Preliminary Cleanup Level Workbook
Supplemental Information

This supplemental information paper provides background information on and instructions for using the Preliminary Cleanup Level (PCUL) workbook. PCULs apply to Model Toxics Control Act (MTCA) sites in Ecology's Northwest Region. The PCULs cover the full range of transport and exposure pathways required by the MTCA and the Sediment Management Standards (SMS).

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 (PCUL-LDW) 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 and other data specific to the LDW.

There are also versions of the PCUL workbook for sites impacting freshwater sediment and surface water (PCUL-Fresh) and sites impacting marine sediment and surface water outside the LDW site (PCUL-Marine). These versions use default values for all parameters. Ask Priscilla Tomlinson[2] to access these versions.

The PCUL document implements the technical approach in an Ecology (2016a) policy memo regarding groundwater 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 water quality criteria (WQC) for conventional parameters
- Rationale for using Method B CULs for groundwater
- Descriptions of literature references used to estimate water concentrations protective of aquatic life.

The PCULs are calculated consistent with MTCA (173-340 WAC), SMS (173-204 WAC), and guidance associated with both regulations.

The PCUL workbook has undergone quality assurance checks. Nevertheless, users are advised to perform their own quality assurance checks. Please notify Priscilla Tomlinson if potential errors are identified.

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

2 priscilla.tomlinson@ecy.wa.gov or 425-324-0732.

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, transport pathways, and exposure pathways of potential 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, groundwater concentrations in compliance with the groundwater 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 groundwater PCUL for that chemical. A successful empirical demonstration depends on adequate data characterizing both source and receiving media. The Ecology site manager will determine whether an empirical demonstration has been met.

The PCUL document should be the starting point for developing final CULs. 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[3], benthic toxicity bioassay[4])
- Use of site-specific modeling (e.g., Reible sediment model, site-specific modeling of groundwater transport)
- Adjustments based on practical quantitation limits (PQLs)
- Adjustments to consider additive noncancer hazards and cancer risks due to multiple chemicals.

Some of these issues are discussed later in this document.

[3] WAC 173-340-730(3)(b)(iii).

[4] WAC 173-204-562(3) and -563(3).

Contents of Workbook

PCULs are calculated for a variety of environmental transport and exposure pathways. Soil PCULs are labeled SL-1 through SL-10; groundwater PCULs are labeled GW-1 through GW-5; sediment PCULs are labeled SD-1 through SD-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 that are addressed in the PCUL document include the following (Figure 1):

- Transport of contaminated groundwater to surface water (GW-2)
- Partitioning of groundwater contamination to sediment (GW-3)
- Leaching of soil contaminants to potable groundwater 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 groundwater followed by transport to surface water
- Leaching of soil contaminants from the vadose zone (SL-4) or the saturated zone (SL-7) to groundwater followed by partitioning to sediment
- Erosion of contaminated soil directly to sediment or soil carried by surface runoff and deposited 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 groundwater (GW-2) into a storm water pipe that outfalls to the river
- Intrusion of soil vapors (SG-1) or vapors from groundwater (GW-4) into a building.

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. However, if soil is protective of the leaching pathway (SL-2 through SL-4), it is expected that surface runoff will be protective of the receiving waterbody through either overland flow or transport through the stormwater system. Similarly, if soil is protective of bank erosion (SL-8), it is expected that any soil entering the stormwater system will be protective of sediment in the receiving waterbody.

Other pathways for contaminant transport to a waterbody, such as atmospheric deposition or spills directly to the waterbody, should be discussed with the site manager.

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)
Groundwater	Potable use	GW-1	--
Air	Inhalation	AR-1	--
Surface water	Direct contact	--	GW-2 (aquatic)
	Seafood consumption	GW-2	--
Sediment	Direct contact	SD-1	SD-3 (benthic)
	Seafood consumption	SD-2	SD-2 (higher trophic level)

The most stringent PCULs are identified for residential land use. Soil and air 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 soil PCULs for many chemicals are dominated by the leaching pathway; these PCULs 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 with soil (default unrestricted land use)
SL-2	Vadose zone protection of drinking water
SL-3	Vadose zone protection of surface water via groundwater
SL-4	Vadose zone protection of sediment via groundwater
SL-5	Saturated zone protection of drinking water
SL-6	Saturated zone protection of surface water via groundwater
SL-7	Saturated zone protection of sediment via groundwater
SL-8	Protection of sediment via soil erosion or surface runoff
SL-9	TEE (default site-specific TEE for unrestricted land use)
SL-10	Natural background soil 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 groundwater concentration
SD-1	Human contact with sediment (default minimum of three scenarios)
SD-2	Consumption of seafood by humans and upper trophic level receptors
SD-3	Benthic criteria
SD-4	Natural background sediment concentration
SD-5	Sediment practical quantitation limit
AR-1	Air cleanup level (default unrestricted land use)
SG-1	Soil gas screening level for protection of indoor air (default unrestricted land use)

The workbook contains the following groups of pages that contain related information.

Category	Page	Contents
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Media Summaries	SL-LDW, SL-FW, SL-M	Most conservative soil PCULs
	GW-LDW, GW-FW, GW-M	Most conservative groundwater PCULs
	SD-LDW, SD-FW, SD-M	Most conservative sediment PCULs and, in the LDW version, CULs and RALs from the LDW ROD
	AR	PCULs for air and soil gas
Background Information	Chem	Chemical names, CAS numbers, and synonyms
	Param	Chemical and toxicological parameters

Category	Page	Contents
	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 TSCA[5] ARAR values for PCBs
	SL-Eq	Calculations for MTCA Equations 740-1, 740-2, 745-1, and 745-2 (soil contact)
	Leach	Calculations for MTCA Equation 747-1 (soil leaching to groundwater)
Groundwater Calculation Support	PW	ARARs and MTCA equation values for potable water and groundwater screening levels for vapor intrusion
	SW	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)
	SW-MMA	Calculations for MTCA Equations 730-1 and 730-2 (surface water) with considerations for mutagenic mode of action
	Partit	Calculations for modified MTCA Equation 747-1, used to model partitioning between groundwater and sediment
	VI	Calculations for groundwater screening levels for protection of indoor air via vapor intrusion
Sediment Calculation Support	SD-Det	Individual inputs for sediment PCULs, including background, PQLs, benthic criteria, direct contact PCULs, and bioaccumulative PCULs
	SD-Eq	Calculations for SMS Equations 9-1 and 9-2 for three sediment contact scenarios
	SD-MMA	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.

[5] CULs 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.

Most PCUL values are calculated within the PCUL workbook, not copied from Ecology's Cleanup Levels and Risk Calculation (CLARC) website. Some PCULs differ from the values presented in CLARC due to either site-specific assumptions or slight differences in rounding. The equation values for cancer CULs for mutagenic chemicals for unrestricted soil contact (MTCA Equation 740-2) and drinking water (MTCA Equation 720-2) are copied from CLARC to reduce level of effort. The equation values for cancer CULs for mutagenic chemicals for surface water (MTCA Equation 730-2) and sediment contact (SCUM Equation 9-1) are calculated within the workbook on pages SW-MMA and SD-MMA, respectively.

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, groundwater, and sediment summary pages (SL, GW, and SD), 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. Soil, groundwater, and air PCULs are not adjusted for PQLs. Such adjustments must be made on a site-specific basis (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 as listed on the Mod page.

Assumptions Specific to the LDW

The PCUL-LDW 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 for adults is 97.5 grams/day (g/day)[6] and for children is 38.6 g/day, based on the LDW human health risk assessment (LDWG 2010).
- The exposure parameter values for human contact with sediment are from the LDW human health risk assessment (LDWG 2010).
- Sediment natural background levels for total PCB Aroclors, total dioxin/furan toxicity equivalents (TEQ), arsenic, and total carcinogenic PAH (cPAH) TEQ are from the LDW ROD.
- The modified version of the MTCA three-phase model (Equations 747-1 and 747-2) for calculating groundwater PCULs to protect sediment uses LDW-specific parameter values for fraction organic carbon, porosity, and particle density (Ecology 2016a).

Cautions on Modifications to 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 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, SD, and AR) are linked to the media detail pages (e.g., SL-Det, PW, SW, SD-Det, 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, SD-Eq, 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 on the 'Param' or 'Eqtn' pages. 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 groundwater at a site is considered potable and thus subject to MCLs.

[6] Note that the state water quality criteria for human health are based on a fish consumption rate of 175 g/day. The evaluation of the protectiveness of these ARARs is discussed under Adjustments to ARARs.

ARARs are evaluated in the workbook to determine if any adjustments are required 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; such adjustments should be performed when developing final CULs for the feasibility study or CAP.

The derivation of the groundwater PCUL for protection of potable water (GW-1) involves identifying MCLs and calculating groundwater CULs per MTCA Equations 720-1 and 720-2 using the toxicity values on the Param page, which are sourced from the CLARC database (Figure 3). If the ratio of the minimum MCL to the Equation 720-1 value does not exceed 1, the hazard quotient associated with the MCL does not exceed 1 and the MCL constitutes the PCUL for noncancer effects. 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, the cancer risk associated with the MCL does not exceed $1x10^{-5}$ and the MCL constitutes the PCUL for cancer effects. 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 oral toxicity values are available, the minimum of the values from Equations 720-1 and 720-2 constitutes the PCUL. If a chemical has no toxicity values and no MCL, there is no PCUL for potable groundwater.

Similarly, the derivation of the groundwater PCUL for protection of surface water (GW-2) involves identifying WQC and calculating groundwater CULs per MTCA Equations 730-1 and 730-2 (Figure 4)[7]. Similar ratios are calculated and adjustments made, if needed, as described above for MCLs.

All areas of Ecology's Northwest Region are part of the usual and accustomed (U&A) harvest areas of one or more tribes. The default MTCA assumptions for fish consumption rate (FCR, 54 g/day) and fish diet fraction (FDF, 0.5) are not sufficiently protective of many tribal subsistence fishers and other populations who consume higher quantities of fish and shellfish. In the PCUL-Fresh and PCUL-Marine workbooks, FCRs are taken from Appendix K of SCUM. The default FCR is 489 g/day and the default FDF is 1, representing an adult member of the Suquamish Tribe. This rate should be used for sites south of Everett. For sites in and north of Everett, the FCR may be reduced to 193 g/day, representing an adult member of the Tulalip Tribe. When calculating surface water PCULs for mutagenic chemicals, the default FCR for children ages 0-6 is 195.6 g/day (Suquamish Tribe,). For sites in and north of Everett, a child FCR of 77.2 g/day (Tulalip Tribe) may be substituted. These values are likely protective for general screening data, but the tribes whose U&A areas overlap the site should be consulted during the remedial investigation to identify the appropriate site-specific FCR.

[7] Some State or Federal WQC require adjustment because of differences in toxicity values used between TCP and WQP. TCP uses the toxicity values from IRIS, EPA's regional screening levels workbook, and additional sources 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.

For the PCUL-LDW workbook, FCR is adjusted to 97.5 g/day and the fish diet fraction is adjusted to 1 (Ecology 2016a), consistent with the LDW ROD. This value does not include salmon. When calculating surface water PCULs for mutagenic chemicals, the FCR for children ages 0-6 is 38.6 g/day, consistent with the LDW ROD.

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.

Notes on Specific Parameters

Chemical Properties

Values for chemical properties (e.g., Koc, Hcc, BCF[8]) are obtained from Ecology's CLARC database. PCULs that depend on chemical properties (e.g., leaching, vapor intrusion, fish ingestion) are not calculated for chemicals without the necessary 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. This results in different dermal toxicity parameter values between the two regulations. 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 normally used for soil contact PCULs because it is usually not necessary to evaluate the dermal pathway when using default Method B or Method C soil contact PCULs. The parameter values are provided in case an evaluation of the dermal pathway is triggered by modifications to exposure assumptions in Equations 740-1, 740-2, 745-1, or 745-2[9]. Chemical-specific parameter values were obtained from CLARC.

The SMS parameter values for ABS and GI are normally used because sediment contact PCULs automatically include the dermal pathway. Chemical-specific parameter values were obtained from SCUM Appendix K. If a semivolatile organic compound (SVOC), pesticide, or herbicide was not listed in Appendix K, ABS was assumed to be 0.1. If a volatile organic compound (VOC) was not listed, ABS was assumed to be 0. GI values for all chemicals not listed in Appendix K were assumed to be 1.

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[8] Organic carbon-water partitioning coefficient, Henry's law constant, and bioconcentration factor, respectively.

[9] WAC 173-340-740(3)(c)(iii) and -745(5)(c)(iii).

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, groundwater, 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, groundwater, and sediment where available. Potentially liable parties (PLPs) may propose natural background concentrations for additional chemicals or may propose site-specific natural background concentrations per WAC 173-340-709.

Natural soil background concentrations for most metals are from Ecology's (1994) study results for the Puget Sound Basin. Natural background values are based on the 90th percentile, the 80th percentile, or four times the median of the data set, depending on the shape of the distribution. Non-detected values in the data sets were replaced with half the detection limit. Because of limitations in the data, the values for antimony, selenium, and silver are based on state-wide datasets and the values for barium, cobalt, and vanadium are based on data sets for the Spokane Valley. The natural background concentrations of these six chemicals have a higher level of uncertainty than the others. The natural background concentration of dioxin and furan TEQ is from Ecology's (2010) Implementation Memo 8.

The natural background concentration of arsenic in groundwater (8 µg/L) is based on the upper 90 percent tolerance limit on the 90th percentile (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.

Natural background concentrations in marine sediment for most chemicals are based on the 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.

Natural background concentrations in freshwater sediment are the minimum of soil background and marine sediment background.

In the PCUL-LDW workbook, the natural background sediment concentrations for total PCB Aroclors, total dioxin/furan TEQ, arsenic, and total cPAH TEQ 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 groundwater PCUL for protection of surface water (GW-2) at sites near marine water considers State and Federal WQC for protection of aquatic life and humans consuming fish and shellfish. GW-2 for sites near fresh water considers WQC for humans consuming water, fish, and shellfish. The State WQC for protection of human health (Ecology 2016c) are shown in the column titled 'WA State WQC'. 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 (WTR)'. 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 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 PCUL-Fresh and PCUL-Marine workbooks, sediment PCULs are developed according to Ecology's guidance in SCUM. Lower tier sediment cleanup objectives (SCOs) are the default sediment PCULs. Upper tier cleanup screening levels (CSLs) are provided for use on a site-specific basis.

In the PCUL-LDW workbook, the minimum sediment CULs in the ROD are the preferred values for 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) with two exceptions. First, some chemicals were eliminated from the list of bioaccumulative chemicals because they were not selected as chemicals of concern in

the human health and ecological risk assessments for the LDW (see Additional Details for Identification of Bioaccumulative Chemicals in LDW). Second, the sediment contact exposure assumptions from the LDW human health risk assessment were used for the beach play, clamming, and netfishing scenarios. SMS CSLs and the RALs in the LDW ROD are also provided for potential use on a site-specific basis.

The LDW ROD lists six different CULs and 13 different RALs covering four different remedial action objectives and multiple depth horizons. All the CULs and RALs are provided in the 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.

Some of the benthic criteria for marine sediment are expressed in terms of organic carbon (OC) normalized concentrations. When evaluating whether sediment complies with benthic criteria, the OC-normalized criteria should be used if the total organic carbon (TOC) in sediment falls between 0.5 and 3.5 percent. If the TOC is outside this range, lowest apparent effects thresholds (LAETs), which are expressed in terms of dry weight, should be used instead. The decision whether to use OC-normalized criteria or LAET is made on a sample-specific basis.

OC normalized criteria are not comparable to sediment CULs expressed in dry weight. Groundwater-sediment partitioning cannot be calculated using OC normalized values. The LAET values are used for calculating groundwater PCULs to protect sediment for all chemicals with benthic criteria.

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-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 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 'SedDet' page.

For the PCUL-Fresh and PCUL-Marine workbooks, 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 2021) (24 analytes).

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

In the PCUL-LDW 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, 21 analytes are identified as present in LDW seafood at levels of potential concern.

The following analytes are identified as bioaccumulative in the PCUL-LDW 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 PCUL-Fresh and PCUL-Marine workbooks is longer.

The SCO concentration for a bioaccumulative chemical is set to the higher of natural background and the PQL. The CSL 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".

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 all 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 the listed chemicals to be potentially present in LDW seafood. All these chemicals are also considered bioaccumulative.

Soil PCULs to Protect Groundwater

MTCA Equation 747-1, shown below, is used to calculate soil PCULs protective of groundwater via the leaching pathway (SL-2 through SL-7, Figure 6) on the 'Leach' page 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 groundwater (mg/kg) (chemical-specific)
C_{gw} = Groundwater PCUL (µg/L) (chemical-specific, could be for protection of drinking water, surface water, or sediment)
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)
θ_w = Water-filled porosity (0.3 ml/ml for vadose zone, 0.43 ml/ml for saturated zone)
θ_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)
ρ_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}, θ_w, θ_a, and ρ_b if approved by the site manager.

Soil PCULs for protection of groundwater are calculated separately for the vadose and the saturated zones because of different default assumptions for DF, θ_w, and θ_a. Because groundwater 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 big driver in the three-phase partitioning model, so this approach is not expected to add much uncertainty.

Groundwater PCULs to Protect Sediment

The following modified version of the MTCA three-phase model is used to calculate groundwater PCULs protective of sediment on the 'Partit' page. 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 groundwater 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} = Groundwater 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)
θ_w = Water-filled porosity (0.615 ml/ml for LDW [LDWG 2010], 0.43 ml/ml for other sites)
ρ_b = Dry sediment bulk density (1.02 kg/L for LDW [Ecology 2016a)], 1.5 kg/L for other sites)

For the PCUL-LDW 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 PCUL-Fresh and PCUL-Marine workbooks, the default value of 0.001 g/g is used. Site-specific values may be used for f_{oc}, θ_w, and ρ_b if approved by the site manager.

As discussed above in Sediment PCULs, LAET values are incorporated into the sediment PCULs for the purpose of calculating default groundwater PCULs to screen data in the remedial investigation. When developing site-specific groundwater CULs for the feasibility study or CAP, benthic criteria expressed as OC-normalized can be handled differently. Replace the Kd

value in the equation above with Koc and eliminate the θ_w/ρ_b term. 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, pore-space air, 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 groundwater 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 groundwater 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[10]. 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.

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

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 as a general, default scenario. However, the modified three-phase model is likely to be conservative when applied to groundwater-sediment partitioning. It will overestimate contaminant adsorption to sediments and thus provide a groundwater PCUL that is lower (more protective) than necessary.

Soil PCULs to protect sediment are derived by using two modeling steps in tandem. First the groundwater 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 groundwater 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 groundwater 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, groundwater, and sediment concentrations, should be considered when developing final soil and groundwater 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 groundwater screening levels for protection of indoor air at industrial sites. These PCULs are not intended to be used for initial screening of soil and groundwater data. They are provided for potential use when developing site-specific soil CULs or RELs at sites that qualify for 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 or commercial.

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 to use Method C for groundwater or surface water (WAC 173-340-706(1)(a)) are rarely met. Any proposal to use Method C for groundwater or surface water must be approved by the site manager.

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 or for commercial or industrial land use.

Note that if a site conducts a site-specific TEE, PCULs for the TEE are needed for all chemicals detected in soil, not just the chemicals listed in MTCA Table 749-3. Work with the Ecology site manager to fill in the data gaps. On the other hand, if a site uses a simplified TEE, only the chemicals listed in MTCA Table 749-2 need to be evaluated in the TEE. If a chemical is listed in Table 749-2 without screening levels, consult with the site manager. It might be necessary to conduct bioassays.

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 heart defects in a developing fetus. The damage can occur early in pregnancy, possibly before the pregnancy is recognized. Vapor intrusion 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 screening levels for soil gas and groundwater are provided in the workbook for both unrestricted land use and commercial/industrial land use. If soil gas or groundwater concentrations exceed the screening levels, additional data should be collected quickly to verify whether the exposure pathway is complete. Short-term action levels for air are also provided. If air concentrations exceed the action levels, rapid response is necessary to collect additional data and possibly mitigate exposures.

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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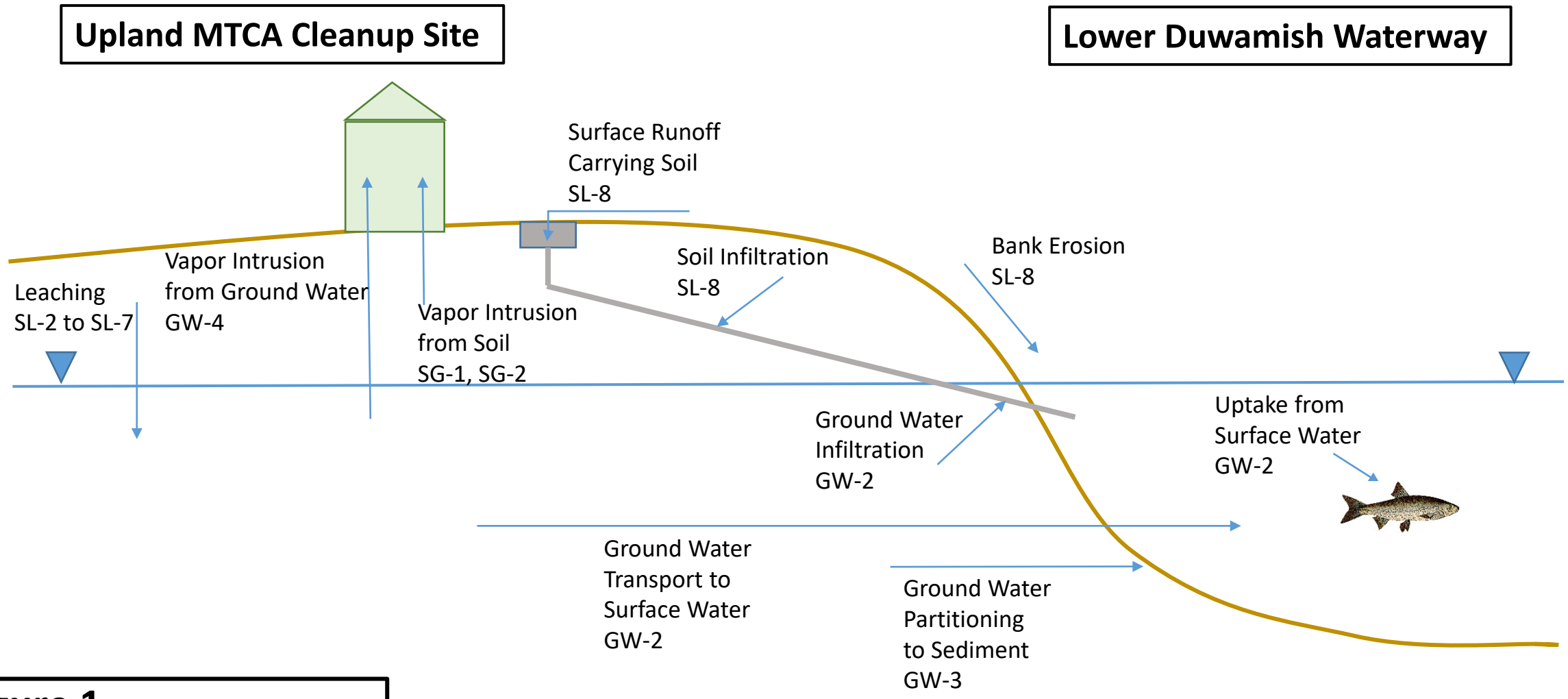

Figure 1.
Transport Pathways

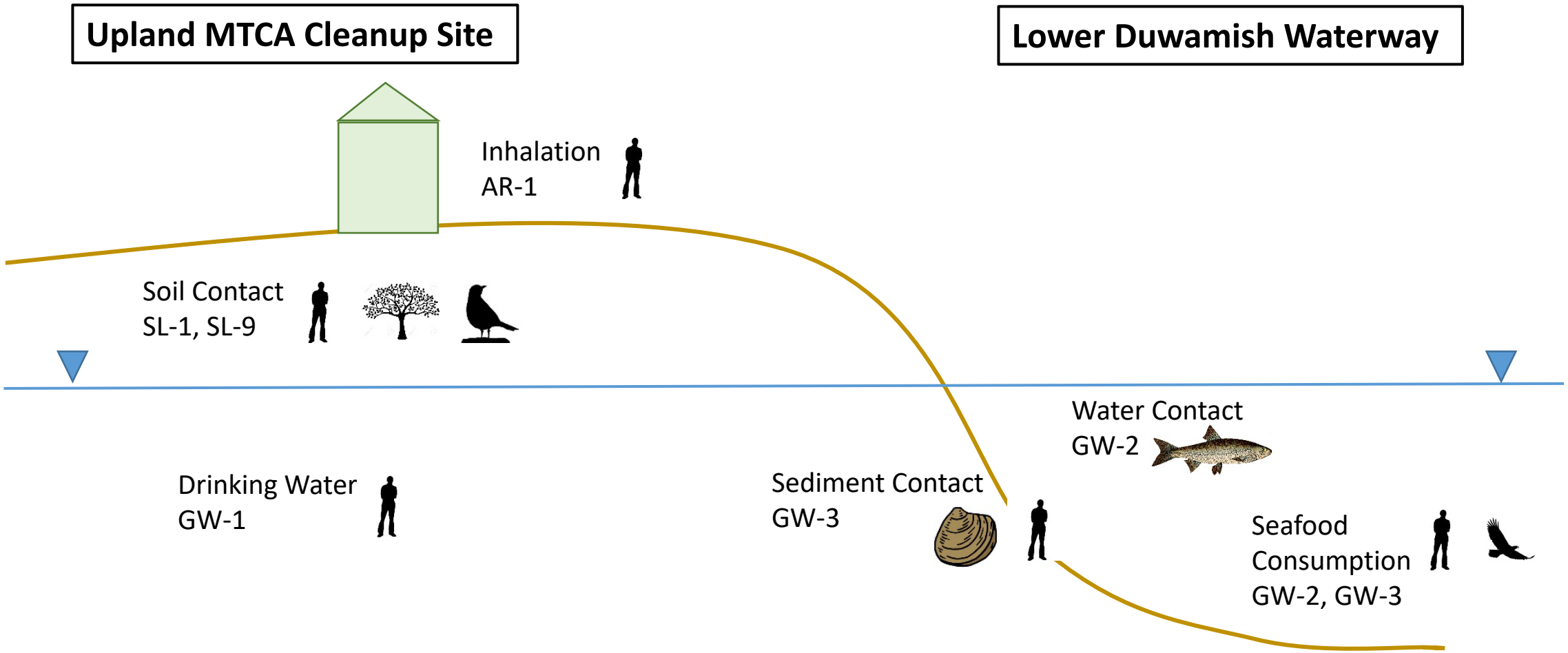

Figure 2.
Exposure Pathways

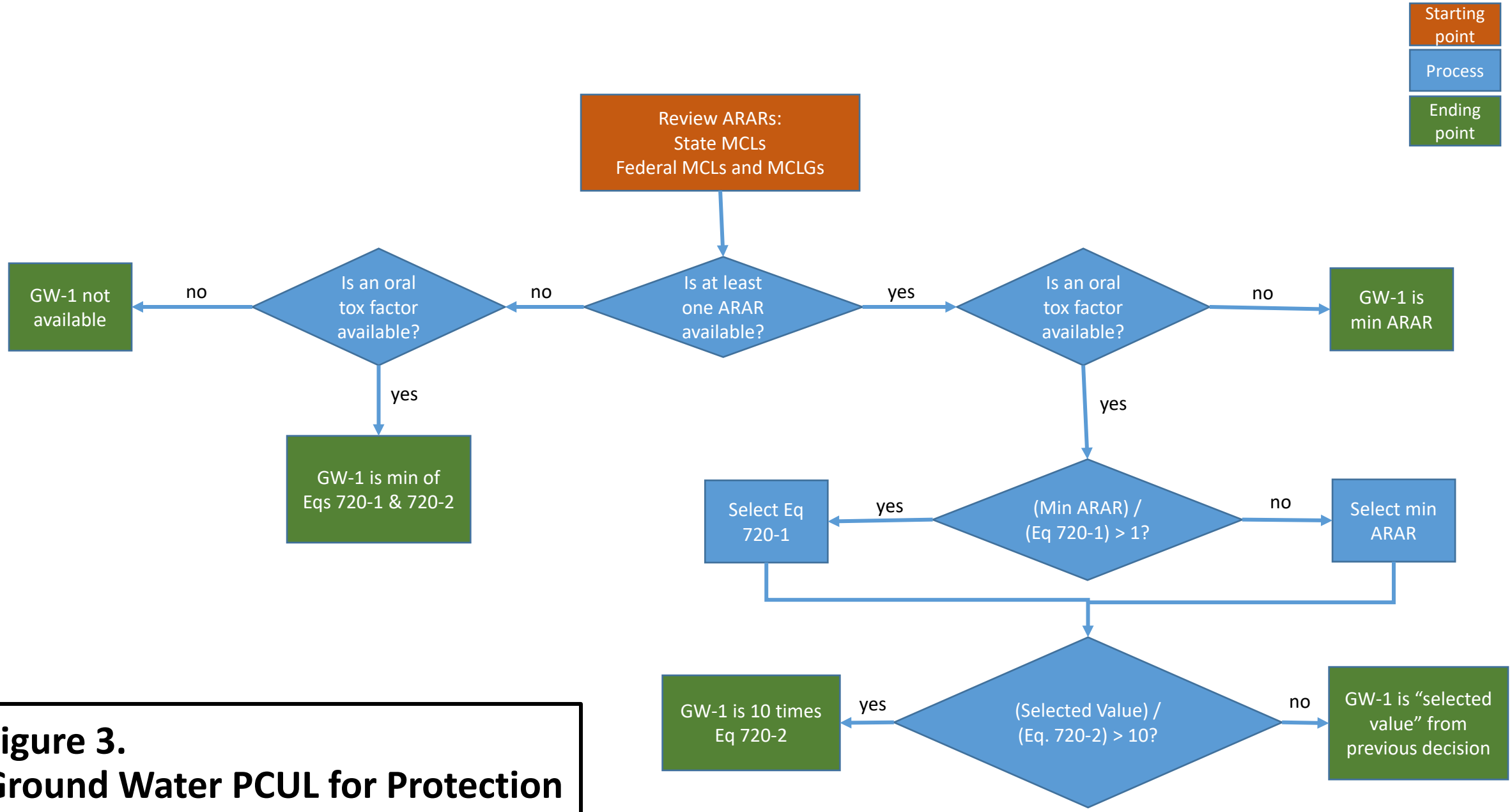

Figure 3.
Ground Water PCUL for Protection of Drinking Water

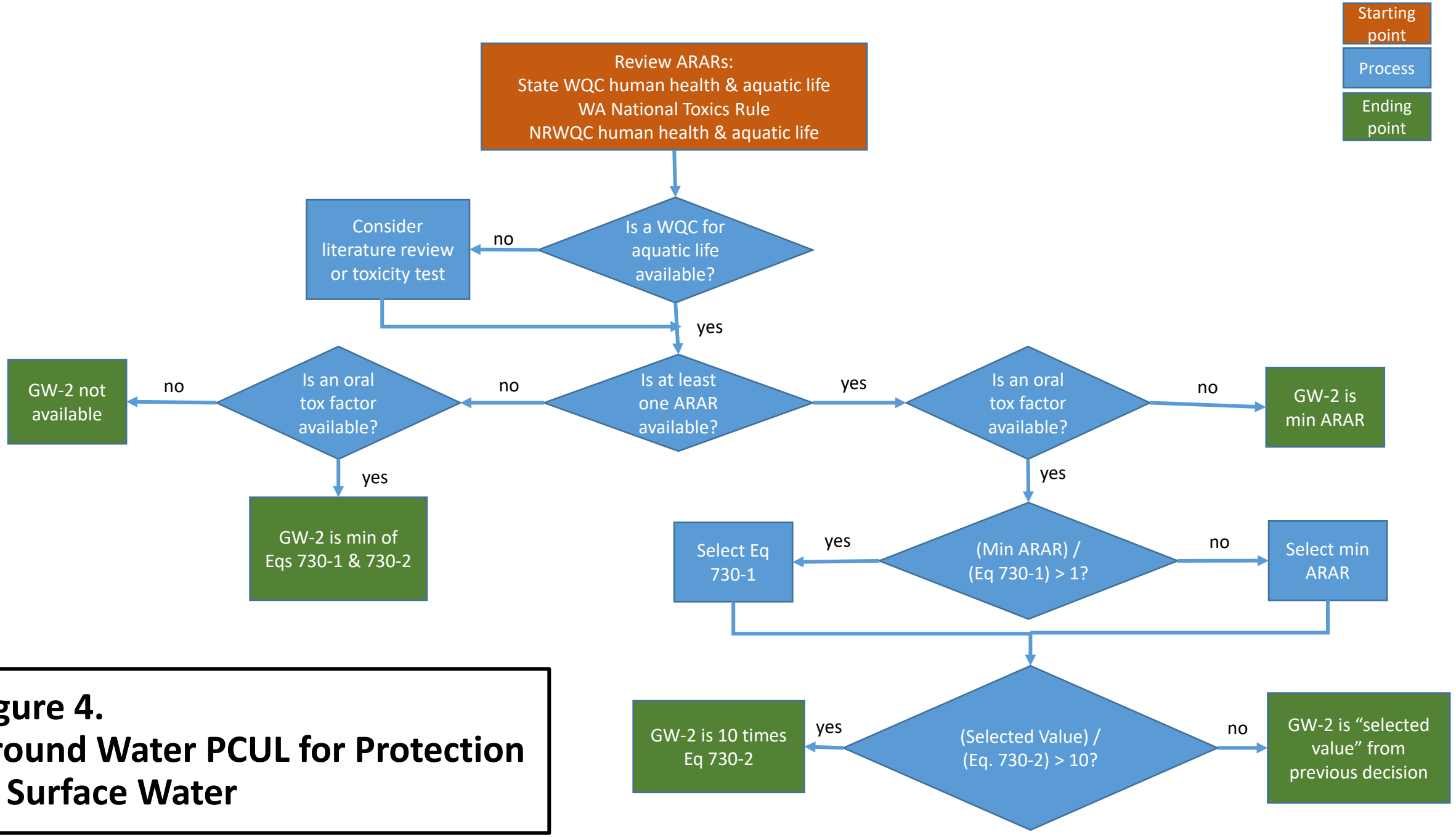

Figure 4.
Ground Water PCUL for Protection of Surface Water

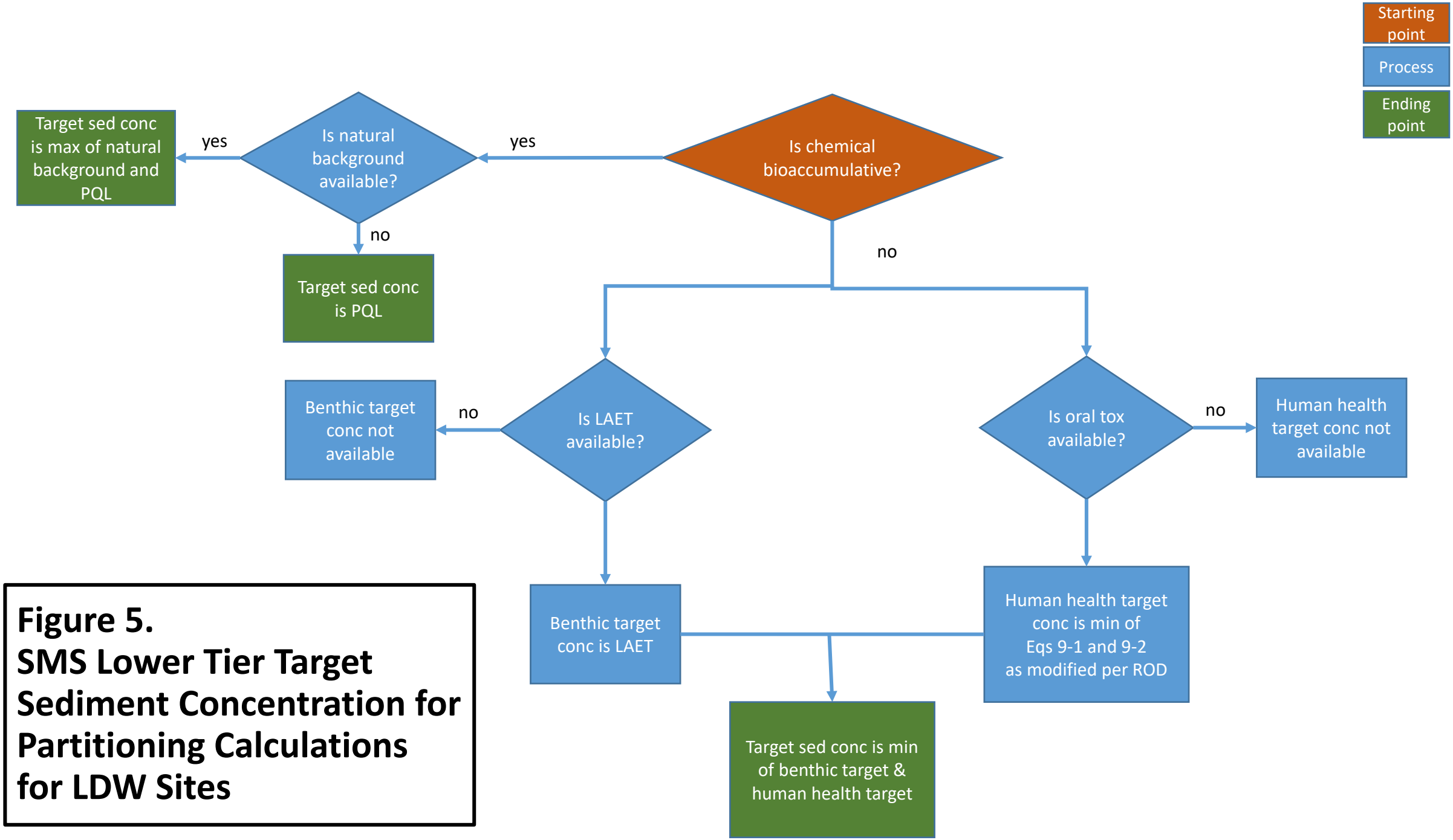

Figure 5.
SMS Lower Tier Target Sediment Concentration for Partitioning Calculations for LDW Sites

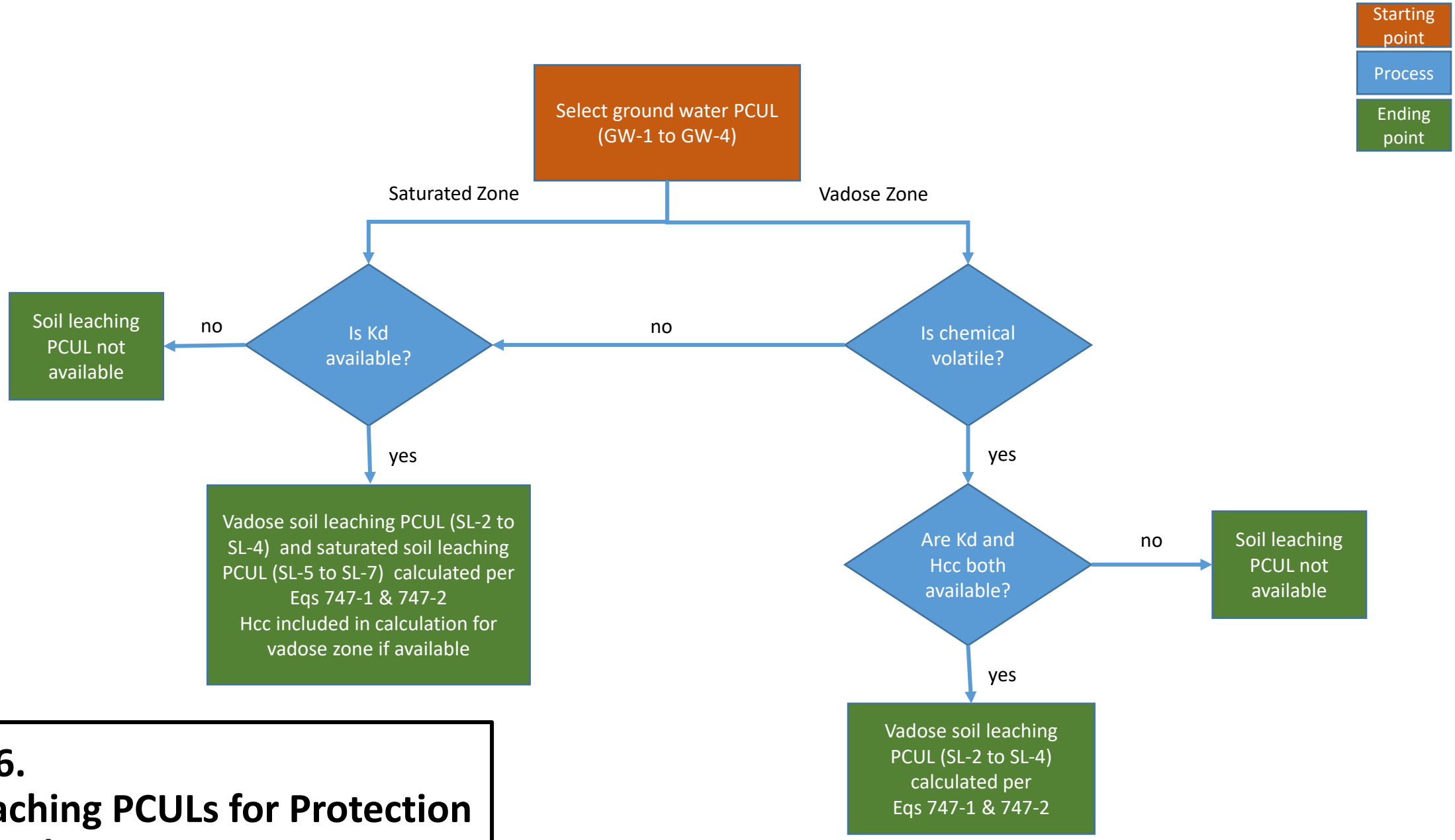

Figure 6.
Soil Leaching PCULs for Protection of Ground Water

Table 1. Notes on Individual Analytes

Analyte	Notes
Mutagenic carcinogens: Hexavalent chromium Benzo(a)pyrene Total cPAH TEQ Benzidine n-Nitrosodimethyl-amine 1,2-Dibromo-3-chloropropane Ethylene oxide Formaldehyde Methylene chloride Trichloroethene 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 SLUG 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 that are bioaccumulative 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 this 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. Ecology (2015b)
Dioxins and furans	To determine compliance for surface water human health, two standards must be met: • Under the NRWQC, the water quality criterion for 2,3,7,8-TCDD must be met. • 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. 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. Ecology (2015c)
Cyanide (multiple forms)	Cyanide may be reported as total (includes some complexes that have little or no bioavailability), free, and weak acid dissociable (WAD, which includes some metal complexes). Notes in individual cells on the PW and SW pages indicate which forms of cyanide should be analyzed for compliance. State WQC for aquatic life are based on WAD. EPA WQC for aquatic life are based on free, but WAD may be used for measuring compliance. WQC for human health are based on total. If a substantial amount of cyanide in the water body is complexed, work with Ecology on evaluating compliance on a site-specific basis. MCLs are based on free cyanide.
Fluoride	PCULs listed for fluoride may also be used for hydrogen fluoride (CAS 7664-39-3), sodium fluoride (CAS 7681-49-4), and fluorine gas (7782-41-4).
Aluminum	Freshwater aquatic life criteria are based on EPA Level II ecoregions. The value of 302 ug/L shown in the PCUL workbook is for Marine West Coast Forest (Puget lowlands). For Western Cordillera (mountains), the value is 180 ug/L.
Arsenic	The toxicity values are for inorganic arsenic. The TEE screening levels are the minimum for arsenic V, the most common form found in soil. If site-specific data are available to determine the form of arsenic, the TEE screening levels specific to that form should be used. 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 of 0.001 mg/kg-day 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 of 0.0005 mg/kg-day for cadmium in water is hand-entered into the MTCA Equation 720-1 calculation rather than calling the value from the Param page.
Chromium	Separate lines are provided for total, trivalent, and hexavalent chromium. If site history suggests that hexavalent chromium could

Analyte	Notes
	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.
Copper	Freshwater aquatic life criteria are based on EPA Level II ecoregions. The value of 1.8 ug/L shown in the PCUL workbook is for Marine West Coast Forest (Puget lowlands). For Western Cordillera (mountains), the value is 1.2 ug/L.
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. Site-specific CULs can be calculated using EPA's Integrated Exposure Uptake Biokinetic model, but this is rarely done.
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. If manganese had a BCF that would allow calculation of Equation 730-2, the RfD of 0.14 mg/kg-day would be used.
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.
Selenium	The aquatic life criteria for freshwater depend on whether the water body is lentic (standing water in lakes and ponds) or lotic (flowing in rivers and streams). The minimum value of 1.5 ug/L for lentic water is shown in the PCUL workbook. The value for lotic water is 3.1 ug/L.
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.
Cadmium Chromium III Lead Nickel Silver Zinc	The aquatic life criteria for fresh surface water are based on hardness of 100 mg/L. Site-specific state and federal criteria may be calculated using site data for hardness.
cPAHs	Method B cancer equation values for all media account for mutagenicity as discussed in the first row of this table. Method C cancer equation values for soil and air do not account for mutagenicity because they apply to adult worker exposures. 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 other individual cPAHs. To determine compliance for drinking water, two standards must be

Analyte	Notes
	met: • Under the SDWA and State MCLs, the MCL for benzo(a)pyrene must be met • Under MTCA, the total cPAH TEQ must meet the CUL for benzo(a)pyrene. To determine compliance for surface water, two standards must be met: • Under the NRWQC, the WTR, and the State water quality rule, the water quality criteria for each individual cPAH must be met. • Under MTCA, the total cPAH TEQ must meet the CUL calculated for benzo(a)pyrene. To determine compliance for sediment, two standards must be met: • The benthic criterion for each individual cPAH must be met. • The total cPAH TEQ must meet the PCULs calculated for benzo(a)pyrene based on direct contact and seafood consumption. Despite the fact that we have surface water and sediment PCULs for individual cPAHs, soil leaching PCULs to protect these media are calculated only for cPAH TEQ per direction from the Policy Unit. 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 (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. Ecology (2016d)
Pentachlorophenol	The aquatic life criteria for fresh surface water are based on pH of 7.8. Site-specific state and federal criteria may be calculated using site data for pH.
Benzoic acid 2-Chlorophenol 2,4-Dichlorophenol 2,4-Dinitrophenol Pentachlorophenol 2,3,4,6-Tetrachlorophenol 2,4,5-Trichlorophenol 2,4,6-Trichlorphenol	The Koc values on the Param page are based on soil pH of 6.8. Koc values for pH 4.9 and 8.0 are available in MTCA Table 747-2.
Bromoform,	The MCLs listed on ‘PW” are 80 µg/L for each of these chemicals.

<table>
<tr><th>Analyte</th><th>Notes</th></tr>
<tr><td>chloroform, dibromochloromethane, dichlorobromomethane</td><td>In addition, 80 µg/L is the MCL for the total of these chemicals.</td></tr>
<tr><td>cis- and trans-1,3-Dichloropropene</td><td>The WQC values shown on the ‘SW’ sheet are from the CLARC row for 1,3-dichloropropene.</td></tr>
<tr><td>Xylenes</td><td>Refers to the sum of all isomers (ortho, meta, and para).</td></tr>
<tr><td>Vinyl chloride</td><td>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.</td></tr>
<tr><td>Per- and polyfluoroalkyl substances (PFAS)</td><td>PFAS are listed as their free acid forms, consistent with the naming conventions in EPA’s analytical methods and as reported by labs. The physical and chemical data are based on anionic forms, which are most commonly found in the environment. PCULs apply to both free acids and anions.

EPA’s MCL (drinking water standard) for GenX, PFBS, PFHxS, and PFNA involves calculating a hazard index. CLARC has a PFAS HI Calculation Tool to help you calculate the HI.

PFOS and PFOA have water quality criteria for aquatic life based on both water concentrations (shown in the PCUL workbook) and tissue concentrations (provided here). Both criteria are independently applicable and neither takes primacy.

Tissue Wet Weight Criteria (mg/kg ww)
<table>
<tr><th rowspan="2">Tissue Type</th><th colspan="2">PFOS</th><th colspan="2">PFOA</th></tr>
<tr><th>EPA</th><th>Ecology</th><th>EPA</th><th>Ecology</th></tr>
<tr><td>Invertebrate whole body</td><td>0.028</td><td>0.937</td><td>1.18</td><td>1.11</td></tr>
<tr><td>Fish whole body</td><td>0.201</td><td>6.75</td><td>6.49</td><td>6.1</td></tr>
<tr><td>Fish muscle</td><td>0.087</td><td>2.91</td><td>0.133</td><td>0.125</td></tr>
</table></td></tr>
<tr><td>Petroleum hydrocarbons</td><td>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</td></tr>
</table>

<table>
<tr><th>Analyte</th><th>Notes</th></tr>
<tr><td></td><td>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.

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.</td></tr>
<tr><td>Gasoline range hydrocarbons</td><td>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.</td></tr>
<tr><td>Diesel and oil range hydrocarbons</td><td>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.</td></tr>
<tr><td>Jet fuel</td><td>Use the PCULs for DRO.</td></tr>
<tr><td>alpha-BHC, beta-BHC, delta-BHC, and lindane (gamma-BHC)</td><td>The TEE screening levels are from benzene hexachloride.</td></tr>
<tr><td>cis- and trans-Chlordane</td><td>The chemical characteristics, toxicity data, and TEE screening levels are from CLARC row for chlordane.</td></tr>
<tr><td>Endosulfan</td><td>Labs report two isomers, endosulfan I (alpha-endosulfan) and endosulfan II (beta-endosulfan). The human health toxicity values for endosulfan include both isomers. The BCF for endosulfan includes both endosulfan isomers and endosulfan sulfate. Here's how to compare endosulfan results with the PCULs.
<table>
<tr><th>Medium</th><th>Endo-sulfan Sulfate</th><th>alpha-Endo-sulfan</th><th>beta-Endo-sulfan</th><th>Sum of alpha & beta</th><th>Sum of alpha, beta, & sulfate</th></tr>
<tr><td>Soil</td><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>Ground-water</td><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>Surface water</td><td>HH criteria</td><td>HH criteria</td><td>HH criteria</td><td>Aq life criteria</td><td>Method B eq. value</td></tr>
</table></td></tr>
<tr><td>Heptachlor, heptachlor</td><td>The TEE screening levels shown for the individual analytes should</td></tr>
</table>

Analyte	Notes
epoxide	be applied to the total of the two analytes.

Additional notes on individual analytes related to specific parameters are discussed 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	Page	Page(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-LDW', 'SL-FW', and 'SL-M' Pages
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: • SL-1: Direct human contact with soil • SL-2: Leaching from vadose zone to protect drinking water • SL-3: Leaching from vadose zone to protect surface water via ground water • SL-4: Leaching from vadose zone to protect sediment via ground water • SL-8: Protection of sediment via bank erosion • SL-9: Site-specific TEE for unrestricted land use. 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: • SL-1: Direct human contact with soil • SL-5: Leaching from saturated zone to protect drinking water • SL-6: Leaching from saturated zone to protect surface water via ground water • SL-7: Leaching from saturated zone to protect sediment via ground water • SL-8: Protection of sediment via bank erosion • SL-9: Site-specific TEE for unrestricted land use. If the minimum PCUL is below the natural background concentration (SL-10), it is

Column	Title	Notes
		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: • SL-1: Direct human contact with soil • SL-3: Leaching from vadose zone to protect surface water via ground water • SL-4: Leaching from vadose zone to protect sediment via ground water • SL-8: Protection of sediment via bank erosion • SL-9: Site-specific TEE for unrestricted land use. 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: • SL-1: Direct human contact with soil • SL-6: Leaching from saturated zone to protect surface water via ground water • SL-7: Leaching from saturated zone to protect sediment via ground water • SL-8: Protection of sediment via bank erosion • SL-9: Site-specific TEE for unrestricted land use. 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 including the desired SL PCULs. List the SL numbers included in the column heading.
H	SL-1, Direct Contact	PCUL for direct human contact with soil. From SL-Det page. 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 Leach page. 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 Leach page. 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 sediment via ground water. From Leach page.

Column	Title	Notes
		WAC 173-340-740(3)(b)(iii)(A), -747(4)
L	SL-5, Protect Drinking Water, Saturated Zone	Leaching PCUL for saturated zone soil to protect drinking water. From Leach page. 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 Leach page. 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 sediment via groundwater. From Leach page. 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 or surface runoff, based on LAET values. From SD-Det page. 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 SL-Det page. 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*. 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.
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.
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.
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.
AT	Select	Use X's to filter on chemicals of interest.
'GW-LDW', GW-FW' and 'GW-M' Pages		
C	Most Stringent PCUL,	Most stringent ground water PCUL for potable ground water, which includes the

Column	Title	Notes
	Potable Water	following endpoints: • GW-1: Drinking water • GW-2: Protection of surface water • GW-3: Protection of sediment • GW-4: Protection of indoor air via vapor intrusion. 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: • GW-2: Protection of surface water • GW-3: Protection of sediment • GW-4: Protection of indoor air via vapor intrusion. 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 including the desired GW PCULs. List the GW numbers included in the column heading.
F	GW-1, Protect Drinking Water	PCUL for drinking water. From PW page. 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 SW page. WAC 173-340-720(1)(c)
H	GW-3, Protect Sediment	PCUL to protect sediment. From Partit page. WAC 173-340-720(1)(c)
I	GW-4, Protect Indoor Air	PCL to protect indoor air via vapor intrusion. From PW page. 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. 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 for the Puget Sound Basin (Ecology 2022a). Sites in Island County may use 13.3 ug/l and sites in portions of Snohomish County may use 13.6 ug/L (Ecology 2022a). No other natural background

Column	Title	Notes
		ground water concentrations have been established. 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.
R-U	Basis – Nonpotable GW	These columns record the endpoint driving the most stringent PCUL for nonpotable ground water.
W	Select	Use X's to filter on chemicals of interest.
'SD-LDW' Page		
C	Contact & Bioaccum. for Sed Data Eval, Dry Weight, SWAC	Minimum of ROD RAOs 1 and 2 (SD-1,2-ROD) if available, otherwise minimum of SMS direct contact (SD-1) and seafood consumption (SD-2). Adjusted up to natural background (SD-4) or PQL (SD-5) if applicable. These PCULs are expressed as dry weight and apply to spatially weighted average concentrations (SWACs). SCUM Section 6.3.4.2
D	Benthic Criterion for Sed Data Eval, Dry Weight, Point by Point	ROD dry weight benthic criterion (SD-3a-ROD) if available, otherwise SMS benthic dry weight criterion (SD-3a). These PCULs are expressed as dry weight and apply on a point by point basis.
E	Benthic Criterion for Sed Data Eval, OC Normalized, Point by Point	ROD organic carbon (OC) normalized benthic criterion (SD-3b-ROD) if available, otherwise SCUM OC normalized benthic criterion (SD-3b). These PCULs are expressed as OC normalized and apply on a point by point basis.
F	Min. Sediment PCUL for Partition Calcs, Dry Weight	Sediment PCUL used for calculating groundwater PCULs for protection of sediment. Can also be used for screening sediment data initially to select chemicals of concern. From SD-Det page.
G	Bioaccumulative	Indicates whether chemical is considered bioaccumulative for the purpose of developing sediment PCULs in the LDW. Refer to the supplement information document for details. Human health direct contact PCULs (SD-1) and seafood consumption PCULs (SD-2) are calculated only for bioaccumulative chemicals. From SD-Det page.
H	Sed-1, SMS-Based Direct Contact SCO	Minimum of sediment contact CULs for beach play, clamming, and netfishing. Calculated using the exposure assumptions from the ROD. From SD-Det page. SCUM Section 9.2
I	Sed-2, SMS Lower Tier Bioaccumulative SCO	Maximum of natural background (SD-4) and PQL (SD-5). From SD-Det page. LDW human health risk assessment, SCUM Section 9.2

Column	Title	Notes
J	Sed-3a, SMS Lower Tier Marine Benthic SCO, Dry Weight	SMS benthic criteria expressed in dry weight. From SD-Det page. SCUM Table 8-1
K	Sed-3b, SMS Lower Tier Marine Benthic SCO, OC Normalized	SMS benthic criteria expressed as OC normalized. From SD-Det page. SCUM Table 8-1
L	Sed-1,2-ROD, Min. LDW ROD CUL, RAOs 1,2,4	Minimum of CULs for remedial action objectives 1, 2, and 4, which includes seafood consumption, sediment contact, and upper trophic level receptors. From SD-Det page. ROD Table 19
M	Sed-3a-ROD, LDW ROD Benthic CUL, RAO 3	ROD benthic criteria expressed in dry weight. From SD-Det page. ROD Table 20
N	Sed-3b-ROD, LDW ROD Benthic CUL, RAO 3	ROD benthic criteria expressed as OC normalized. From SD-Det page. ROD Table 20
O	Sed-4, Natural Background	Natural background concentration for the LDW. From SD-Det page, which calls from the Param page. LDW ROD Table 3 and SCUM Table 10-1
P	Sed-5, PQL	Practical quantitation limit for sediment. From SD-Det page. SCUM Tables 11-1, D-1
R-X	Basis – PCUL for Partitioning Calc.	These columns record the endpoint driving the PCUL for partitioning calculations.
Z	Select	Use X's to filter on chemicals of interest.
'SD-FW' Page		
Note all freshwater sediment PCULs are expressed as dry weight.		
C	Contact & Bioaccum. for Sed Data Eval, SWAC	Minimum of SMS direct contact (SD-1) and seafood consumption (SD-2). Adjusted up to natural background (SD-4) or PQL (SD-5) if applicable. These PCULs apply to spatially weighted average concentrations (SWACs). SCUM Section 6.3.4.2
D	Benthic Criterion for Sed Data Eval, Point by Point	SMS benthic criterion (SD-3). These PCULs apply on a point by point basis.
E	Min. Sediment PCUL for Partition Calcs, Dry Weight	Sediment PCUL used for calculating groundwater PCULs for protection of sediment. Can also be used for screening sediment data initially to select chemicals of concern.

Column	Title	Notes
		From SD-Det page.
F	Bioaccumulative	Indicates whether chemical is considered bioaccumulative for the purpose of developing sediment PCULs. Refer to the supplement information document for details. Human health direct contact PCULs (SD-1) and seafood consumption PCULs (SD-2) are calculated only for bioaccumulative chemicals. From SD-Det page.
G	Sed-1, SMS-Based Direct Contact SCO	Minimum of sediment contact CULs for beach play, clamming, and netfishing. Calculated using the exposure assumptions from SCUM. From SD-Det page. SCUM Section 9.2
H	Sed-2, SMS Lower Tier Bioaccumulative SCO	Maximum of natural background (SD-4) and PQL (SD-5). From SD-Det page. SCUM Section 9.2
I	Sed-3, SMS Lower Tier Marine Benthic SCO	SMS benthic criteria. From SD-Det page. SCUM Table 8-1
J	Sed-4, Natural Background	Natural background concentration for freshwater sediment. From SD-Det page, which calls from the Param page. LDW ROD Table 3 and SCUM Table 10-1
K	Sed-5, PQL	Practical quantitation limit for sediment. From SD-Det page. SCUM Tables 11-1, D-1
M-P	Basis – PCUL for Partitioning Calc.	These columns record the endpoint driving the PCUL for partitioning calculations.
R	Select	Use X's to filter on chemicals of interest.
'SD-M' Page		
C	Contact & Bioaccum. for Sed Data Eval, Dry Weight, SWAC	Minimum of SMS direct contact (SD-1) and seafood consumption (SD-2). Adjusted up to natural background (SD-4) or PQL (SD-5) if applicable. These PCULs are expressed as dry weight and apply to spatially weighted average concentrations (SWACs). SCUM Section 6.3.4.2
D	Benthic Criterion for Sed Data Eval, Dry Weight, Point by Point	SMS benthic dry weight criterion (SD-3a). These PCULs are expressed as dry weight and apply on a point by point basis.
E	Benthic Criterion for Sed Data Eval, OC Normalized, Point by Point	SCUM OC normalized benthic criterion (SD-3b). These PCULs are expressed as OC normalized and apply on a point by point basis.

Column	Title	Notes
F	Min. Sediment PCUL for Partition Calcs, Dry Weight	Sediment PCUL used for calculating groundwater PCULs for protection of sediment. Can also be used for screening sediment data initially to select chemicals of concern. From SD-Det page.
G	Bioaccumulative	Indicates whether chemical is considered bioaccumulative for the purpose of developing sediment PCULs. Refer to the supplement information document for details. Human health direct contact PCULs (SD-1) and seafood consumption PCULs (SD-2) are calculated only for bioaccumulative chemicals. From SD-Det page.
H	Sed-1, SMS-Based Direct Contact SCO	Minimum of sediment contact CULs for beach play, clamming, and netfishing. Calculated using the exposure assumptions from SCUM. From SD-Det page. SCUM Section 9.2
I	Sed-2, SMS Lower Tier Bioaccumulative SCO	Maximum of natural background (SD-4) and PQL (SD-5). From SD-Det page. SCUM Section 9.2
J	Sed-3a, SMS Lower Tier Marine Benthic SCO, Dry Weight	SMS benthic criteria expressed in dry weight. From SD-Det page. SCUM Table 8-1
K	Sed-3b, SMS Lower Tier Marine Benthic SCO, OC Normalized	SMS benthic criteria expressed as OC normalized. From SD-Det page. SCUM Table 8-1
L	Sed-4, Natural Background	Natural background concentration for marine sediment. From SD-Det page, which calls from the Param page. LDW ROD Table 3 and SCUM Table 10-1
M	Sed-5, PQL	Practical quantitation limit for sediment. From SD-Det page. SCUM Tables 11-1, D-1
O-S	Basis – PCUL for Partitioning Calc.	These columns record the endpoint driving the PCUL for partitioning calculations.
U	Select	Use X's to filter on chemicals of interest.
'AR' Page		
C	AR-1, Indoor Air PCUL	Method B PCUL for indoor air. From AR-Det page. WAC 173-340-750(3)(b)(ii)
D	TCE Short-Term Air Action Level for Cardiac Birth	Action level that would typically trigger further sampling or mitigation to protect women of childbearing age.

Column	Title	Notes
	Defects, Unrestricted	Ecology's (2020) *Vapor Intrusion Guidance, Appendix A*
E	SG-1, Soil Gas Screening Level, Protect Indoor Air, Unrestricted	Method B PCUL for soil gas to protect indoor air. From AR-Det page. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Equation 2
F	TCE Short-Term Soil Gas 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. 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' Page		
B	Chemical	Not all chemicals listed in CLARC have been included; the selected list of chemicals is based on those most frequently analyzed at cleanup sites. The remedial investigation should include all chemicals listed in CLARC that are suspected of being present at the site. 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.
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. Some organic chemicals also have commonly used abbreviations.
G	Synonyms	If a synonym was encountered while searching for chemical-specific information, it is recorded here. For a complete list of synonyms, see the rightmost column of the Master CLARC Spreadsheet page in CLARC.
I	Select	Use X's to filter on chemicals of interest.
'Param' Page in PCUL-LDW Workbook		
C	Koc	Soil organic carbon-water partitioning coefficient (Koc) from CLARC for organic chemicals. Values listed in CLARC for ionizing organics are from MTCA Table 747-2. The default soil pH assumed for CLARC and PCULs is 6.8. Koc's for ionizing

Column	Title	Notes
		organics at other soil pHs are available in EPA (1996) Table C-2 and would need to be hand-entered in individual cells in this column. Ionizing organics include benzoic acid, 2-chlorophenol, 2,4-dichlorophenol, 2,4-dinitrophenol, pentachlorophenol, 2,3,4,5-tetrachlorophenol, 2,3,4,6-tetrachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol.
D	Kd Inorganics at Soil pH 6.8	Soil-water distribution coefficient (Kd) from CLARC for inorganic chemicals at the soil pH. The default soil pH assumed for CLARC and PCULs is 6.8. Kd's for inorganic chemicals at other soil pHs are available in EPA (1996) Table C-4 and would need to be hand-entered in this column.
E	Kd Organics at Soil foc	Kd calculated for organic chemicals per MTCA Equation 747-2 for the soil fraction organic carbon (foc) value listed in cell F1. The default value of foc for CLARC and PCULs is 0.001. A site-specific value for foc may be entered in cell F1 if approved by the Ecology site manager.
F	Selected Soil Kd	Kd for inorganics in soil if available, otherwise Kd for organics in soil.
G	Koc Ionizing Organics at Sediment pH 8	Koc values for ionizing organics at the sediment pH. The default pH for sediment is 8. Koc values for other pH's are available in the table cited below and would need to be hand-entered in this column. EPA (1996) Table C-2
H	Kd Inorganics at Sediment pH 8	Kd for inorganic chemicals. The default pH for sediment is 8. Kd values for other pH's are available in the table cited below and would need to be hand-entered in this column. EPA (1996) Table C-4
I	Kd Organics at Sediment foc	Kd calculated for organic chemicals per MTCA Equation 747-2 for the sediment foc value listed in cell J1. The average foc for the LDW is 0.019 (EPA 2010). A site-specific value for foc may be entered in cell J1 if approved by the site manager.
J	Selected Sediment Kd	If a value is available for Koc for ionizing organics in sediment, the value reported in this column is the Koc multiplied by the sediment foc in cell J1. If a value is available for Kd for inorganics in sediment, that is the value reported in this column. If a value is available for Kd organics in sediment, that is the value reported in this column.
K	Hcc at 13°C	Henry's law constant from CLARC for a soil temperature of 13°C.
L	Hcc at 25°C	Henry's law constant from CLARC for a soil temperature of 25°C.
M	Selected Hcc	Hcc at 13°C if available, otherwise Hcc at 25°C.

Column	Title	Notes
N	BCF	Fish bioconcentration factor from CLARC.
O	RfDo	Oral reference dose (RfD) from CLARC.
P	GI (MTCA)	Gastrointestinal absorption conversion factor from CLARC. Used to convert oral toxicity values to dermal toxicity values.
Q	RfDd (MTCA)	Dermal RfD calculated per SCUM Equation 9-4 using GI value from CLARC.
R	GIABS (SMS)	Gastrointestinal absorption conversion factor from SCUM Appendix K. Used to convert oral toxicity values to dermal toxicity values.
S	RfDd (SMS)	Dermal RfD calculated per SCUM Equation 9-4 using GIABS values from SCUM Appendix K.
T	RfC	Inhalation reference concentration (RfC) from CLARC.
U	RfDi	Calculated from RfC assuming body weight of 70 kg and inhalation rate of 20 m^3/day.
V	CPFo	Oral carcinogenic potency factor (CPF) from CLARC.
W	CPFd (MTCA)	Dermal CPF calculated per SCUM Equation 9-3 using GI values from CLARC.
X	CPFd (SMS)	Dermal CPF calculated per SCUM Equation 9-3 using GIABS values from SCUM Appendix K.
Y	IUR	Inhalation unit risk from CLARC.
Z	CPFi	Inhalation carcinogenic potency factor calculated from IUR assuming 70 kg body weight and 20 m^3/day inhalation rate.
AA	Noted as Mutagen in CLARC	Indicates whether the chemical causes cancer through a mutagenic mode of action. Values for MTCA Equations 740-2 (soil contact), 720-2 (groundwater ingestion), and 750-2 (air inhalation) for mutagens are hand-entered from CLARC because the CLARC values account for higher risk of developing cancer from exposures incurred during childhood. Values for MTCA Equation 730-2 (seafood ingestion) for mutagens are calculated on the SW-MMA page because the PCUL workbooks assume a higher fish consumption rate than default MTCA values; they are linked into the GW-Eq page. Values for SCUM Equation 9-2 (sediment contact) for mutagens are calculated on the SD-MMA page because sediment CULs aren't available in CLARC; they are linked into the SD-Eq page. Mutagens are denoted on multiple pages with yellow highlights in column B. Cells with links to the SW-MMA and SD-MMA pages are white to alert the spreadsheet user not to copy down the decision logic from the cell above.
AB	INH	Groundwater vapor inhalation correction factor from CLARC. Accounts for extra

Column	Title	Notes
		exposure to volatile chemicals in groundwater due to vaporization during household use (e.g., showering, cooking, and laundry). This pathway is different from vapor intrusion.
AC	ABS (MTCA)	Dermal absorption fraction from CLARC. Used for calculating CULs for dermal contact.
AD	AB1 (MTCA) / G1 (SCUM)	Gastrointestinal absorption fraction from MTCA Equation 740-5. The default values are 0.6 for dioxins and furans and 1 for all other chemicals.
AE	ABS (SMS)	Dermal absorption fraction from SCUM Appendix K. Used for calculating CULs for dermal contact.
AF	Listed on CLARC VI pages	Indicates whether chemical is considered volatile for purposes of evaluating vapor intrusion.
AG	PBT List	Listed as a persistent bioaccumulative toxin in WAC 173-333-310.
AH	DMMP List 1 or 2	Included on List 1 or List 2 in the DMMP's *Dredged Material Evaluation and Disposal Procedures User Manual*.
AI	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).
AJ	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).
AK	Considered Bioaccumulative for Calculating LDW Sediment PCULs	"YES" is recorded if ***both*** of the following criteria are met: 1. The chemical is listed on the PBT list, on DMMP Lists 1 or 2, or both. 2. The chemical is listed in RI Table B.7-1, RI Table A.8-1, or both.
AL	Natural Background, Soil Puget Sound Basin	Natural background concentrations for soils in the Puget Sound Basin from Ecology's (1994) *Natural Background Soil Metals Concentrations in Washington State*. Uses the values from the MTCAStat print-outs provided in Section 11 because there are typos in the summary tables at the front of the document.
AM	Natural Background Marine Sediment	Natural background concentrations for marine sediment from SCUM Table 10-1.
AN	LDW Background Sediment	Background concentrations for LDW sediment from ROD Table 19.
AP	Select	Use X's to filter on chemicals of interest.
'Param' Page in PCUL-Fresh Workbook		
C	Koc	Soil organic carbon-water partitioning coefficient (Koc) from CLARC for organic chemicals. Values listed in CLARC for ionizing organics are from MTCA Table 747-2.

Column	Title	Notes
		The default soil pH assumed for CLARC and PCULs is 6.8. Koc's for ionizing organics at other soil pHs are available in EPA (1996) Table C-2 and would need to be hand-entered in individual cells in this column. Ionizing organics include benzoic acid, 2-chlorophenol, 2,4-dichlorophenol, 2,4-dinitrophenol, pentachlorophenol, 2,3,4,5-tetrachlorophenol, 2,3,4,6-tetrachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol.
D	Kd Inorganics at Soil pH 6.8	Soil-water distribution coefficient (Kd) from CLARC for inorganic chemicals at the soil pH. The default soil pH assumed for CLARC and PCULs is 6.8. Kd's for inorganic chemicals at other soil pHs are available in EPA (1996) Table C-4 and would need to be hand-entered in this column.
E	Kd Organics at Soil foc	Kd calculated for organic chemicals per MTCA Equation 747-2 for the soil fraction organic carbon (foc) value listed in cell F1. The default value of foc for CLARC and PCULs is 0.001. A site-specific value for foc may be entered in cell F1 if approved by the Ecology site manager.
F	Selected Soil Kd	Kd for inorganics in soil if available, otherwise Kd for organics in soil.
G	Koc Ionizing Organics at Sediment pH 8	Koc values for ionizing organics at the sediment pH. The default pH for sediment is 8. Koc values for other pH's are available in the table cited below and would need to be hand-entered in this column. EPA (1996) Table C-2
H	Kd Inorganics at Sediment pH 8	Kd for inorganic chemicals. The default pH for sediment is 8. Kd values for other pH's are available in the table cited below and would need to be hand-entered in this column. EPA (1996) Table C-4
I	Kd Organics at Sediment foc	Kd calculated for organic chemicals per MTCA Equation 747-2 for the sediment foc value listed in cell J1. The average foc for the LDW is 0.019 (EPA 2010). A site-specific value for foc may be entered in cell J1 if approved by the site manager.
J	Selected Sediment Kd	If a value is available for Koc for ionizing organics in sediment, the value reported in this column is the Koc multiplied by the sediment foc in cell J1. If a value is available for Kd for inorganics in sediment, that is the value reported in this column. If a value is available for Kd organics in sediment, that is the value reported in this column.
K	Hcc at 13°C	Henry's law constant from CLARC for a soil temperature of 13°C.
L	Hcc at 25°C	Henry's law constant from CLARC for a soil temperature of 25°C.

Column	Title	Notes
M	Selected Hcc	Hcc at 13°C if available, otherwise Hcc at 25°C.
N	BCF	Fish bioconcentration factor from CLARC.
O	RfDo	Oral reference dose (RfD) from CLARC.
P	GI (MTCA)	Gastrointestinal absorption conversion factor from CLARC. Used to convert oral toxicity values to dermal toxicity values.
Q	RfDd (MTCA)	Dermal RfD calculated per SCUM Equation 9-4 using GI value from CLARC.
R	GIABS (SMS)	Gastrointestinal absorption conversion factor from SCUM Appendix K. Used to convert oral toxicity values to dermal toxicity values.
S	RfDd (SMS)	Dermal RfD calculated per SCUM Equation 9-4 using GIABS values from SCUM Appendix K.
T	RfC	Inhalation reference concentration (RfC) from CLARC.
U	RfDi	Calculated from RfC assuming body weight of 70 kg and inhalation rate of 20 m^3/day.
V	CPFo	Oral carcinogenic potency factor (CPF) from CLARC.
W	CPFd (MTCA)	Dermal CPF calculated per SCUM Equation 9-3 using GI values from CLARC.
X	CPFd (SMS)	Dermal CPF calculated per SCUM Equation 9-3 using GIABS values from SCUM Appendix K.
Y	IUR	Inhalation unit risk from CLARC.
Z	CPFi	Inhalation carcinogenic potency factor calculated from IUR assuming 70 kg body weight and 20 m^3/day inhalation rate.
AA	Noted as Mutagen in CLARC	Indicates whether the chemical causes cancer through a mutagenic mode of action. Values for MTCA Equations 740-2 (soil contact), 720-2 (groundwater ingestion), and 750-2 (air inhalation) for mutagens are hand-entered from CLARC because the CLARC values account for higher risk of developing cancer from exposures incurred during childhood. Values for MTCA Equation 730-2 (seafood ingestion) for mutagens are calculated on the SW-MMA page because the PCUL workbooks assume a higher fish consumption rate than default MTCA values; they are linked into the GW-Eq page. Values for SCUM Equation 9-2 (sediment contact) for mutagens are calculated on the SD-MMA page because sediment CULs aren't available in CLARC; they are linked into the SD-Eq page. Mutagens are denoted on multiple pages with yellow highlights in column B. Cells with links to the SW-MMA and SD-MMA pages are white to alert the spreadsheet user not to copy down the decision logic from the cell above.

Column	Title	Notes
AB	INH	Groundwater vapor inhalation correction factor from CLARC. Accounts for extra exposure to volatile chemicals in groundwater due to vaporization during household use (e.g., showering, cooking, and laundry). This pathway is different from vapor intrusion.
AC	ABS (MTCA)	Dermal absorption fraction from CLARC. Used for calculating CULs for dermal contact.
AD	AB1 (MTCA) / G1 (SCUM)	Gastrointestinal absorption fraction from MTCA Equation 740-5. The default values are 0.6 for dioxins and furans and 1 for all other chemicals.
AE	ABS (SMS)	Dermal absorption fraction from SCUM Appendix K. Used for calculating CULs for dermal contact.
AF	Listed on CLARC VI pages	Indicates whether chemical is considered volatile for purposes of evaluating vapor intrusion.
AG	PBT List	Listed as a persistent bioaccumulative toxin in WAC 173-333-310.
AH	DMMP List 1 or 2	Included on List 1 or List 2 in the DMMP's *Dredged Material Evaluation and Disposal Procedures User Manual*.
AI	Considered Bioaccumulative for Calculating Sediment PCULs	"YES" is recorded if ***either*** of the following criteria are met: • "YES" for PBT list • "YES" for DMMP List 1 or 2.
AJ	Natural Background, Soil Puget Sound Basin	Natural background concentrations for soils in the Puget Sound Basin from Ecology's (1994) *Natural Background Soil Metals Concentrations in Washington State*. Uses the values from the MTCAStat print-outs provided in Section 11 because there are typos in the summary tables at the front of the document.
AK	Natural Background Marine Sediment	Natural background concentrations for marine sediment from SCUM Table 10-1.
AL	Natural Background Freshwater Sediment	Minimum of natural background soil in the Puget Sound Basin and natural background marine sediment. These values will be used until a natural background study is conducted for freshwater sediments.
AM	Regional Background Port Gardner Bay Sediment	Regional marine sediment background concentrations for the Everett area from SCUM Table 10-2. May not be used for sediment SCOs (lower tier) but may be used for sediment CSLs (upper tier).
AN	Regional Background	Regional marine sediment background concentrations for the Bellingham area from

Column	Title	Notes
	Bellingham Bay Sediment	SCUM Table 10-2. May not be used for sediment SCOs (lower tier) but may be used for sediment CSLs (upper tier).
AO	Regional Background Lake Washington Sediment	Regional freshwater sediment background concentrations for the Lake Washington area from SCUM Table 10-2. May not be used for sediment SCOs (lower tier) but may be used for sediment CSLs (upper tier).
AQ	Select	Use X's to filter on chemicals of interest.
'Param' Page in PCUL-Marine Workbook		
C	Koc	Soil organic carbon-water partitioning coefficient (Koc) from CLARC for organic chemicals. Values listed in CLARC for ionizing organics are from MTCA Table 747-2. The default soil pH assumed for CLARC and PCULs is 6.8. Koc's for ionizing organics at other soil pHs are available in EPA (1996) Table C-2 and would need to be hand-entered in individual cells in this column. Ionizing organics include benzoic acid, 2-chlorophenol, 2,4-dichlorophenol, 2,4-dinitrophenol, pentachlorophenol, 2,3,4,5-tetrachlorophenol, 2,3,4,6-tetrachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol.
D	Kd Inorganics at Soil pH 6.8	Soil-water distribution coefficient (Kd) from CLARC for inorganic chemicals at the soil pH. The default soil pH assumed for CLARC and PCULs is 6.8. Kd's for inorganic chemicals at other soil pHs are available in EPA (1996) Table C-4 and would need to be hand-entered in this column.
E	Kd Organics at Soil foc	Kd calculated for organic chemicals per MTCA Equation 747-2 for the soil fraction organic carbon (foc) value listed in cell F1. The default value of foc for CLARC and PCULs is 0.001. A site-specific value for foc may be entered in cell F1 if approved by the Ecology site manager.
F	Selected Soil Kd	Kd for inorganics in soil if available, otherwise Kd for organics in soil.
G	Koc Ionizing Organics at Sediment pH 8	Koc values for ionizing organics at the sediment pH. The default pH for sediment is 8. Koc values for other pH's are available in the table cited below and would need to be hand-entered in this column. EPA (1996) Table C-2
H	Kd Inorganics at Sediment pH 8	Kd for inorganic chemicals. The default pH for sediment is 8. Kd values for other pH's are available in the table cited below and would need to be hand-entered in this column. EPA (1996) Table C-4

Column	Title	Notes
I	Kd Organics at Sediment foc	Kd calculated for organic chemicals per MTCA Equation 747-2 for the sediment foc value listed in cell J1. The average foc for the LDW is 0.019 (EPA 2010). A site-specific value for foc may be entered in cell J1 if approved by the site manager.
J	Selected Sediment Kd	If a value is available for Koc for ionizing organics in sediment, the value reported in this column is the Koc multiplied by the sediment foc in cell J1. If a value is available for Kd for inorganics in sediment, that is the value reported in this column. If a value is available for Kd organics in sediment, that is the value reported in this column.
K	Hcc at 13ºC	Henry's law constant from CLARC for a soil temperature of 13ºC.
L	Hcc at 25ºC	Henry's law constant from CLARC for a soil temperature of 25ºC.
M	Selected Hcc	Hcc at 13ºC if available, otherwise Hcc at 25ºC.
N	BCF	Fish bioconcentration factor from CLARC.
O	RfDo	Oral reference dose (RfD) from CLARC.
P	GI (MTCA)	Gastrointestinal absorption conversion factor from CLARC. Used to convert oral toxicity values to dermal toxicity values.
Q	RfDd (MTCA)	Dermal RfD calculated per SCUM Equation 9-4 using GI value from CLARC.
R	GIABS (SMS)	Gastrointestinal absorption conversion factor from SCUM Appendix K. Used to convert oral toxicity values to dermal toxicity values.
S	RfDd (SMS)	Dermal RfD calculated per SCUM Equation 9-4 using GIABS values from SCUM Appendix K.
T	RfC	Inhalation reference concentration (RfC) from CLARC.
U	RfDi	Calculated from RfC assuming body weight of 70 kg and inhalation rate of 20 m^3/day.
V	CPFo	Oral carcinogenic potency factor (CPF) from CLARC.
W	CPFd (MTCA)	Dermal CPF calculated per SCUM Equation 9-3 using GI values from CLARC.
X	CPFd (SMS)	Dermal CPF calculated per SCUM Equation 9-3 using GIABS values from SCUM Appendix K.
Y	IUR	Inhalation unit risk from CLARC.
Z	CPFi	Inhalation carcinogenic potency factor calculated from IUR assuming 70 kg body weight and 20 m^3/day inhalation rate.
AA	Noted as Mutagen in CLARC	Indicates whether the chemical causes cancer through a mutagenic mode of action. Values for MTCA Equations 740-2 (soil contact), 720-2 (groundwater ingestion), and 750-2 (air inhalation) for mutagens are hand-entered from CLARC because the CLARC

Column	Title	Notes
		values account for higher risk of developing cancer from exposures incurred during childhood. Values for MTCA Equation 730-2 (seafood ingestion) for mutagens are calculated on the SW-MMA page because the PCUL workbooks assume a higher fish consumption rate than default MTCA values; they are linked into the GW-Eq page. Values for SCUM Equation 9-2 (sediment contact) for mutagens are calculated on the SD-MMA page because sediment CULs aren't available in CLARC; they are linked into the SD-Eq page. Mutagens are denoted on multiple pages with yellow highlights in column B. Cells with links to the SW-MMA and SD-MMA pages are white to alert the spreadsheet user not to copy down the decision logic from the cell above.
AB	INH	Groundwater vapor inhalation correction factor from CLARC. Accounts for extra exposure to volatile chemicals in groundwater due to vaporization during household use (e.g., showering, cooking, and laundry). This pathway is different from vapor intrusion.
AC	ABS (MTCA)	Dermal absorption fraction from CLARC. Used for calculating CULs for dermal contact.
AD	AB1 (MTCA) / G1 (SCUM)	Gastrointestinal absorption fraction from MTCA Equation 740-5. The default values are 0.6 for dioxins and furans and 1 for all other chemicals.
AE	ABS (SMS)	Dermal absorption fraction from SCUM Appendix K. Used for calculating CULs for dermal contact.
AF	Listed on CLARC VI pages	Indicates whether chemical is considered volatile for purposes of evaluating vapor intrusion.
AG	PBT List	Listed as a persistent bioaccumulative toxin in WAC 173-333-310.
AH	DMMP List 1 or 2	Included on List 1 or List 2 in the DMMP's *Dredged Material Evaluation and Disposal Procedures User Manual*.
AI	Considered Bioaccumulative for Calculating Sediment PCULs	"YES" is recorded if ***either*** of the following criteria are met: • "YES" for PBT list "YES" for DMMP List 1 or 2.
AJ	Natural Background, Soil Puget Sound Basin	Natural background concentrations for soils in the Puget Sound Basin from Ecology's (1994) *Natural Background Soil Metals Concentrations in Washington State*. Uses the values from the MTCAStat print-outs provided in Section 11 because there are typos in the summary tables at the front of the document.
AK	Natural Background Marine	Natural background concentrations for marine sediment from SCUM Table 10-1.

Column	Title	Notes
	Sediment	
AL	Regional Background Port Gardner Bay Sediment	Regional marine sediment background concentrations for the Everett area from SCUM Table 10-2. May not be used for sediment SCOs (lower tier) but may be used for sediment CSLs (upper tier).
AM	Regional Background Bellingham Bay Sediment	Regional marine sediment background concentrations for the Bellingham area from SCUM Table 10-2. May not be used for sediment SCOs (lower tier) but may be used for sediment CSLs (upper tier).
AO	Select	Use X's to filter on chemicals of interest.
'Eqtn' Page		
Calculation pages (SL-Eq, GW-Eq, SD-Eq, and AR-Eq) link to the equations shown on this page. Any changes to assumptions/parameters on this page will be reflected in the equation pages and subsequently the media summary pages (SL, GW, SD, and AR). This page is protected with the password "LDW" to prevent inadvertent changes.		
'SL-Det' Page		
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 page.
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 page.
E	SL-1, MTCA-B Soil Direct Contact	Minimum of Method B noncancer and cancer PCULs.
F	Site-Specific TEE, Eco. 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	Site-Specific TEE, Eco. 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	Site-Specific TEE, Eco. Indicator Soil Conc., Wildlife	Site-specific terrestrial ecological evaluation screening level for wildlife from MTCA Table 749-3.
I	SL-9, Site-Specific TEE, Eco. 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.

Column	Title	Notes
J	Site-Specific TEE, Eco. Indicator Soil Conc., Industrial/Commercial Land Use	Site-specific terrestrial ecological evaluation screening level for industrial or commercial land use. Value for wildlife only. Not used for PCULs but provided for potential use in site-specific CULs or RELs.
K	Simplified TEE, Unrestricted Land Use	Simplified terrestrial ecological evaluation screening level for unrestricted land use from MTCA Table 749-2. Not used for PCULs but provided for potential use in site-specific CULs or RELs.
L	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 page. 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 page. 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. Not used for PCULs but provided for potential use in site-specific CULs or RELs.
P	Federal TSCA, Unrestricted Access	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. The value is consistent with Method A.
Q	Federal TSCA, Restricted Access	The TSCA action level is sufficiently protective, per WAC 173-340-740(5)(b), so it replaces the MTCA Equation 745-2 value. The value is consistent with Method A.
S	Select	Use X's to filter on chemicals of interest.
'SL-Eq' Page		
C	RfDo	Oral reference dose from Param page.
D	CPFo	Oral carcinogenic potency factor from Param page.
E	AB1	Gastrointestinal absorption fraction from Param page.
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	Method B PCUL for cancer effects from soil contact under a residential scenario

Column	Title	Notes
	Contact, Cancer	calculated per MTCA Equation 740-2. Values for mutagenic chemicals are hand-entered from CLARC and the cells are not colored to warn the user not to copy down decision logic from the cell above.
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 use in site-specific CULs or RELs.
K	Select	Use X's to filter on chemicals of interest.
'Leach' Page		
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	Selected soil Kd. From Param page.
D	Selected Hcc	Selected value for the unitless version of Henry's law constant. From Param page.
E	GW-1, GW PCUL, Protect Drinking Water	Ground water PCUL for protection of drinking water. From PW page.
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 SW page.
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. From Partit page.
L	SL-4, Soil Protect Sediment,	Soil PCUL for leaching from the vadose zone to protect sediment, calculated per

Column	Title	Notes
	Vadose Zone	MTCA Equation 747-1.
M	SL-7, Soil 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 is available for evaluating the leaching pathway for alternative groundwater PCULs.
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-Defined GW PCUL, Saturated Zone	Soil PCUL for leaching from the saturated zone to achieve the user-defined ground water PCUL, calculated per MTCA Equation 747-1.
R	Select	Use X's to filter on chemicals of interest.
'PW' Page		
C	Federal MCL	Federal maximum contaminant level for drinking water (40 CFR 141).
D	Federal MCLG	Federal MCL goal for noncarcinogenic effects (non-zero values).
E	WA State MCL	State MCL for drinking water (WAC 246-290).
F	Most Stringent ARAR	Minimum of three drinking water ARARs above.
G	MTCA-B Ground Water, Noncancer	Calculated per MTCA Equation 720-1. From GW-Eq page.
H	Noncancer ARAR Evaluation	Ratio of minimum ARAR to MTCA Equation 720-1 value.
I	Does ARAR need adjustment for noncancer health effects?	If the ratio in the previous column exceeds 1, the entry is "YES", indicating 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 no adjustment is needed.
J	Protection of Drinking Water, Noncancer	Noncancer PCUL for drinking water: If the entry in the previous column is "YES", the adjusted noncancer PCUL is the value from MTCA Equation 720-1. Otherwise, if there is a minimum ARAR, 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 page.

Column	Title	Notes
L	Cancer ARAR Evaluation	Ratio of minimum ARAR to MTCA Equation 720-2 value.
M	Does ARAR need adjustment for cancer health effects?	If the ratio in the previous column exceeds 10, the entry is "YES", indicating 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 no adjustment is needed.
N	Protection of Drinking Water, Cancer	Cancer PCUL for drinking water: If the entry in the previous column is "YES", the adjusted cancer PCUL is 10 times the value from MTCA Equation 720-2. If the entry is "no", the cancer PCUL is the minimum ARAR. If the entry is "na", 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.
P	GW-4, Ground Water PCUL, Protect Indoor Air	Method B ground water screening level to protect indoor air via vapor intrusion. From VI page. Ecology's (2022) *Guidance for Evaluating Vapor Intrusion in Washington State*, Eq. 1.
R	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) and the Method B ground water screening level to protect indoor air via vapor intrusion (GW-4).
S-Z	Basis	These columns record the endpoint driving the most stringent PCUL for drinking water.
AB	Select	Use X's to filter on chemicals of interest.
'SW' Page		
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	Washington State WQC for protection of human health (WAC 173-201A-240, Table 240). The values in the PCUL-Fresh workbook include consumption of water and aquatic organisms. The values in the PCUL-LDW and PCUL-Marine workbooks include consumption of aquatic organisms only.
F	WA Toxics Rule, Human Health	National Toxics Rule WQC for Washington State for protection of human health (40 CFR 131.3). The values in the PCUL-Fresh workbook include consumption of water and aquatic organisms. The values in the PCUL-LDW and PCUL-Marine workbooks include consumption of aquatic organisms only.

Column	Title	Notes
G	NRWQC, Human Health	National recommended water quality criterion for protection of human health (Clean Water Act Section 3). The values in the PCUL-Fresh workbook include consumption of water and aquatic organisms. The values in the PCUL-LDW and PCUL-Marine workbooks include consumption of aquatic organisms only.
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): • Oak Ridge National Laboratory's Risk Assessment Information System (RAIS) • National Oceanic and Atmospheric Administration's Screening Quick Reference Tables (SQuiRT) • EPA's EcoTox database • Verbruggen et al. (2008) • De Rooij et al. (2004). WAC 173-340-730(3)(b)(ii)
I	Most Stringent ARAR	Minimum of the six surface water ARARs above. The aquatic life literature values are not technically ARARs because they are not promulgated regulatory values. They are included among the ARARs for ease of calculation. This is not expected to affect groundwater PCULs for protection of surface water.
J	MTCA-B Surface Water, Fish Consumption, Noncancer	Calculated per MTCA Equation 730-1. From GW-Eq page.
K	ARAR Evaluation	Ratio of minimum ARAR to MTCA Equation 730-1 value.
L	Does ARAR need adjustment for noncancer health effects?	If the ratio in the previous column exceeds 1, the entry is "YES", indicating 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 no adjustment is needed.
M	Protection of Surface Water, Noncancer	Noncancer PCUL for protection of surface water: If the entry in the previous column is "YES", the adjusted noncancer PCUL is the value from MTCA Equation 730-1. Otherwise, if there is a minimum ARAR, 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,	Calculated per MTCA Equation 730-2. From GW-Eq page.

Column	Title	Notes
	Fish Consumption, Cancer	
O	ARAR Evaluation	Ratio of minimum ARAR to MTCA Equation 720-2 value.
P	Does ARAR need adjustment for cancer health effects?	If the ratio in the previous column exceeds 10, the entry is "YES", indicating 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 no adjustment is needed.
Q	Protection of Surface Water, Cancer	Cancer PCUL for protection of surface water: If the entry in the previous column is "YES", the adjusted cancer PCUL is 10 times the value from MTCA Equation 730-2. If the entry is "no", the cancer PCUL is the minimum ARAR. If the entry is "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.
T-AC	Basis for PCUL	These columns record the endpoint driving the most stringent PCUL for protection of surface water (GW-2).
AE	Select	Use X's to filter on chemicals of interest.
	'GW-Eq' Page	
C	RfDo	Oral reference dose from Param page.
D	CPFo	Oral carcinogenic potency factor from Param page.
E	INH	Inhalation correction factor from Param page.
F	BCF	Fish bioconcentration factor from Param page.
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. Values for mutagenic chemicals are hand-entered from CLARC and the cells are not colored to warn the user not to copy down decision logic from the cell above.
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. Default fish consumption rates differ among the LDW, freshwater, and marine versions of the spreadsheet as discussed in the supplemental information document.
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 . Default fish consumption rates differ among the LDW, freshwater, and marine versions of the spreadsheet as discussed in the

Column	Title	Notes
		supplemental information document. Values for mutagenic chemicals are linked to the SW-MMA page and the cells are not colored to warn the user not to copy down decision logic from the cell above.
L	Select	Use X's to filter on chemicals of interest.
'SW-MMA' Page		
Calculates MTCA Equation 730-2 for chemicals that cause cancer through a mutagenic mode of action, which are indicated on the Param page by yellow highlights. Age-dependent adjustment factors are included to account for higher risk of cancer when exposures occur during childhood. In the PCUL-LDW workbook, fish consumption rates are consistent with the LDW ROD. In the PCUL-Fresh and PCUL-Marine workbooks, fish consumption rates are from SCUM Appendix K. Values calculated on this page link to the GW-Eq page.		
'Partit' Page in PCUL-LDW Workbook		
C	Sediment Kd	Sediment Kd at pH 8 and foc 1.9%. From Param page.
D	Sediment PCUL	Minimum ROD CUL or SMS lower tier sediment PCUL for chemicals not listed in the ROD. From SD-Det page.
E	GW-3, Ground Water PCUL, Protect Sediment	Ground water PCUL to protect sediment, calculated per the modified form of MTCA Equation 747-1. See supplemental information document for details.
F	SMS Upper Tier	SMS upper tier sediment PCUL. From SD-Det page.
G	Ground Water PCUL, Protect Sediment, SMS Upper Tier	Ground water PCUL to protect sediment at the SMS upper tier sediment PCUL, calculated per the modified form of MTCA Equation 747-1. See supplemental information document for details. Not used for PCULs but provided for potential use in site-specific CULs or RELs.
H	Minimum ROD RAL	Minimum ROD RAL. From SD-Det page.
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. See supplemental information document for details. Not used for PCULs but provided for potential use in site-specific CULs or RELs.
J	User-Defined Sediment PCUL	User-defined sediment PCUL.

Column	Title	Notes
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. See supplemental information document for details.
M	Select	Use X's to filter on chemicals of interest.
'Partit' Page in PCUL-Fresh and PCUL-Marine Workbooks		
C	Sediment Kd	Sediment Kd at pH 8 and foc 1.9%. From Param page.
D	SMS Lower Tier, Sediment PCUL	SMS lower tier sediment PCUL. From SD-Det page.
E	Ground Water PCUL, Protect Sediment, SMS Lower Tier	Ground water PCUL to protect sediment at the SMS lower tier sediment PCUL, calculated per the modified form of MTCA Equation 747-1. See supplemental information document for details.
F	SMS Upper Tier	SMS upper tier sediment PCUL. From SD-Det page.
G	Ground Water PCUL, Protect Sediment, SMS Upper Tier	Ground water PCUL to protect sediment at the SMS upper tier sediment PCUL, calculated per the modified form of MTCA Equation 747-1. See supplemental information document for details. Not used for PCULs but provided for potential use in site-specific CULs or RELs.
H	User-Defined Sediment PCUL	User-defined sediment PCUL.
I	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. See supplemental information document for details.
K	Select	Use X's to filter on chemicals of interest.
'VI' Page		
C	Listed on CLARC VI pages	Indicates whether the chemical is listed on the CLARC pages titled VI Method B (calc), VI Meth C (calc), and VI Wkr (calc).
D	Hcc	Selected value for the unitless version of Henry's law constanct. From Param page.
E	AR-1, MTCA-B Air	Method B air PCUL from Air-Det page.
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) VI guidance Eq. 1
G	MTCA-C Air	Method C air PCUL from Air-Det page. Not used for PCULs but provided for potential

Column	Title	Notes
		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) VI guidance 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) VI guidance Eq. 1
K	TCE Short-Term Action Level for Cardiac Birth Defects, Commercial Worker, Groundwater	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 informational purposes and potential use as a site-specific REL. Ecology's (2022) VI guidance, Appendix A
M	Select	Use X's to filter on chemicals of interest.
'SD-Det' Page in PCUL-LDW Workbook		
C	Bioaccumulative	Indicates which chemicals are considered bioaccumulative for the purpose of developing sediment PCULs for LDW sediment sites. Human health direct contact PCULs (SD-1) and seafood consumption PCULs (SD-2) are calculated only for bioaccumulative chemicals. From Param page.
D	Lower Tier SCO, 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. From Param page.
E	Upper Tier CSL, Regional Background	Regional background concentrations, which would be used in determining the upper tier sediment PCUL but which have not been developed for the LDW.
F	PQL	Programmatic sediment PQL. From Param page.
G	SMS Lower Tier SCO, Marine Benthic, OC Normalized	OC-normalized benthic SCO provided for use in setting site-specific CULs. Not currently used in any calculations in the spreadsheet because the benthic criteria in the LDW ROD are used. However the LDW ROD benthic criteria are equal to the SMS SCO benthic criteria. SCUM Table 8-1

Column	Title	Notes
H	SMS Lower Tier SCO, 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 OC normalized concentrations should be used to evaluate compliance if foc is between 0.5% and 3.5%. If the foc falls outside this range, the LAET should be used to evaluate compliance. The modified MTCA Eq. 747-2 (on the Partit page) cannot use OC normalized concentrations. Thus, the dry weight LAET concentrations are used for calculating groundwater CULs to protect sediment. SCUM Table 8-1
I	SMS Upper Tier CSL, Marine Benthic, OC Normalized	OC-normalized benthic CSL provided for use in setting site-specific CULs. Not currently used in any calculations in the spreadsheet but provided for potential use in site-specific CULs. SCUM Table 8-1
J	SMS Upper Tier CSL, Marine Benthic 2nd LAET, Dry Weight	Second LAET value for marine benthic organisms. See the discussion of dry weight and OC normalized criteria for the LAET column above. Not currently used in any calculations in the spreadsheet but provided for potential use in site-specific CULs. SCUM Table 8-1
K	SMS Lower Tier SCO, Human Direct Contact	For chemicals considered bioaccumulative, minimum CUL for cancer risk of 1E-6 and HQ=1 for sediment contact under the scenarios included in the LDW ROD. From SD-Eq page.
L	SMS Upper Tier CSL, Human Direct Contact	For chemicals considered bioaccumulative, minimum CUL for cancer risk of 1E-5 and HQ=1 for sediment contact under the scenarios included in the LDW ROD. From SD-Eq page.
M	SMS Lower Tier SCO, Seafood Consumption	For chemicals considered bioaccumulative, the value in this column is the maximum of the natural background concentration and the PQL. 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	SMS Upper Tier CSL, Seafood Consumption	For chemicals considered bioaccumulative, the value in this column is the maximum of the regional background concentration and the PQL. If no regional background concentration is available, the natural background concentration is substituted if available. If neither a natural background concentration, a regional background, nor a

Column	Title	Notes
		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	SMS Lower Tier SCO, Benthic & Human Health, for Partition Calculation	The lower tier PCUL under SMS is the minimum SCO value among benthic criterion (dry weight), human direct contact, and seafood consumption. This value is called into the Partit page to calculate the groundwater PCUL for protection of sediment.
P	SMS Upper Tier CSL, Benthic & Human Health for Partition Calculation	The upper tier PCUL under SMS is the minimum CSL value among benthic criterion (dry weight), human direct contact, and seafood consumption. Not used for PCULs but provided for potential use in site-specific CULs.
Q	LDW ROD, RAO 1 CUL, Human Seafood Consumption	The sediment CUL for remedial action objective 1 (human seafood consumption). CULs are applied throughout the LDW. ROD Table 19
R	LDW ROD, RAO 2 CUL, Human Direct Contact	Sediment CUL for remedial action objective 2 (human sediment contact during netfishing). CULs are applied throughout the LDW. ROD Table 19
S	LDW ROD, RAO 2 CUL, Human Direct Contact, Clamming	Sediment CUL for RAO 2 (human sediment contact during clamming). CULs are applied in clamming areas (LDW RI Map B.3-2). ROD Table 19
T	LDW ROD, RAO 2 CUL, Beaches	Sediment CUL for RAO 2 (human sediment contact with sediment during beach play). CULs are applied at beach areas (LDW RI Map B.3-1). ROD Table 19
U	LDW ROD, RAO 3 CUL, Benthic Invertebrates, Dry Weight	Sediment CUL for RAO 3 (protection of benthic invertebrates) expressed as dry weight. ROD Table 20
V	LDW ROD, RAO 3 CUL, Benthic Invertebrates, OC Normalized	Sediment CUL for RAO 3 (protection of benthic invertebrates) expressed as OC normalized. ROD Table 20
W	LAET Values in Dry Weight for RAO 3 CULs Expressed as OC Normalized	LAET value for marine benthic organisms. The dry weight LAET concentrations are used for calculating groundwater CULs to protect sediment. SCUM Table 8-1
X	LDW ROD, RAO 4 CUL, Ecological	Sediment CUL for RAO 4 (protection of upper trophic level ecological receptors). ROD Table 19

Column	Title	Notes
Y	Minimum LDW ROD CUL	Overall minimum sediment CUL from ROD, which includes RAOs 1, 2, 4, and RAO 3 values expressed as dry weight.
Z	Min. Sediment PCUL for Partition Calcs	Sediment PCUL for calculating ground water PCUL protective of sediment. The overall minimum sediment CUL from the ROD is the preferred value. If no ROD CUL is available, the SMS lower tier SCO concentration is used.
AA	LDW ROD RAL, Intertidal Rec. Cat. 1 (Limited)	Sediment RAL for intertidal sediments in recovery category 1 (0-10 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AB	LDW ROD RAL, Intertidal Rec. Cat. 1 (Limited)	Sediment RAL for intertidal sediments in recovery category 1 (0-45 cm). Not used for PCULs but provided for potential use in site-specific CULs.
AC	LDW ROD RAL, Intertidal Rec. Cat. 2 (Less Certain)	Sediment RAL for intertidal sediments in recovery category 2 (0-10 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AD	LDW ROD RAL, Intertidal Rec. Cat. 2 (Less Certain), Upper Limit for ENR	Upper limit for the enhanced natural recovery for intertidal sediments in recovery category 2 (0-10 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AE	LDW ROD RAL, Intertidal Rec. Cat. 2	Sediment RAL for intertidal sediments in recovery category 2 (0-45 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AF	LDW ROD RAL, Intertidal Rec. Cat. 2, Upper Limit for ENR	Upper limit for the enhanced natural recovery for intertidal sediments in recovery category 2 (0-45 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AG	LDW ROD RAL, Subtidal Rec. Cat. 1	Sediment RAL for subtidal sediments in recovery category 1 (0-10 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AH	LDW ROD RAL, Subtidal Rec. Cat. 1	Sediment RAL for subtidal sediments in recovery category 1 (0-60 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AI	LDW ROD RAL, Subtidal	Sediment RAL for subtidal sediments in recovery category 2 (0-10 cm). Not used for

Column	Title	Notes
	Rec. Cat. 2	PCULs but provided for potential use in site-specific CULs. ROD Table 28
AJ	LDW ROD RAL, Subtidal Rec. Cat. 2, Upper Limit for ENR	Upper limit for enhanced natural recovery for subtidal sediments in recovery category 2 (0-10 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AK	LDW ROD RAL, Subtidal Rec. Cat. 2	Sediment RAL for subtidal sediments in recovery category 2 (0-60 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AL	LDW ROD RAL, Subtidal Rec. Cat. 2, Upper Limit for ENR	Upper limit for enhanced natural recovery for subtidal sediments in recovery category 2 (0-60 cm). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AM	LDW ROD RAL, Subtidal Shoaled Areas	Sediment RAL for subtidal shoaled areas (top of navigation depth plus 2 feet). Not used for PCULs but provided for potential use in site-specific CULs. ROD Table 28
AN	Minimum LDW ROD RAL, Intertidal, Rec. Cat. 1	Minimum ROD RAL for intertidal sediments in recovery category 1. Not used for PCULs but provided for potential use in site-specific CULs.
AO	Minimum LDW ROD RAL, Intertidal, Rec. Cat. 2	Minimum ROD RAL for intertidal sediments in recovery category 2. Not used for PCULs but provided for potential use in site-specific CULs.
AP	Minimum LDW ROD RAL, Subtidal, Rec. Cat. 1	Minimum ROD RAL for subtidal sediments in recovery category 1. Not used for PCULs but provided for potential use in site-specific CULs.
AQ	Minimum LDW ROD RAL, Subtidal, Rec. Cat. 2	Minimum ROD RAL for subtidal sediments in recovery category 2. Not used for PCULs but provided for potential use in site-specific CULs.
AR	Minimum LDW ROD RAL, Overall	Overall minimum ROD RAL. Not used for PCULs but provided for potential use in site-specific CULs.
AS	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.
AU-BJ	Basis for SMS Lower Tier Basis for SMS Upper Tier Basis for Min. Sed. PCUL for Partitioning	These columns record the endpoints driving the SMS lower tier SCO sediment PCUL, the SMS upper tier CSL sediment PCUL, and the minimum sediment PCUL for partitioning calculations.

Column	Title	Notes
BL	Select	Use X's to filter on chemicals of interest.
'SD-Det' Page in PCUL-Fresh Workbook		
C	Bioaccumulative	Indicates which chemicals are considered bioaccumulative for the purpose of developing sediment PCULs. Human health direct contact PCULs (SD-1) and seafood consumption PCULs (SD-2) are calculated only for bioaccumulative chemicals. From Param page.
D	Lower Tier SCO, Natural Background	Natural background concentrations. From Param page.
E	Upper Tier CSL, Regional Background	Regional background concentrations. Values are available for the Lake Washington area on the Param page.
F	PQL	Programmatic sediment PQL. From Param page.
G	SD-3, Lower Tier SCO, Fresh Benthic	Lower Tier SCO for protection of freshwater benthic organisms. SCUM Table 8-1
H	Upper Tier CSL, Fresh Benthic	Upper Tier CSL for protection of freshwater benthic organisms. SCUM Table 8-1
I	SD-1, Lower Tier SCO, Human Direct Contact	For chemicals considered bioaccumulative, minimum CUL for cancer risk of 1E-6 and HQ=1 for sediment contact under three scenarios: beach play, clamming, and netfishing. From SD-Eq page.
J	Upper Tier CSL, Human Direct Contact	For chemicals considered bioaccumulative, minimum CUL for cancer risk of 1E-5 and HQ=1 for sediment contact under three scenarios: beach play, clamming, and netfishing. From SD-Eq page.
K	SD-2, Lower Tier SCO, Seafood Consumption	For chemicals considered bioaccumulative, the value in this column is the maximum of the natural background concentration and the PQL. 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".
L	Upper Tier CSL, Seafood Consumption	For chemicals considered bioaccumulative, the value in this column is the maximum of the regional background concentration and the PQL. If no regional background concentration is available, the natural background concentration is substituted if available. If neither a natural background concentration, a regional background, nor a

Column	Title	Notes
		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".
M	Lower Tier SCO for Partitioning Calculations	The lower tier PCUL is the minimum SCO value among benthic criterion, human direct contact, and seafood consumption. This value is called into the Partit page to calculate the groundwater PCUL for protection of sediment.
N	Upper Tier CSL for Partitioning Calculations	The upper tier PCUL is the minimum CSL value among benthic criterion, human direct contact, and seafood consumption. Not used for PCULs but provided for potential use in site-specific CULs.
O	User-Defined Sediment PCUL	The user may define a site-specific sediment PCUL by specifying the PCULs relevant to the site. Indicate the PCULs that are included in the column heading.
Q-X	Basis Lower Tier SCO, Basis Upper Tier CSL	These columns record the endpoints driving the lower tier SCO and the upper tier CSL.
Z	Select	Use X's to filter on chemicals of interest.
'SD-Det' Page in PCUL-Marine Workbook		
C	Bioaccumulative	Indicates which chemicals are considered bioaccumulative for the purpose of developing sediment PCULs. Human health direct contact PCULs (SD-1) and seafood consumption PCULs (SD-2) are calculated only for bioaccumulative chemicals. From Param page.
D	Lower Tier SCO, Natural Background	Natural background concentrations. From Param page.
E	Upper Tier CSL, Regional Background	Regional background concentrations. Values are available for Port Gardner Bay and Bellingham Bay on the Param page.
F	PQL	Programmatic sediment PQL. From Param page.
G	SD-3a, Lower Tier SCO, Marine Benthic, OC Normalized	Lower Tier SCO for protection of marine benthic organisms normalized to organic carbon. SCUM Table 8-1
H	SD-3b, Lower Tier SCO, 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 OC normalized concentrations should be used to evaluate compliance if foc is between 0.5% and 3.5%. If the foc falls outside this range, the LAET should be used to evaluate

Column	Title	Notes
		compliance. The modified MTCA Eq. 747-2 (on the Partit page) cannot use OC normalized concentrations. Thus, the dry weight LAET concentrations are used for calculating groundwater CULs to protect sediment. SCUM Table 8-1
I	Upper Tier CSL, Marine Benthic, OC Normalized	Upper Tier CSL for protection of marine benthic organisms normalized to organic carbon. SCUM Table 8-1
J	Upper Tier CSL, Marine Benthic, 2nd LAET, Dry Weight	Second LAET value for marine benthic organisms. See the discussion of dry weight and OC normalized criteria for the LAET column above. Not currently used in any calculations in the spreadsheet but provided for potential use in site-specific CULs. SCUM Table 8-1
K	SD-1, Lower Tier SCO, Human Direct Contact	For chemicals considered bioaccumulative, minimum CUL for cancer risk of 1E-6 and HQ=1 for sediment contact under three scenarios: beach play, clamming, and netfishing. From SD-Eq page.
L	Upper Tier CSL, Human Direct Contact	For chemicals considered bioaccumulative, minimum CUL for cancer risk of 1E-5 and HQ=1 for sediment contact under three scenarios: beach play, clamming, and netfishing. From SD-Eq page.
M	SD-2, Lower Tier SCO, Seafood Consumption	For chemicals considered bioaccumulative, the value in this column is the maximum of the natural background concentration and the PQL. 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 CSL, Seafood Consumption	For chemicals considered bioaccumulative, the value in this column is the maximum of the regional background concentration and the PQL. If no regional background concentration is available, the natural background concentration 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 SCO for Partitioning Calculations	The lower tier PCUL is the minimum SCO value among benthic criterion (dry weight), human direct contact, and seafood consumption. This value is called into the Partit page to calculate the groundwater PCUL for protection of sediment.

Column	Title	Notes
P	Upper Tier CSL for Partitioning Calculations	The upper tier PCUL is the minimum CSL value among benthic criterion (dry weight), human direct contact, and seafood consumption. Not used for PCULs but provided for potential use in site-specific CULs.
Q	User-Defined Sediment PCUL	The user may define a site-specific sediment PCUL by specifying the PCULs relevant to the site. Indicate the PCULs that are included in the column heading.
S-Z	Basis Lower Tier SCO, Basis Upper Tier CSL	These columns record the endpoints driving the lower tier SCO and the upper tier CSL.
AB	Select	Use X's to filter on chemicals of interest.
	'Sed-Eq' Page	
C	Bioaccumulative	Indicates whether the chemical is considered bioaccumulative for the purpose of calculating sediment PCULs. Sediment contact PCULs (SD-1) are calculated only for bioaccumulative chemicals. From Param page.
D	CPFo	Oral carcinogenic potency factor from Param page.
E	CPFd	Dermal carcinogenic potency factor from Param page.
F	RfDo	Oral reference dose from Param page.
G	RfDd	Dermal reference dose from Param page.
H	AB	Gastrointestinal absorption fraction from Param page.
I	ABS	Dermal absorption fraction from Param page.
J	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. Values for mutagenic chemicals are linked to the SD-MMA page and the cells are not colored to warn the user not to copy down decision logic from the cell above.
K	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. Values for mutagenic chemicals are linked to the SD-MMA page and the cells are not colored to warn the user not to copy down decision logic from the cell above.
L	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. Values for mutagenic chemicals are linked to the SD-MMA page and the cells are not colored to warn the user not to copy down decision logic from the cell above.
M	Beach Play, Risk=1E-5	Sediment PCUL to protect a child engaged in beach play, based on a cancer risk of 1E-

Column	Title	Notes
		5. Calculated per SMS Equation 9-1 using LDW exposure assumptions from the ROD.
N	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.
O	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.
P	Beach Play, HQ=1	Sediment PCUL to protect a child engaged in beach play, based on a noncancer hazard quotient of 1. Calculated per SMS Equation 9-2 using LDW exposure assumptions from the ROD.
Q	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.
R	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.
S	Lower Tier, Beach Play (1E-6 or HQ=1)	Minimum of PCULs for beach play.
T	Lower Tier, Clam Digging (1E-6 or HQ=1)	Minimum of PCULs for clam digging.
U	Lower Tier, Netfishing (1E-6 or HQ=1)	Minimum of PCULs for netfishing.
V	Lower Tier Minimum Direct Contact Scenario	Minimum of the three scenarios.
W	Upper Tier, Beach Play (1E-5 or HQ=1)	Minimum of PCULs for beach play.
X	Upper Tier, Clam Digging (1E-5 or HQ=1)	Minimum of PCULs for clam digging.
Y	Upper Tier, Netfishing (1E-5 or HQ=1)	Minimum of PCULs for netfishing.
Z	Upper Tier Minimum Direct Contact Scenario	Minimum of the three scenarios.
AB	Select	Use X's to filter on chemicals of interest.
'SedMMA' Page		

Column	Title	Notes
Calculates sediment contact PCULs for chemicals that cause cancer through a mutagenic mode of action, which are indicated on the Param page by yellow highlights. Age-dependent adjustment factors are included to account for higher risk of cancer when exposures occur during childhood. In the PCUL-LDW workbook, exposure parameters are consistent with the LDW ROD. Only the child beach play scenario is evaluated for mutagenic effects, consistent with the LDW ROD. In the PCUL-Fresh and PCUL-Marine workbooks, exposure parameters are set to SCUM default values in Table 9-2. Child beach play, clamming, and netfishing scenarios are evaluated for mutagenic effects. Values on this page link to the SD-Eq page.		
'AR-Det' Page		
C	MTCA-B Air, Noncancer	Method B air PCUL for noncancer effects. From AR-Eq page.
D	MTCA-B Air, Cancer	Method B air PCUL for cancer effects. From AR-Eq page.
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 and cancer effects.
G	SG-1, MTCA-B, Soil Gas, Protect Indoor Air	Method B shallow/sub-slab soil gas PCUL calculated from AR-1. 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 page. 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 page. 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 and cancer effects. 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. 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 page. 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*

Column	Title	Notes
M	Commercial Air, Cancer	Commercial air PCUL for cancer effects. From AR-Eq page. 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 and cancer effects. 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. 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
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' Page		
C	RfDi	Inhalation reference dose from Param page.
D	CPFi	Inhalation carcinogenic potency factor from Param page.
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. Values for mutagenic chemicals are hand-entered from CLARC and the cells are not colored to warn the user not to copy down decision logic from the cell above.
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.

Column	Title	Notes
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.

Table 3. Abbreviations

Acronym	Definition
AB1	Gastrointestinal absorption fraction (abbreviation used in MTCA)
ABS	Dermal absorption fraction
ADAF	Age-dependent adjustment factor
ARAR	Applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
BCF	Fish bioconcentration factor
BEHP	Bis(2-ethylhexyl) phthalate
BSAF	Biota-sediment accumulation factor
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
COPC	Chemical of potential concern
CPF	Carcinogenic potency factor (also known as slope factor)
CPFd	Dermal CPF
CPFi	Inhalation CPF
CPFo	Oral CPF
CSL	Cleanup screening level
CUL	Cleanup level
DDD	Dichlorodiphenyl dichloroethane
DDE	Dichlorodiphenyl dichloroethene
DDT	Dichlorodiphenyl trichloroethane
DF	Dilution factor
DMMP	Dredged Materials Management Program
DRO	Diesel range organics or diesel range hydrocarbons
DW	Dry weight
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
Eq	Equation
FCR	Fish consumption rate
FDF	Fish diet fraction
foc	Fraction organic carbon in soil
FS	Feasibility study
GI, GIABS	Gastrointestinal absorption conversion factor
Hcc	Henry's law constant
HEAST	Health Effects Assessment Summary Tables
IRIS	Integrated Risk Information System
IUR	Inhalation unit risk

Acronym	Definition
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
MCL	Maximum contaminant level
MCLG	MCL goal
MTCA	Model Toxics Control Act
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
PAH	Polycyclic aromatic hydrocarbon
PBT	Persistent bioaccumulative toxin
PCBs	Polychlorinated biphenyls
pH	Logarithmic scale used to specify the acidity or basicity of aqueous solutions
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
RAIS	Risk Assessment Information System
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
SCO	Sediment cleanup objective
SCUM	Sediment Cleanup Users Manual
SLUG	South Lake Union Group

Acronym	Definition
SMS	Sediment Management Standards
SQuiRT	Screening quick reference tables
SVOC	Semi-volatile organic compound
SWAC	Spatially weighted average concentration
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-*p*-dioxin
TCE	Trichloroethene (trichloroethylene)
TCP	Toxics Cleanup Program
TEE	Terrestrial ecological evaluation
TEF	Toxicity equivalence factor
TEQ	Toxicity equivalents or toxicity equivalent concentration
TOC	Total organic carbon
TSCA	Toxic Substances Control Act
UCF	Unit conversion factor
U&A	Usual and accustomed
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
WAC	Washington Administrative Code
WQC	Water quality criteria
WQP	Water Quality Program
WQS	Water quality standard
WTR	Washington Toxics Rule, state-specific version of National Toxics Rule (NTR)
θa	Air-filled soil porosity
θw	Water-filled soil porosity
ρb	Dry soil bulk density