs. However, chemical concentrations associated with individual upland cleanup sites may be different from the river-wide exposure concentrations considered in LDWG's ecological risk assessment. Ecology considered all of the listed chemicals to be potentially present in LDW seafood. All of these chemicals are also considered bioaccumulative and so they are treated as bioaccumulative for the purpose of deriving sediment PCULs.

## Soil PCULs to Protect Ground Water

MTCA Equation 747-1, shown below, is used to calculate soil PCULs protective of ground water via the leaching pathway (SL-2 through SL-7, Figure 6) on the 'Leach' and 'LeachFW' pages of the workbook. All parameter values are default values provided in MTCA.

$$C_{soil} = C_{gw}\ x\ UCF\ x\ DF\ \left[K_d + \frac{\theta_w + \theta_a\ x\ H_{cc}}{\rho_b}\right]$$

Where:

$C_{soil}$ = Soil PCUL for protection of ground water (mg/kg) (chemical-specific)
$C_{gw}$ = Ground water PCUL (µg/L) (chemical-specific)
UCF = Unit conversion factor (1 mg/1,000 µg)
DF = Dilution factor (unitless) (20 for vadose zone, 1 for saturated zone)
$K_d$ = Soil-water distribution coefficient (L/kg) (chemical-specific) ($K_d$ for organic chemicals is calculated per MTCA Equation 747-2 below)
$\theta_w$ = Water-filled porosity (0.3 ml/ml for vadose zone, 0.43 ml/ml for saturated zone)
$\theta_a$ = Air-filled porosity (0.13 ml/ml for vadose zone, 0 ml/ml for saturated zone)
$H_{cc}$ = Henry's law constant (unitless) (chemical-specific)
$\rho_b$ = Dry soil bulk density (1.5 kg/L).

MTCA Equation 747-2, shown below, is used to calculate Kd for organic chemicals:

$$K_d = K_{oc} \times f_{oc}$$

Where:

$K_d$ = Soil-water distribution coefficient (L/kg) (chemical-specific)
$K_{oc}$ = Soil organic carbon-water partitioning coefficient (ml/g) (chemical-specific)
$f_{oc}$ = Soil fraction of organic carbon (0.001 g/g).

Site-specific values may be used for $f_{oc}$, $\theta_w$, $\theta_a$, and $\rho_b$ if approved by the site manager.

Soil PCULs for protection of ground water are calculated separately for the vadose and the saturated zones because of different default assumptions for DF, $\theta_w$, and $\theta_a$. Because ground water is shallow near the LDW, and because sea level rise could make it shallower, the use of soil PCULs for the vadose zone must be approved by the site manager.

When no Henry's law constant (Hcc) is available for a chemical, it is assigned a value of 0 to allow the calculation to proceed. Chemical loss due to volatilization is not a major driver in the three-phase partitioning model.

## Ground Water PCULs to Protect Sediment

The following modified version of the MTCA three-phase model is used to calculate ground water PCULs protective of sediment on the 'Partit' and 'PartitFW' pages of the workbook. The equation below is based on an Ecology (2016a) memorandum, but the sediment PCULs have

been updated to LAET values (see Sediment PCULs above). The ground water PCULs for protection of sediment supersede the CULs published in the 2016 memorandum. Parameter values are default values provided in MTCA unless noted otherwise.

$$C_{gw} = \frac{C_{sed}}{UCF\ x\ DF\ \left[K_d + \frac{\theta_w}{\rho_b}\right]}$$

Where:

$C_{gw}$ = Ground water PCUL for protection of sediment (µg/L) (chemical-specific)
$C_{sed}$ = Sediment PCUL (mg/kg) (chemical-specific)
UCF = Unit conversion factor (1 mg/1,000 µg)
DF = Dilution factor (unitless) (1 for saturated sediment)
$K_d$ = Soil-water distribution coefficient (L/kg) (chemical-specific) ($K_d$ for organic chemicals is calculated per MTCA Equation 747-2 above)
$\theta_w$ = Water-filled porosity (0.615 ml/ml for LDW [LDWG 2010], 0.43 ml/ml for other sites)
$\rho_b$ = Dry sediment bulk density (1.02 kg/L for LDW [Ecology 2016a)], 1.5 kg/L for other sites)

For the LDW version of the workbook, a value of 0.019 g/g is used for $f_{oc}$ in Equation 747-2, based on the remedial investigation (RI) report (LDWG 2010). For the SLU version of the workbook, the default value of 0.001 g/g is used. Site-specific values may be used for $f_{oc}$, $\theta_w$, and $\rho_b$ if approved by the site manager.

When developing CULs for the FS or CAP, if some of the sediment CULs are expressed as OC normalized (see Sediment PCULs above), the Kd value in the equation above should be replaced by Koc and the term $\theta_w/\rho_b$ should be eliminated. The elimination of this term will have negligible impact on the result.

It should be noted that the three-phase model is a simple mass-balance equation calculated independently for each contaminant in soil. It was developed for soil subsurface conditions and uses mass-balance between soil grains, air pore-space, and associated aqueous phases. The mass balance among the three phases is based on two chemical factors: Kd and Henry's Law constant. In the sediment environment, sediment and water physicochemical conditions (e.g. salinity, pH, hardness, dissolved oxygen, alkalinity, and multiple solutes) and dynamic physical conditions (e.g. currents; waves; temperature changes; and light intensity) are significantly different from, and more complex than, soil conditions. Hence, the model results for the transition zone between ground water and surface water do not fully account for the complexity of this environment.

These differing physicochemical sediment/water conditions have diverse impacts upon various chemical classes and their ionic forms and partial charges, which in turn, impact bioavailability and toxicity. For example, metals are often significantly affected by the physicochemical properties (e.g., pH, alkalinity, salinity) of the water. Marine or estuarine water can significantly impact pH due to its high buffering capacity. High sulfide conditions within the marine environment can also significantly affect formations of metal–sulfide complexes. Changes in pH

in the near shoreline transition zone between fresh ground water and saline marine water can regulate dissolution of the metal solids in upland soil leachate.

Nonpolar organics, on the other hand, are less affected by these conditions because their nonpolar properties restrict the chemical response to water conditions. However, light-intensity has a greater impact on non-polar organics due to their photoactivation properties and this significantly affects reactivity and toxicity.

With approval from the site manager, other models developed specifically for sediment and water may be used on a site-specific basis with site-specific modifications, such as the Reible Two-Layer Sediment Cap and Steady State Analytical[6]. The Two-Layer model was developed to predict sediment cap effectiveness and is a two-layer steady state model that predicts concentrations and fluxes in a chemical isolation layer or in the near surface biologically active zone (bioturbation layer).

The Steady State model uses input parameters that incorporate a significant number of variables that may be important in improving overall model accuracy in predicting effectiveness. Some of these variables include depositional velocity, conventional and active cap decay rates, and carbon fractions within conventional and active cap layers. The model determines concentrations and fluxes in a two-layer sediment cap at steady-state, using various sediment, water and chemical factors assuming advection, diffusion, dispersion, deposition/erosion, sorption onto colloidal organic matter, and boundary layer mass transfer. This is normally used to estimate migration through an active layer (lower layer) and a conventional cap layer (upper layer). Unlike the Two-Layer model, however, the Steady State model does not consider a bioturbation layer.

The Two-Layer Sediment Cap and the Steady State Analytical models cannot be used for the PCULs because they require site-specific data. The modified version of the MTCA three-phase model was used instead because it can be run on a general, default scenario. However, the modified three-phase model is likely to be conservative when applied to ground water-sediment partitioning. It will overestimate contaminant adsorption to sediments and thus provide a ground water PCUL that is lower (more protective) than necessary.

Soil PCULs to protect sediment are derived by using two modeling steps in tandem. First the ground water PCUL to protect sediment (GW-3) is calculated using the modified version of Equation 747-1. Then soil PCULs (SL-4 and SL-7) are calculated using the standard version of Equation 747-1. The use of two models in tandem introduces a higher level of uncertainty than the use of either model alone.

The soil and ground water PCULs for protection of sediment are useful for screening purposes, but professional judgement should be used when setting final CULs to protect sediment. For example, if bulk sediment concentrations do not exceed their sediment PCULs, the site manager may consider the ground water to be protective of sediment regardless of the predictions of the partitioning model (i.e., empirical demonstration). Sediment bioassays and alternative partitioning models, such as those discussed above, can provide additional lines of evidence. The use of bioassays or alternative models must be approved by the site manager. The complete weight of evidence, including the empirical relationships between soil, ground water, and

[6] Available at: https://www.depts.ttu.edu/ceweb/groups/reiblesgroup/downloads.html.

sediment concentrations, should be considered when developing final soil and ground water CULs for protection of sediment.

### PCULs for Industrial/Commercial Land Use

Method C PCULs for soil and air at industrial sites are provided on detail pages in the workbook. These include soil PCULs for worker contact, site-specific and simplified TEE soil concentrations for industrial/commercial sites, air PCULs for industrial sites, and soil gas and ground water screening levels for protection of indoor air at industrial sites. These PCULs are not intended to be used for initial screening of soil and ground water data. They are provided for potential use when developing site-specific soil CULs or RELs at sites that qualify for commercial or industrial land use per WAC 173-340-706(1), -745(1), -745(2), and -7490(3)(c) as determined by the site manager. Note that soil CULs for many chemicals are likely to be based on the leaching pathway, which is not affected by the designation of a site as industrial.

Method C PCULs for drinking water and protection of surface water are not included in the workbook because industrial land use does not qualify a site for Method C in these media (Ecology 2016a). The criteria that must be met to use Method C for groundwater or surface water (WAC 173-340-706(1)(a)) are rarely met.

Air, soil gas, and groundwater PCULs are provided for vapor intrusion at commercial sites. These PCULs are calculated consistent with Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*. They may not be used as CULs but they may be used as RELs that are protective of workers during the time it takes for the cleanup to achieve the CULs.

### Screening Levels for Terrestrial Ecological Evaluation

The TEE screening levels provided for initial screening of soil data are the minima of the values for protection of plants, soil biota, and wildlife in the site-specific TEE under unrestricted land use. Screening levels for site-specific TEEs under industrial/commercial land use and screening levels for simplified TEEs (unrestricted or industrial/commercial land use) are provided on the soil detail page for developing site-specific soil CULs or RELs. The site manager will determine if a site qualifies for the simplified TEE.

Note that if a site undergoes a site-specific TEE, PCULs for the TEE are needed for all detected chemicals, not just the chemicals listed in MTCA Table 749-3. On the other hand, if a site undergoes a simplified TEE, only the chemicals listed in MTCA Table 749-2 need to be evaluated in the TEE.

If the site manager determines that a site qualifies for exclusion from the TEE, SL-9 may be eliminated from consideration.

### Short-Term Action Levels for Trichloroethene (TCE)

Short-term inhalation of TCE in indoor air may cause serious heart defects in a developing fetus. The damage can occur early in pregnancy, possibly before the pregnancy is recognized. Vapor assessments must be conducted quickly at sites with TCE to protect women of childbearing age.

For additional information on this issue, refer to Appendix A of Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*.

Short-term action levels for air are provided in the PCUL workbook for both unrestricted land use and commercial/industrial land use. If air concentrations exceed the action levels, rapid response is necessary to collect additional data and possibly mitigate exposures. Short-term screening levels for soil gas and groundwater are also provided. If soil gas or groundwater concentrations exceed the screening levels, additional data should be collected quickly to verify whether the exposure pathway is complete.

The short-term action levels and screening levels are higher than the chronic air CULs and soil gas and groundwater screening levels. They are used to ensure that women of childbearing age are not overexposed during the time it takes for the final remedy to be implemented. The short-term action levels and screening levels may not be used as CULs but they might be used as RELs at some sites. The site manager will determine the appropriate CULs and RELs for TCE.

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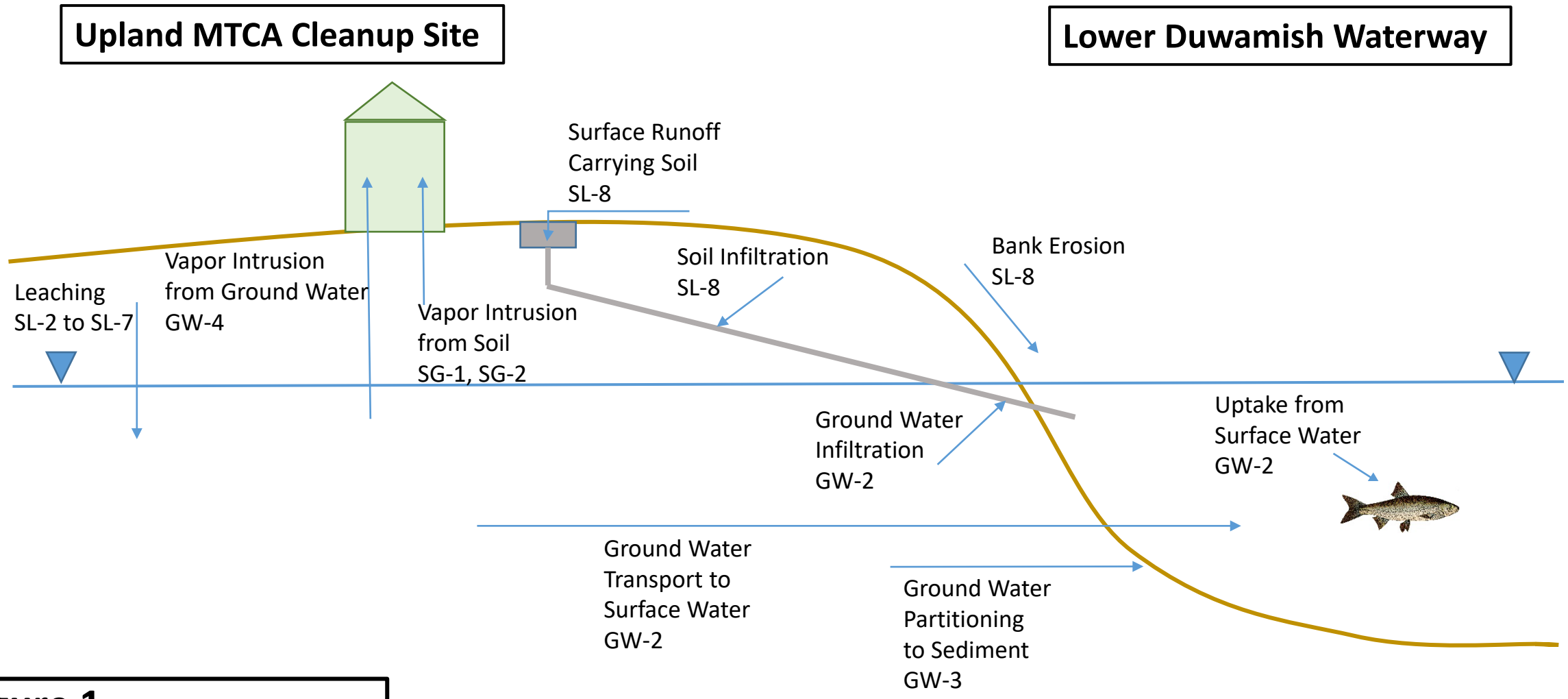


**Figure 1.**
**Transport Pathways**

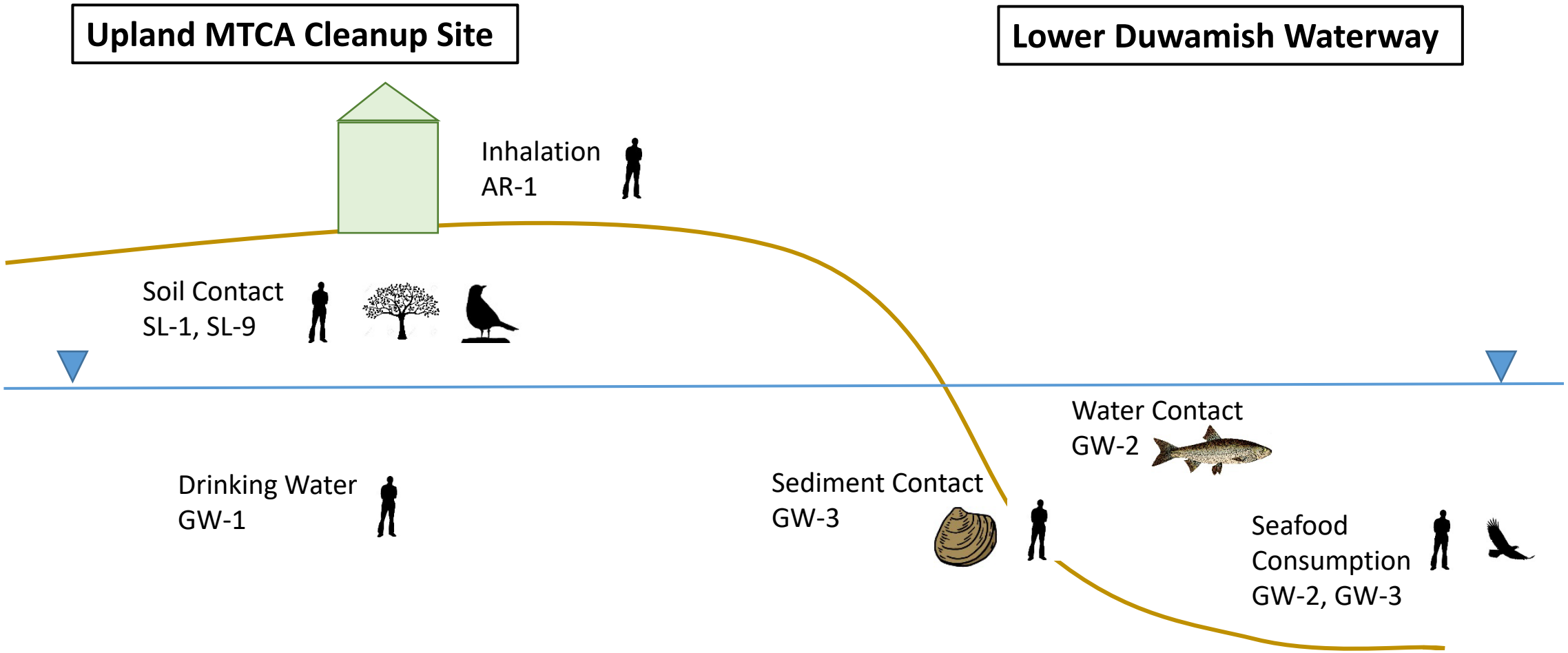


**Figure 2.**
**Exposure Pathways**

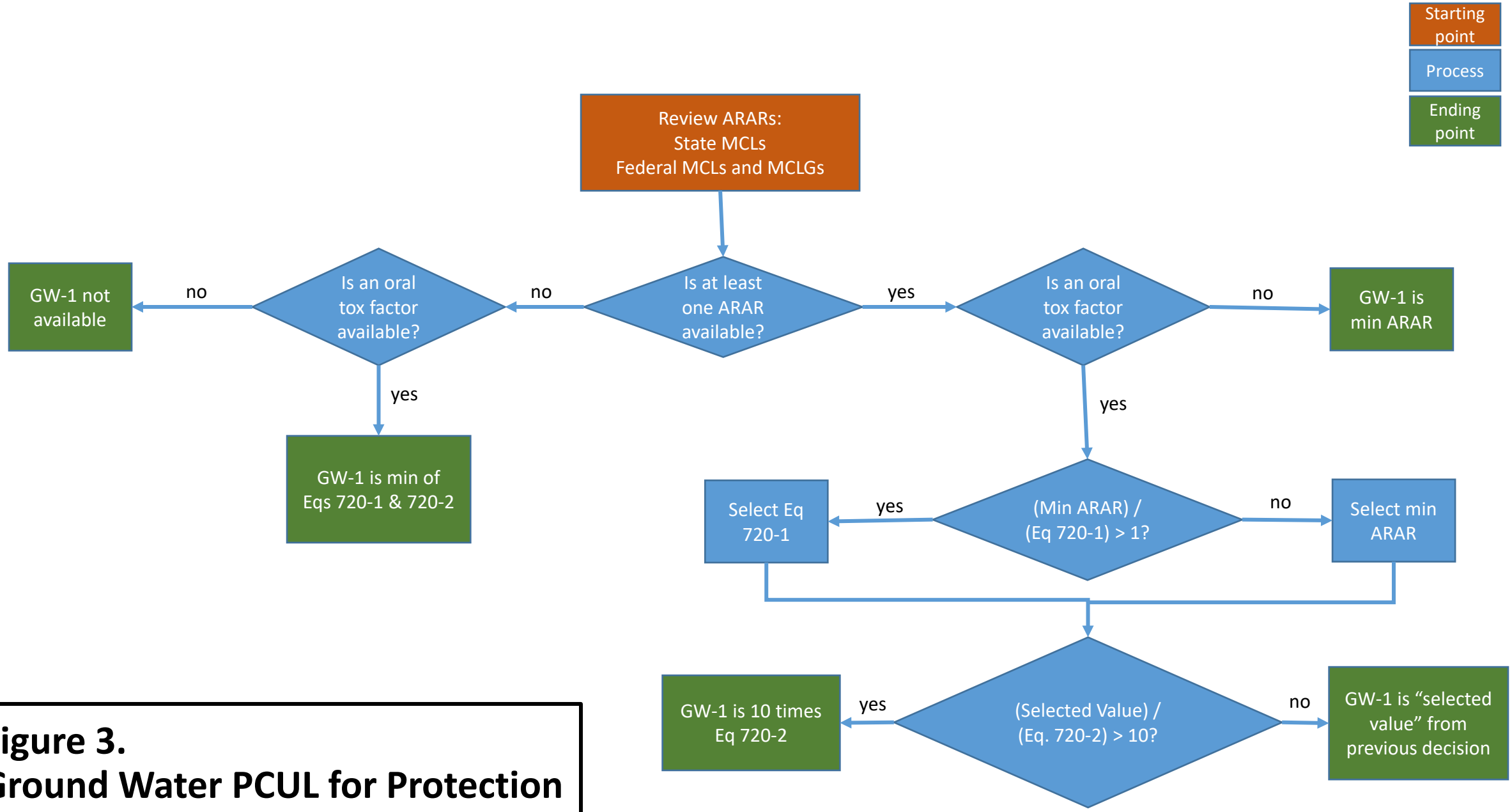


**Figure 3.**
**Ground Water PCUL for Protection of Drinking Water**

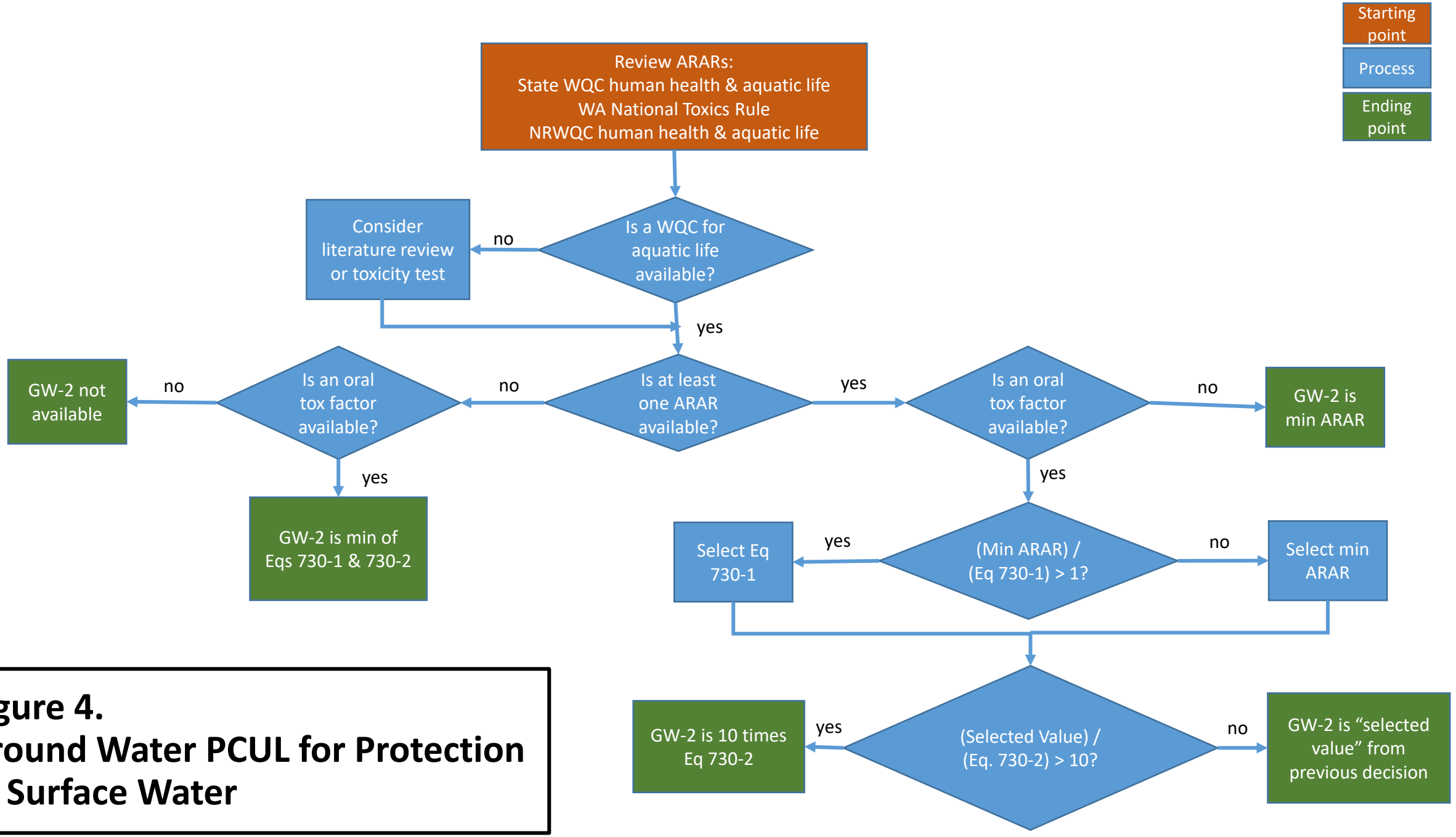


**Figure 4.**
**Ground Water PCUL for Protection of Surface Water**

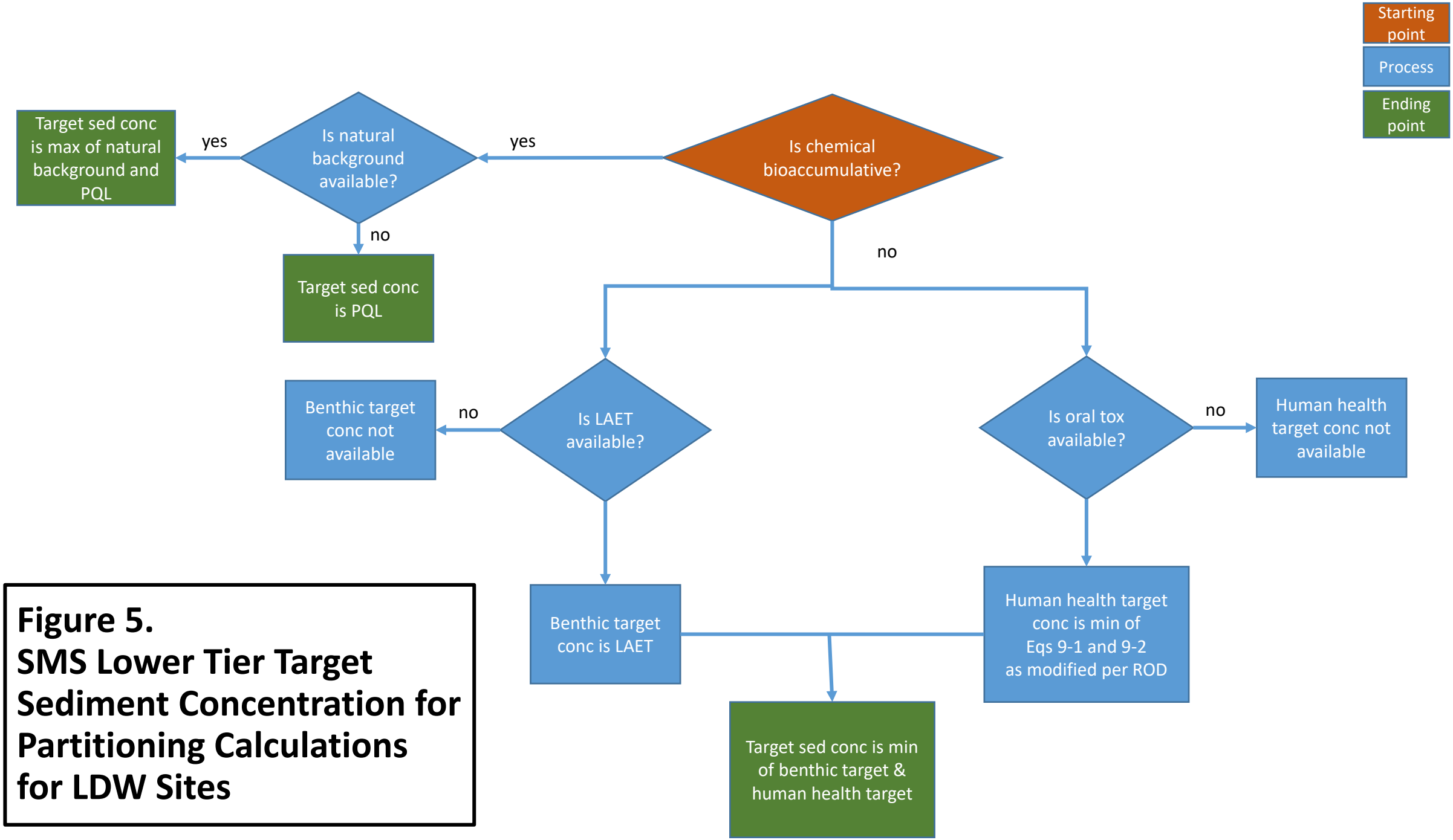


**Figure 5.**
**SMS Lower Tier Target Sediment Concentration for Partitioning Calculations for LDW Sites**

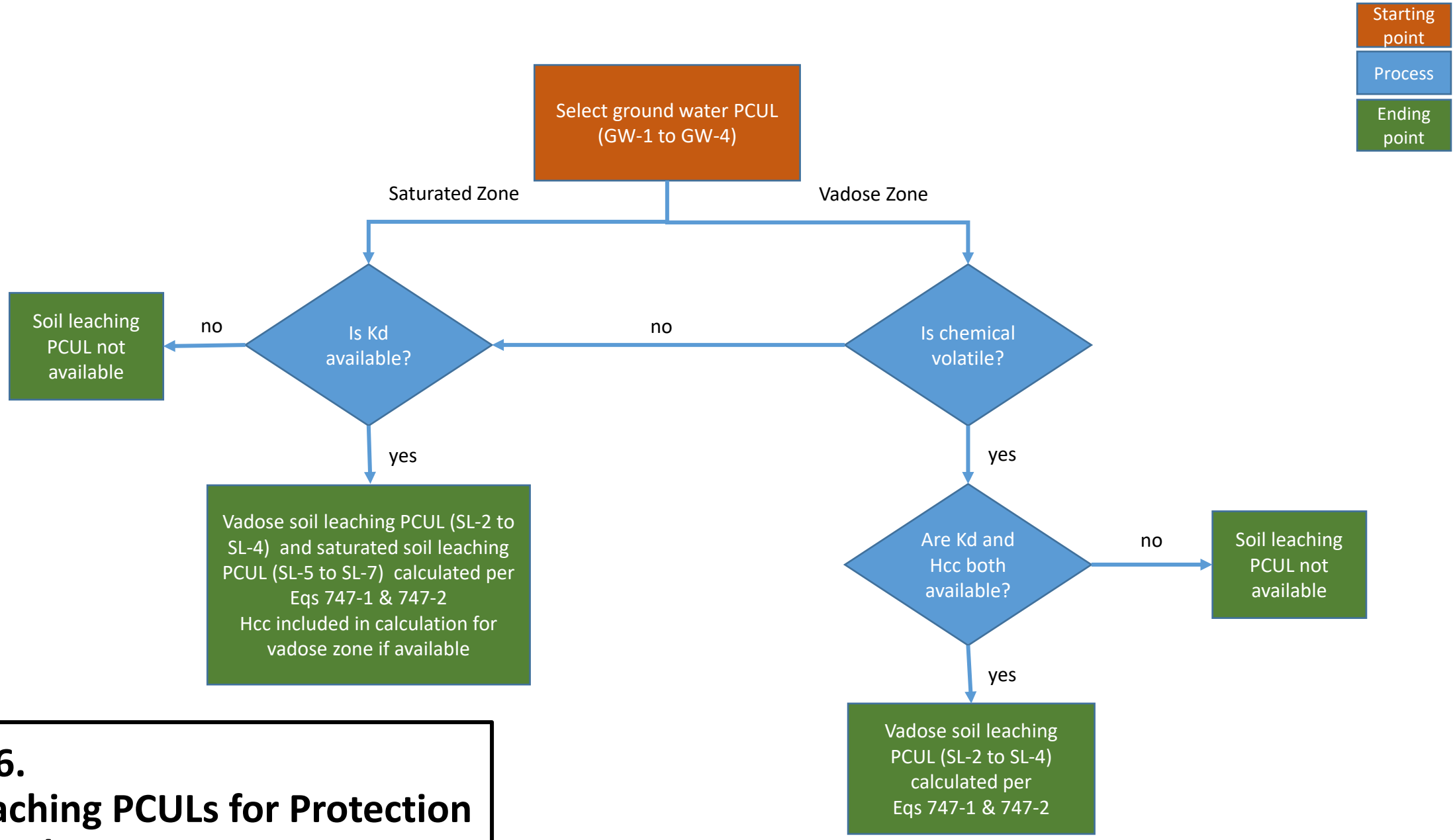


**Figure 6.**
**Soil Leaching PCULs for Protection of Ground Water**

## Table 1. Notes on Individual Analytes

| Analyte | Notes |
|---|---|
| Mutagenic carcinogens:<br>Hexavalent chromium<br>Benzo(a)pyrene<br>Total cPAH TEQ<br>Benzidine<br>n-Nitrosodimethyl-amine<br>1,2-Dibromo-3-chloropropane<br>Ethylene oxide<br>Methylene chloride<br>Trichloroethene<br>1,2,3-Trichloropropane | The Method B carcinogen equation values for soil, ground water, and air were hand-entered from CLARC to account for exposures to mutagens during early life stages when children are more susceptible to cancer. In both the LDW and the SLU versions of the workbook, the Method B carcinogen equation value in CLARC for surface water was adjusted to account for the LDW site-specific fish consumption rate of 97.5 g/day with a fish diet fraction of 1, as opposed to the default MTCA rate of 54 g/day with a fish diet fraction of 0.5. The consumption rate of 97.5 g/day is commonly used at MTCA sites, but the tribes with usual and accustomed fishing areas overlapping the site should be consulted on the appropriate fish consumption rate. Sediment contact PCULs for mutagens are calculated on the pages titled 'SedMMA' or 'SedMMA-FW'. |
| PCBs | The site manager will determine whether site samples should be analyzed for PCB Aroclors, congeners, or both in accordance with Implementation Memos 12 and 13 (Ecology 2015a, 2016d). |
| Total PCB Aroclors | Represents the sum of detected PCB Aroclors. This is the best parameter for comparison with benthic criteria. |
| Total PCB congeners | Represents the sum of detected congeners not modified using TEFs. This is the appropriate parameter for comparison with the CUL for human consumption of seafood, which is based on natural background. Total congeners may be substituted for total Aroclors for comparison with benthic criteria, if it is necessary to reduce the number of parameters analyzed, though it is not ideal. |
| Total PCB TEQ | Represents the sum of the 12 dioxin-like PCB congeners, each adjusted using its TEF in MTCA Table 708-4. PCULs are derived using the toxicity values for 2,3,7,8-TCDD. When calculating TEQ, treat nondetected values as instructed in Ecology's Implementation Memo 11. This is the appropriate parameter for comparison with CULs for human health contact with sediment. If dioxins and furans are also COCs, the PCB TEQ should be added to the dioxin/furan TEQ and compared against the PCUL for 2,3,7,8-TCDD.<br>Ecology (2015b) |
| Dioxins and furans | To determine compliance for surface water human health, two standards must be met:<br>• Under the NRWQC, the water quality criterion for 2,3,7,8-TCDD must be met.<br>• Under MTCA, the total dioxin/furan TEQ must meet the CUL for 2,3,7,8-TCDD. The calculation of total dioxin/furan TEQ is explained below.<br>WAC 173-340-708(8)(d) |

| Analyte | Notes |
|---|---|
| Total dioxin/furan TEQ | Represents the sum of the 17 carcinogenic congeners, each adjusted using its TEF in MTCA Table 708-1. PCULs are derived using the toxicity values and ARARs for 2,3,7,8-TCDD. When calculating TEQ, treat nondetected values as instructed in Ecology's Implementation Memo 11.<br>Ecology (2015c) |
| Arsenic | The toxicity values are for inorganic arsenic. The TEE screening levels are the minimum for arsenic III and arsenic V. If site-specific data are available to determine the form of arsenic, the TEE screening levels specific to that form should be used.<br><br>Because the ground water PCULs for protection of drinking water and surface water are below natural background (8 μg/L), a leaching PCUL based on natural background is calculated in the User-Defined Groundwater PCUL column on the 'Leach' or 'LeachFW' page. This value is carried into the leaching columns for protection of drinking water and surface water on the SL page. |
| Cadmium | Has two separate RfDs for water and soil/food matrices due to differences in absorption. The RfD listed on the 'Param' sheet is for cadmium in soil; this RfD is used for MTCA Equations 730-1 (ingestion of fish) and 740-1 and 745-1 (incidental ingestion of soil). The RfD for cadmium in water is hand-entered into the MTCA Equation 720-1 calculation. |
| Chromium | Separate lines are provided for total, trivalent, and hexavalent chromium. If site history suggests that hexavalent chromium could be present, at least some samples of soil, groundwater, and sediment should be speciated. If hexavalent chromium is not suspected of being present, use the values on the total chromium and trivalent chromium lines for screening. |
| Lead | The values listed for MTCA Equations 720-1, 740-1, and 745-1 are from the Method A tables because lead has neither an RfD nor a CPF. |
| Manganese | EPA's oral RfD of 0.14 mg/kg-day is divided by 3 (modified RfD of 0.0467 mg/kg-day) for non-food exposures. |
| Mercury | The RfD is for mercuric chloride. If a different form of mercury is present, the site manager may approve a different toxicity value. |
| Nickel | The RfD is for nickel soluble salts. If a different form of nickel is present, the site manager may approve a different toxicity value. |
| Thallium | The RfD is for thallium soluble salts. If a different form of thallium is present, the site manager may approve a different toxicity value. |
| Tributyltin | The RfD is for tributyltin oxide. If a different form of tributyltin is present, the site manager may approve a different toxicity value. |
| cPAHs | Method B cancer equation values for all media account for mutagenicity as discussed in the first row of this table. Method C |

| Analyte | Notes |
|---|---|
| | cancer equation values for soil and air do not account for mutagenicity because they apply to adult worker exposures.<br><br>The cPAH TEQ concentrations must meet the Method B or C CULs calculated for benzo(a)pyrene. Calculating TEQ is discussed in the row below. The Method B and Method C noncancer equation values for benzo(a)pyrene apply only to benzo(a)pyrene, not to cPAH TEQ or any of the individual cPAHs.<br><br>To determine compliance for drinking water, two standards must be met:<br>• Under the SDWA and State MCLs, the MCL for benzo(a)pyrene must be met<br>• Under MTCA, the total cPAH TEQ must meet the CUL for benzo(a)pyrene.<br><br>To determine compliance for surface water, two standards must be met:<br>• Under the NRWQC, the WTR, and the State water quality rule, the water quality criteria for each individual cPAH must be met.<br>• Under MTCA, the total cPAH TEQ must meet the CUL calculated for benzo(a)pyrene.<br><br>To determine compliance for sediment, two standards must be met:<br>• The benthic criterion for each individual cPAH must be met.<br>• The total cPAH TEQ must meet the PCULs calculated for benzo(a)pyrene based on direct contact and seafood consumption.<br><br>Despite the fact that we have surface water and sediment PCULs for individual cPAHs, leaching PCULs to protect these media are calculated only for cPAH TEQ consistent with direction from the Policy Unit.<br>WAC 173-340-708(8)(e) |
| Total cPAH TEQ | Represents the sum of the 7 carcinogenic PAH compounds, each adjusted using its TEF in MTCA Table 708-2. If the PCUL is based on the leaching pathway (e.g., Method C soil), the TEQ calculation must also include relative mobility factors, as discussed in Implementation Memo 10. Treat nondetected values as instructed in Implementation Memo 10.<br>Ecology (2016d) |
| VOCs | Sediment PCULs are provided for VOCs. For the LDW site, however, VOCs were not detected in sediments and will not |

| Analyte | Notes |
|---|---|
| | normally need PCULs. |
| Bromoform, chloroform, dibromochloromethane, dichlorobromomethane | The MCLs listed on 'PW" are 80 µg/L for each of these chemicals, but 80 µg/L is the MCL for the total of these chemicals. |
| cis- and trans-1,3-Dichloropropene | The WQC values shown on the 'SW' sheet are for 1,3-dichloropropene. |
| Xylenes | Refers to the sum of all isomers (ortho, meta, and para). |
| Vinyl chloride | Cancer equation values for soil contact and air inhalation at industrial sites are calculated using conservative CPFs that consider early life exposure to mutagens because pregnant women could be present. Although vinyl chloride is mutagenic, the specialized calculations used for other mutagens are not needed because the CPF has been adjusted to account for mutagenicity. |
| Per- and polyfluoroalkyl substances (PFAS) | On the 'PW' page, the values listed under 'WA State MCLs' are state action levels (SALs) rather than MCLs or MCLGs. SALs must be evaluated on a site-specific basis per WAC 173-340-710(4) to determine if they are relevant and appropriate for the conditions at the site. Ecology expects that in most cases where groundwater qualifies as potable, the SALs will be determined to be relevant and appropriate. |
| Petroleum hydrocarbons | The value listed for Method B soil contact for gasoline range hydrocarbons is from Ecology's (2017) *Model Remedies for Sites with Petroleum Contaminated Soils*. The value listed for Method C soil contact is the Method B value adjusted for an industrial exposure scenario per advice from Policy. The values listed for MTCA Equation 747-1 are from the Method A soil table. The values listed for MTCA Equation 720-1 are from the Method A ground water table. The value listed for MTCA Equation 750-1 is from Appendix E of Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*. Refer to the guidance for the proper use of this value. The TEE values for protection of plants and soil biota for gasoline and diesel range hydrocarbons are from Ecology's (2017) *Implementation Memo 19*. The literature values for protection of aquatic life are from Ecology's (2021) *Implementation Memo 23*.<br><br>Site-specific Method B or C CULs can be calculated by analyzing soil or groundwater samples for volatile petroleum hydrocarbons and extractable petroleum hydrocarbons and using the MTCATPH spreadsheet. |
| Gasoline range hydrocarbons | Separate rows are provided for fresh and weathered gas. You may use the row for weathered gas if no benzene is present. If benzene is present, you should generally use the row for fresh gas. The site manager will determine which row is appropriate. |

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| Diesel and oil range hydrocarbons | Separate rows are provided for various combinations of heavy hydrocarbons. If only DRO was analyzed, use the row for diesel range hydrocarbons. If only ORO was analyzed, use the row for oil range hydrocarbons. If both DRO and ORO were analyzed, sum the results and compare the sum to the row for total diesel & oil range hydrocarbons. For additional detail, refer to Implementation Memo 4. |
| Jet fuel | Use the PCULs for DRO. |
| alpha-BHC, beta-BHC, delta-BHC, and lindane (gamma-BHC) | The TEE screening levels are from benzene hexachloride. |
| cis- and trans-Chlordane | The chemical characteristics, toxicity data, and TEE screening levels are from chlordane. |
| DDD, DDE, and DDT | Total DDD, total DDE, and total DDT each includes the 2,4' and 4,4' forms. TEE PCULs are shown individually for DDD, DDE, and DDT but should be applied to the total of DDD, DDE, and DDT. |
| Endosulfan I, Endosultan II | The RfDs are for endosulfan. |
| Heptachlor, heptachlor epoxide | The TEE screening levels shown for the individual analytes should be applied to the total of the two analytes. |

Additional notes on individual analytes related to specific parameters are noted in the column-by-column notes in Table 2 and in comments inserted into individual cells within the workbook.

## Table 2. Column by Column Notes

| Column | Title | Notes |
|---|---|---|
| | | ***'Mod' Sheet*** |
| A | Date | Date of modification. |
| B | Sheet | Sheet(s) modified. |
| C | Chemical/Parameter Modified | Chemicals or parameters affected by modification. |
| D | Modification | Description of modification. |
| E | Consequences | Changes that occurred as a result of the modifications, particularly changes to most stringent PCUL values. |
| | | ***'SL' and 'SL-FW' Sheets*** |
| C | Most Stringent Soil PCUL, Vadose Zone, Potable GW | Most stringent soil PCUL for the vadose (unsaturated) zone above potable ground water, which includes the following endpoints:<br>• SL-1: Direct human contact with soil<br>• SL-2: Leaching from vadose zone to protect drinking water<br>• SL-3: Leaching from vadose zone to protect surface water via ground water<br>• SL-4: Leaching from vadose zone to protect sediment via ground water<br>• SL-8: Protection of sediment via bank erosion<br>• SL-9: Site-specific TEE for unrestricted land use.<br>If the minimum PCUL is below the natural background concentration (SL-10), it is adjusted up to the natural background concentration. |
| D | Most Stringent Soil PCUL, Saturated Zone, Potable GW | Most stringent soil PCUL for the saturated zone in potable ground water, which includes the following endpoints:<br>• SL-1: Direct human contact with soil<br>• SL-2: Leaching from saturated zone to protect drinking water<br>• SL-3: Leaching from saturated zone to protect surface water via ground water<br>• SL-4: Leaching from saturated zone to protect sediment via ground water<br>• SL-8: Protection of sediment via bank erosion<br>• SL-9: Site-specific TEE for unrestricted land use.<br>If the minimum PCUL is below the natural background concentration (SL-10), it is |

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| | | adjusted up to the natural background concentration. |
| E | Most Stringent Soil PCUL, Vadose Zone, Nonpotable GW | Most stringent soil PCUL for the vadose (unsaturated) zone above nonpotable ground water, which includes the following endpoints:<br>• SL-1: Direct human contact with soil<br>• SL-3: Leaching from vadose zone to protect surface water via ground water<br>• SL-4: Leaching from vadose zone to protect sediment via ground water<br>• SL-8: Protection of sediment via bank erosion<br>• SL-9: Site-specific TEE for unrestricted land use.<br>If the minimum PCUL is below the natural background concentration (SL-10), it is adjusted up to the natural background concentration. |
| F | Most Stringent Soil PCUL, Saturated Zone, Nonpotable GW | Most stringent soil PCUL for the saturated zone in nonpotable ground water, which includes the following endpoints:<br>• SL-1: Direct human contact with soil<br>• SL-3: Leaching from saturated zone to protect surface water via ground water<br>• SL-4: Leaching from saturated zone to protect sediment via ground water<br>• SL-8: Protection of sediment via bank erosion<br>• SL-9: Site-specific TEE for unrestricted land use.<br>If the minimum PCUL is below the natural background concentration (SL-10), it is adjusted up to the natural background concentration. |
| G | User-Defined PCUL | The user may define a site-specific PCUL by specifying the desired SL numbers. List the SL numbers included in the column heading. |
| H | SL-1, Direct Contact | PCUL for direct human contact with soil. From 'SL-Detail' sheet.<br>WAC 173-340-740(3)(b)(iii)(B) |
| I | SL-2, Protect Drinking Water, Vadose Zone | Leaching PCUL for vadose zone soil to protect drinking water. From '747-1' sheet.<br>WAC 173-340-740(3)(b)(iii)(A), -747(4) |
| J | SL-3, Protect Surface Water via Ground Water, Vadose Zone | Leaching PCUL for vadose zone soil to protect surface water via ground water. From '747-1' sheet.<br>WAC 173-340-740(3)(b)(iii)(A), -747(4) |
| K | SL-4, Protect Sediment via Ground Water, Vadose Zone | Leaching PCUL for vadose zone soil to protect the sediment PCUL via ground water. From '747-1' sheet.<br>WAC 173-340-740(3)(b)(iii)(A), -747(4) |

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| L | SL-5, Protect Drinking Water, Saturated Zone | Leaching PCUL for saturated zone soil to protect drinking water. From '747-1' sheet.<br>WAC 173-340-740(3)(b)(iii)(A), -747(4) |
| M | SL-6, Protect Surface Water via Ground Water, Saturated Zone | Leaching PCUL for saturated zone soil to protect surface water via ground water. From '747-1' sheet.<br>WAC 173-340-740(3)(b)(iii)(A), -747(4) |
| N | SL-7, Protect Sediment via Ground Water, Saturated Zone | Leaching PCUL for saturated zone soil to protect drinking water. From '747-1' sheet.<br>WAC 173-340-740(3)(b)(iii)(A), -747(4) |
| O | SL-8, Protect Sediment via Bank Erosion | PCUL to protect sediment via direct bank erosion, based on LAET values. From 'Sed' sheet.<br>WAC 173-340-740(1)(d) |
| P | SL-9, Site-Specific TEE, Unrestricted Land Use | Terrestrial ecological evaluation screening level for unrestricted land use from MTCA Table 749-3.<br>WAC 173-340-7740(2)(b)(ii), -7492 |
| Q | SL-10, Natural Background | The background value for dioxins/furans (statewide) is from Ecology's (2010) Implementation Memo 8. Background values for metals in the Puget Sound region are from Ecology's (1994) *Natural Background Soil Metals Concentrations in Washington State*.<br>WAC 173-340-700(6)(d), -740(5)(c) |
| S-Y | Basis for PCUL – Vadose, Potable GW | These columns record the endpoint driving the most stringent PCUL for the vadose zone above potable ground water (column D). |
| Z-AF | Basis for PCUL – Saturated, Potable GW | These columns record the endpoint driving the most stringent PCUL for the saturated zone in potable ground water (column E). |
| AG-AL | Basis for PCUL – Vadose, Nonpotable GW | These columns record the endpoint driving the most stringent PCUL for the vadose zone above nonpotable ground water (column F). |
| AM-AR | Basis for PCUL – Saturated, Nonpotable GW | These columns record the endpoint driving the most stringent PCUL for the saturated zone in nonpotable ground water (column G). |
| AT | Select | Use X's to filter on chemicals of interest. |

| *'GW' and 'GW-FW' Sheets* | | |
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| C | Most Stringent PCUL, Potable Water | Most stringent ground water PCUL for potable ground water, which includes the following endpoints:<br>• GW-1: Drinking water<br>• GW-2: Protection of surface water<br>• GW-3: Protection of sediment<br>• GW-4: Protection of indoor air via vapor intrusion.<br>If the minimum PCUL is below the natural background concentration (GW-5), it is adjusted up to natural background. |
| D | Most Stringent PCUL, Nonpotable Water | Most stringent ground water PCUL for nonpotable ground water, which includes the following endpoints:<br>• GW-2: Protection of surface water<br>• GW-3: Protection of sediment<br>• GW-4: Protection of indoor air via vapor intrusion.<br>If the minimum PCUL is below the natural background concentration (GW-5), it is adjusted up to natural background. |
| E | User-Defined PCUL | The user may define a site-specific PCUL by specifying the desired GW numbers. List the GW numbers included in the column heading. |
| F | GW-1, Protect Drinking Water | PCUL for drinking water. From 'GW-Detail-PW' sheet.<br>WAC 173-340-720(4)(b)(i), '720(4)(b)(iii), and -720(7)(b) |
| G | GW-2, Protect Surface Water | PCUL to protect surface water. From 'GW-Detail-SW' sheet.<br>WAC 173-340-720(1)(c) |
| H | GW-3, Protect Sediment | PCUL to protect the sediment PCUL. From 'Mod.747-1' sheet.<br>WAC 173-340-720(1)(c) |
| I | GW-4, Protect Indoor Air | PCL to protect indoor air via vapor intrusion. From 'GW-Detail-PW' sheet.<br>WAC 173-340-720(1)(d)(iv) |
| J | TCE Short-Term Action Level for Cardiac Birth Defects | Action level that would typically trigger expedited soil gas sampling to protect women of childbearing age in buildings overlying the groundwater.<br>Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State, Appendix A* |
| K | GW-5, Natural Background | Natural background concentration. The value for arsenic is based on the Puget Sound Basin is from Ecology's (2018) draft *Ambient Ground Water Arsenic Concentrations in* |

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| | | *Washington State* and Environmental Partners, Inc, et al. (2006) *Boeing Plant 2, Seattle/Tukwila, Washington, Technical Memorandum: Development and Use of Background Values*. No other natural background ground water concentrations have been established.<br>WAC 173-340-700(6)(d), -720(7)(c) |
| M-Q | Basis – Potable GW | These columns record the endpoint driving the most stringent PCUL for potable ground water (column D). |
| R-U | Basis – Nonpotable GW | These columns record the endpoint driving the most stringent PCUL for nonpotable ground water (column E). |
| W | Select | Use X's to filter on chemicals of interest. |
| ***'Sed' Sheet*** | | |
| C | Most Stringent PCUL Dry Weight, Min. ROD CUL or Min. SMS SCO | Most stringent dry weight sediment PCUL. If a dry weight CUL is available in EPA's record of decision (ROD) for the Lower Duwamish Waterway (LDW), this value is preferred. This includes remedial action objectives (RAOs) 1, 2, and 4 (column H) and CULs for RAO 3 (column J) for some chemicals.<br><br>If no dry weight CUL is available in the LDW ROD, this column selects the minimum dry weight CUL per the Sediment Management Standards (SMS). This includes direct human contact (column F), bioaccumulative (column G), and benthic criteria (column E) for some chemicals. |
| D | Benthic Criterion OC Normalized, Marine Benthic SCO | The benthic criteria for some chemicals in SMS are presented as normalized to the organic carbon content of the sediment (OC normalized). All are listed in this column. Most of the OC normalized benthic criteria are also listed in the LDW ROD (except 2-methylphenol, diethyl phthalate, di-n-butyl phthalate, di-n-octyl phthalate, and acenaphthylene). |
| E | SMS Lower Tier Marine Benthic SCO, Dry Weight | PCUL to protect marine benthic organisms. From 'SedDet' sheet.<br>SCUM Table 8-1 |
| F | SMS Lower Tier Human Health Direct Contact SCO, Dry Weight | PCUL to protect human direct contact with sediment with exposures via incidental ingestion and dermal absorption. From 'SedDet' sheet.<br>SCUM Section 9.2.2 |
| G | SMS Lower Tier Risk-Based Conc. For Bioaccumulatives SCO, Dry Weight | PCUL to protect human ingestion of seafood. Maximum of natural background and PQL. From 'SedDet' sheet.<br>SCUM Section 9.2 |

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| H | Min. LDW ROD CUL for Comparison to Average Conc. Dry Weight | Minimum of CULs for RAOs 1,2, and 4 in LDW ROD for comparison with spatially weighted average sediment concentrations (SWACs). From 'SedDet' sheet.<br>ROD Table 19 |
| I | LDW ROD CUL for Point-by-Point Comparisons Dry Weight | Dry weight ROD CULs for RAO 3 in LDW ROD for comparison with individual sediment results. From 'SedDet' sheet.<br>ROD Table 20 |
| J | LDW ROD CUL for Point-by-Point Comparisons OC Normalized | OC-normalized ROD CULs for RAO 3 in LDW ROD for comparison with individual sediment results. From 'SedDet' sheet.<br>ROD Table 20 |
| M-Q | Basis | These columns record the endpoint driving the most stringent dry weight sediment PCUL (column C). |
| S | Select | Use X's to filter on chemicals of interest. |
| ***'AR' Sheet*** | | |
| C | AR-1, Indoor Air PCUL | Method B PCUL for indoor air. From 'AR-Detail' sheet.<br>WAC 173-340-750(3)(b)(ii) |
| D | TCE Short-Term Action Level for Cardiac Birth Defects, Indoor Air | Action level that would typically trigger further sampling or mitigation to protect women of childbearing age.<br>Ecology's (2020) *Vapor Intrusion Guidance, Appendix A* |
| E | SG-1, Soil Gas PCUL, Protect Indoor Air | Method B PCUL for soil gas to protect indoor air. From 'AR-Detail' sheet.<br>Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Equation 2 |
| F | TCE Short-Term Action Level for Cardiac Birth Defects, Unrestricted Soil Gas | Action level that would typically trigger expedited soil gas sampling to protect women of childbearing age in buildings overlying the contamination.<br>Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, *Appendix A* |
| H | Select | Use X's to filter on chemicals of interest. |
| ***'Chem' Sheet*** | | |
| B | Chemical | Not all chemicals listed in CLARC have been included; the selected list of chemicals is based on those most frequently analyzed at LDW cleanup sites. The Ecology site manager must approve PCULs for chemicals not listed in the workbook. |
| C | CAS No. | For chemical groups without a Chemical Abstracts Service number, a letter designation is used. |

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| D | Chemical Name in CLARC | If the chemical name shown in CLARC is different from the name shown in the workbook, the CLARC name is provided here. |
| E | Alternate CAS No. | If a different CAS number was encountered while searching for chemical-specific information, it is recorded here. |
| F | Abbreviation | The elemental abbreviations are provided for metals. |
| G | Synonyms | If a synonym was encountered while searching for chemical-specific information, it is recorded here. There was no attempt to provide a complete list of synonyms. |
| I | Select | Use X's to filter on chemicals of interest. |
| ***'Param' Sheet*** | | |
| C | Koc | Soil organic carbon-water partitioning coefficient from CLARC for organic chemicals. |
| D | Kd – Inorganics, pH 6.8 | Distribution factor from CLARC for inorganic chemicals and ionizing organic chemicals at the typical ground water pH of 6.8. |
| E | Kd – Organics, Foc 0.1% | Soil-water partitioning coefficient calculated for organic chemicals per MTCA Equation 747-2 assuming the default value of 0.001 for fraction organic carbon. |
| F | Selected Soil Kd (pH 6.8, Foc 0.1%) | The values in columns E and F are collected here. |
| G | Kd – Inorganics, pH 8.0 | Soil-water partitioning coefficient from Table 46 of EPA's (1996) *Soil Screening Guidance Technical Background Document* for inorganic chemicals and ionizing organic chemicals at the typical marine pH of 8. |
| H | Kd – Organics, Foc 1.9% | Soil-water partitioning coefficients are calculated for organic chemicals per MTCA Equation 747-2 assuming a value of 0.019 for fraction organic carbon, which is the average value for LDW sediment. For ionizing organic, Kd values are calculated using Koc values adjusted to pH 8.0, from Table 42 of EPA (1996). |
| I | Selected Sediment Kd (pH 8.0, Foc 1.9%) | The values in columns E and F are collected here. |
| J | Hcc at 13ºC | Henry's law constant from CLARC for a soil temperature of 13ºC. |
| K | Hcc at 25ºC | Henry's law constant from CLARC for a soil temperature of 25ºC. |
| L | Selected Hcc | Hcc values are collected here. Hcc at 13ºC is preferred. Hcc at 25ºC is used for chemicals without a value at 13ºC. |
| M | BCF | Fish bioconcentration factor from CLARC. |
| N | RfDo | Oral RfD from CLARC. |
| O | RfDo Source | Source of oral RfD, including the following: |

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| | | • EPA's Integrated Risk Information System (denoted by "IRIS" in the source column)<br>• EPA's Provisional Peer-Reviewed Toxicity Values ("PPRTV")<br>• ATSDR's minimal risk levels ("ATSDR")<br>• CalEPA's chronic reference exposure levels ("CalEPA")<br>• PPRTV appendix values ("PPRTV-APP")<br>• Health Effects Assessment Summary Tables ("HEAST")<br>• Other EPA sources ("Other EPA"). |
| P | Oral Noncancer Target Organ | Noncancer target organ from CLARC for evaluating additive noncancer hazards to target organs via ingestion/dermal exposure. |
| Q | GI-MTCA | Gastrointestinal absorption conversion factor from CLARC. |
| R | RfDd-MTCA | Dermal RfD calculated per SCUM Equation 9-4 using GI values from CLARC. |
| S | GI/GIABS-SMS | Gastrointestinal absorption conversion factor from SCUM Appendix K. |
| T | RfDd-SMS | Dermal RfD calculated per SCUM Equation 9-4 using GI values from SCUM Appendix K. |
| U | RfC | Inhalation reference concentration (RfC) from CLARC. |
| V | RfC Source | Source of inhalation RfC. Abbreviations listed above in column O. |
| W | RfDi | Calculated from RfC assuming body weight of 70 kg and inhalation rate of 20 $m^3$/day. |
| X | Inhalation Noncancer Target Organ | Noncancer target organ from CLARC for evaluating additive noncancer hazards to target organs via inhalation exposure. |
| Y | CPFo | Oral CPF (slope factor) from CLARC. |
| Z | CPFo Source | Source of oral CPF. Sources are as listed for column O. |
| AA | CPFd-MTCA | Dermal CPF calculated per SCUM Equation 9-3 using GI values from CLARC. |
| AB | CPFd-SMS | Dermal CPF calculated per SCUM Equation 9-3 using GI values from SCUM Appendix K. |
| AC | IUR | Inhalation unit risk from CLARC. |
| AD | IUR Source | Source of inhalation CPF. Sources are as listed for column O. |
| AE | CPFi | Inhalation carcinogenic potency factor calculated from IUR assuming 70 kg body weight and 20 $m^3$/day inhalation rate. |
| AF | Noted as Mutagen in CLARC | Indicates whether the chemical causes cancer through a mutagenic mode of action. Equation values for mutagens are hand-entered from CLARC because the CLARC values account for higher risk of developing cancer from exposures incurred during |

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| | | childhood. |
| AG | INH | Groundwater vapor inhalation correction factor from CLARC. Accounts for extra exposure to volatile chemicals in groundwater due to vaporization during household use. For chemicals not listed in CLARC, a value of 2 is assigned for chemicals that qualify as volatile organic compounds per WAC 173-340-210. |
| AH | ABS-MTCA | Dermal absorption fraction from CLARC. |
| AI | AB1 | Gastrointestinal absorption fraction from MTCA Equation 740-5. |
| AJ | ABS-SMS | Dermal absorption fraction from SCUM Appendix K. |
| AK | Listed on CLARC VI page? | Indicates whether chemical is considered volatile for purposes of evaluating vapor intrusion. |
| AL | PBT List | Listed as a persistent bioaccumulative toxin in WAC 173-333-310. |
| AM | DMMP List 1 or 2 | Included on List 1 or List 2 in the DMMP's *Dredged Material Evaluation and Disposal Procedures User Manual*. |
| AN | LDW COC for Human Consumption of Seafood | Listed as a chemical of concern for human health in Table B.7-1 of the LDW RI report (LDWG 2010). |
| AO | Exceeded NOAEL for LDW Higher Trophic Level | Listed as a chemical of concern for ecological receptors in Table A.8-1 of the LDW RI report (LDWG 2010). |
| AP | Considered Bioaccumulative for Calculating LDW Sediment PCULs | "YES" is recorded if ***both*** of the following criteria are met:<br>1. The chemical is listed on the PBT list (column AC), on DMMP Lists 1 or 2 (column AD), or both.<br>2. The chemical is listed in RI Table B.7-1 (column AE), RI Table A.8-1 (column AF), or both.<br>In addition, "YES" is recorded for all dioxin/furan analytes. Although the decision logic would return "YES" for total PCB Aroclors, an entry of "no" was hand-entered to over-ride the decision logic. This allows the LAET to be reported as the sediment PCUL. A result of "YES" would have caused the sediment PCUL to be a text entry "PQL". |
| AQ | Natural Background Marine Sediment | Natural background concentrations for marine sediment from SCUM Table 10-1. Also used as natural background for freshwater sediment because no natural background concentrations have been developed for freshwater sediment. |
| AR | LDW Background Sediment | Background concentrations for LDW sediment from ROD Table 19. |
| AS | Regional Background Port | Regional sediment background concentrations for the Everett area from SCUM Table |

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| | Gardner Bay Sediment | 10-2. |
| AT | Regional Background Bellingham Bay Sediment | Regional sediment background concentrations for the Bellingham area from SCUM Table 10-2. |
| AU | Regional Background Lake Washington Sediment | Regional sediment background concentrations for the Lake Washington area from SCUM Table 10-2. |
| AW | Select | Use X's to filter on chemicals of interest. |
| ***'Eqtn' Sheet*** | | |
| Calculation sheets (Sl-Eq, GW-Eq, Sed-Eq, and AR-Eq) link to the equations shown on this sheet. Any changes to assumptions/parameters on this sheet will be reflected on the equation sheets and subsequently the three media summary sheets (SL, GW, and AR). This sheet is protected with the password "LDW" to prevent inadvertent changes. | | |
| ***'SL-Det' Sheet*** | | |
| C | MTCA-B Soil Direct Contact, Noncancer | Method B PCUL for direct human contact with soil for noncancer health effects under a residential scenario calculated per MTCA Equation 740-1. From 'SL-Eq' sheet. |
| D | MTCA-B Soil Direct Contact, Cancer | Method B PCUL for direct human contact with soil for cancer under a residential scenario calculated per MTCA Equation 740-2. From 'SL-Eq' sheet. |
| E | SL-1, MTCA-B Soil Direct Contact | Minimum of Method B noncancer and cancer PCULs (columns D and E). |
| F | MTCA Ecological Indicator Soil Conc., Plants | Site-specific terrestrial ecological evaluation screening level for plants from MTCA Table 749-3. Values for gasoline and diesel range hydrocarbons are from Ecology's (2017) Implementation Memo 19. |
| G | MTCA Ecological Indicator Soil Conc., Soil Biota | Site-specific terrestrial ecological evaluation screening level for soil biota from MTCA Table 749-3. Values for gasoline and diesel range hydrocarbons are from Ecology's (2017) Implementation Memo 19. |
| H | MTCA Ecological Indicator Soil Conc., Wildlife | Site-specific terrestrial ecological evaluation screening level for wildlife from MTCA Table 749-3. |
| I | SL-9, MTCA Ecological Indicator Soil Conc., Unrestricted Land Use | Site-specific terrestrial ecological evaluation screening level for unrestricted land use. Minimum of values for plants, soil biota, and wildlife (columns G, H, and I). |
| J | MTCA Ecological Indicator Soil Conc., Industrial or Commercial Land Use | Site-specific terrestrial ecological evaluation screening level for industrial or commercial land use. Value for wildlife only (column I). Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| K | MTCA Simplified TEE, | Simplified terrestrial ecological evaluation screening level for unrestricted land use |

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| | Unrestricted Land Use | from MTCA Table 749-2. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| L | MTCA Simplified TEE, Industrial or Commercial Land Use | Terrestrial ecological evaluation screening level for commercial or industrial land use from MTCA Table 749-2. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| M | MTCA-C Soil Direct Contact, Noncancer | Method C PCUL for direct human contact with soil for noncancer health effects under an industrial scenario calculated per MTCA Equation 745-1. From 'SL-Eq' sheet. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| N | MTCA-C Soil Direct Contact, Cancer | Method C PCUL for direct human contact with soil for cancer under an industrial scenario calculated per MTCA Equation 745-2. From 'SL-Eq' sheet. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| O | MTCA-C Soil Direct Contact | Minimum of Method C noncancer and cancer PCULs (columns H and I). Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| P | Federal TSCA | The only ARAR for soil is the TSCA cleanup action level for PCBs. The TSCA action level is sufficiently protective, per WAC 173-340-740(5)(b), so it replaces the MTCA Equation 740-2 value. Depending on the material and the occupancy usage, TSCA cleanup action levels are 1 or 10 ppm for high occupancy areas, and 25 or 50 or 100 ppm for low occupancy areas. A value of 1 mg/kg is used on this sheet. |
| R | Select | Use X's to filter on chemicals of interest. |
| ***'SL-Eq' Sheet*** | | |
| C | RfDo | Oral reference dose from 'Param' sheet. |
| D | CPFo | Oral carcinogenic potency factor from 'Param' sheet. |
| E | AB1 | Gastrointestinal absorption fraction from 'Param' sheet. |
| F | MTCA-B Soil Direct Contact, Noncancer | Method B PCUL for noncancer effects from soil contact under a residential scenario calculated per MTCA Equation 740-1. |
| G | MTCA-B Soil Direct Contact, Cancer | Method B PCUL for cancer effects from soil contact under a residential scenario calculated per MTCA Equation 740-2. |
| H | MTCA-C Soil Direct Contact, Noncancer | Method C PCUL for noncancer effects from soil contact under an industrial scenario calculated per MTCA Equation 745-1. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| I | MTCA-C Soil Direct Contact, Cancer | Method C PCUL for cancer effects from soil contact under an industrial scenario calculated per MTCA Equation 745-2. Not used for PCULs but provided for potential |

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| | | use in site-specific CULs or RELs. |
| K | Select | Use X's to filter on chemicals of interest. |
| ***'Leach' and 'LeachFW' Sheets*** | | |
| For nonvolatile chemicals without numerical values for Hcc, the portion of the equation that uses Hcc is eliminated to allow the calculation to be performed. For volatile chemicals without numerical values for Hcc, no leaching calculation is performed (entry shows as "na"). This is discussed in more detail in the text. | | |
| C | Soil Kd | Soil Kd at pH 6.8 and foc 0.1%. From 'Param' sheet. |
| D | Hcc at 13ºC | Selected value for the unitless version of Henry's law constant. From 'Param' sheet. |
| E | GW-1, GW PCUL, Protect Drinking Water | Ground water PCUL for protection of drinking water. From 'GW-Detail-PW' sheet. |
| F | SL-2, Soil Protect Drinking Water Vadose Zone | Soil PCUL for leaching to drinking water from the vadose zone calculated per MTCA Equation 747-1. |
| G | SL-5, Soil Protect Drinking Water, Saturated Zone | Soil PCUL for leaching to drinking water from the saturated zone calculated per MTCA Equation 747-1. |
| H | GW-2, GW PCUL Protect Surface Water | Ground water PCUL for protection of surface water. From 'GW-Detail-SW' sheet. |
| I | SL-3, Soil Protect Surface Water, Vadose Zone | Soil PCUL for leaching to surface water from the vadose zone calculated per MTCA Equation 747-1. |
| J | SL-6, Soil Protect Surface Water, Saturated Zone. | Soil PCUL for leaching to surface water from the saturated zone calculated per MTCA Equation 747-1. |
| K | GW-3, GW PCUL, Protect Sediment | Ground water PCUL for protection of sediment (minimum ROD CUL plus SMS lower tier concentration for chemicals not listed in ROD). From 'Mod.747-1' sheet. |
| L | SL-4, Protect Sediment, Vadose Zone | Soil PCUL for leaching from the vadose zone to protect sediment, calculated per MTCA Equation 747-1. |
| M | SL-7, Protect Sediment, Saturated Zone | Soil PCUL for leaching from the saturated zone to protect sediment, calculated per MTCA Equation 747-1. |
| N | User-Defined Ground Water PCUL | This could be the value defined in column F of the 'GW' sheet. |
| O | Soil Protect GW at User-Defined GW PCUL, Vadose Zone | Soil PCUL for leaching from the vadose zone to achieve the user-defined ground water PCUL, calculated per MTCA Equation 747-1. |
| P | Soil Protect GW at User- | Soil PCUL for leaching from the saturated zone to achieve the user-defined ground |

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| | Defined GW PCUL, Saturated Zone | water PCUL, calculated per MTCA Equation 747-1. |
| R | Select | Use X's to filter on chemicals of interest. |
| ***'PW' Sheet*** | | |
| C | Federal MCLs | Federal maximum contaminant level for drinking water (40 CFR 141). |
| D | Federal MCLGs | Federal MCL goal for noncarcinogens only (non-zero values). |
| E | WA State MCLs | State MCL for drinking water (WAC 246-290). |
| F | Most Stringent ARAR | Minimum of drinking water ARARs (columns D through F). |
| G | MTCA-B Ground Water, Noncancer | Calculated per MTCA Equation 720-1. From 'GW-Eq' sheet. |
| H | ARAR Evaluation | Ratio of minimum ARAR (column G) to MTCA Equation 720-1 value (column H). |
| I | Does ARAR need adjustment for noncancer health effects? | If the ratio in column I exceeds 1, the entry is "YES", indicating that the associated hazard quotient exceeds 1 and the minimum ARAR needs to be adjusted. If the ratio does not exceed 1, the entry is "no", indicating that no adjustment is needed. If one or both of columns G and H are blank, the entry is "na", indicating that the ratio cannot be calculated. |
| J | Protection of Drinking Water, Noncancer | Noncancer PCUL for drinking water: If the entry in column J is "YES", the adjusted noncancer PCUL is the value from MTCA Equation 720-1 (column H). Otherwise, if there is a minimum ARAR (column G), the noncancer PCUL is the minimum ARAR. Otherwise, if there is a value from Equation 720-1, the noncancer PCUL is the equation value. Otherwise, the value in this column is "na". |
| K | MTCA-B Ground Water, Cancer | Calculated per MTCA Equation 720-2. From 'GW-Eq' sheet. |
| L | ARAR Evaluation | Ratio of minimum ARAR (column G) to MTCA Equation 720-2 value (column L). |
| M | Does ARAR need adjustment for cancer health effects? | If the ratio in column M exceeds 10, the entry is "YES", indicating that the associated cancer risk exceeds 1E-5 and the minimum ARAR needs to be adjusted. If the ratio does not exceed 10, the entry is "no", indicating that no adjustment is needed. If one or both of columns G and L are blank, the entry is "na", indicating that the ratio cannot be calculated. |
| N | Protection of Drinking Water, Cancer | Cancer PCUL for drinking water: If the entry in column N is "YES", the adjusted cancer PCUL is 10 times the value from MTCA Equation 720-2 (column L). If the entry is "no", the cancer PCUL is the minimum ARAR (column G). If the entry is "na", |

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| | | the cancer PCUL is noted as "na". |
| O | GW-1, Ground Water PCUL, Protect Drinking Water | The ground water PCUL for protection of drinking water is the minimum of the noncancer and cancer PCULs (columns K and O). |
| P | GW-4, Ground Water PCUL, Protect Indoor Air | Method B ground water screening level to protect indoor air via vapor intrusion. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 1 |
| Q | MTCA-C GW Protect Indoor Air | Method C ground water screening level to protect indoor air via vapor intrusion. Not used for PCULs but provided for potential use in site-specific CULs or RELs. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 1 |
| S | Most Stringent Drinking Water PCUL | The most stringent PCUL for drinking water is the minimum of the ground water PCUL for protection of drinking water (GW-1 in column P) and the Method B ground water screening level to protect indoor air via vapor intrusion (GW-7 in column Q). |
| T-AA | Basis | These columns record the endpoint driving the most stringent PCUL for drinking water (column U). |
| AC | Select | Use X's to filter on chemicals of interest. |
| ***'SW' and 'SW-FW' Sheets*** | | |
| C | WA State WQC, Aquatic Life, Marine-Chronic | Washington State WQC for protection of marine aquatic life under chronic exposure (WAC 173-201A-240, Table 240). |
| D | NRWQC, Aquatic Life, Marine – Chronic | National recommended WQC for protection of marine aquatic life under chronic exposure (Clean Water Act Section 304). |
| E | WA State WQC, Human Health, Consumption of Organisms | Washington State WQC for protection of human health via consumption of aquatic organisms published in August 2016 (WAC 173-201A-240, Table 240). |
| F | WA Toxics Rule, Human Health, Consumption of Organisms | National Toxics Rule WQC for Washington State for protection of human health via consumption of aquatic organisms published in November 2016 (40 CFR 131.3). |
| G | NRWQC, Human Health, Consumption of Organisms | National recommended water quality criterion for protection of human health via consumption of aquatic organisms (Clean Water Act Section 3). |
| H | Aquatic Life: Literature Values | Concentration estimated to result in no adverse effects on the protection and propagation of wildlife, fish, and other aquatic life, based on a literature review of the following sources (Ecology 2016a):<br>• Oak Ridge National Laboratory's Risk Assessment Information System (RAIS) |

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| | | • National Oceanic and Atmospheric Administration's Screening Quick Reference Tables (SQuiRT)<br>• EPA's EcoTox database<br>• Verbruggen et al. (2008)<br>• De Rooij et al. (2004).<br>WAC 173-340-730(3)(b)(ii) |
| I | Most Stringent ARAR | Minimum of surface water ARARs (columns D through J). |
| J | MTCA-B Surface Water, Fish Consumption, Noncancer | Calculated per MTCA Equation 730-1. From 'GW-Eq' sheet. |
| K | ARAR Evaluation | Ratio of minimum ARAR (column K) to MTCA Equation 730-1 value (column L). |
| L | Does ARAR need adjustment for noncancer health effects? | If the ratio in column M exceeds 1, the entry is "YES", indicating that the associated hazard quotient exceeds 1 and the minimum ARAR needs to be adjusted. If the ratio does not exceed 1, the entry is "no", indicating that no adjustment is needed. If one or both of columns K and L are blank, the entry is "na", indicating that the ratio cannot be calculated. |
| M | Protection of Surface Water, Noncancer | Noncancer PCUL for protection of surface water: If the entry in column N is "YES", the adjusted noncancer PCUL is the value from MTCA Equation 730-1 (column L). Otherwise, if there is a minimum ARAR (column K), the noncancer PCUL is the minimum ARAR. Otherwise, if there is a value from Equation 730-1, the noncancer PCUL is the equation value. Otherwise, the value in this column is "na". |
| N | MTCA-B Surface Water, Fish Consumption, Cancer | Calculated per MTCA Equation 730-2. From 'GW-Eq' sheet. |
| O | ARAR Evaluation | Ratio of minimum ARAR (column K) to MTCA Equation 720-2 value (column P). |
| P | Does ARAR need adjustment for cancer health effects? | If the ratio in column Q exceeds 10, the entry is "YES", indicating that the associated cancer risk exceeds 1E-5 and the minimum ARAR needs to be adjusted. If the ratio does not exceed 10, the entry is "no", indicating that no adjustment is needed. If one or both of columns K and P are blank, the entry is "na", indicating that the ratio cannot be calculated. |
| Q | Protection of Surface Water, Cancer | Cancer PCUL for protection of surface water: If the entry in column R is "YES", the adjusted cancer PCUL is 10 times the value from MTCA Equation 730-2 (column P). If the entry is "no", the cancer PCUL is the minimum ARAR (column K). If the entry is |

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| | | "na", the cancer PCUL is noted as "na". |
| R | GW-2, Ground Water PCUL, Protect Surface Water | The ground water PCUL for protection of surface water is the minimum of the noncancer and cancer PCULs (columns O and S). |
| T-AC | Basis for PCUL | These columns record the endpoint driving the most stringent PCUL for protection of surface water (GW-2 in column R). |
| AE | Select | Use X's to filter on chemicals of interest. |
| ***'GW-Eq' Sheet*** | | |
| C | RfDo | Oral reference dose from 'Param' sheet. |
| D | CPFo | Oral carcinogenic potency factor from 'Param' sheet. |
| E | INH | Inhalation correction factor from 'Param' sheet. |
| F | BCF | Fish bioconcentration factor from 'Param' sheet. |
| G | MTCA-B, Ground Water, Noncancer | Method B PCUL for noncancer effects from drinking water calculated per MTCA Equation 720-1. |
| H | MTCA-B, Ground Water, Cancer | Method B PCUL for cancer effects from drinking water calculated per MTCA Equation 720-2. |
| I | MTCA-B, Surface Water, Noncancer | Method B PCUL for noncancer effects from consuming fish contaminated from surface water, calculated per MTCA Equation 730-1 with fish consumption rate (97.5 g/day) and fish diet fraction (1) from the ROD. |
| J | MTCA-B, Surface Water, Cancer | Method B PCUL for cancer effects from consuming fish contaminated from surface water, calculated per MTCA Equation 730-2 with fish consumption rate (97.5 g/day) and fish diet fraction (1) from the ROD. |
| L | Select | Use X's to filter on chemicals of interest. |
| ***'Partit' and 'PartitFW' Sheets*** | | |
| The PartitFW sheet is structured the same as the 'Partit' sheet except it calls sediment PCULs from the 'SedDetFW' page. | | |
| C | Sediment Kd | Sediment Kd at pH 8 and foc 1.9%. From 'Param' sheet. |
| D | Sediment PCUL | Minimum ROD CUL or SMS lower tier sediment PCUL for chemicals not listed in the ROD. From 'SedDet' sheet. |
| E | GW-3, Ground Water PCUL, Protect Sediment | Ground water PCUL to protect sediment, calculated per the modified form of MTCA Equation 747-1. |
| F | SMS Upper Tier | SMS upper tier sediment PCUL. From 'SedDet' sheet. |
| G | Ground Water PCUL, Protect Sediment, SMS | Ground water PCUL to protect sediment at the SMS upper tier sediment PCUL, calculated per the modified form of MTCA Equation 747-1. Not used for PCULs but |

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| | Upper Tier | provided for potential use in site-specific CULs or RELs. |
| H | Minimum ROD RAL | Minimum ROD RAL. From 'SedDet' sheet. |
| I | Ground Water PCUL, Protect Sediment, Minimum ROD RAL | Ground water PCUL to protect sediment at minimum ROD RAL calculated per the modified form of MTCA Equation 747-1. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| J | User-Defined Sediment PCUL | User-defined sediment PCUL. |
| K | Ground Water PCUL to Protect User-Defined Sediment PCUL | Ground water PCUL to achieve the user-defined sediment PCUL, calculated per the modified form of MTCA Equation 747-1. |
| M | Select | Use X's to filter on chemicals of interest. |
| ***'VI' Sheet*** | | |
| C | Listed on CLARC VI page? | Indicates whether the chemical is listed as a VOC in Ecology's (2009) draft guidance on VI. |
| D | Hcc | Selected value for the unitless version of Henry's law constanct. From 'Param' sheet. |
| E | AR-1, MTCA-B Air | Method B air PCUL from 'Air-Detail' sheet. |
| F | GW-4, MTCA-B Ground Water, Protect Indoor Air via Vapor Intrusion | Ground water PCUL to protect indoor air via vapor intrusion under Method B. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 1 |
| G | MTCA-C Air | Method C air PCUL from 'Air-Detail' sheet. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| H | MTCA-C Ground Water, Protect Indoor Air via Vapor Intrusion | Ground water PCUL to protect indoor air via vapor intrusion under Method C. Not used for PCULs but provided for potential use in site-specific CULs or RELs. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 1 |
| I | Commercial Air | Air remediation levels to protect workers. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| J | Ground Water Protect Indoor Air via Vapor Intrusion, Commercial | Groundwater remediation levels to protect workers from VI. Not used for PCULs but provided for potential use in site-specific CULs or RELs. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 1 |
| K | TCE Short-Term Action Level for Cardiac Birth Defects, Commercial | Action level that would typically trigger expedited soil gas sampling to protect women of childbearing age in buildings overlying the contamination. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |

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| | Worker, Groundwater | Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State, Appendix A* |
| M | Select | Use X's to filter on chemicals of interest. |
| ***'SedDet' Sheet*** | | |
| C | Bioaccumulative | Indicates which chemicals are considered bioaccumulative for the purpose of developing lower tier and upper tier sediment PCULs for LDW sediment sites. |
| D | Lower Tier, Natural Background | The preferred source for natural background sediment concentrations is EPA's ROD Table 3. Background concentrations for additional chemicals are from SCUM Table 10-1. |
| E | Upper Tier, Regional Background | Regional background concentration, which would be used in determining the upper tier sediment PCUL but which has not been developed. |
| F | PQL | Programmatic sediment PQL from SCUM Table 11-1. If no value is available in SCUM Table 11-1, the average value from SCUM Table D-1 is reported. |
| G | SMS Lower Tier, Marine Benthic SCO, Dry Weight | Dry weight benthic SCO. Not currently used in any calculations in the spreadsheet. |
| H | SMS Lower Tier, Marine Benthic SCO, OC Normalized | OC-normalized benthic SCO provided for use in setting site-specific CULs. Not currently used in any calculations in the spreadsheet. |
| I | SMS Lower Tier, Marine Benthic LAET, Dry Weight | Lowest apparent effects threshold (LAET) value for marine benthic organisms. For chemicals with dry weight benthic SCOs, the SCO and LAET are the same value. For chemicals with OC normalized SCOs, the SCO and the LAET are different. The dry weight LAET concentrations are used for calculating groundwater CULs to protect sediment. |
| J | SMS Upper Tier, Marine Benthic CSL, Dry Weight | Dry weight benthic CSL. Not currently used in any calculations in the spreadsheet. |
| K | SMS Upper Tier, Marine Benthic CSL, OC Normalized | OC-normalized benthic CSL provided for use in setting site-specific CULs. Not currently used in any calculations in the spreadsheet. |
| L | SMS Upper Tier, Marine Benthic 2nd LAET, Dry Weight | Second LAET value for marine benthic organisms. For chemicals with dry weight benthic CSLs, the CSL and 2nd LAET are the same value. For chemicals with OC normalized CSLs, the CL and the 2nd LAET are different. The dry weight 2nd LAET concentrations are used for calculating groundwater CULs to protect sediment. |

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| M | SMS Lower Tier, Human Health Direct Contact | Minimum CUL for cancer risk of 1E-6 and HQ=1 for sediment contact under the scenarios included in the ROD. |
| N | SMS Upper Tier, Human Health, Direct Contact | Minimum CUL for cancer risk of 1E-5 and HQ=1 for sediment contact under the scenarios included in the ROD. |
| O | Lower Tier, Risk-Based Concentration for Bioaccumulatives | For chemicals considered bioaccumulative (column C), the value in this column is the maximum of the natural background concentration (column D) and the PQL (column F). If neither a natural background concentration nor a numerical PQL value is available, the value in this column is "PQL". If the chemical is not considered bioaccumulative, the value in this column is "na". |
| P | Upper Tier, Risk-Based Concentration for Bioaccumulatives | For chemicals considered bioaccumulative (column C), the value in this column is the maximum of the regional background concentration (column E) and the PQL (column F). If no regional background concentration is available, the natural background concentration (column D) is substituted if available. If neither a natural background concentration, a regional background, nor a numerical PQL value is available, the value in this column is "PQL". If the chemical is not considered bioaccumulative, the value in this column is "na". |
| Q | Lower Tier, Risk-Based Concentration for Non-Bioaccumulatives | For nonbioaccumulative chemicals, the value in this column is the minimum of the LAET (column I) and the lower tier CUL for human sediment contact (column M). If the risk-based concentration falls below the PQL, it is adjusted up to the PQL. If the chemical is considered bioaccumulative, the value in this column is "na". |
| R | Upper Tier, Risk-Based Concentration for Non-Bioaccumulatives | For nonbioaccumulative chemicals, the value in this column is the minimum of the 2ndLAET (column L) and the upper tier PCUL for human sediment contact (column N). If the risk-based concentration falls below the PQL, it is adjusted up to the PQL. If the chemical is considered bioaccumulative, the value in this column is "na". |
| S | SMS Lower Tier, Benthic & Human Health, SCO | The lower tier PCUL under SMS is either the value in column N for bioaccumulatives or the value in column O for nonbioaccumulatives. |
| T | SMS Upper Tier, Benthic & Human Health, CSL | The upper tier PCUL under SMS is either the value in column N for bioaccumulatives or the value in column P for nonbioaccumulatives. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| U | LDW ROD, RAO 1 CUL | The sediment CUL for remedial action objective 1 (human seafood consumption) in EPA's record of decision for LDW, Table 19. |
| V | LDW ROD, RAO 2 CUL, LDW-Wide | Sediment CUL for remedial action objective 2 (human sediment contact with sediment throughout the LDW) in EPA's record of decision for LDW, Table 19. |

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| W | LDW ROD, RAO 2 CUL, Clamming | Sediment CUL for RAO 2 (human sediment contact with in clamming areas) in ROD Table 19. |
| X | LDW ROD, RAO 2 CUL, Beaches | Sediment CUL for RAO 2 (human sediment contact with sediment at beaches) in ROD Table 19. |
| Y | LDW ROD, RAO 3 CUL | Sediment CUL for RAO 3 (protection of benthic invertebrates) in ROD Table 20. |
| Z | LDW ROD, RAO 4 CUL | Sediment CUL for RAO 4 (protection of upper trophic level ecological receptors) in ROD Table 19. |
| AA | Lowest LDW ROD CUL for Comparison to Average Conc. | Minimum ROD CUL for comparison with average sediment concentrations, which includes RAO 1 (column T), RAO 2 (columns U through W), and RAO 4 (column Y). |
| AB | LDW ROD CUL for Point-by-Point Comparisons | ROD CUL for point by point comparisons, which is for RAO 3 (column X). |
| AC | Minimum LDW ROD CUL | Overall minimum sediment CUL from ROD, which is the minimum of columns Z and AA. |
| AD | Sediment PCUL, Minimum ROD CUL + SMS Lower Tier | Sediment PCUL for calculating ground water PCUL protective of sediment. The overall minimum sediment CUL from the ROD (column AB) is the preferred value. If no ROD CUL is available, the SMS lower tier concentration (column R) is used. |
| AE | LDW ROD RAL, Intertidal Rec. Cat. 1 (Limited), 0-10 cm | Sediment RAL for intertidal sediments in recovery category 1 (0-10 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AF | LDW ROD RAL, Intertidal Rec. Cat. 1 (Limited), 0-45 cm | Sediment RAL for intertidal sediments in recovery category 1 (0-45 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AG | LDW ROD RAL, Intertidal Rec. Cat. 2 (Less Certain), 0-10 cm | Sediment RAL for intertidal sediments in recovery category 2 (0-10 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AH | LDW ROD RAL, Intertidal Rec. Cat. 2 (Less Certain), Upper Limit for ENR, 0-10 cm | Upper limit for the enhanced natural recovery remedy for intertidal sediments in recovery category 2 (0-10 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AI | LDW ROD RAL, Intertidal Rec. Cat. 2, 0-45 cm | Sediment RAL for intertidal sediments in recovery category 2 (0-45 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |

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| AJ | LDW ROD RAL, Intertidal Rec. Cat. 2, Upper Limit for ENR, 0-45 cm | Upper limit for the enhanced natural recovery remedy for intertidal sediments in recovery category 2 (0-45 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AK | LDW ROD RAL, Subtidal Rec. Cat. 1, 0-10 cm | Sediment RAL for subtidal sediments in recovery category 1 (0-10 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AL | LDW ROD RAL, Subtidal Rec. Cat. 1, 0-60 cm | Sediment RAL for subtidal sediments in recovery category 1 (0-60 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AM | LDW ROD RAL, Subtidal Rec. Cat. 2, 0-10 cm | Sediment RAL for subtidal sediments in recovery category 2 (0-10 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AN | LDW ROD RAL, Subtidal Rec. Cat. 2, Upper Limit for ENR, 0-10 cm | Upper limit for the enhanced natural recovery remedy for subtidal sediments in recovery category 2 (0-10 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AO | LDW ROD RAL, Subtidal Rec. Cat. 2, 0-60 cm | Sediment RAL for subtidal sediments in recovery category 2 (0-60 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AP | LDW ROD RAL, Subtidal Rec. Cat. 2, Upper Limit for ENR, 0-60 cm | Upper limit for the enhanced natural recovery remedy for subtidal sediments in recovery category 2 (0-60 cm) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AQ | LDW ROD RAL, Subtidal Shoaled Areas | Sediment RAL for subtidal shoaled areas (top of navigation depth plus 2 feet) in ROD Table 28. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AR | Minimum LDW ROD RAL, Intertidal, Rec. Cat. 1 | Minimum ROD RAL for intertidal sediments in recovery category 1, which includes columns AD and AE. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AS | Minimum LDW ROD RAL, Intertidal, Rec. Cat. 2 | Minimum ROD RAL for intertidal sediments in recovery category 2, which includes columns AF and AI. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AT | Minimum LDW ROD RAVAL, Subtidal, Rec. Cat. 1 | Minimum ROD RAL for subtidal sediments in recovery category 1, which includes columns AJ and AK. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AU | Minimum LDW ROD RAL, Subtidal, Rec. Cat. 2 | Minimum ROD RAL for subtidal sediments in recovery category 2, which includes columns AL through AO. Not used for PCULs but provided for potential use in site-specific CULs. |

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| AV | Minimum LDW ROD RAL, Overall | Overall minimum ROD RAL, which includes columns AQ through AT. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| AW | User-Defined Sediment PCUL | The user may define a site-specific sediment PCUL by specifying the ROD CULs or RALs relevant to the site. Indicate the CULs or RALs that are included in the column heading. |
| AY-BP | Basis for SMS Lower Tier<br>Basis for SMS Upper Tier<br>Basis for Minimum ROD CUL<br>Basis for Minimum ROD RAL | These columns record the endpoints driving the SMS lower tier sediment PCUL (column S), the SMS upper tier sediment PCUL (column T), the minimum ROD CUL (column AC), and the minimum ROD RAL (column AV). |
| BR | Select | Use X's to filter on chemicals of interest. |
| ***'SedEq' and 'SedEq-FW' Sheets*** | | |
| C | CPFo | Oral carcinogenic potency factor from 'Param' sheet. |
| D | CPFd | Dermal carcinogenic potency factor from 'Param' sheet. |
| E | RfDo | Oral reference dose from 'Param' sheet. |
| F | RfDd | Dermal reference dose from 'Param' sheet. |
| G | AB | Gastrointestinal absorption fraction from 'Param' sheet. |
| H | ABS | Dermal absorption fraction from 'Param' sheet. |
| I | Beach Play, Risk=1E-6 | Sediment PCUL to protect a child engaged in beach play, based on a cancer risk of 1E-6. Calculated per SMS Equation 9-1 using LDW exposure assumptions from the ROD. |
| J | Subsistence Clam Digging, Risk=1E-6 | Sediment PCUL to protect an adult digging clams, based on a cancer risk of 1E-6. Calculated per SMS Equation 9-1 using LDW exposure assumptions from the ROD. |
| K | Subsistence Netfishing, Risk=1E-6 | Sediment PCUL to protect an adult netfisher, based on a cancer risk of 1E-6. Calculated per SMS Equation 9-1 using LDW exposure assumptions from the ROD. |
| L | Beach Play, Risk=1E-5 | Sediment PCUL to protect a child engaged in beach play, based on a cancer risk of 1E-5. Calculated per SMS Equation 9-1 using LDW exposure assumptions from the ROD. |
| M | Subsistence Clam Digging, Risk=1E-5 | Sediment PCUL to protect an adult digging clams, based on a cancer risk of 1E-5. Calculated per SMS Equation 9-1 using LDW exposure assumptions from the ROD. |
| N | Subsistence Netfishing, Risk=1E-5 | Sediment PCUL to protect an adult netfisher, based on a cancer risk of 1E-5. Calculated per SMS Equation 9-1 using LDW exposure assumptions from the ROD. |
| O | Beach Play, HQ=1 | Sediment PCUL to protect a child engaged in beach play, based on a noncancer hazard |

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| | | quotient of 1. Calculated per SMS Equation 9-2 using LDW exposure assumptions from the ROD. |
| P | Subsistence Clam Digging, HQ=1 | Sediment PCUL to protect an adult digging clams, based on a noncancer hazard quotient of 1. Calculated per SMS Equation 9-2 using LDW exposure assumptions from the ROD. |
| Q | Subsistence Netfishing, HQ=1 | Sediment PCUL to protect an adult netfisher, based on a noncancer hazard quotient of 1. Calculated per SMS Equation 9-2 using LDW exposure assumptions from the ROD. |
| R | Lower Tier, Beach Play (1E-6 or HQ=1) | Minimum of PCULs for beach play (columns I and O). |
| S | Lower Tier, Clam Digging (1E-6 or HQ=1) | Minimum of PCULs for clam digging (columns J and P). |
| T | Lower Tier, Netfishing (1E-6 or HQ=1) | Minimum of PCULs for netfishing (columns K and Q). |
| U | Lower Tier Minimum Direct Contact Scenario | Minimum of the three scenarios (columns R-T). |
| V | Upper Tier, Beach Play (1E-5 or HQ=1) | Minimum of PCULs for beach play (columns L and O). |
| W | Upper Tier, Clam Digging (1E-5 or HQ=1) | Minimum of PCULs for clam digging (columns M and P). |
| X | Upper Tier, Netfishing (1E-5 or HQ=1) | Minimum of PCULs for netfishing (columns N and Q). |
| Y | Upper Tier Minimum Direct Contact Scenario | Minimum of the three scenarios (columns V-X). |
| AA | Select | Use X's to filter on chemicals of interest. |
| ***'SedMMA' and 'SedMMA-FW' Sheets*** | | |
| Calculates sediment contact PCULs for chemicals that cause cancer through a mutagenic mode of action, which are indicated on the Param page.<br><br>On the 'SedMMA' sheet, exposure parameters are consistent with the LDW ROD but age-dependent adjustment factors are included to account for higher risk of cancer when exposures occur during childhood. Only the child beach play scenario is evaluated, consistent with the LDW ROD. Values calculated on this page link to the 'SedEq' page. | | |

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| On the 'SedMMA-FW' sheet, exposure parameters are set to SCUM default values in Table 9-2. Child beach play, clamming, and netfishing scenarios are evaluated. Values on this page link to the 'SedEq-FW' page. | | |
| ***'AR-Det' Sheet*** | | |
| C | MTCA-B Air, Noncancer | Method B air PCUL for noncancer effects. From 'AR-Eq' sheet. |
| D | MTCA-B Air, Cancer | Method B air PCUL for cancer effects. From 'AR-Eq' sheet. |
| E | Listed on CLARC VI page? | YES indicates chemical is considered volatile for purposes of evaluating vapor intrusion. |
| F | AR-1, MTCA-B Air | Minimum of Method B PCULs for noncancer effects (column C) and cancer effects (column D). |
| G | SG-1, MTCA-B, Soil Gas, Protect Indoor Air | Method B shallow/sub-slab soil gas PCUL calculated from AR-1 (column E). Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 2 |
| H | MTCA-C Air, Noncancer | Method C air PCUL for noncancer effects. From 'AR-Eq' sheet. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| I | MTCA-C Air, Cancer | Method C air PCUL for cancer effects. From 'AR-Eq' sheet. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| J | MTCA-C Air | Minimum of Method C PCULs for noncancer effects (column H) and cancer effects (column I). Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| K | MTCA-C, Soil Gas, Protect Indoor Air, Industrial | Method C soil gas PCUL calculated from MTCA-C Air (column J). Not used for PCULs but provided for potential use in site-specific CULs or RELs. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 2 |
| L | Commercial Air, Noncancer | Commercial air PCUL for noncancer effects. From 'AR-Eq' sheet. Not used for PCULs but provided for potential use in site-specific CULs or RELs. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State* |
| M | Commercial Air, Cancer | Commercial air PCUL for cancer effects. From 'AR-Eq' sheet. Not used for PCULs but provided for potential use in site-specific CULs or RELs. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State* |
| N | Commercial Air | Minimum of commercial PCULs for noncancer effects (column L) and cancer effects (column M). Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| O | Commercial Soil Gas, Protect Indoor Air | Commercial gas PCUL calculated from Commercial Air (column N). Not used for PCULs but provided for potential use in site-specific CULs or RELs. |

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| | | Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 2 |
| P | TCE Short-Term Action Level for Cardiac Birth Defects, Commercial Worker, Air | Action level that would typically trigger additional sampling or mitigation to protect women of childbearing age working in buildings overlying the contamination. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State, Appendix A* |
| Q | TCE Short-Term Action Level for Cardiac Birth Defects, Commercial Worker, Soil Gas | Action level that would typically trigger indoor air sampling or mitigation to protect women of childbearing age working in buildings overlying the contamination. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State, Appendix A* |
| S | Select | Use X's to filter on chemicals of interest. |
| ***'AR-Eq' Sheet*** | | |
| C | RfDi | Inhalation reference dose from 'Param' sheet. |
| D | CPFi | Inhalation carcinogenic potency factor from 'Param' sheet. |
| E | MTCA-B Air, Noncancer | Method B air PCUL for noncancer effects calculated per MTCA Equation 750-1. The values for GRO and DRO are from CLARC. |
| F | MTCA-B Air, Cancer | Method B air PCUL for cancer effects calculated per MTCA Equation 750-2. |
| G | MTCA-C Air, Noncancer | Method C air PCUL for noncancer effects calculated per MTCA Equation 750-1 adjusted per WAC 173-340-750(4). Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| H | MTCA-C Air, Cancer | Method C air PCUL for cancer effects calculated per MTCA Equation 750-2 adjusted per WAC 173-340-750(4). Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| I | Commercial Air, Noncancer | Commercial air PCUL for noncancer effects calculated per VI guidance. Not used for PCULs but provided for potential use in site-specific CULs or RELs. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State* |
| J | Commercial Air, Cancer | Commercial air PCUL for cancer effects calculated per VI guidance. Not used for PCULs but provided for potential use in site-specific CULs or RELs. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State* |
| L | Select | Use X's to filter on chemicals of interest. |
| ***'SedFW' Sheet*** | | |
| C | Most Stringent Sediment PCUL | Most stringent sediment PCUL, which includes the following:<br>• SD-1: SMS lower tier freshwater benthic SCO |

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| | | • SD-2: SMS lower tier human health direct contact SCO<br>• SD-3: SMS lower tier risk-based concentration for bioaccumulatives SCO |
| D | SD-1, SMS Lower Tier Freshwater Benthic SCO | PCUL to protect freshwater benthic organisms. This PCUL should be compared to the results of individual sediment sampling locations. |
| E | SD-2, SMS Lower Tier Human Health Direct Contact SCO | PCUL to protect human sediment contact, with exposures via incidental ingestion and dermal absorption. This PCUL should be compared to spatially weighted average sediment concentrations (SWACs). |
| F | SD-3, SMS Lower Tier Risk-Based Conc. for Bioaccumulatives SCO | PCUL to protect human ingestion of fish and shellfish. This PCUL should be compared to SWACs. |
| H-J | Basis | These columns record the endpoint driving the most stringent sediment PCUL (column C). |
| L | Select | Use X's to filter on chemicals of interest. |
| ***'Hard-pH' Sheet*** | | |
| Calculates aquatic life criteria based on site-specific values for hardness and pH for seven metals and pentachlorophenol. Default values of 100 mg/L hardness and 7 pH units are used in the absence of site-specific data. | | |
| ***'SedDetFW' Sheet*** | | |
| C | PBT List | Listed as a persistent bioaccumulative toxin in WAC 173-333-310. |
| D | DMMP List 1 or 2 | Included on List 1 or List 2 in the DMMP's *Dredged Material Evaluation and Disposal Procedures User Manual*. |
| E | Bioaccumulative | Indicates which chemicals are considered bioaccumulative for the purpose of developing lower tier and upper tier sediment PCULs under SMS. A chemical is considered bioaccumulative if it appears on either the PBT list or DMMP List 1 or 2. |
| F | Lower Tier, Natural Background | The preferred source for natural background sediment concentrations is EPA's ROD Table 3. Background concentrations for additional chemicals are from SCUM II Table 10-1. |
| G | Upper Tier, Regional Background | Regional background concentration, which would be used in determining the upper tier sediment PCUL but which has not been developed. |
| H | PQL | Programmatic sediment PQL from SCUM Table 11-1. If no value is available in SCUM Table 11-1, the average value from SCUM Table D-1 is reported. |
| I | SMS Lower Tier SCO, | Benthic SCO. |

| | | |
|---|---|---|
| | Freshwater Benthic | |
| J | SMS Upper Tier CSL, Freshwater Benthic | Benthic CSL. Not currently used in any calculations in the spreadsheet. |
| K | SMS Lower Tier, Human Health Direct Contact SCO | Minimum CUL for cancer risk of 1E-6 and HQ=1 for sediment contact scenarios in SCUM. |
| L | SMS Upper Tier, Human Health, Direct Contact CSL | Minimum CUL for cancer risk of 1E-5 and HQ=1 for sediment contact scenarios in SCUM. |
| M | Lower Tier, Risk-Based Concentration for Bioaccumulatives SCO | For chemicals considered bioaccumulative (column E), the value in this column is the maximum of the natural background concentration (column F) and the PQL (column H). If neither a natural background concentration nor a numerical PQL value is available, the value in this column is "PQL". If the chemical is not considered bioaccumulative, the value in this column is "na". |
| N | Upper Tier, Risk-Based Concentration for Bioaccumulatives CSL | For chemicals considered bioaccumulative (column E), the value in this column is the maximum of the regional background concentration (column G) and the PQL (column H). If no regional background concentration is available, the natural background concentration (column D) is substituted if available. If neither a natural background concentration, a regional background, nor a numerical PQL value is available, the value in this column is "PQL". If the chemical is not considered bioaccumulative, the value in this column is "na". |
| O | Lower Tier, Risk-Based Concentration for Non-Bioaccumulatives | For nonbioaccumulative chemicals, the value in this column is the minimum of the benthic SCO (column I) and the human sediment contact SCO (column K). If the risk-based concentration falls below the PQL, it is adjusted up to the PQL. If the chemical is considered bioaccumulative, the value in this column is "na". |
| P | Upper Tier, Risk-Based Concentration for Non-Bioaccumulatives | For nonbioaccumulative chemicals, the value in this column is the minimum of the benthic CSL (column J) and the human sediment contact CSL (column L). If the risk-based concentration falls below the PQL, it is adjusted up to the PQL. If the chemical is considered bioaccumulative, the value in this column is "na". |
| Q | SMS Lower Tier, Benthic & Human Health, SCO | The lower tier PCUL under SMS is either the value in column M for bioaccumulatives or the value in column O for nonbioaccumulatives. |
| R | SMS Upper Tier, Benthic & Human Health, CSL | The upper tier PCUL under SMS is either the value in column N for bioaccumulatives or the value in column P for nonbioaccumulatives. Not used for PCULs but provided for potential use in site-specific CULs or RELs. |
| U-AB | Basis for SMS Lower Tier, | The columns record the endpoints driving the SMS lower tier SCO sediment PCUL |

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| | Basis for SMS Upper Tier | (column Q) and the SMS upper tier CSL sediment PCUL (column R). |
| AD | Select | Use X’s to filter on chemicals of interest. |

## Table 3. Abbreviations

| Acronym | Definition |
|---|---|
| AB | Gastrointestinal absorption fraction (abbreviation used in SMS) |
| AB1 | Gastrointestinal absorption fraction (abbreviation used in MTCA) |
| ABS | Dermal absorption fraction |
| ADAF | Age-dependent adjustment factor |
| AF | Sediment-skin adherence factor |
| AR | Air |
| ARAR | Applicable or relevant and appropriate requirement |
| AT | Averaging time |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| BCF | Fish bioconcentration factor |
| BEHP | Bis(2-ethylhexyl) phthalate |
| BHC | Benzene hexachloride (hexachlorocyclohexane) |
| BW | Body weight |
| CalEPA | California Environmental Protection Agency |
| CAP | Cleanup action plan |
| CAS | Chemical Abstract Service |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CLARC | Cleanup Levels and Risk Calculation database |
| COC | Chemical of concern |
| cPAH | Carcinogenic polycyclic aromatic hydrocarbon |
| CPF | Carcinogenic potency factor (also known as slope factor) |
| CPFd | Dermal CPF |
| CPFi | Inhalation CPF |
| CPFo | Oral CPF |
| CR | Target cancer risk |
| CSL | Cleanup screening level |
| CUL | Cleanup level |
| DDD | Dichlorodiphenyl dichloroethane |
| DDE | Dichlorodiphenyl dichloroethene |
| DDT | Dichlorodiphenyl trichloroethane |
| DMMP | Dredged Materials Management Program |
| DRO | Diesel range organics or diesel range hydrocarbons |
| DW | Dry weight |
| Ecology | Washington State Department of Ecology |
| ED | Exposure duration |
| EF | Exposure frequency |
| ENR | Enhanced natural recovery |
| EPA | U.S. Environmental Protection Agency |
| Eq | Equation |
| FS | Feasibility study |
| GI, GIABS | Gastrointestinal absorption conversion factor |

| Acronym | Definition |
|---|---|
| GW | Ground water |
| GRO | Gasoline range organics |
| Hcc | Henry's law constant |
| HEAST | Health Effects Assessment Summary Tables |
| HH | Human health |
| HPAH | High molecular weight polycyclic aromatic hydrocarbons |
| HQ | Noncancer hazard quotient |
| INH | Inhalation correction factor |
| IR | Ingestion rate |
| IRIS | Integrated Risk Information System |
| IUR | Inhalation unit risk |
| Kd | Soil-water partitioning coefficient |
| Koc | Organic carbon-water partitioning coefficient |
| LAET | Lowest apparent effects threshold |
| LDW | Lower Duwamish Waterway |
| LDWG | Lower Duwamish Working Group |
| LOAEL | Lowest observed adverse effect level |
| LPAH | Low molecular weight polycyclic aromatic hydrocarbons |
| MCL | Maximum contaminant level |
| MCLG | MCL goal |
| MTCA | Model Toxics Control Act |
| MTCA-B | MTCA Method B |
| MTCA-C | MTCA Method C |
| na | Not available or not applicable |
| NOAA | National Oceanic and Atmospheric Administration |
| NOAEL | No observed adverse effects level |
| NRWQC | National recommended water quality criteria |
| NTR | National toxics rule |
| OC | Organic carbon (normalized) |
| ORNL | Oak Ridge National Laboratory |
| ORO | Oil range organics or oil range hydrocarbons |
| PAH | Polycyclic aromatic hydrocarbon |
| PBT | Persistent bioaccumulative toxin |
| PCBs | Polychlorinated biphenyls |
| RAO | Remedial action objective |
| PCB | Polychlorinated biphenyl |
| PCUL | Preliminary cleanup level |
| PLP | Potentially liable party |
| PPRTV | Preliminary peer-reviewed toxicity value |
| PQL | Practical quantitation limit |
| PW | Potable water |
| RAIS | Risk Assessment Information System |

| Acronym | Definition |
|---|---|
| RAL | Remedial action level |
| RAO | Remedial action objective |
| Rec. Cat. | Recovery category |
| REL | Remediation level |
| RfC | Reference concentration |
| RfD | Reference dose |
| RfDd | Dermal RfD |
| RfDi | Inhalation RfD |
| RfDo | Oral RfD |
| RI | Remedial investigation |
| ROD | Record of decision |
| RSL | EPA's regional screening levels |
| SA | Surface area |
| SAL | State action level |
| SCO | Sediment cleanup objective |
| SCUM | Sediment Cleanup Users Manual |
| SL | Soil |
| SLU | South Lake Union |
| SMS | Sediment Management Standards |
| SQuiRT | Screening quick reference tables |
| SVOC | Semi-volatile organic compound |
| SW | Surface water |
| SWAC | Spatially weighted average concentration |
| 2,3,7,8-TCDD | 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin |
| TBD | To be determined |
| TCE | Trichloroethene (trichloroethylene) |
| TCP | Toxics Cleanup Program |
| TEE | Terrestrial ecological evaluation |
| TEF | Toxicity equivalence factor |
| TEQ | Toxicity equivalent concentration |
| TOC | Total organic carbon |
| TPH | Total petroleum hydrocarbon |
| TSCA | Toxic Substances Control Act |
| UCF | Unit conversion factor |
| 95UCL | Upper 95 percent confidence limit on the mean |
| 90/90 UTL | Upper 90 percent tolerance limit on the $90^{th}$ percentile |
| VI | Vapor intrusion |
| VOC | Volatile organic compound |
| WA | Washington State |
| WQC | Water quality criteria |
| WQP | Water Quality Program |
| WQS | Water quality standard |

| Acronym | Definition |
|---|---|
| WTR | Washington Toxics Rule, state-specific version of National Toxics Rule (NTR) |