Sections 700 through 710—Summary of Proposed Changes [1]

Section 700 Overview of Cleanup Standards

- Updated discussion to conform to changes made in other sections of the rule.
- Revised description of how to establish TPH cleanup levels; eliminating retrofitting and substitution options.
- Table 830-1 testing requirements for petroleum contamination has been revised and supplemented with Table 830-2, identifying which petroleum products fall within the petroleum categories used in the rule.

Section 702 General Policies

- Added provision describing when mixing of Methods A, B and C is acceptable

Section 704 Use of Method A

- Eliminated restriction that Method A be used on "Routine sites".
- Added condition that Method A cannot be used if surface water is likely to be impacted, since Method A values don't consider this exposure pathway.
- Added a condition that Method A cannot be used at sites conducting a site-specific TEE. This is a condition retained from "routine sites".
- Added a requirement that vapor intrusion be evaluated.

Section 705 Use of Method B

- Eliminated "standard" and "modified" terminology.
- Added a requirement that vapor intrusion be evaluated.

Section 706 Use of Method C

- Eliminated "standard" and "modified" terminology.
- Added a statement that sites using Method C must have an institutional control for consistency with Section 440.
- Added a requirement that vapor intrusion be evaluated.

Section 708 Human Health Risk Assessment Procedures

- "Carcinogenic potency factor" term replaced with "cancer slope factor"; Science Advisory Board eliminated as a result of 2007 legislation.
- HEAST removed as a presumptive source for reference dose, reference concentration and cancer slope factor. Replaced with a reference to EPA's OSWER Directive 9285.7-53. Ecology commits to publishing and periodically updating a list of these values.
- The method for calculating cleanup levels for carcinogenic PAHs changed to account for early life exposure per EPA's 2003 guidance. cPAHs to be evaluated as individual hazardous substances. The basis for early life exposure adjustments is discussed in the March 22, 2009 MTCA/SMS Advisory Group materials. http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html
- Bioaccumulation factor added. Ecology commits to publishing and periodically updating a list of bioconcentration and bioaccumulation values.
- EPA's IEUBK and Adult Lead Model recognized as acceptable methods for calculating site-specific soil cleanup levels for lead. Also sets standards for use of these models.

Section 709 Background

- Kaplan-Meier added as an acceptable method for evaluating non-detected values.
- Ecology commits to publishing and periodically updating a list of natural background concentrations.

Section 710 Applicable State and Federal Laws

- Landfill closure law reference updated.
- Clarified that WQ law exemption only applies to state waste discharge permits, not NPDES permits, reflecting a decision by Ecology's director in 2008.

[1] ***NOTE: Language proposed to be deleted is shown in ~~blue with a strikout~~, proposed new language is shown in red and underlined. Purple colored language completely replaces existing language and to facilitate review, does not show strikeout of existing language or underlining of new language.***

Section 720: Groundwater Cleanup Standards—Summary of Changes

General changes

- Major reorganization—former Section 720 broken into multiple Sections to facilitate readability and use. Because of this, these will likely be published by the Code Reviser as new Sections without the changes highlighted. To facilitate review, changes from existing language are highlighted in traditional bill format.
- "Ground water" now one word: "groundwater".
- "Standard" and "Modified" Method B & C terminology eliminated (changes are still allowed to the default assumptions).

Potable groundwater criteria:

- Clarification of yield provision. Some have interpreted the reference to WAC 173-160 to mean if a well can't meet the WAC setback or sealing requirements, the aquifer is nonpotable. This was not intended by this provision. Rather, it was intended to prevent using a pump test at a monitoring well with a small diameter or short screen length to justify non-potability. This is addressed by the revised language.
- Replaced reference to WAC 173-200 with Method B groundwater cleanup levels to provide for the same standards to be applied throughout the site.

Method A

- Eliminated restriction that Method A be used on "Routine sites".
- Added condition that Method A cannot be used if surface water is likely to be impacted, since Method A values don't consider this exposure pathway.
- Added a requirement that vapor intrusion be evaluated.
- Changes to several values in Table 720-1 are under consideration.

Method B for potable groundwater

- Eliminated drinking water maximum contaminant level goals (MCLGs) as an ARAR.
- Restoration timeframe added to clarify when surface water protection needs to be factored into groundwater cleanup levels.
- Added a requirement that vapor intrusion be evaluated.
- Averaging time for carcinogens changed from 75 to 70 years to conform to EPA risk assessment guidance.
- The method for calculating cleanup levels for carcinogens changed to account for early life exposure per Section 708.

Method B for non-potable groundwater

- Amended language for surface water protection to include restoration timeframe.
- Added a requirement that vapor intrusion be evaluated.

Method C groundwater cleanup standards

- Incorporated the same changes as above for potable and non-potable Method B.

Point of Compliance

- Combined "directly abutting" and "near" surface water point of compliance provisions. This change is intended to simplify the point of compliance for situations where groundwater is discharging to surface water and provide more comprehensive public notice to potentially impacted persons and agencies.

Demonstrating compliance

- Changed presumption regarding filtering of monitoring well samples to accepting filtering for naturally occurring inorganic contaminants, providing certain conditions are met.
- Added a statement allowing use of no-purge sampling methods provided a site-specific demonstration can be made that it is comparable to low flow sampling methods.
- Added "direct comparison" options for demonstrating compliance.
- Added a performance standard for non-parametric statistical methods calculating a UCL.
- Added requirements that well screen placement and dilution be considered when evaluating extent of natural attenuation between near-shore monitoring wells and surface water.
- Simplified handing of non-detects by allowing simple direct substitution methods. This reflects current practice for handling of non-detects and generally provides a conservative (high) estimate of residual concentrations for determining compliance.
- Added Kaplan-Meier method as an acceptable alternative to direct substitution for non-detects.

Section 730: Surface Water Cleanup Standards—Summary of Changes

General changes

- Major reorganization—former Section 730 broken into multiple Sections to facilitate readability and use.
- Method A eliminated. It is proposed to eliminate Method A as an option for surface water cleanup standards, since there are currently no Method A table values and values in applicable state and federal laws don't incorporate tribal fish consumption rates.
- "Standard" and "Modified" Method B & C terminology eliminated (changes are still allowed to the default assumptions).

Method B & C

- Added discussion of fish consumption rate and diet fraction to more explicitly acknowledge high fish consuming populations, such as tribes, need to be considered when establishing cleanup levels.
- Averaging time for carcinogens changed from 75 to 70 years. This is conform MTCA to EPA risk assessment guidance.
- The method for calculating cleanup levels for carcinogens changed to account for early life exposure per Section 708.
- Added preference for using bioaccumulation factor instead of bioconcentration factor, where sufficient information is available. Bioaccumulation takes into account contaminants accumulating in fish and shellfish through their food consumption, in addition to exposure to the water.
- Petroleum mixture cleanup level equation added to enable calculation of site-specific TPH cleanup levels.

Demonstrating Compliance

- Added provision describing interpretation of non-detected values for consistency with the other sections of the MTCA rule.

Sections 740 & 745: Soil Cleanup Standards—Summary of Changes

General changes

- Major reorganization—former Sections 740 & 745 broken into multiple Sections to facilitate readability and use.
- "Standard" and "Modified" terminology eliminated (changes to default parameters are still allowed).

Method A

- Eliminated restriction that Method A be used on "Routine sites".
- Added condition that Method A cannot be used if surface water is likely to be impacted, since Method A values don't consider this exposure pathway.
- Added a condition that Method A cannot be used at sites conducting a site-specific TEE. This is a condition retained from "routine sites". Sites requiring a site-specific TEE are complex sites not suitable for a simple Method A approach. This is consistent with the approach under the current MTCA rule.
- Added a requirement that vapor intrusion be evaluated.
- Changes to several values in Tables 740-1 and 745-1 are under consideration.

Method B

- Added requirement that vapor intrusion be evaluated.
- Direct contact equations modified to include dermal exposure for all substances. This is to reduce rule complexity and make MTCA consistent with EPA risk assessment guidance. The affect of these changes on several chemicals are illustrated in Tables 1 & 2.
- Averaging time for carcinogens changed from 75 to 70 years. This is conform MTCA to EPA risk assessment guidance.
- The method for calculating cleanup levels for carcinogens changed to account for early life exposure per Section 708.
- Added EPA's IEUBK Model as method for calculating site-specific soil cleanup levels for lead, since neither a cancer slope factor nor reference dose is available for lead.

Method C

- Incorporated the same changes as above under Method B except EPA's Adult Lead Model used for calculating soil lead cleanup levels. Also, early life exposure not included since this is an adult worker exposure model.
- Changed soil adherence factor from 0.2 to 0.07 for consistency with EPA risk assessment guidance.

Demonstrating Compliance

- Added discussion of when consideration of soil nuggets >2 mm in size should be considered. Birds commonly ingest small stones to help with digestion. Ingestion of lead pellets by children has also been reported in the literature. This addition is to address this concern.
- Added a performance standard for non-parametric statistical methods calculating a UCL.
- Simplified handing of non-detects by allowing use of direct substitution. This is consistent with current practice and generally provides a conservative (high) estimate of residual site concentrations.
- Added Kaplan-Meier method as an acceptable alternative to direct substitution for non-detects. This reflects EPA statistical guidance.

Section 747: Deriving soil concentrations for ground water protection

Summary of Changes

- Table 747-1 is proposed to be expanded to include Koc's for more chemicals and temperature adjusted Henry's constants.
- Table 747-4 to be updated with values from Oak Ridge National Laboratories.
- Added requirement that soil foc values be obtained from uncontaminated soils.
- Description added on how to derive Hcc values from the scientific literature, including how to correct values for groundwater temperature.
- Added a table providing direction on number of soil samples to be analyzed for petroleum fractions. (dependent on volume of contaminated soils)
- Added a statement that Ecology may require persons proposing new models to submit the model code and demonstrate the model has been validated and verified.
- Added a statement allowing post-remediation empirical demonstrations. In these cases, the cleanup would be considered an interim action until the demonstration has been completed.

Terrestrial Ecological Evaluation Procedures under MTCA—summary of changes

These sections have been significantly reorganized and rewritten to clarify how the terrestrial ecological evaluation process works.

Section 7490 Terrestrial ecological evaluation procedures.

- Process overview added.
- Added provision allowing balancing cleanup vs. habitat destruction in areas of "especially valuable habitat".
- Policy statements added clarifying point of compliance, compliance monitoring and institutional controls for sites where cleanup levels are controlled by TEE values.

Section 7491 Terrestrial ecological evaluation exclusions.

- Several definitions moved to Section 200.
- Clarified that gravel can be an effective "physical barrier".
- Added a requirement that barriers must be maintained to be effective.

Section 7492 Applicability of a simplified terrestrial ecological evaluation.

- Moved criteria for determining if a site is eligible for a simplified TEE to here from Section 7491.
- Clarified that 10 acres of undeveloped property must be on or within 500 feet of the area of soil contamination (instead of "site").

Section 7493 Simplified terrestrial ecological evaluation procedures.

- The current rule is confusing regarding procedures for conducting a simplified TEE and options for setting cleanup levels. The proposed changes are intended to more explicitly describe the simplified TEE process and options for setting concentration protective of terrestrial ecological receptors. The primary change is to clarify that bioassays can be used in two ways. That is, for: (1) Determining toxicity of a contaminated soil; and, (2) For making limited modifications to the wildlife exposure model. These changes reflect current practice.

Section 7494 Site-specific terrestrial ecological evaluation procedures.

- Added summary of methods for developing concentrations protective of TEE pathway at site-specific TEE sites. The actual methods have not been changed.

Table 749-1
- Clarified that "site" as used in the context of this table means area of contaminated soil.

Table 749-2
- Changes to several values in this Table are under consideration.

Table 749-3
- Changes to several values in this Table are under consideration.

Table 749-4
- No changes.

Table 749-5
- Changes to several values in this Table are under consideration based on updates to the Oak Ridge National Laboratory database.

Table 749-6
- New table added to provide ecological TEFs for dioxins and furans.

Section 750: Air Cleanup Standards—Summary of Changes

General changes
- Major reorganization—former Section 750 broken into multiple Sections to facilitate readability and use.
- "Standard" and "Modified" Method B & C terminology eliminated (changes are still allowed to the default assumptions).

Method B & C
- Method B & C equations changed to conform to latest EPA guidance on calculation of air cleanup levels.
- Petroleum mixture cleanup level equation added to enable calculation of site-specific TPH air cleanup levels.

Demonstrating Compliance
- Point of compliance provisions changed to address compliance in both indoor and outdoor situations, use of groundwater and soil gas screening levels, and discharges from remedial actions.
- Several provisions added addressing compliance monitoring and evaluation of data. Includes how to factor in urban background and use of multiple lines of evidence to demonstrate compliance.

Sections 3500 through 3520: Vapor Intrusion (New Sections)

These Sections reflect preliminary discussions that occurred in 2010 with the vapor subcommittee of the MTCA/SMS workgroup. These Sections are intended to provide a framework for determining if vapor intrusion is an issue of concern at a site that needs to be addressed. In general, the process includes:

- Clarification of information needed to evaluate the vapor intrusion exposure pathway
- Criteria for exempting sites from having to evaluate vapor intrusion
- Methods for conducting simplified vapor intrusion evaluations
- Site-specific vapor intrusion evaluation procedures

Several issues were identified by the subcommittee that have not been fully vetted in this draft. Reviewers are invited for provide input on these and other issues related to vapor intrusion evaluations.

WAC 173-340-700 Overview of cleanup standards. [2]

(1) Purpose. This section provides an overview of the methods for establishing cleanup standards that apply to a release or threatened release of a hazardous substance at a site. If there are any inconsistencies between this section and any specifically referenced section, the referenced section shall govern.

(2) Explanation of term "cleanup level." A cleanup level is the concentration of a hazardous substance in soil, water, air or sediment that is determined to be protective of human health and the environment under specified exposure conditions. Cleanup levels, in combination with points of compliance, typically define the area or volume of soil, water, air or sediment at a site that must be addressed by the cleanup action.

(3) Explanation of term "cleanup standards." Cleanup standards consist of the following:

(a) Cleanup levels for hazardous substances present at the site;

(b) The location where these cleanup levels must be met (point of compliance); and

(c) Other regulatory requirements that apply to the site because of the type of action and/or location of the site ("applicable state and federal laws").

(4) Relationship between cleanup standards and cleanup actions.

(a) Cleanup standards are identified for the particular hazardous substances at a site and the specific areas or pathways, such as land or water, where humans and the environment can become exposed to these substances. This part provides uniform methods state-wide for identifying cleanup standards and requires that all cleanups under the act meet these standards. The actual degree of cleanup may vary from site to site and will be determined by the cleanup action alternative selected under WAC 173-340-350 through 173-340-390.

(b) For most sites, there are several cleanup technologies or combinations of cleanup technologies ("cleanup action alternatives") that may be used to comply with cleanup standards at individual sites. Other parts of this rule govern the process for planning and deciding on the cleanup action to be taken at a site. This may include establishing "remediation levels," or the concentrations of hazardous substances above which a particular cleanup technology will be applied. See WAC 173-340-350 through 173-340-390. WAC 173-340-355 contains detailed information on establishing remediation levels. WAC 173-340-410 specifies the monitoring required to ensure that the remedy is effective.

(c) Where a cleanup action involves containment of soils with hazardous substances above cleanup levels, the cleanup action may be determined to comply with cleanup standards, provided the compliance monitoring program is designed to ensure the long-term integrity of the containment system, and the other requirements for containment in this chapter are met.

(5) Methods for setting cleanup levels. The first step in setting cleanup levels is to identify the nature of the contamination, the potentially contaminated media, the current and potential pathways of exposure, the current and potential receptors, and the current and potential land and resource uses. A conceptual site model may be developed as part of this scoping process. Cleanup levels may then be established for each media. Both the conceptual site model and cleanup levels may be refined as additional information is collected during the remedial investigation/feasibility study. See WAC 173-340-708(3)

[2] All of the changes in this section, except where specifically noted, are editorial and intended to reflect changes made in subsequent sections.

[3] The outline here and in other sections has been added to facilitate review. It may not appear in the final rule.

for additional information on how to determine current and potential future land and resource uses for the conceptual site model.

These rules provide three ~~approaches~~ methods for establishing cleanup levels:

(a) Method A: ARARs and Tables. On some sites, the cleanup action may be ~~routine (WAC 173-340-200) or may~~ straight-forward and involve relatively few hazardous substances. [4] Under Method A, cleanup levels at these sites are set at concentrations at least as stringent as concentrations specified in applicable state and federal laws (ARARs) and Tables 720-1, 740-1, and 745-1 of this chapter.

Method A cleanup levels for hazardous substances that are deemed indicator hazardous substances at the site under WAC 173-340-~~708(2)~~703, and are not addressed under applicable state and federal laws or Tables 720-1, 740-1, and 745-1, must be established at concentrations which do not exceed the natural background concentration or the practical quantitation limit, whichever is higher.

For soil contamination, the potential impact of hazardous substances on terrestrial ecological receptors must be evaluated ~~under WAC 173-340-7490 through 173-340-7494~~. Specifically, either an exclusion must be established for the site under WAC 173-340-7491 or a simplified terrestrial ecological evaluation must be conducted under WAC ~~173-340-7492 or~~ 173-340-7493. The terrestrial ecological evaluation may result in a more stringent Method A soil cleanup level than is required to protect human health.

In addition, where volatile hazardous substances are present at the site, an evaluation must be conducted under WAC 173-340-3500 through 3520 to determine if vapor intrusion into existing or potential future structures may be a concern that needs to be addressed. [5]

Except where institutional controls are required by WAC 173-340-440(4), site cleanups that achieve Method A cleanup levels may be used without future restrictions on the property due to residual levels of contamination.

(b) Method B: Universal method. Method B is the universal method for determining cleanup levels for all media at all sites. Under Method B, cleanup levels for individual hazardous substances are established using applicable state and federal laws and the risk equations and other requirements specified in WAC 173-340-7200 through 173-340-760.

~~Method B is divided into two tiers: Standard and modified. Standard~~ Method B uses generic default assumptions to calculate cleanup levels. ~~Modified~~ Method B also provides for the use of chemical-specific or site-specific information to change selected default assumptions, within the limitations allowed in WAC 173-340-708.~~. Modified Method B may be used~~ to establish cleanup levels. [6]

~~Modified~~ Method B may also be used in a quantitative risk assessment to help assess the protectiveness of a remedy by modifying input parameters as described in WAC 173-340-7200 through 173-340-~~750~~ 760 or by using other modifications that meet the requirements of WAC 173-340-702 and 173-340-708. See WAC 173-340-355 and 173-340-357 for more information on remediation levels and quantitative risk assessment.

For individual carcinogens, ~~both standard and modified~~ Method B cleanup levels are based upon the upper bound of the estimated individual lifetime excess ~~lifetime~~ cancer risk of one in one million (1×10^{-6}). [7]

For individual noncarcinogenic substances, ~~both standard and modified~~ Method B cleanup levels are set at concentrations which are anticipated to result in no acute or chronic toxic effects on human health (that is, hazard quotient of one

[4] The definition of routine site is proposed to be removed.

[5] EPA research has shown that even small amounts of volatile contaminants in groundwater or soil can cause vapor intrusion problems in overlying structures. This change is made throughout this and subsequent chapters.

[6] Editorial change reflecting proposed elimination of "standard" and "modified" terminology. This change is made throughout this and subsequent chapters. (Users will still have the option of changing certain parameters.)

[7] "Estimated individual lifetime excess cancer risk" is an editorial change to more accurately describe what the $1X10^{-6}$ and 10^{-5} risks are. This change is made throughout this and subsequent chapters.

(1) or less) and no significant adverse effects on the propagation of aquatic and terrestrial organisms.

Where a hazardous waste site involves multiple hazardous substances and/or multiple pathways of exposure, then ~~standard and modified~~ Method B cleanup levels for individual substances must be adjusted downward for additive health effects in accordance with the procedures in WAC 173-340-708 if the total estimated individual lifetime excess ~~lifetime~~ cancer risk for a site exceeds one in one hundred thousand (1×10^{-5}) or the hazard index for substances with similar noncarcinogenic toxic effects exceeds one (1).

For soil contamination, the potential impact of hazardous substances on terrestrial ecological receptors must be evaluated under WAC 173-340-7490 through 173-340-7494. Specifically, either an exclusion must be established for the site under WAC 173-340-7491 or a terrestrial ecological evaluation must be conducted under WAC 173-340-~~7492 or 173-340-~~7493 or 7494.

For sites where hazardous substances have reached or are likely to reach surface water, the health risks to persons eating fish and other aquatic organisms needs to be considered, along with impacts on the aquatic organisms that reside in the surface water and sediments. This includes consideration of surface water standards (WAC 173-340-7300) and sediment standards (WAC 173-204). [8]

The terrestrial ecological evaluation and evaluation of impacts to aquatic organisms may result in a more stringent Method B soil cleanup level for the site than is required to protect human health.

In addition, where volatile hazardous substances are present at the site, an evaluation must be conducted under WAC 173-340-3500 through 3520 to determine if vapor intrusion into existing or potential future structures may be a concern that needs to be addressed.

[8] Added to recognize that protection of surface water and sediments is playing an increasing role in the setting of cleanup levels at contaminated sites. Similar language repeated elsewhere throughout this rule.

Except where institutional controls are required by WAC 173-340-440(4), site cleanups that achieve Method B cleanup levels may be used without future restrictions on the property due to residual levels of contamination.

(c) Method C: Conditional method. Compliance with cleanup levels developed under Method A or B may be impossible to achieve or may cause greater environmental harm. In those situations, Method C cleanup levels for individual hazardous substances may be established for surface water, ground water, and air. Method C industrial soil and air cleanup levels may also be established at industrial properties that meet the criteria in WAC 173-340-~~745~~7400.

Under Method C, cleanup levels for individual hazardous substances are established using applicable state and federal laws and the risk equations and other requirements specified in WAC 173-340-7200 through 173-340-760. ~~Method C is divided into two tiers: Standard and modified. Standard~~ Method C uses generic default assumptions to calculate cleanup levels. ~~Modified~~ Method C also provides for the use of chemical-specific or site-specific information to change selected default assumptions, within the limitations allowed in WAC 173-340-708,~~. Modified Method C may be used~~ to establish cleanup levels.

~~Modified~~ Method C may also be used in a quantitative risk assessment to help assess the protectiveness of a remedy by modifying input parameters as described in WAC 173-340-7200 through 173-340-~~750~~760 or by using other modifications that meet the requirements of WAC 173-340-702 and 173-340-708. See WAC 173-340-355 and 173-340-357 for more information on remediation levels and quantitative risk assessment.

For individual carcinogens, ~~both standard and modified~~ Method C cleanup levels are based upon the upper bound of the estimated individual lifetime excess cancer risk of one in one hundred thousand (1×10^{-5}).

For individual noncarcinogenic substances, ~~both standard and modified~~ Method C cleanup levels are set at concentrations which are anticipated to result in no acute or chronic toxic effects on human health (that is, hazard quotient of one

(1) or less) and no significant adverse effects on the protection and propagation of aquatic and terrestrial organisms.

Where a hazardous waste site involves multiple hazardous substances and/or multiple pathways of exposure, then ~~both standard and modified~~ Method C cleanup levels for individual substances must be adjusted downward for additive health effects in accordance with the procedures in WAC 173-340-708 if the total estimated individual lifetime excess ~~lifetime~~ cancer risk for a site exceeds one in one hundred thousand (1×10^{-5}) or the hazard index for substances with similar noncarcinogenic toxic effects exceeds one (1).

For soil contamination, the potential impact of hazardous substances on terrestrial ecological receptors must be evaluated under WAC 173-340-7490 through 173-340-7494. Specifically, either an exclusion must be established for the site under WAC 173-340-7491 or a terrestrial ecological evaluation must be conducted under WAC 173-340-~~7492 or 173-340-~~7493 or 7494.

For sites where hazardous substances have reached or are likely to reach surface water, the health risks to persons eating fish and other aquatic organisms needs to be considered, along with impacts on the aquatic organisms that reside in the surface water and sediments. This includes consideration of surface water standards (WAC 173-340-7300) and sediment standards (WAC 173-204).

The terrestrial ecological evaluation and evaluation of impacts to aquatic organisms may result in a more stringent Method C soil cleanup level for the site than is required to protect human health.

In addition, where volatile hazardous substances are present at the site, an evaluation must be conducted under WAC 173-340-3500 through 3520 to determine if vapor intrusion into existing or potential future structures may be a concern that needs to be addressed.

Site cleanups establishing Method C cleanup levels must have restrictions placed on the property (institutional controls) to ensure future protection of human health and the environment.

(6) Requirements for setting cleanup levels. Several requirements apply to cleanups under any of the three methods. ~~Some of these requirements, such as the identification of applicable state and federal laws, describe analyses used along with Methods A, B or C in order to set cleanup levels for particular substances at a site. Others describe the technical procedures to be used.~~ The following highlights several of these requirements:

(a) Applicable state and federal laws. RCW 70.105D.030 (2)~~(d)~~(e) requires the cleanup standards in these rules to be "at least as stringent as all applicable state and federal laws." In addition to establishing minimum ~~requirements for cleanup standards~~ concentrations that must be met, applicable state and federal laws may also impose certain technical and procedural requirements, ~~for performing cleanup actions~~ depending on the remedy selected. ~~These requirements~~ Criteria for determining which laws are applicable to a site are described in WAC 173-340-710 and are similar to the "ARAR" (applicable, relevant and appropriate requirements) approach of the federal superfund law. Sites that are cleaned up under an order or decree may be exempt from obtaining a permit under certain other laws but they must still meet the substantive requirements of these other laws. (See WAC 173-340-710(9).)

(b) Cross-media contamination. In some situations, migration of hazardous substances from one medium may cause contamination in a second media. For example, the ~~release~~ leaching of hazardous substances ~~in~~ from soil may cause ground-water contamination. Under Methods A, B, and C, cleanup levels must be established at concentrations that prevent violations of cleanup levels for other media.

(c) Risk assessment procedures. WAC 173-340-703 provides criteria for deciding which hazardous substances need to have cleanup levels established. The analyses performed under Methods B and C use several default assumptions for ~~defining~~ calculating cleanup levels for carcinogens and noncarcinogens. The individual default assumptions and procedures for modifying these assumptions ~~based on~~ using site-specific information are specified in WAC 173-340-708 and 173-340-7200 through 173-340-~~750~~ 760. ~~WAC 173-340-708 also provides rules for use of indicator hazardous substances.~~ The standards for

review of new scientific information are described in WAC 173-340-702 (14), (15) and (16).

(d) Natural background and analytical considerations. In some cases, cleanup levels calculated using the methods specified in this chapter are less than natural background levels or levels that can be reliably measured. In those situations, the cleanup level shall be established at a concentration equal to the practical quantitation limit or natural background concentration, whichever is higher. See WAC 173-340-707 and 173-340-709 for additional information.

(7) Procedures for demonstrating compliance with cleanup standards. Setting cleanup standards also involves being able to demonstrate that they have been met. This involves specifying where on the site the cleanup levels must be met ("points of compliance"), how long it takes for a site to meet cleanup levels ("restoration time frame"), and conducting sufficient monitoring to demonstrate that the cleanup standards have been met and will continue to be met in the future. The provisions for establishing points of compliance are in WAC 173-340-720 through 173-340-750. The provisions for establishing a restoration time frames are in WAC 173-340-360. The compliance monitoring plan prepared under WAC 173-340-410 describes the monitoring to be conducted at the site to demonstrate compliance with these requirements ~~specifies precisely how these are measured for each site~~. At sites where remediation levels are used, the compliance monitoring plan will also need to describe the ~~performance~~ monitoring to be conducted to demonstrate the remediation levels have been achieved.

(8) Specific procedures for setting cleanup levels at petroleum contaminated sites. In addition to the other requirements in this section, this chapter provides for the following specific procedures to establish cleanup levels at sites where there has been a release of total petroleum hydrocarbons (TPH) and hazardous substances associated with a release of TPH.

[Delete existing TPH language and replace with the following.] [9]

(a) Conceptual site model. A conceptual site model should be used to identify the nature of the contamination, the potentially contaminated media, the current and potential pathways of exposure, the current and potential receptors, and the current and potential land and resource uses.

(b) Choosing a Method. There are three methods for establishing cleanup levels at petroleum contaminated sites:

- **Method A:** Intended for simple sites. Specific criteria must be met to use Method A cleanup levels at a site.
- **Method B:** Universal method that can be used at any site.
- **Method C:** Can be used under limited circumstances, such as soil cleanup at an industrial facility.

Choosing one method doesn't preclude choosing a different method later. But using a different method may require collecting additional samples and conducting different analyses. Mixing of these methods is only allowed under limited circumstances (See WAC 173-340-702(17).

(c) Determination of product composition. How the composition of the product released is determined will depend on the Method selected to establish cleanup levels.

(i) For sites proposing to use Method A cleanup levels, if the type of product is unknown, a hydrocarbon identification method (HCID) should be used to determine the types of products released. The total TPH contaminant levels in soil and groundwater are determined using the northwest TPH (NWTPH) method, described in WAC 173-340-830. The NWTPH method is a

[9] This description has been completely replaced to correspond better with current practice. The terminology of "tiers" has been eliminated as it isn't used elsewhere in this rule and isn't used in practice.

Also, the correlation and retrofitting methods were intended to provide a transition for sites with cleanups underway in 2001. This is no longer appropriate given the length of time that has transpired since 2001, and are proposed to be eliminated.

simplified and relatively inexpensive analytical method for measuring TPH.

(ii) For sites using Methods B or C, product composition is determined by analyzing several samples for twelve (six aromatic and six aliphatic) petroleum fractions using the VPH/EPH methods described in WAC 173-340-830.

(iii) Under all methods (A, B & C), individual hazardous substances that are likely to be present (such as benzene) in the petroleum mixture are also measured. (See table 830-1).

(d) Terrestrial ecological evaluation. For soil contamination, the potential impact of TPH on soil biota, plants and animals must be evaluated under WAC 173-340-7490 through 173-340-7494. The following options are available:

- The site is determined to have little or no habitat and is excluded under WAC 173-340-7491 from conducting a terrestrial ecological evaluation.
- The site has limited habitat and thus under WAC 173-340-7492 qualifies for a simplified terrestrial ecological evaluation. Cleanup levels protective of soil biota, plants and animals are established under WAC 173-340-7493 at these sites.
- The site has high quality habitat or a large area of habitat that requires a site-specific ecological evaluation. Cleanup levels protective of soil biota, plants and animals are established under WAC 173-340-7494 at these sites. This method cannot be used at Method A sites.

It should be noted that a terrestrial ecological evaluation may result in more stringent soil cleanup levels than those required to protect human health.

(e) Vapor intrusion. For gasoline and other petroleum products with volatile constituents, an evaluation must be conducted under WAC 173-340-3500 through 3520 to determine if vapor intrusion into existing or potential future structures is a concern at the site that needs to be addressed.

(f) Method A. Method A TPH cleanup levels protective of human health for the most common exposure pathways have been determined for four petroleum mixtures: gasoline range organics, diesel range organics, heavy oils, and electrical insulating mineral oil. Cleanup levels have also been determined for the most common hazardous substances found in these mixtures. These values can be found in Tables 720-1 for groundwater, and Tables 740-1 and 745-1 for soil.

(g) Methods B and C. Methods B and C can be used to develop site-specific TPH cleanup levels. Under these Methods, the petroleum composition and the toxicity of the components making up the mixture are used to develop a TPH cleanup level unique to the site. The TPH cleanup level must be set at a concentration that assures the overall mixture concentration meets requirements for both total TPH and for individual hazardous substances within the mixture. The following is a general description of how this is done. A more detailed description of this process can be found in guidance documents published by the department.

(i) Calculations. Once the composition of a sample has been established, this information is used to calculate a protective concentration for each pathway of concern. This is done by assigning a reference dose to each petroleum fraction and for other hazardous substances in the sample for which a reference dose is available. A TPH concentration is then calculated using a pathway-specific equation that takes into account the additive noncarcinogenic effects of these fractions and compounds. The objective is to derive a TPH concentration that will not exceed a hazard index of one for the exposure pathway of concern (such as direct contact or leaching).

(ii) Adjustments. The calculated TPH concentration for the pathway of concern must be adjusted downward if the resultant TPH concentration would result in individual substances present in the mixture exceeding acceptable carcinogenic risk levels or applicable state and federal laws. This means that in some cases, a specific substance, such as benzene, will drive the overall TPH concentration below a hazard index of one.

The department has made available a spreadsheet that takes into account steps (i) and (ii).

(iii) Selecting a *sample* cleanup level. Where multiple pathways of exposure are of concern, the most stringent of the concentrations calculated for the various exposure pathways becomes the cleanup level for that sample.

(iv) Selecting a *site* cleanup level. At most sites, multiple samples are required to be analyzed to take into account the variability in product composition and site conditions. Cleanup levels calculated for each sample will typically be somewhat different. The department recommends using the median TPH cleanup level for all samples as the site cleanup level against which compliance is measured. If there are areas on the site with different product types or ages, there may be significant differences in cleanup levels between samples taken across the site. In this case, it may be appropriate to group samples representing different parts of the site, calculate a unique median concentration for each grouping, and use this information to assign different cleanup levels to different parts of the site.

(h) Selecting a *method of cleanup*. Once a TPH cleanup level has been established for the site (or different levels for different parts of the site), alternative methods of cleanup for achieving this level are identified in a feasibility study. Where it isn't feasible to completely clean up a site, alternatives may be identified that look at partial cleanup coupled with containment of the remaining contamination. All of these methods are then screened to develop a short list of alternatives that are evaluated in more detail to determine the appropriate method and amount of cleanup at the site. The process for identifying, screening, evaluating, and selecting a remedy is described in WAC 173-340-350. The criteria for evaluating remedies are described in WAC 173-340-360. In cases where all or part of the contamination is contained on site, restrictions on future uses of the property, called institutional controls, will need to be placed to limit the potential for future exposure to residual contamination.

(i) Consultation with the department. Because of the complexity of the development of site-specific Method B and Method C petroleum cleanup levels using petroleum fraction data, persons planning on using these methods are encouraged to contact the department to obtain the latest technical guidance.

Table 830-1 Required Testing for Petroleum Releases (1) [10]						
Contaminant of Concern	**PETROLEUM PRODUCT (2)**					
	Gasoline	**Naphtha & Mineral Spirits**	**Middle Distillates (4)**	**Heavy Oils**	**Mineral Oil**	**Waste Oil & Crude Oil**
Total Petroleum Hydrocarbons (3)						
Method A (NWTPH-Gx or Dx)	✓	✓	✓	✓	✓	✓
Method B or C (VPH)	✓	✓	✓			✓
Method B or C (EPH)			✓	✓	✓	✓
Common Petroleum Components						
Benzene	✓		✓	✓		✓
Toluene	✓		✓	✓		✓
Ethylbenzene	✓		✓	✓		✓
Xylenes (m-, o-, p-)	✓	✓	✓	✓		✓
n-Hexane **(5)**	✓					✓
Naphthalenes (Naphthalene, 1-Methyl and 2-Methyl)	✓	✓	✓	✓		✓
Carcinogenic PAHs **(6)**				✓		✓
Fuel Additives and Blending Compounds						
MTBE	✓					✓
Ethylene Dibromide (EDB)	✓					✓
Ethylene Dichloride (EDC)	✓					✓
Other Additives and Blending Compounds (e.g., ethanol, methanol, TBA, TAME, ETBE)	✓					✓
Metals						
Cadmium, Chromium, Copper, Nickel and Zinc						✓
Lead **(7)**	✓					✓
Other Non-Petroleum Substances and Indicators						
PCBs **(8)**				✓	✓	✓
Halogenated Volatile Organic Compounds (VOCs)						✓
Other Site Contaminants **(9)**	✓	✓	✓	✓	✓	✓

(1) A checkmark means the testing requirement applies to all affected media, unless otherwise specified in the footnotes. Every sample does not have to be tested for all substances listed. Testing is required for a sufficient number of samples in each medium of concern to determine whether the substance is present at concentrations of concern. Testing should first be conducted on those samples most likely to contain the highest concentrations of the substance based on field screening. If this testing reveals the substance is not present at concentrations of concern, then subsequent samples do not need to be tested for that substance.

(2) See Table 830-2 for definitions of products in this Table. If the type of petroleum hydrocarbons present is not known or there is a mixture of petroleum products at the site, then analyze one or more representative samples using the NWTPH-HCID method to determine the appropriate analytical method(s). For a mixture of products, test for the required substances for all products in the mixture. Consult with Ecology for testing recommendations for petroleum products not identified in this table and Table 830-2.

[Footnotes continue on the next page!]

[10] Delete table 830-1 in its entirety and replace with this table (table will still be in the back of the rule)
Substantive changes include: VPH added to diesel range organics; non PCB mineral oil has been defined as containing less than 1 ppm PCBs; testing for several volatile contaminants in soils no longer contingent on groundwater test results; copper added as a metal of potential concern.

(3) The analytical methods NWTPH-Gx, NWTPH-Dx, NWTPH-HCID, VPH, and EPH are methods published by the Department of Ecology and available on the department's Internet web site: http://www.ecy.wa.gov/programs/tcp/cleanup.html.

(4) Releases of home heating oil from systems capable of storing 1,100 gallons or less do not need to be analyzed for BTEX.

(5) n-Hexane only needs to be tested if the VPH method is being used.

(6) See Tables 708-1 and 708-2 for a list of carcinogenic PAHs.

(7) Lead only needs to be tested if the release occurred prior to 1996 or, for more recent releases, whenever one or more of the following products are present: aviation gasoline, racing fuel or other off road vehicle fuels (where lead additives are still allowed).

(8) Testing affected media (that is, soil and groundwater) for PCBs is required unless it can be demonstrated that: (1) the release originated from an electrical device manufactured for use in the United States after July 1, 1979; (2) oil containing PCBs was never used in the equipment suspected as the source of the release (examples of equipment where PCBs are likely to be found include transformers, electric motors, hydraulic systems, heat transfer systems, electromagnets, compressors, capacitors, switches and miscellaneous other electrical devices); or, (3) the oil released was recently tested and contained less than 2 mg/liter (ppm) of PCBs.

(9) Analyze for any non-petroleum contaminants that are known or suspected of being present at the site. For example, testing for pesticides should be conducted if diesel was used as a pesticide carrier. Another example is groundwater tests to demonstrate natural attenuation is occurring at a site (such as dissolved oxygen, redox potential, pH, specific conductivity, nitrate, soluble Mn & Fe, sulfate, alkalinity, methane).

Table 830-2 Categories of Petroleum Products [11]

Gasoline (Gasoline Range Organics) includes the following products:

- Automotive Gasoline
- Aviation Gasoline
- Automotive Racing Fuels
- Mineral Spirits
- Naptha
- Stoddard Solvents

Middle Distillates/Oils (Diesel Range Organics) includes the following products:

- Diesel No. 1
- Kerosene
- Diesel No. 2
- Diesel & Biodiesel mixtures
- Home heating oil
- Jet Fuel (such as JP-4, JP-5, JP-7, JP-8)
- Light Oil

Heavy Fuels/Oils (Heavy Oils) includes the following products:

- Bunker C
- No. 4 Fuel Oil
- No. 5 Fuel Oil
- No. 6 Fuel Oil
- Products included under waste oil **before use**

Mineral Oil is a subcategory of heavy oil. It includes:

- Insulating oil or coolant used in electrical devices such as transformers and capacitors containing less than 2 mg/liter (ppm) of PCBs.

Waste Oil is any **used oil** and includes the following products:

- Engine lubricating oil
- Hydraulic fluid
- Industrial process oil/fluid
- Metalworking oil/fluid
- Oil used as a drilling buoyant
- Refrigeration/compressor oil
- Transmission/differential fluid

[11] A release falls within these categories when a 90% match can be achieved using the HCID method.

WAC 173-340-702 General policies.

(1) Purpose. This section defines the general policies and principles that shall be followed when establishing and implementing cleanup standards. This section shall be used in combination with other sections of this chapter.

(2) Policy on expediting cleanups. Establishing cleanup standards and selecting an appropriate cleanup action involves many technical and public policy decisions. This chapter is intended to constrain the range of decisions made on individual sites to promote expeditious cleanups.

(3) Goal for cleanups. The Model Toxics Control Act contains policies that state, in part, each person has a fundamental and inalienable right to a healthful environment and it is essential that sites be cleaned up well. Consistent with these policies, cleanup standards and cleanup actions selected under this chapter shall be established that provide conservative estimates of human health and environmental risks that protect susceptible individuals as well as the general population.

(4) Current and potential site and resource uses. Cleanup standards and cleanup actions selected under this chapter shall be established that protect human health and the environment for current and potential future site and resource uses.

(5) Presumption for cleanup actions. Cleanup actions that achieve cleanup levels at the applicable point of compliance under Methods A, B, or C (as applicable) and comply with applicable state and federal laws shall be presumed to be protective of human health and the environment.

(6) Cost considerations. Except as provided for in applicable state and federal laws, cost shall not be a factor in determining what cleanup level is protective of human health and the environment. In addition, where specifically provided for in this chapter, cost may be appropriate for certain other determinations related to cleanup standards such as point of compliance. Cost shall, however, be considered when selecting an appropriate cleanup action.

(7) Cleanup action alternatives. At most sites, there is more than one hazardous substance and more than one pathway for hazardous substances to get into the environment. For many sites there is more than one method of cleanup (cleanup action component) that could address each of these. When evaluating cleanup action alternatives it is appropriate to consider a representative range of cleanup action components that could address each of these as well as different combinations of these components to accomplish the overall site cleanup.

(8) Cross-media impacts. ~~The cleanup of a particular~~ Contamination in one medium at a site will often affect other media at the site. [12] These cross-media impacts shall be considered when establishing cleanup standards and selecting a cleanup action. Cleanup actions conducted under this chapter shall use appropriate engineering controls or other measures to minimize these cross-media impacts.

(9) Relationship between cleanup levels and cleanup actions. In general, cleanup levels must be met throughout a site before the site will be considered clean. A cleanup action that leaves hazardous substances on a site in excess of cleanup levels may be acceptable as long as the cleanup action complies with WAC 173-340-350 through 173-340-390. However, these rules are intended

[12] Editorial change.

to promote thorough cleanups rather than long-term partial cleanups or containment measures.

(10) Relationship to federal cleanup law. When evaluating cleanup actions performed under the federal cleanup law, the department shall consider WAC 173-340-350, 173-340-355, 173-340-357, 173-340-360, 173-340-410, 173-340-420, 173-340-440, 173-340-450, 173-340-700 through 173-340-760, and 173-340-830 to be legally applicable requirements under Section 121(d) of the Federal Cleanup Law.

(11) Reviewing and updating cleanup standards. The department shall review and, as appropriate, update WAC 173-340-700 through 173-340-760 at least once every five years.

(12) Applicability of new cleanup levels.

(a) For cleanup actions conducted by the department, or under an order or decree, the department shall determine the cleanup level that applies to a release based on the rules in effect under this chapter at the time the department issues a final cleanup action plan for that release.

(b) In reviewing the adequacy of independent remedial actions, the department shall determine the cleanup level that applies to a release based on the rules in effect at the time the final cleanup action for that release began or in effect when the department reviews the cleanup action, whichever is less stringent.

(c) A release cleaned up under the cleanup levels determined in (a) or (b) of this subsection shall not be subject to further cleanup action due solely to subsequent amendments to the provisions in this chapter on cleanup levels, unless the department determines, on a case-by-case basis, that the previous cleanup action is no longer sufficiently protective of human health and the environment.

(d) Nothing in this subsection constitutes a settlement or release of liability under the Model Toxics Control Act.

(13) Institutional controls. Institutional controls shall be required whenever any of the circumstances identified in WAC 173-340-440(4) are present at a site.

(14) Burden of proof. Any person responsible for undertaking a cleanup action under this chapter who proposes to:

(a) Use a reasonable maximum exposure scenario other than the default provided for each medium;

(b) Use assumptions other than the default values provided for in this chapter;

(c) Establish a cleanup level under Method C; or

(d) Use a conditional point of compliance, shall have the burden of demonstrating to the department that requirements in this chapter have been met to ensure protection of human health and the environment. The department shall only approve of such proposals when it determines that this burden of proof is met.

(15) New scientific information. The department shall consider new scientific information when establishing cleanup levels and remediation levels for individual sites. In making a determination on how to use this new information, the department shall, as appropriate, consult with the science advisory board, the department of health, and the United States Environmental Protection Agency. Any proposal to use new scientific information shall meet the quality of information requirements in subsection (16) of this section. To minimize delay in cleanups, any proposal to use new scientific information should be introduced as early in the cleanup process as possible. Proposals to use new scientific information may be considered up to the time of issuance of the final cleanup action plan governing the cleanup action for a site unless triggered as part of a periodic review under WAC 173-340-420 or through a reopener under RCW 70.105D.040 (4)(c).

(16) Criteria for quality of information.

(a) The intent of this subsection is to establish minimum criteria to be considered when evaluating information used by or submitted to the department proposing to modify the default methods or assumptions specified in this chapter or proposing methods or assumptions not specified in this chapter for calculating cleanup levels and remediation levels. This subsection does not establish a burden of proof or alter the burden of proof provided for elsewhere in this chapter.

(b) When deciding whether to approve or require modifications to the default methods or assumptions specified in this chapter for establishing

cleanup levels and remediation levels or when deciding whether to approve or require alternative or additional methods or assumptions, the department shall consider information submitted by all interested persons and the quality of that information. When evaluating the quality of the information the department shall consider the following factors, as appropriate for the type of information submitted:

(i) Whether the information is based on a theory or technique that has widespread acceptance within the relevant scientific community;

(ii) Whether the information was derived using standard testing methods or other widely accepted scientific methods;

(iii) Whether a review of relevant available information, both in support of and not in support of the proposed modification, has been provided along with the rationale explaining the reasons for the proposed modification;

(iv) Whether the assumptions used in applying the information to the facility are valid and would ensure the proposed modification would err on behalf of protection of human health and the environment;

(v) Whether the information adequately addresses populations that are more highly exposed than the population as a whole and are reasonably likely to be present at the site; and

(vi) Whether adequate quality assurance and quality control procedures have been used, any significant anomalies are adequately explained, the limitations of the information are identified, and the known or potential rate of error is acceptable.

(17) Mixing of methods. [13] Except as provided for in this subsection, Methods A, B and C cannot be mixed to establish cleanup levels for different hazardous substances within a particular medium at a site.

(a) If Method A is used to establish cleanup levels in a medium at a site, then Methods B and C cannot be used to establish cleanup levels for that same medium at the site. [14]

(b) If Method B is used to establish cleanup levels in a medium at a site, then Method C cannot be used to establish cleanup levels for that same medium at the site. [15]

(c) The Method A value for arsenic in table 720-1 can be used as a Method B or C groundwater cleanup level. [16]

(d) The Method A values for lead in tables 740-1 and 745-1 can be used respectively as Method B and Method C soil cleanup levels. [17]

(e) The Method A values for total petroleum hydrocarbons (TPH) in Table 720-1 can be used as Method B or C surface water cleanup levels addressing the fish consumption exposure pathway. [18]

[13] This language is proposed to address questions about the mixing of Methods A, B and C cleanup levels and, for the most part, reflects current practice.

[14] If a substance is present at the site that does not have a method A table value or ARAR, then the substance must be assigned a cleanup level of natural background or the PQL, whichever is higher OR cleanup levels for all substances must be established under Methods B or C, as appropriate. This is because Method A doesn't consider additive risk.

[15] Methods B and C use different levels of risk and different exposure assumptions and are inappropriate to mix.

[16] The Method A values for arsenic and lead described in (c) and (d) were developed using the same methods used under Methods B & C. Thus, to expedite cleanups, Ecology believes these values are appropriate for use under Method B and C also, particularly where these substances are a minor contaminant at a site. This is not intended to preclude developing site-specific Method B or C cleanup levels.

[17] When using these lead values, exposure pathways not addressed by these table values (such as TEE, surface water) must still be addressed if these are issues at the site. [footnote to be added to rule]

[18] The Method A TPH drinking water values have been determined to also prevent bioaccumulation of TPH in fish and shellfish in levels above health concern. These values are allowed to be used as the basis for a surface water cleanup level under the current MTCA rule. However, these values may not always be protective of aquatic life. Surface water and sediment bioassays may also need to be conducted to determine if these concentrations are protective of aquatic life for the product(s) present at the site. [underlined part of footnote to be added to rule]

WAC 173-340-703 Selection of indicator hazardous substances.

(1) Purpose. When defining cleanup requirements at a site that is contaminated with a large number of hazardous substances, the department may eliminate from consideration those hazardous substances that contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances shall serve as indicator hazardous substances for purposes of defining site cleanup requirements.

(2) Approach. If the department considers this approach appropriate for a particular site, the factors evaluated when eliminating individual hazardous substances from further consideration shall include:

(a) The toxicological characteristics of the hazardous substance that influence its ability to adversely affect human health or the environment relative to the concentration of the hazardous substance at the site, including consideration of essential nutrient requirements;

(b) The chemical and physical characteristics of the hazardous substance which govern its tendency to persist in the environment;

(c) The chemical and physical characteristics of the hazardous substance which govern its tendency to move into and through environmental media;

(d) The natural background concentrations of the hazardous substance;

(e) The thoroughness of testing for the hazardous substance at the site;

(f) The frequency that the hazardous substance has been detected at the site; and

(g) Degradation by-products of the hazardous substance.

(3) Biological tests. [19] When the department determines that the use of indicator hazardous substances is appropriate for a particular site, it may also require biological testing to address potential toxic effects associated with hazardous substances eliminated from consideration under this subsection.

[19] Title added for consistency with other subsections.

WAC 173-340-704 Use of Method A.

(1) Applicability. Method A may be used to establish cleanup levels at sites that have few hazardous substances and that meet ~~one~~ all of the following ~~criteria~~ conditions: [20]

(a) ~~Sites undergoing a routine cleanup action as defined in WAC 173-340-200; or~~

(b) ~~Sites where~~ Except as provided for in subsection (2)(e) of this section, numerical standards are available in the tables in this chapter or applicable state and federal laws for all indicator hazardous substances in the media for which the Method A cleanup level is being used~~.~~**;**

(b) Hazardous substances have not reached surface water and are unlikely to reach surface water during estimated restoration timeframe; and [21]

(c) For soil only, the site qualifies for either: [22]

(i) An exclusion from conducting a terrestrial ecological evaluation under WAC 173-340-7491; or

(ii) A simplified terrestrial ecological evaluation under WAC 173-340-7492 and uses the procedures in WAC 173-340-7493 to set cleanup levels protective of soil biota, plants and animals;

(2) Procedures. Method A cleanup levels shall be established in accordance with the procedures in WAC 173-340-720 through 173-340-760. Method A cleanup levels shall be at least as stringent as all of the following:

(a) Concentrations of individual hazardous substances listed in Tables 720-1, 740-1, or 745-1 in this chapter;

(b) Concentrations of individual hazardous substances established under applicable state and federal laws;

(c) Concentrations that result in no significant adverse effects on the protection and propagation of terrestrial ecological receptors using the procedures specified in WAC 173-340-7490 through 173-340-7493, unless it is demonstrated under those sections that establishing a soil concentration is unnecessary**;**

(d) Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7505. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion; and [23]

~~**(d)**~~**(e)** For individual hazardous substances deemed indicator hazardous substances for the medium of concern under WAC 173-340-~~708(2)~~ 703 and not addressed under (a) ~~and (b)~~ of this subsection, concentrations that do not exceed natural background levels or the practical quantitation limit, whichever is higher, for the substance in question. [24]

(3) More stringent cleanup levels. The department may ~~establish~~ require Method A cleanup levels more stringent than those required by subsection (2) of this section, when based on a site-specific evaluation, the department determines that such levels are necessary to protect human health and the environment. Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708.

(4) Remediation levels. Under Method A, the Method B formulas may be modified for the purpose of using a human health risk assessment to evaluate the protectiveness of a remedy. WAC 173-340-708 (3) and (10) describe the adjustments that can be made to the Method B formulas to assess whether a remedy is protective of human health. Also see WAC 173-340-355 and 173-340-

[20] These changes are intended to open up Method A for use at most sites, rather than just "routine" sites.
[21] Method A CULs don't consider surface water impacts. CULs should be established under Method B at these sites.
[22] Sites that use a site-specific terrestrial ecological evaluation are complex sites, not suitable for the use of Method A. The criteria in (c) are from the current footnotes to table 740-1 and 745-1.
[23] Reflects the addition of new chapters addressing the vapor intrusion exposure pathway.
[24] Cross-reference updated.

357 for more detailed information on remediation levels and quantitative risk assessment. [25]

(5) ~~I~~Effect of inconsistencies. If there are any inconsistencies between this section and any specifically referenced sections, the referenced section shall govern.

[25] Editorial changes.

WAC 173-340-705 Use of Method B.

(1) Applicability. Method B is applicable to all sites. It shall be used to develop cleanup levels unless ~~one or more of~~ the conditions for using Method A or Method C are demonstrated to exist and the person conducting the cleanup action elects to use ~~that~~ one of those methods.

(2) Cleanup levels. ~~Method B consists of two approaches, standard and modified. Standard~~ Method B uses default formulas, assumptions, and procedures to develop cleanup levels. Under ~~modified~~ Method B, chemical-specific or site-specific information may also be used to change certain assumptions to calculate different cleanup levels. ~~When the term "Method B" is used in this chapter, it means both standard and modified Method B.~~ Method B cleanup levels shall be established in accordance with the procedures in WAC 173-340-720 through 173-340-760. Method B cleanup levels shall be at least as stringent as all of the following: [26]

(a) Concentrations of individual hazardous substances established under applicable state and federal laws;

(b) Concentrations that are estimated to result in no adverse effects on the protection and propagation of aquatic life, and no significant adverse effects on terrestrial ecological receptors using the procedures specified in WAC 173-340-7490 through 173-340-7494;

(c) Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7505. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion; [27]

(d) For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, those concentrations which protect human health as determined by the following methods:

(i) Concentrations that are estimated to result in no acute or chronic toxic effects on human health as determined using a hazard quotient of one (1) and the procedures specified in WAC 173-340-720 through 173-340-760;

(ii) For known or suspected carcinogens, concentrations for which the upper bound on the estimated individual lifetime excess cancer risk is less than or equal to one in one million (1×10^{-6}) as determined using the procedures specified in WAC 173-340-720 through 173-340-760; and

(iii) Concentrations that eliminate or minimize the potential for food chain contamination as necessary to protect human health.

(3) More stringent cleanup levels. The department may establish Method B cleanup levels that are more stringent than those required by subsection (2) of this section, when based upon a site-specific evaluation, the department determines that such levels are necessary to protect human health and the environment. Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708.

(4) Multiple hazardous substances or pathways. Concentrations of individual hazardous substances established under subsections (2) and (3) of this section, including those based on applicable state and federal laws, shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure. These adjustments need to be made only if, without these adjustments, the hazard index would exceed one (1) or the total excess estimated individual lifetime cancer risk would exceed one in one hundred thousand (1×10^{-5}). These

[26] Editorial changes reflecting proposed elimination of "standard" and "modified" terminology.

[27] Reflects the addition of new chapters addressing the vapor intrusion exposure pathway.

adjustments shall be made in accordance with the procedures in WAC 173-340-708 (5) and (6). In making these adjustments, the hazard index shall not exceed one (1) and the total estimated individual lifetime excess cancer risk shall not exceed one in one hundred thousand (1×10^{-5}).

(5) Adjustments to cleanup levels based on applicable laws. Where a cleanup level is based on an applicable state or federal law, and the level of risk upon which the applicable state and federal law is based exceeds an estimated individual lifetime excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of one (1), the cleanup level must be adjusted downward so that:

- ~~The total~~ The estimated individual lifetime excess cancer risk ~~and hazard index at the site does not exceed~~ for the substance does not exceed one in one hundred thousand (1×10^{-5});
- The hazard quotient for the substance does not exceed one (1); and
- ~~the~~ The limits on total site risk established in subsection (4) of this section are not exceeded.[28]

(6) Limitation on adjustments. Cleanup levels determined using Method B, including cleanup levels adjusted under subsections (4) and (5) of this section, shall not be set at levels below the practical quantitation limit or natural background, whichever is higher. See WAC 173-340-707 and 173-340-709 for additional requirements on practical quantitation limits and natural background.

(7) Remediation levels. Method B formulas may be modified ~~for the purpose of~~ when using a human health risk assessment to evaluate the protectiveness of a remedy. WAC 173-340-708 (3) and (10) describe the adjustments that can be made to the Method B formulas. Also see WAC 173-340-355 and 173-340-357 for more detailed information on remediation levels and quantitative risk assessment.

(8) ~~I~~Effect of inconsistencies. If there are any inconsistencies between this section and any specifically referenced sections, the referenced section shall govern.

[28] Reformatted with editorial changes, to improved readability. Not intended to be substantive.

WAC 173-340-706 Use of Method C.

(1) Applicability. Method C cleanup levels represent concentrations that are protective of human health and the environment for specified site uses and conditions. A site (or portion of a site) that qualifies for a Method C cleanup level for one medium does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium. Sites that use Method C must use institutional controls to limit exposure to hazardous substances at the site consistent with the exposure scenario on which the Method C cleanup levels are based.[29] Method C cleanup levels may be used in the following situations:

(a) For surface water, ground groundwater ~~water and air,~~ and sediments, Method C cleanup levels may be established where the person conducting the cleanup action can demonstrate that such levels comply with applicable state and federal laws, that all practicable methods of treatment are used, that institutional controls are implemented in accordance with WAC 173-340-440, and that one or more of the following conditions exist:

(i) Where Method A or B cleanup levels are below area background concentrations, Method C cleanup levels may be established at concentrations that are equal to area background concentrations, but in no case greater than concentrations specified in subsection (2) of this section;

(ii) Where attainment of Method A or B cleanup levels has the potential for creating a significantly greater overall threat to human health or the environment than attainment of Method C cleanup levels established under this chapter, Method C cleanup levels may be established at concentrations that minimize those overall threats, but in no case greater than concentrations specified in subsection (2) of this section. Factors that shall be considered in making this determination include:

(A) Results of a site-specific risk assessment;
(B) Duration of threats;
(C) Reversibility of threats;
(D) Magnitude of threats; and
(E) Nature of affected population.

(iii) Where Method A or B cleanup levels are below technically possible concentrations, Method C cleanup levels may be established at the technically possible concentrations, but in no case greater than levels specified in subsection (2) of this section.

(b) Method C soil cleanup levels may only be established where the person conducting the cleanup action can demonstrate that the area under consideration is an industrial property and meets the criteria for establishing industrial soil cleanup levels under WAC 173-340-745.

(c) Method C air cleanup levels may ~~also~~ only be established for facilities qualifying as industrial property under WAC 173-340-745 and for utility vaults and manholes. ~~(See WAC 173-340-750.)~~[30]

(2) Cleanup levels. ~~Method C consists of two approaches, standard and modified. Standard~~ Method C uses default formulas, assumptions, and procedures to develop cleanup levels. Under ~~modified~~ Method C, chemical-specific or site-specific information also may ~~also~~ be used to change certain assumptions to calculate different cleanup levels. ~~When the term "Method C" is used in this chapter, it means both standard and modified Method C.~~ Method C cleanup levels shall be established in accordance with the procedures in WAC 173-340-720 through 173-

[29] For example, a Method C cleanup level based on industrial worker exposure would require restricting future land uses to industrial uses. Reflects current practice and already existing requirements in Section 440.

[30] To reflect that Method C Air cleanup levels are proposed to be based on an adult worker exposure, and thus their use should be limited to settings where only adult workers can be exposed.

340-760. Method C cleanup levels shall be at least as stringent as all of the following: [31]

(a) Concentrations established under applicable state and federal laws;

(b) Concentrations that are estimated to result in no significant adverse effects on the protection and propagation of aquatic life, and no significant adverse effects on wildlife using the procedures specified in WAC 173-340-7490 through 173-340-7494;

(c) Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7505. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion; [32]

(d) For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, those concentrations which are protective of human health as determined by the following methods:

(i) Concentrations that are estimated to result in no significant adverse acute or chronic toxic effects on human health as estimated using a hazard quotient of one (1) and the procedures defined in WAC 173-340-720 through 173-340-760;

(ii) For known or suspected carcinogens, concentrations for which the upper bound on the estimated individual lifetime excess cancer risk is less than or equal to one in one hundred thousand (1×10^{-5}) as determined using the procedures defined in WAC 173-340-720 through 173-340-760; and

(iii) Concentrations that eliminate or minimize the potential for food chain contamination as necessary to protect human health.

(3) More stringent cleanup levels. The department may establish Method C cleanup levels that are more stringent than those required by subsection (2) of this section when based upon a site-specific evaluation, the department determines that such levels are necessary to protect human health and the environment. Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708.

(4) Multiple hazardous substances or pathways. Concentrations of individual hazardous substances established under subsections (2) and (3) of this section, including those based on applicable state and federal laws, shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure. These adjustments need to be made only if, without these adjustments, the hazard index would exceed one (1) or the total estimated individual lifetime excess cancer risk would exceed one in one hundred thousand (1×10^{-5}). These adjustments shall be made in accordance with WAC 173-340-708 (5) and (6). In making these adjustments, the hazard index shall not exceed one and the total estimated individual lifetime excess cancer risk shall not exceed one in one hundred thousand (1×10^{-5}).

(5) Adjustments to cleanup levels based on applicable laws. When a cleanup level is based on an applicable state or federal law and the level of risk upon which the applicable law is based exceeds an estimated individual lifetime excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of one (1), the cleanup level must be adjusted downward so that:

- ~~The total~~ The estimated individual lifetime excess cancer risk for the substance does not exceed one in one hundred thousand (1×10^{-5});
- ~~and the~~ The hazard ~~index~~ quotient for the substance does not exceed one (1); and ~~at the site.~~
- The limits on total site risk established in subsection (4) of this section are not exceeded. [33]

(6) Limitation on adjustments. Cleanup levels determined using Method C, including cleanup levels adjusted under subsections (4) and (5) of this section, shall not be set at levels below the practical quantitation limit or natural back-

[31] Editorial changes reflecting proposed elimination of "standard" and "modified" terminology.

[32] Reflects the addition of new chapters addressing the vapor intrusion exposure pathway.

[33] Reformatted with editorial changes, to improved readability. Not intended to be substantive.

ground, whichever is higher. See WAC 173-340-707 and 173-340-709 for additional requirements on practical quantitation limits and natural background.

(7) Remediation levels. Method C formulas may be modified ~~for the purpose of~~ when using a human health risk assessment to evaluate the protectiveness of a remedy. WAC 173-340-708 (3) and (10) describe the adjustments that can be made to the Method C formulas. Also see WAC 173-340-355 and 173-340-357 for more detailed information on remediation levels and quantitative risk assessment.

(8) ~~I~~Effect of inconsistencies. If there are any inconsistencies between this subsection and any specifically referenced sections, the referenced section shall govern.

WAC 173-340-707 Analytical considerations. [34]

(1) Analytical methods.

(2) Use of practical quantitation limits.

(3) Special methods.

(4) Relationship to periodic reviews.

(1) Analytical methods. Analytical methods used to evaluate the effectiveness of a cleanup action shall comply with the requirements in WAC 173-340-830.

(2) Use of practical quantitation limits. The department recognizes that there may be situations where a hazardous substance is not detected or is detected at a concentration below the practical quantitation limit utilizing sampling and analytical procedures which comply with the requirements of WAC 173-340-830. If those situations arise and the practical quantitation limit is higher than the cleanup level for that substance, the cleanup level shall be considered to have been attained, subject to subsection (4) of this section, only when the more stringent of the following conditions are met:

(a) The practical quantitation limit is no greater than ten times the method detection limit; or

(b) The practical quantitation limit for the particular hazardous substance, medium, and analytical procedure is no greater than the practical quantitation limit established by the United States Environmental Protection Agency and used to establish requirements in 40 CFR 136, 40 CFR 141 through 143, ~~or~~ 40 CFR 260 through 270, 40 CFR 300-399 or 40 CFR 700-799. [35]

(3) Special methods. In cases where a cleanup level required by this chapter is less than the practical quantitation limit using an approved analytical procedure, the department may also require one or more of the following:

(a) Use of surrogate measures of hazardous substance contamination;

(b) Use or development of specialized sample collection or analysis techniques to improve the method detection limit or practical quantitation limit for the hazardous substances at the site; or

(c) Monitoring to assure that the concentration of a hazardous substance does not exceed detectable levels.

(4) Relationship to periodic reviews. When the practical quantitation limit is above the cleanup level, the department shall consider the availability of improved analytical techniques when performing periodic reviews under WAC 173-340-420. Subsequent to those reviews, the department may require the use of improved analytical techniques with lower practical quantitation limits and other appropriate actions.

[34] Added subsection titles for consistency with rest of rule.

[35] Amended to add reference to the federal CERCLA and TSCA regulations, both of which reference analytical methods.

WAC 173-340-708 Human health risk assessment procedures.

(1) Purpose. This section defines the risk assessment framework that shall be used to establish cleanup levels, and remediation levels using a quantitative risk assessment, under this chapter. As used in this section, cleanup levels and remediation levels means the human health risk assessment component of these levels. This chapter defines certain default values and methods to be used in calculating cleanup levels and remediation levels. This section allows varying from these default values and methods under certain circumstances. When deciding whether to approve alternate values and methods the department shall ensure that the use of alternative values and methods will not significantly delay site cleanups.

(2) Selection of indicator hazardous substances. When defining cleanup requirements at a site that is contaminated with a large number of hazardous substances, the department may eliminate from consideration those hazardous substances that contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances shall serve as indicator hazardous substances for purposes of defining site cleanup requirements. See WAC 173-340-703 for additional information on establishing indicator hazardous substances.

(3) Reasonable maximum exposure.

(a) Cleanup levels and remediation levels shall be based on estimates of current and future resource uses and reasonable maximum exposures expected to occur under both current and potential future site use conditions, as specified further in this chapter.

(b) The reasonable maximum exposure is defined as the highest exposure that is reasonably expected to occur at a site under current and potential future site use. WAC 173-340-720 through 173-340-760 define the reasonable maximum exposures for ground-water, surface water, soil, and air. These reasonable maximum exposures will apply to most sites where individuals or groups of individuals are or could be exposed to hazardous substances. For example, the reasonable maximum exposure for most ground water is defined as exposure to hazardous substances in drinking water and other domestic uses.

(c) Persons performing cleanup actions under this chapter may use the evaluation criteria in WAC 173-340-720 through 173-340-760, where allowed in those sections, to demonstrate that the reasonable maximum exposure scenarios specified in those sections are not appropriate for cleanup levels for a particular site. For example, the criteria in WAC 173-340-720(2) could be used to demonstrate that the reasonable maximum exposure for ground water beneath a site does not need to be based on drinking water use. The use of an alternate exposure scenario shall be documented by the person performing the cleanup action. Documentation for the use of alternate exposure scenarios under this provision shall be based on the results of investigations performed in accordance with WAC 173-340-350.

(d) Persons performing cleanup actions under this chapter may also use alternate reasonable maximum exposure scenarios to help assess the protectiveness to human health of a cleanup action alternative that incorporates remediation levels and uses engineered controls and/or institutional controls to limit exposure to the contamination remaining on the site.

(i) An alternate reasonable maximum exposure scenario shall reflect the highest exposure that is reasonably expected to occur under current and potential future site conditions considering, among other appropriate factors, the potential for institutional controls to fail and the extent of the time period of failure under these scenarios and the land uses at the site.

(ii) Land uses other than residential and industrial, such as agricultural, recreational, and commercial, shall not be used as the basis for a reasonable maximum exposure scenario for the purpose of establishing a cleanup level. However, these land uses may be used as a basis for an alternate reasonable maximum exposure scenario for the purpose of assessing the protectiveness of a remedy. For example, if a cap (with appropriate institutional controls) is the proposed cleanup action at a commercial site, the reasonable maximum exposure scenario for assessing the protectiveness of the cap with regard to direct soil contact could be changed from a child living on the site to a construction or maintenance worker and child trespasser scenario.

(iii) The department expects that in evaluating the protectiveness of a remedy with regard to the soil direct contact pathway, many types of commercial sites may, where appropriate, qualify for alternative exposure scenarios under this provision since contaminated soil at these sites is typically characterized by a cover of buildings, pavement, and landscaped areas. Examples of these types of sites include:

(A) Commercial properties in a location removed from single family homes, duplexes or subdivided individual lots;

(B) Private and public recreational facilities where access to these facilities is physically controlled (e.g., a private golf course to which access is restricted by fencing);

(C) Urban residential sites (e.g., upper-story residential units over ground floor commercial businesses);

(D) Offices, restaurants, and other facilities primarily devoted to support administrative functions of a commercial/industrial nature (e.g., an employee credit union or cafeteria in a large office or industrial complex).

(e) ~~A conceptual site model may be used to identify when i~~ Individuals or groups of individuals may be exposed to hazardous substances through more than one exposure pathway. For example, a person may be exposed to hazardous substances from a site by drinking contaminated ground water, eating contaminated fish, and breathing contaminated air. At sites where the same individuals or groups of individuals are or could be consistently exposed through more than one pathway, the reasonable maximum exposure shall represent the total exposure through all of those pathways. ~~At such sites, the cleanup levels and remediation levels derived for individual pathways under WAC 173-340-720 through 173-340-760 and WAC 173-340-350 through 173-340-390 shall be adjusted downward to take into account multiple exposure pathways.~~ [36]

(4) Cleanup levels for individual hazardous substances. Cleanup levels for individual hazardous substances will generally be based on a combination of requirements in applicable state and federal laws and risk assessment.

(5) Multiple hazardous substances.

(a) Cleanup levels for individual hazardous substances established under Methods B and C and remediation levels shall be adjusted downward to take into account exposure to multiple hazardous substances. This adjustment needs to be made only if, without this adjustment, the hazard index would exceed one (1) or the total estimated individual lifetime excess cancer risk would exceed one in one hundred thousand (1×10^{-5}).

(b) Adverse effects resulting from exposure to two or more hazardous substances with similar types of toxic response are assumed to be additive unless scientific evidence is available to demonstrate otherwise. Cancer risks resulting from exposure to two or more carcinogens are assumed to be additive unless scientific evidence is available to demonstrate otherwise.

(c) For noncarcinogens, for purposes of establishing cleanup levels under Methods B and C, and for remediation levels, the health threats resulting from exposure to two or more hazardous substances with similar types of toxic response may be apportioned between those hazardous substances in any combination as long as the hazard index does not exceed one (1).

[36] Conceptual site models now addressed elsewhere in this rule. The last sentence is a redundant provision already addressed in (5).

(d) For carcinogens, for purposes of establishing cleanup levels under Methods B and C, and for remediation levels, the cancer risks resulting from exposure to multiple hazardous substances may be apportioned between hazardous substances in any combination as long as the total estimated individual lifetime excess cancer risk does not exceed one in one hundred thousand (1 x 10^{-5}).

(e) The department may require biological testing to assess the potential interactive effects associated with chemical mixtures.

(f) When making adjustments to cleanup levels and remediation levels for multiple hazardous substances, the concentration for individual hazardous substances shall not be adjusted downward to less than the practical quantitation limit or natural background. When a cleanup level for a hazardous substance is established at natural background, the risk posed by that substance may be ignored when calculating a hazard index or the total estimated individual lifetime excess cancer risk for multiple hazardous substances. [37]

(6) Multiple pathways of exposure.

(a) Estimated doses of individual hazardous substances resulting from more than one pathway of exposure are assumed to be additive unless scientific evidence is available to demonstrate otherwise.

(b) Cleanup levels and remediation levels based on one pathway of exposure shall be adjusted downward to take into account exposures from more than one exposure pathway. The number of exposure pathways considered at a given site shall be based on the reasonable maximum exposure scenario as defined in WAC 173-340-708(3). This adjustment needs to be made only if exposure through multiple pathways is likely to occur at a site and, without the adjustment, the hazard index would exceed one (1) or the total estimated individual lifetime excess cancer risk would exceed one in one hundred thousand (1 x 10^{-5}).

(c) For noncarcinogens, for purposes of establishing cleanup levels under Methods B and C, and remediation levels, the health threats associated with exposure via multiple pathways may be apportioned between exposure pathways in any combination as long as the hazard index does not exceed one (1).

(d) For carcinogens, for purposes of establishing cleanup levels under Methods B and C, and for remediation levels, the cancer risks associated with exposure via multiple pathways may be apportioned between exposure pathways in any combination as long as the total estimated individual lifetime excess cancer risk does not exceed one in one hundred thousand (1 x 10^{-5}).

(e) When making adjustments to cleanup levels and remediation levels for multiple pathways of exposure, the concentration for individual hazardous substances shall not be adjusted downward to less than the practical quantitation limit or natural background. When a cleanup level for a hazardous substance is established at natural background, the risk posed by that substance may be ignored when calculating a hazard index or the total estimated individual lifetime excess cancer risk for multiple pathways of exposure. [38]

(7) Reference doses and reference concentrations.

(a) The chronic reference dose/reference concentration and the developmental reference dose/ reference concentration shall be used to establish cleanup levels and remediation levels under this chapter. Cleanup levels and remediation levels shall be established using the value which results in the most protective concentration.

(b) ~~Inhalation reference doses/reference concentrations shall be used in WAC 173-340-750. Where the inhalation reference dose/reference concentration is reported as a concentration in air, that value shall be converted to a corresponding inhaled intake (mg/kg-day) using a human body weight of 70 kg and an inhalation rate of 20 m^3/day, and take into account, where available, the respiratory deposition and absorption characteristics of the gases and inhaled particles.~~ [39]

[37] Added to clarify how to handle additive risk when the cleanup level is based on natural background.

[38] Added to clarify how to handle additive risk when the cleanup level is based on natural background.

[39] This provision is inconsistent with EPA risk assessment guidance that calls for the use of a reference concentration.

~~(c)~~ A subchronic reference dose/reference concentration may be used to evaluate potential noncarcinogenic effects resulting from exposure to hazardous substances over short periods of time. This value may be used in place of the chronic reference dose/reference concentration where it can be demonstrated that a particular hazardous substance will degrade to negligible concentrations during the exposure period.

~~(d)~~ **(c)** For purposes of establishing cleanup levels and remediation levels for hazardous substances under this chapter, ~~a~~ reference dose~~s~~/ and reference concentrations established by the United States Environmental Protection Agency (USEPA) and available through the "integrated risk information system" (IRIS) data base shall be used.

(d) If a reference dose/ reference concentration for a hazardous substance is not available through the IRIS data base, a reference dose/reference concentration from the ~~U.S. EPA Health Effects Assessment Summary Table ("HEAST") database or, if more appropriate, the~~ National Center for Environmental Assessment ("NCEA") shall be used.

[Delete existing (e), (f), (g) & (h) and replace with the following]

(e) If a reference dose/reference concentration for a hazardous substance is not available through IRIS or the NCEA, reference doses and reference concentrations from other sources may be used to establish a cleanup level and remediation level. The department will use USEPA's Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-53 when evaluating the appropriateness of using alternative sources. The reference dose/reference concentration shall be developed by the department in consultation with the United States Environmental Protection Agency and the Washington State Department of Health. The department may also consult with other qualified persons. [40]

(f) The department shall, as resources permit, publish and periodically update a list of reference doses and reference concentrations for use in developing cleanup levels and remediation levels under this chapter. For hazardous substances with a reference dose or reference concentration not based on IRIS or the NCEA, the department shall provide an opportunity for public review and comment before publishing a new or revised value on this list. [41]

(8) ~~Carcinogenic potency~~ Cancer slope factors and inhalation unit risk factors.

(a) For purposes of establishing cleanup levels and remediation levels for hazardous substances under this chapter, ~~a carcinogenic potency~~ cancer slope factors and inhalation unit risk factors established by the United States Environmental Protection Agency (USEPA) and available through the IRIS data base shall be used.

(b) If a ~~carcinogenic potency~~ cancer slope factor or inhalation unit risk factor is not available for a hazardous substance from the IRIS data base, ~~a carcinogenic potency~~ a cancer slope factor or inhalation unit risk factor ~~from HEAST or, if more appropriate,~~ from the NCEA shall be used.

[Delete existing (b) and (c) and replace with the following]

(c) If a cancer slope factor/inhalation unit risk factor for a hazardous substance is not available through IRIS or the NCEA, cancer slope factors and inhalation unit risk factors from other sources may be used to establish a cleanup level and remediation level. The department will use the hierarchy in the USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-53 when evaluating the appropriateness of using alternative sources. The cancer slope factor/inhalation unit risk factor shall be developed by the department in consultation with the United States Environmental Protection Agency and the Washington State Department of

[40] The reflects a change from using HEAST as the next highest priority source of RfDs and RfCs because this database has not be updated for several years. The OSWER directive is dated December 5, 2003.

[41] This change represents a shift from developing RfDs & RfCs on a site-specific basis to publishing a database available state-wide (like the current CLARC database). The change in public comment from site-specific to a state-wide review reflects this approach.

Health. The department may also consult with other qualified persons. [42]

(d) When establishing cleanup levels and remediation levels, cancer slope factors and inhalation unit risk factors shall be adjusted to account for increased susceptibility to carcinogens during early life exposure. Adjustments shall be made using the methods described in "Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens", USEPA, March 2005. EPA/630/R-03/003F. Early life stage adjustments shall be required only for carcinogens identified by the USEPA as acting through a mutagenic mode of action. [43]

(e) The department shall, as resources permit, publish and periodically update a list of cancer slope factors and inhalation unit risk factors for use in developing cleanup levels and remediation levels under this chapter. For hazardous substances with a cancer slope factor/inhalation unit risk factor not based on IRIS or the NCEA, the department shall provide an opportunity for public review and comment before publishing a new or revised value on this list. [44]

~~(d)~~**(f) Mixtures of dioxins and furans.** When establishing and determining compliance with cleanup levels and remediation levels for mixtures of chlorinated dibenzo-p-dioxins (dioxins) and/or chlorinated dibenzofurans (furans), the following procedures shall be used:

(i) Assessing as single hazardous substance. When establishing and determining compliance with cleanup levels and remediation levels, including when determining compliance with the excess cancer risk requirements in this chapter, mixtures of dioxins and/or furans shall be considered a single hazardous substance.

(ii) Establishing cleanup levels and remediation levels. The cleanup levels and remediation levels established for 2,3,7,8 tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) shall be used, respectively, as the cleanup levels and remediation levels for mixtures of dioxins and/or furans.

(iii) Determining compliance with cleanup levels and remediation levels. When determining compliance with the cleanup levels and remediation levels established for mixtures of dioxins and/or furans, the following procedures shall be used:

(A) Calculate the total toxic equivalent concentration of 2,3,7,8-TCDD for each sample of the mixture. The total toxic equivalent concentration shall be calculated using the following method, unless the department determines that there is clear and convincing scientific data which demonstrates that the use of this method is inappropriate:

(I) Analyze samples from the medium of concern to determine the concentration of each dioxin and furan congener listed in Table 708-1;

(II) For each sample analyzed, multiply the measured concentration of each congener in the sample by its corresponding toxicity equivalency factor (TEF) in Table 708-1 to obtain the toxic equivalent concentration of 2,3,7,8-TCDD for that congener; and

(III) For each sample analyzed, add together the toxic equivalent concentrations of all the congeners within the sample to obtain the total toxic equivalent concentration of 2,3,7,8-TCDD for that sample.

(B) After calculating the total toxic equivalent concentration of each sample of the mixture, use the applicable compliance monitoring requirements in WAC 173-340-720 through 173-340-760 to determine whether the total toxic equivalent concentrations of the samples comply with the cleanup level or remediation level for the mixture at the applicable point of compliance.

(iv) Protecting the quality of other media. When establishing cleanup levels and remediation levels for mixtures of dioxins and/or furans in a medium of concern that are based on protection of

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[42] This reflects a change from using HEAST as the next highest priority source of RfDs and RfCs because this database has not be updated for several years. The OSWER directive is dated December 5, 2003.

[43] The basis for early life exposure adjustments is discussed in the March 22, 2009 MTCA/SMS Advisory Group materials. http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html

[44] This change represents a shift from developing RfDs & RfCs on a site-specific basis to publishing a database available state-wide (like the current CLARC database). The change in public comment from site-specific to a state-wide review reflects this approach.

another medium (the receiving medium) (e.g., soil levels protective of ground water quality), the following procedures shall be used:

(A) The cleanup level or remediation level for 2,3,7,8-TCDD in the receiving medium shall be used, respectively, as the cleanup level or remediation level for the receiving medium.

(B) When determining the concentrations in the medium of concern that will achieve the cleanup level or remediation level in the receiving medium, the congener-specific physical and chemical properties shall be considered during that assessment.

~~(e)~~**(g) Mixtures of carcinogenic PAHs.** When establishing and determining compliance with cleanup levels and remediation levels for mixtures of carcinogenic polycyclic aromatic hydrocarbons (carcinogenic PAHs), the following procedures shall be used: [45]

[Delete existing (i) and replace with the following]

(i) Establishing cleanup levels and remediation levels. Benzo(a)pyrene shall be the benchmark hazardous substance for other carcinogenic PAHs. The cancer slope factor for benzo(a)pyrene shall take into account early life exposures. The cancer slope factor for other individual carcinogenic PAHs shall be determined by multiplying the cancer slope factor for benzo(a)pyrene by the toxicity equivalency factor (TEF) in Tables 708-2 and 708-3 for the carcinogenic PAH of concern. These modified slope factors shall be used, along with the formulas and narrative requirements in this chapter, to calculate cleanup levels and remediation levels for individual carcinogenic PAHs, just like for any other hazardous substance. The acceptable estimated individual lifetime excess cancer for cleanup levels and remediation levels for individual carcinogenic PAHs shall be the same as for other individual carcinogens (1 x 10^{-6} under Method B and 1 x 10^{-5} under Method C). [46]

(ii) Determining compliance with cleanup levels and remediation levels. When determining compliance with cleanup levels and remediation levels established for mixtures of carcinogenic PAHs, the following procedures shall be used:

(A) Analyze samples from the medium of concern to determine the concentration of each carcinogenic PAH listed in Table 708-2 and, for those carcinogenic PAHs required by the department under WAC 173-340-708(8)(g)(iii), in Table 708-3;

[Delete existing (ii)(B) and replace with the following]

(B) Establish a cleanup level or remediation level for each carcinogenic PAH found in the medium of concern using the modified cancer slope factor as described in provision (8)(g)(i). Adjust these levels for the limit on total excess cancer risk, if necessary; and,

(C) Use the applicable compliance monitoring requirements in WAC 173-340-720 through 173-340-760 to determine whether the measured concentrations of individual cPAHs in the samples comply with the cleanup level or remediation level for that substance at the applicable point of compliance. NOTE: Do not adjust the sample carcinogenic PAH concentrations using the TEFs. The TEFs have already been taken into account through multiplication of the cancer slope factor by the TEF.

(iii) When using this methodology, at a minimum, the compounds in Table 708-2 shall be analyzed for and included in the calculations. The department may require additional compounds in Table 708-3 to be included in the methodology should site testing data or information from other comparable sites or waste types indicate the additional compounds are potentially present at the site. *NOTE: Many of the polycyclic aromatic*

[45] Because an adjustment has been made for early life exposures in the cancer slope factor for benzo(a) pyrene (and by extrapolation, other carcinogenic PAHs), cPAH mixtures no longer need to be considered a single hazardous substance. The changes to this subsection reflect this. See the March 22, 2009 MTCA/SMS Advisory Group materials: http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html

[46] NOTE: The limit on the total excess cancer risk of all carcinogens of one in one hundred thousand (1 x 10^{-5}) also applies to the mixture as a whole. [This footnote to be part of rule]

hydrocarbons in Table 708-3 are found primarily in air emissions from combustion sources and may not be present in the soil or water at contaminated sites. Users should consult with the department for information on the need to test for these additional compounds.

~~(f)~~**(h) PCB mixtures.** When establishing and determining compliance with cleanup levels and remediation levels for polychlorinated biphenyls (PCBs) mixtures, the following procedures shall be used:

(i) Assessing as single hazardous substance. When establishing and determining compliance with cleanup levels and remediation levels, including when determining compliance with the excess cancer risk requirements in this chapter, PCB mixtures shall be considered a single hazardous substance.

(ii) Establishing cleanup levels and remediation levels. When establishing cleanup levels and remediation levels under Methods B and C for PCB mixtures, the following procedures shall be used unless the department determines that there is clear and convincing scientific data which demonstrates that the use of these methods is inappropriate:

(A) Assume the PCB mixture is equally potent and use the appropriate carcinogenic potency factor provided for under WAC 173-340-708(8)(a) through (c) for the entire mixture; or

(B) Use the toxicity equivalency factors for the dioxin-like PCBs congeners in Table 708-4 and procedures approved by the department. When using toxicity equivalency factors, the department may require that the health effects posed by the dioxin-like PCB congeners and nondioxin-like PCB congeners be considered in the evaluation.

(iii) Determining compliance with cleanup levels and remediation levels. When determining compliance with cleanup levels and remediation levels established for PCB mixtures, the following procedures shall be used:

(A) Analyze compliance monitoring samples for a total PCB concentration and use the applicable compliance monitoring requirements in WAC 173-340-720 through 173-340-760 to determine whether the total PCB concentrations of the samples complies with the cleanup level or remediation level for the mixture at the applicable point of compliance; or

(B) When using toxicity equivalency factors to determine compliance with cleanup or remediation levels for PCB mixtures, use procedures approved by the department.

~~(g)~~**(i)** In estimating a carcinogenic potency factor for a hazardous substance under (c) of this subsection, or approving the use of a toxicity equivalency factor other than that established under (d), (e) or (f) of this subsection, the department shall, as appropriate, consult with ~~the science advisory board,~~ [47] the department of health, and the United States Environmental Protection Agency and may, as appropriate, consult with other qualified persons. Scientific data supporting such a change shall be subject to the requirements under WAC 173-340-702(14), (15) and (16). Once the department has established a carcinogenic potency factor or approved an alternative toxicity equivalency factor for a hazardous substance under this provision, the department is not required to consult again for the same hazardous substance.

~~(h)~~**(j)** Where a carcinogenic potency factor other than that established under (a) of this subsection or a toxicity equivalency factor other than that established under (d), (e) or (f) of this subsection is used to establish cleanup levels or remediation levels at individual sites, the department shall summarize the scientific rationale for the use of that value in the cleanup action plan. The department shall provide the opportunity for public review and comment on this value in accordance with the requirements of WAC 173-340-380 and 173-340-600.

(9) Bioconcentration and bioaccumulation factors. [48]

[47] The MTCA SAB was eliminated by SB 5995, passed in 2009 legislative session.

[48] This subsection has been amended to reflect that Ecology is considering adding the use of bioaccumulation factors now incorporated into USEPA guidance describing how to establish surface water standards. Bioaccumulation factors reflect accumulation of contaminants in aquatic organisms through both feeding behavior and exposure to the water column, whereas bioconcentration factors only reflect

(a) For purposes of establishing cleanup levels and remediation levels for a hazardous substance under WAC 173-340-7300 through 7304, a bioconcentration or bioaccumulation factor established by the United States Environmental Protection Agency and used to establish the ambient water quality criterion for that substance under section 304 of the Clean Water Act shall be used. These values shall be used unless the department determines that there is adequate scientific data which demonstrates that the use of an alternate value is more appropriate.

(b) If the department determines that a bioconcentration/bioaccumulation factor described in (a) of this subsection is unavailable or inappropriate for a specific hazardous substance ~~and no such factor has been established by USEPA~~, then other appropriate EPA documents, literature sources or empirical information may be used to determine a bioconcentration/bioaccumulation factor. [49]

~~(b)~~**(c)** When using a bioconcentration /bioaccumulation factor other than that described in (a) of this subsection ~~used to establish the ambient water quality criterion~~, the department shall, as appropriate, consult with ~~the science advisory board,~~ the department of health, ~~and~~ the United States Environmental Protection Agency, and with other qualified persons. Scientific data supporting such a value shall be subject to the requirements under WAC 173-340-702 (14), (15) and (16). Once the department has established a bioconcentration/bioaccumulation factor for a hazardous substance under this provision, the department is not required to consult again for the same hazardous substance.

~~(c) Where a bioaccumulation/bioconcentration factor other than that established under (a) of this subsection is used to establish cleanup levels or remediation levels at individual sites, the department shall summarize the scientific rationale for the use of that factor in the draft cleanup action plan. The department shall provide the opportunity for public review and comment on the value in accordance with the requirements of WAC 173-340-380 and 173-340-600.~~

(d) The department shall publish and periodically update a list of bioconcentration /bioaccumulation factors for use in developing cleanup levels and remediation levels under this chapter. For hazardous substances with bioconcentration/ bioaccumulation factors not based on methods described in (a) of this subsection, the department shall provide an opportunity for public review and comment before publishing a changed or new value on this list. [50]

(10) Lead. The following methods shall be used to determine soil lead cleanup levels for the human health soil direct contact exposure pathway: [51]

(i) For Method B, use the United States Environmental Protection Agency's Integrated Exposure Uptake Biokinetic Model;

(ii) For Method C, use the United States Environmental Protection Agency's Adult Lead Model; and

(iii) When using these models the soil cleanup level shall be based on preventing a site-related increase in blood lead concentration resulting from soil exposure of five (5) micrograms per deciliter or less in 99% of the potentially exposed population.

(11) Exposure parameters.

(a) As a matter of policy, the department has defined in WAC 173-340-720 through 173-340-760 the default values for exposure parameters to be used when establishing cleanup levels and remediation levels under this chapter. Except as provided for in (b) and (c) of this subsection and

accumulation of contaminants through exposure to the water column.

[49] Such as: Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health. U.S. Environmental Protection Agency. EPA-822-B-00-004. October 2000. [Footnote to be added to rule.]

[50] This change represents a shift from developing BAFs & BCFs on a site-specific basis to publishing a database available state-wide (like the current CLARC database). The change in public comment from site-specific to a state-wide review reflects this approach.

[51] These models reflect current recommended EPA Methods for assessing lead exposures. The basis for the target blood lead concentration is discussed in "Updating Cleanup Levels for Lead-Contaminated Soils", March, 2010. See March 22, 2009 MTCA/SMS Advisory Group materials at: http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html

in WAC 173-340-720 through 173-340-760, these default values shall not be changed for individual hazardous substances or sites.

(b) Exposure parameters that are primarily a function of the exposed population characteristics (such as body weight and lifetime) and those that are primarily a function of human behavior that cannot be controlled through an engineered or institutional control (such as: Fish consumption rate; soil ingestion rate; drinking water ingestion rate; and breathing rate) are not expected to vary on a site-by-site basis. The default values for these exposure parameters shall not be changed when calculating cleanup levels except when necessary to establish a more stringent cleanup level to protect human health. For remediation levels the default values for these exposure parameters may only be changed when an alternate reasonable maximum exposure scenario is used, as provided for in WAC 173-340-708 (3)(d), that reflects a different exposed population such as using an adult instead of a child exposure scenario. Other exposure parameters may be changed only as follows:

(i) For calculation of cleanup levels, the types of exposure parameters that may be changed are those that are:

(A) Primarily a function of reliably measurable characteristics of the hazardous substance, soil, hydrologic or hydrogeologic conditions at the site; and

(B) Not dependent on the success of engineered controls or institutional controls for controlling exposure of persons to the hazardous substances at the site.

The default values for these exposure parameters may be changed where there is adequate scientific data to demonstrate that use of an alternative or additional value would be more appropriate for the conditions present at the site. Examples of exposure parameters for which the default values may be changed under this provision are as follows: Contaminant leaching and transport variables (such as the soil organic carbon content, aquifer permeability and soil sorption coefficient); inhalation correction factor; fish bioconcentration/bioaccumulation factor; and soil gastrointestinal absorption fraction~~; and inhalation absorption percentage~~.[52]

(ii) For calculation of remediation levels, in addition to the exposure parameters that may be changed under (b)(i) of this subsection, the types of exposure parameters that may be changed from the default values are those where a demonstration can be made that the proposed cleanup action uses engineered controls and/or institutional controls that can be successfully relied on, for the reasonably foreseeable future, to control contaminant mobility and/or exposure to the contamination remaining on the site. In general, exposure parameters that may be changed under this provision are those that define the exposure frequency, exposure duration and exposure time. The default values for these exposure parameters may be changed where there is adequate scientific data to demonstrate that use of an alternative or additional value would be more appropriate for the conditions present at the site. Examples of exposure parameters for which the default value may be changed under this provision are as follows: Infiltration rate; frequency of soil contact; duration of soil exposure; duration of drinking water exposure; duration of air exposure; drinking water fraction; and fish diet fraction.

(c) When the modifications provided for in (b) of this subsection result in significantly higher values for cleanup levels or remediation levels than would be calculated using the default values for exposure parameters, the risk from other potentially relevant pathways of exposure shall be addressed under the procedures provided for in WAC 173-340-720 through 173-340-760. For exposure pathways and parameters for which default values are not specified in this chapter, the framework provided for by this subsection, along with the quality of information requirements in WAC 173-340-702, shall be used to establish appropriate or additional assumptions for these parameters and pathways.

(d) Where the department approves the use of exposure parameters other than those established under WAC 173-340-720 through 173-340-760 to

[52] Reflects changes in surface water and air cleanup level equations.

establish cleanup levels or remediation levels at individual sites, the department shall summarize the scientific rationale for the use of those parameters in the cleanup action plan. The department shall provide the opportunity for public review and comment on those values in accordance with the requirements of WAC 173-340-380 and 173-340-600. Scientific data supporting such a change shall be subject to the requirements under WAC 173-340-702 (14), (15) and (16).

~~(11)~~**(12) Probabilistic risk assessment.** Probabilistic risk assessment methods may be used under this chapter only on an informational basis for evaluating alternative remedies. Such methods shall not be used to replace cleanup standards and remediation levels derived using deterministic methods under this chapter until the department has adopted rules describing adequate technical protocols and policies for the use of probabilistic risk assessment under this chapter.

WAC 173-340-709 Methods for defining background concentrations.

(1) Purpose. Sampling of hazardous substances in background areas may be conducted to distinguish site-related concentration from nonsite related concentrations of hazardous substances or to support the development of a Method C cleanup level under the provisions of WAC 173-340-706. For purposes of this chapter, two types of background may be determined, natural background and area background concentrations, as defined in WAC 173-340-200.

(2) Background concentrations. For purposes of defining background concentrations, samples shall be collected from areas that have the same basic characteristics as the medium of concern at the site, have not been influenced by releases from the site and, in the case of natural background concentrations, have not been influenced by releases from other localized human activities.

(3) Statistical analysis.

(a) The statistical methods used to evaluate data sets shall be appropriate for the distribution of each hazardous substance. More than one statistical method may be required at a site.

(b) Background sampling data shall be assumed to be lognormally distributed unless it can be demonstrated that another distribution is more appropriate.

(c) For lognormally distributed data sets, background shall be defined as the true upper 90th percentile or four times the true 50th percentile, whichever is lower.

(d) For normally distributed data sets, background shall be defined as the true upper 80th percentile or four times the true 50th percentile, whichever is lower.

(e) Other statistical methods may be used if approved by the department.

(4) Sample size. When determining natural background concentrations for soil, a sample size of ten or more background soil samples shall be required. When determining area background concentrations for soil, a sample size of twenty or more soil samples shall be required. The number of samples for other media shall be sufficient to provide a representative measure of background concentrations and shall be determined on a case-by-case basis.

(5) ~~Procedures~~ Interpreting non-detect values. For the purposes of estimating background concentrations, the following procedures shall be used for measurements below the practical quantitation limit:

(a) Measurements below the method detection limit shall be assigned a value equal to one-half of the method detection limit.

(b) Measurements above the method detection limit, but below the practical quantitation limit shall be assigned a value equal to the method detection limit.

(c) Measurements below the method detection limit and/or practical quantitation limit may also be evaluated using the Kaplan-Meier method. [53]

(d) The department may approve the use of alternate ~~statistical~~ procedures for handling data below the method detection limit or practical quantitation limit.

(e) The department shall, as resources permit, publish and periodically update a list of hazardous substance natural background concentrations for use under this chapter. The department shall provide an opportunity for public review and comment before publishing a new or revised value on this list. [54]

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[53] See: USEPA's ProUCL statistical software http://www.epa.gov/esd/tsc/software.htm; and Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance; EPA 530-R-09-007, March, 2009. *[Footnote to be added to rule.]* http://www.epa.gov/osw/hazard/correctiveaction/resources/guidance/sitechar/gwstats/unified-guid.pdf.

[54] This change represents a shift from the expectation that natural background concentrations will be developed as needed on a site-specific basis, to Ecology publishing a database available for use throughout the state (like the current CLARC database). This is intended to help expedite cleanups but doesn't preclude a responsible party from developing a site-specific natural background level.

WAC 173-340-710 Applicable local, state and federal laws.

(1) Applicable state and federal laws. All cleanup actions conducted under this chapter shall comply with applicable state and federal laws. For purposes of this chapter, the term "applicable state and federal laws" shall include legally applicable requirements and those requirements that the department determines, based on consideration of the criteria in subsection (4) of this section, are relevant and appropriate requirements.

(2) Department determination. The person conducting a cleanup action shall identify all applicable state and federal laws. The department shall make the final interpretation on whether these requirements have been correctly identified and are legally applicable or relevant and appropriate.

(3) Legally applicable requirements. Legally applicable requirements include those cleanup standards, standards of control, and other environmental protection requirements, criteria, or limitations adopted under state or federal law that specifically address a hazardous substance, cleanup action, location or other circumstances at the site.

(4) Relevant and appropriate requirements. Relevant and appropriate requirements include those cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that, while not legally applicable to the hazardous substance, cleanup action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. WAC 173-340-710 through 173-340-760 identifies several requirements the department shall consider relevant and appropriate for establishing cleanup standards. For other regulatory requirements, the following criteria shall be evaluated, where pertinent, to determine whether such requirements are relevant and appropriate for a particular hazardous substance, remedial action, or site:

(a) Whether the purpose for which the statute or regulations under which the requirement was created is similar to the purpose of the cleanup action;

(b) Whether the media regulated or affected by the requirement is similar to the media contaminated or affected at the site;

(c) Whether the hazardous substance regulated by the requirement is similar to the hazardous substance found at the site;

(d) Whether the entities or interests affected or protected by the requirement are similar to the entities or interests affected by the site;

(e) Whether the actions or activities regulated by the requirement are similar to the cleanup action contemplated at the site;

(f) Whether any variance, waiver, or exemption to the requirements is~~are~~ available for the circumstances of the site;

(g) Whether the type of place regulated is similar to the site;

(h) Whether the type and size of structure or site regulated is similar to the type and size of structure or site affected by the release or contemplated by the cleanup action; and

(i) Whether any consideration of use or potential use of affected resources in the requirement is similar to the use or potential use of the resources affected by the site or contemplated cleanup action.

(5) Variances. For purposes of this chapter, a regulatory variance or waiver provision included in an applicable state and federal law shall be considered potentially applicable to interim actions and cleanup actions and the department may determine that a particular regulatory variance or waiver is appropriate if the substantive conditions for such a regulatory variance or waiver are met. In all such cases, interim actions and cleanup actions shall be protective of human health and the environment.

(6) New requirements. The department shall consider new applicable state and federal laws as part of the periodic review under WAC 173-340-420. Cleanup actions shall be evaluated in light of these new requirements to determine whether the cleanup action is still protective of human health and the environment.

(7) Selection of cleanup actions. To demonstrate compliance with WAC 173-340-350 through 173-340-390, cleanup actions shall comply with all applicable state and federal laws in addition to the other requirements of this chapter. The following, which is not a complete list, are selected applications of specific applicable state and federal laws to cleanup actions.

(a) Water discharge requirements. Hazardous substances that are directly or indirectly released or proposed to be released to waters of the state shall be provided with all known, available and reasonable methods of treatment consistent with the requirements of chapters 90.48 and 90.54 RCW and the regulations that implement those statutes.

(b) Air emission requirements. Best available control technologies consistent with the requirements of chapter 70.94 RCW and the regulations that implement this statute shall be applied to releases of hazardous substances to the air resulting from cleanup actions at a site.

(c) Solid waste landfill closure requirements. For solid waste landfills, the solid waste closure requirements in chapter 173-304 WAC shall be minimum requirements for cleanup actions conducted under this chapter. In addition, when the department determines that the closure requirements in chapters 173-350, 173-351 or 173-303 WAC are legally applicable or relevant and appropriate requirements, the more stringent closure requirements under those laws shall also apply to cleanup actions conducted under this chapter. [55]

(d) Sediment management requirements. Sediment cleanup actions conducted under this chapter shall comply with the sediment cleanup standards in chapter 173-204 WAC. In addition, a remedial investigation/feasibility study conducted under WAC 173-340-350 shall also comply with the ~~cleanup study plan~~ requirements under chapter 173-204 WAC. The process for selecting sediment cleanup actions under this chapter shall comply with the requirements in WAC 173-340-350 through 173-340-390, in addition to the requirements in chapter 173-204 WAC. [56]

(8) Interim actions. Interim actions conducted under this chapter shall comply with legally applicable requirements. The department may also determine, based on the criteria in subsection (3) of this section, that other requirements, criteria, or limitations are relevant and appropriate for interim actions.

(9) Permits and exemptions.

(a) Independent remedial actions must obtain permits required by other federal, state and local laws.

(b) Under RCW 70.105D.090, remedial actions conducted under a consent decree, order, or agreed order, and the department when it conducts a remedial action are exempt from the procedural requirements of certain laws. This exemption shall not apply if the department determines that the exemption would result in loss of approval from a federal agency necessary for the state to administer any federal law. This exemption applies to the following laws:

(i) Chapter 70.94 RCW (Air);

(ii) Chapter 70.95 RCW (Solid Waste);

(iii) Chapter 70.105 RCW (Hazardous Waste); [57]

(iv) Chapter ~~75.20~~ 77.15 RCW (Hydraulic Permits);

(v) Chapter 90.48 RCW (Water Quality); [58]

[55] Chapter 173-350 addresses non-municipal waste landfills.

[56] One of several changes to better integrate this rule with the sediment rule.

[57] NOTE: This exemption applies to only state-designated hazardous wastes, not federally designated hazardous waste. *[This note to be part of the rule and reflects a decision made by the Ecology director in 2004.]*

[58] NOTE : This exemption applies only to state waste discharge permits, not NPDES permits. *[This note to be part of rule and reflects a decision made by the Ecology director in 2008.]*

(vi) Chapter 90.58 RCW (Shoreline Management); and

(vii) Any laws requiring or authorizing local government permits or approvals for the remedial action.

(c) Remedial actions exempt from procedural requirements under (a) and (b) of this subsection still must comply with the substantive requirements of these laws.

(d) The department shall ensure compliance with substantive requirements and provide an opportunity for comment by the public and by the state agencies and local governments that would otherwise implement these laws as follows:

(i) Before proposing any substantive requirements, the department or potentially liable persons, if directed to do so by the department, shall consult with the state agencies and local governments to identify potential permits and to obtain written documentation from the consulted agencies regarding the substantive requirements for permits exempted under RCW 70.105D.090.

(ii) The permit exemptions and the substantive requirements, to the extent they are known, shall be identified by the department in the order, decree, or if the cleanup is being conducted by the department, in the work plan prepared by the department.

(iii) A public notice of the order, decree or work plan shall be issued in accordance with WAC 173-340-600. The notice shall specifically identify the permits exempted under RCW 70.105D.090 and seek comment on the substantive requirements proposed to be applied to the remedial action. This notice shall be mailed to the state agencies and local governments that would otherwise implement these permits. This notice shall also be mailed to the same individuals that the state agencies and local government have identified that would normally be mailed notice to if a permit was being issued.

(iv) Substantive requirements, to the extent known and identified by the state agencies and local governments before issuing the order, decree or work plan and those identified by the state agencies and local government during the public comment period shall be incorporated into the order, decree or work plan if approved by the department.

(e) It shall be the continuing obligation of persons conducting remedial actions to determine whether additional permits or approvals or substantive requirements are required. In the event that either the person conducting the remedial action or the department becomes aware of additional permits or approvals or substantive requirements that apply to the remedial action, they shall promptly notify the other party of this knowledge. The department, or the potentially liable person at the department's request, shall consult with the state or local agency on these additional requirements. The department shall make the final determination on the application of any additional substantive requirements at the site.

WAC 173-340-7200 General considerations for establishing groundwater cleanup standards.

(1) Basis for groundwater cleanup levels.
(2) When cleanup is required.
(3) Protection of other environmental media.
(4) Cleanup levels for other beneficial uses and exposure pathways.
(5) Potable groundwater defined.

WAC 173-340-7201 Method A groundwater cleanup standards.

(1) Applicability.
(2) Concentration.
(3) Adjustments.
(4) Point of compliance.
(5) Determining compliance.

WAC 173-340-7202 Method B cleanup standards for potable groundwater.

(1) Applicability.
(2) Concentration.
  (a) Applicable state and federal laws.
  (b) Drinking water protection.
  (c) Surface water protection.
  (d) Vapor intrusion.
(3) Allowable Method B Modifications.
(4) Adjustments.
(5) Using Method B to evaluate groundwater remediation levels
(6) Point of compliance.
(7) Determining compliance.

WAC 173-340-7203 Method B Cleanup standards for nonpotable groundwater.

(1) Applicability.
(2) Concentration.
(3) Site-specific risk assessment requirements.
(4) Site-specific risk assessment limitations.
(5) Adjustments.
(6) Point of compliance.
(7) Determining compliance.

WAC 173-340-7204 Method C groundwater cleanup standards.

(1) Applicability.
(2) Potable groundwater cleanup levels.
(3) Nonpotable groundwater cleanup levels.
(4) Adjustments.
(5) Point of compliance.
(6) Determining compliance.

WAC 173-340-7205 Adjustments to groundwater cleanup levels.

(1) Total site risk adjustments.
(2) Adjustments to applicable state and federal laws.
(3) Natural background and analytical considerations.
(4) Nonaqueous phase liquid limitation.

WAC 173-340-7206 Groundwater point of compliance.

(1) General requirements.
(2) Standard point of compliance.
(3) Conditional point of compliance.
(4) Off-property conditional point of compliance.
  (a) Sites with cleanup levels based on protection of surface water.
  (b) Areawide conditional point of compliance.

WAC 173-340-7207 Demonstrating compliance with groundwater cleanup standards.

(1) Sampling required.
(2) Compliance monitoring plan.
(3) Filtering.
(4) Use of no-purge sampling.
(5) Data analysis and evaluation-general requirements.
(6) Data evaluation methods-direct comparison.
(7) Statistical methods.
(8) Surface water compliance evaluations.
(9) Interpreting non-detect values.

NEW SECTION [59]

WAC 173-340-7200 General considerations for establishing groundwater cleanup standards.

(1) Basis for groundwater cleanup levels.

(2) When cleanup is required.

(3) Protection of other environmental media.

(4) Cleanup levels for other beneficial uses and exposure pathways.

(5) Potable groundwater defined.

(1) ~~General considerations~~ Basis for groundwater cleanup levels.

(a) Groundwater ~~water~~ cleanup levels shall be based on estimates of the highest beneficial use and the reasonable maximum exposure expected to occur under both current and potential future site and resource use~~s conditions~~.

(b) The department has determined that at most sites use of groundwater ~~water~~ as a source of drinking water is the beneficial use requiring the highest quality of groundwater ~~water~~ and that exposure to hazardous substances through ingestion of drinking water and other domestic uses represents the reasonable maximum exposure.

Unless a site qualifies under subsection ~~(2)~~ (5) of this section for a different groundwater beneficial use, groundwater ~~water~~ cleanup levels shall be established using this presumed exposure scenario and ~~be established in accordance with subsection (3), (4) or (5) of this section~~ the procedures described in WAC 173-340-7201, 7202, 7204 and 7205, as applicable to the site.

(c) ~~If a site qualifies for a different groundwater beneficial use, ground water cleanup levels shall be established under subsection (6) of this section.~~ For sites that qualify for nonpotable groundwater beneficial use under subsection (5) of this section, groundwater cleanup levels shall be established using the procedures in WAC 173-340-7203 or 7204, as applicable to the site.

~~(b)~~(2) When cleanup is required. In the event of a release of a hazardous substance at a site, a cleanup action complying with this chapter shall be conducted to address all areas where the concentration of the hazardous substance in groundwater ~~water~~ exceeds cleanup levels.

~~(c)~~(3) Protection of other environmental media. Groundwater ~~water~~ cleanup levels shall also be established at concentrations that do not directly or indirectly cause violations of surface water, sediments, soil, or air cleanup standards established under this chapter or other applicable state and federal laws. A site that qualifies for a Method C groundwater ~~water~~ cleanup level under this section does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium.

~~(d)~~(4) Cleanup levels for other beneficial uses and exposure pathways. The department may require more stringent cleanup levels than specified in ~~this section~~ WAC 173-340-7200 through 7205 where necessary to protect other beneficial uses or otherwise protect human health and the environment. Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708. The following are examples of situations that may require more stringent cleanup levels:

~~(i)~~(a) Concentrations ~~that are~~ necessary to protect sensitive subgroups;

~~(ii)~~(b) Concentrations that eliminate or minimize the potential for food chain contamination; and

[59] Former WAC 173-340-720 has been reorganized into smaller multiple Sections to facilitate readability and use. Because of this, the Code Reviser will likely publish these as new Sections without the changes highlighted. To facilitate review, changes from existing language are highlighted.

~~(iii)~~(c) Concentrations that eliminate or minimize the potential for damage to soils or biota in the soils which could impair the use of the soil for agricultural or silvicultural purposes~~;~~

~~**(iv)** Concentrations that eliminate or minimize the potential for the accumulation of vapors in buildings or other structures to concentrations which pose a threat to human health or the environment; and~~

~~**(v)** Concentrations that protect nearby surface waters~~.[60]

~~(2)~~(5) **Potable groundwater defined.** Groundwater ~~water~~ shall be classified as potable to protect drinking water beneficial uses unless the following can be demonstrated:

(a) The groundwater ~~water~~ does not serve as a current source of drinking water;

(b) The groundwater ~~water~~ is not a potential future source of drinking water for any of the following reasons:

(i) The groundwater ~~water~~ is present in insufficient quantity to yield greater than 0.5 gallon per minute on a sustainable basis to a well constructed with a diameter and screen length comparable to that used for ~~in compliance with chapter 173-160 WAC and in accordance with~~ normal domestic water wells ~~construction practices~~ for the area in which the site is located; [61]

(ii) The groundwater ~~water~~ contains natural background concentrations of organic or inorganic constituents that make use of the water as a drinking water source not practicable. Groundwater ~~water~~ containing total dissolved solids at concentrations greater than 10,000 mg/l shall normally be considered to have fulfilled this requirement; *(NOTE: The total dissolved solids concentration provided here is an example. There may be other situations where high natural background levels also meet this requirement.)* or

(iii) The ground water is situated at a great depth or location that makes recovery of water for drinking water purposes technically impossible; and

(c) The department determines it is unlikely that hazardous substances will be transported from the contaminated groundwater to groundwater ~~water~~ that is a current or potential future source of drinking water, as defined in (a) and (b) of this subsection, at concentrations which exceed groundwater ~~quality criteria published in chapter 173-200 WAC~~ cleanup levels established under WAC 173-340-7202.[62]

In making a determination under this provision, the department shall consider site-specific factors including:

(i) The extent of affected groundwater ~~water~~;

(ii) The distance to existing water supply wells;

(iii) The likelihood of interconnection between the contaminated groundwater ~~water~~ and groundwater ~~water~~ that is a current or potential future source of drinking water due to well construction practices in the area of the state where the site is located;

(iv) The physical and chemical characteristics of the hazardous substance;

(v) The hydrogeologic characteristics of the site;

(vi) The presence of discontinuities in the affected geologic stratum; and

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[60] (iv) and (v) are addressed by more specific language later in this Chapter.

[61] The WAC reference has been struck because some have interpreted this to mean if a well can't meet the WAC setback or sealing requirements, the aquifer is nonpotable. As discussed in the 1991 responsiveness summary, this was not intended by this provision. Rather, it was intended to prevent using a pump test at a monitoring well with a small diameter or short screen length to justify non-potability. This is addressed by the revised language.

[62] To provide for application of the same standards throughout the site. The two standards are similar but the standards under Section 7202 are generally less stringent for substances with a drinking water MCL.

(vii) The degree of confidence in any predictive modeling performed.

(d) Even if groundwater ~~water~~ is classified as a potential future source of drinking water under (b) of this subsection, the department recognizes that there may be sites where there is an extremely low probability that the groundwater ~~water~~ will be used for that purpose because of the site's proximity to surface water that is not suitable as a domestic water supply. An example of this situation would be shallow groundwaters ~~waters~~ in close proximity to marine waters such as on Harbor Island in Seattle. At such sites, the department may allow groundwater ~~water~~ to be classified as nonpotable for the purposes of this section if each of the following conditions can be demonstrated. These determinations must be for reasons other than that the groundwater or surface water has been contaminated by a release of a hazardous substance at the site.

(i) The conditions specified in (a) and (c) of this subsection are met;

(ii) There are known or projected points of entry of the groundwater ~~water~~ into the surface water;

(iii) The surface water is not classified as a suitable domestic water supply source under chapter 173-201A WAC; and

(iv) The groundwater ~~water~~ is sufficiently hydraulically connected to the surface water that the groundwater ~~water~~ is not practicable to use as a drinking water source.

[NOTE: Former subsections (3), (4), (5) & (6) are proposed to be deleted in their entirety and replaced by the following new chapters. Where language differs from original language, it is highlighted in the text or footnotes.]

(NEW SECTION)

[Formerly WAC 173-340-720(3)]

WAC 173-340-7201 Method A groundwater cleanup standards.

(1) Applicability.

(2) Concentration.

(3) Adjustments.

(4) Point of compliance.

(5) Determining compliance.

~~(a)~~**(1) Applicability.** Method A groundwater cleanup standards may ~~only~~ be used only at sites ~~qualifying under WAC 173-340-704(1).~~ with few hazardous substances and where all of the following conditions are met: [63]

(a) Except as provided for in subsection (2)(b)(iii) of this section, numeric standards are available in Table 720-1 or applicable state and federal laws for all indicator hazardous substances at the site; and

(b) Hazardous substances have not reached surface water and are unlikely to reach surface water during the estimated restoration timeframe.

~~(b)~~**(2)** ~~**General requirements.**~~ **Concentration.** Method A cleanup levels shall be at least as stringent as all of the following:

~~(i)~~**(a)** Concentrations listed in Table 720-1 and compliance with the corresponding footnotes.

~~(ii)~~**(b)** Concentrations established under applicable state and federal laws, including the following:

~~(A)~~**(i)** Maximum contaminant levels established under the federal Safe Drinking Water Act and published in 40 C.F.R. 141; and

~~**(B)** Maximum contaminant level goals for noncarcinogens established under the Safe Drinking Water Act and published in 40 C.F.R. 141;~~ [64]

~~(C)~~**(ii)** Maximum contaminant levels ~~established by the state board of health and~~ published in chapter 246-290 WAC. [65]

~~(iii)~~**(c)** For hazardous substances deemed indicator hazardous substances for groundwater under WAC 173-340-708(2) and for which there is no value in Table 720-1 or applicable state and federal laws, concentrations that do not exceed natural background or the practical quantitation limit, subject to the limitations in this chapter.

~~**(iv) Protection of surface water beneficial uses.** Concentrations established in accordance with the methods specified in WAC 173-340-730 for protecting surface water beneficial uses, unless it can be demonstrated that the hazardous substances are not likely to reach surface water. This demonstration must be based on factors other than implementation of a cleanup action at the site.~~ [66]

(d) Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7505. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion. [67]

(3) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background, practical quantitation limit and

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[63] Reflects criteria in Section 704. The restriction limiting use of Method A to "routine sites" has been eliminated.

[64] MCLGs are proposed to be eliminated. MCLGs for non carcinogens are generally set at the same standard as the MCL. The one exception is lead, which has an MCLG of zero and is not a practical standard to apply to cleanups. To Ecology's knowledge, this MCLG has never been applied to a cleanup site.

[65] Editorial change.

[66] Eliminated as a result of the addition of condition (1)(b).

[67] Based on EPA research indicating very low groundwater concentrations of many chemicals have the potential to pose a vapor hazard in overlying structures.

non-aqueous phase limitations. See WAC 173-340-7205 for procedures for making these adjustments.[68]

(4) Point of compliance. The point of compliance for Method A groundwater cleanup levels is specified in WAC 173-340-7206.

(5) Determining compliance. Compliance monitoring requirements and procedures for determining compliance with Method A groundwater cleanup standards are specified in WAC 173-340-7207.

[68] Subsections (3), (4) and (5) are added as a result of the reorganization of these Sections.

NEW SECTION

WAC 173-340-7202 Method B cleanup standards for potable groundwater.

[Formerly WAC 173-340-720(4)] [69]

(1) Applicability.

(2) Concentration.

(3) Allowable Method B Modifications.

(4) Adjustments.

(5) Using Method B to evaluate groundwater remediation levels.

(6) Point of compliance.

(7) Determining compliance.

(1) Applicability. Method B potable ground water cleanup standards may be used at any site.

(2) Concentration. Method B potable groundwater cleanup levels shall be at least as stringent as all of the following:

(a) Applicable state and federal laws. Concentrations established under applicable state and federal laws, including the following requirements: [70]

(i) Maximum contaminant levels established under the federal Safe Drinking Water Act and published in 40 C.F.R. 141; and

(ii) Maximum contaminant levels published in chapter 246-290 WAC.

(b) Drinking water protection. For hazardous substances for which sufficiently protective, health-based drinking water criteria or standards have not been established under applicable state and federal laws, concentrations which protect human health as determined by the following methods: *[Equations moved to end of this section]*

(i) Noncarcinogens. For noncarcinogens, concentrations that are estimated to result in no acute or chronic toxic effects on human health as determined using Equation 720-1.

(ii) Carcinogens. For known or suspected carcinogens, concentrations for which the upper bound on the estimated individual lifetime excess cancer risk is less than or equal to one in one million (1×10^{-6}) as determined using Equation 720-2.

(iii) Petroleum mixtures.

For petroleum mixtures, total petroleum hydrocarbon (TPH) concentrations that result in no toxic effects on human health as determined using Equation 720-3. The total petroleum hydrocarbon concentration calculated using this equation must be adjusted downward if individual substances present in the mixture (such as benzene) exceed acceptable cancer risk levels or applicable state and federal laws at the calculated TPH concentration. A spreadsheet is available from the department to facilitate these calculations. A total petroleum hydrocarbon cleanup level for petroleum mixtures derived using Equation 720-3 shall be adjusted when necessary so that biological degradation of the petroleum does not result in exceedances of the maximum contaminant levels in chapter 246-290 WAC or natural background, whichever is higher. See Table 830-1 for the analyses required for various petroleum products to use this method. [71]

(c) Surface water protection. Concentrations established in accordance with the methods specified in WAC 173-340-730 for protecting surface water beneficial uses, and preventing contamination of sediments above the standards established under Chapter 173-204 WAC. This requirement applies unless it can be demonstrated that the hazardous sub-

[69] Substantially reorganized and edited, including changes to reflect proposed elimination of "standard" and "modified" Method B terminology. Deleted text isn't shown to facilitate review.

[70] Replaced cross-reference to Method A with list of applicable laws.

[71] Editorial change to better match this description with how the calculation is actually done.

stances have not reached surface water and are unlikely to reach surface water during the estimated restoration timeframe. When a cutoff wall, gradient control, or similar system is used to limit entry of contaminants into the surface water, this demonstration must be based on factors other than implementation of these systems at the site.[72]

(d) Vapor intrusion. Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7505. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion.[73]

(3) Allowable Method B Modifications. The default assumptions in Equations 720-1, 720-2 and 720-3 can be changed only with chemical-specific or site-specific data as provided for in this subsection and WAC 173-340-708(10).[74]

(a) The resultant cleanup levels shall meet applicable state and federal laws.

(b) The resultant cleanup levels must meet the hazard quotient, hazard index and cancer risk limitations in WAC 173-340-705.

(c) The inhalation correction factor is an adjustment factor that takes into account exposure to hazardous substances that are volatilized and inhaled during showering and other domestic activities. When available, hazardous substance-specific information may be used to estimate this factor;

(d) Where separate toxicity factors (reference doses and carcinogenic potency factors) are available for inhalation and oral exposures, the health hazards associated with the inhalation of hazardous substances in ground water during showering and other domestic activities may be evaluated separately from the health hazards associated with ingestion of drinking water. In these cases, the ground water cleanup level based on ingestion of drinking water shall be modified to take into account multiple exposure pathways in accordance with WAC 173-340-708(6);

(e) Adjustments to the reference dose and cancer slope factor may be made if the requirements in WAC 173-340-708 (7) and (8) are met.

(f) Modifications incorporating new science as provided for in WAC 173-340-702 (14), (15) and (16).

(4) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background, practical quantitation limit and non-aqueous phase limitations. See WAC 173-340-7205 for procedures for making these adjustments.[75]

(5) Using Method B to evaluate ground water remediation levels. In addition to the modifications allowed under subsection (3) of this subsection, adjustments to the reasonable maximum exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357, and 173-340-708 (3)(d) and (10)(b).

(6) Point of compliance. The point of compliance for Method B cleanup levels for

[72] Added sediments rule reference as part of integration of these two rules. Added timeframe for determining whether contaminants will reach surface water based on advisory committee feedback. Modified last sentence to clarify demonstration that needs to be made.

[73] Based on EPA research indicating very low groundwater concentrations of some chemicals have the potential to pose a vapor hazard in overlying structures under many circumstances.

[74] Reworded to reflect elimination of "standard" and "modified" terminology. No substantive change intended.

[75] Subsections (4), (6) and (7) are added as a result of the reorganization of these Sections.

potable groundwater is specified in WAC 173-340-7206.

(7) Determining compliance. Compliance monitoring requirements and procedures for determining compliance with Method B cleanup standards for potable groundwater are specified in WAC 173-340-7207.

Equation 720-1 (Noncarcinogens) [76]

$$\text{Groundwater cleanup level (ug/l)} = \frac{RfD_O \times ABW \times UCF \times HQ \times AT}{DWIR \times INH \times DWF \times ED}$$

Where:

Rfd_O	=	Oral reference dose as specified in WAC 173-340-708(7).
AWB	=	Average body weight during the exposure duration (16 kg)
UCF	=	Unit conversion factor (1,000 ug/mg)
HQ	=	Hazard quotient (1) (unitless)
AT	=	Averaging time (6 years)
DWIR	=	Drinking water ingestion rate (1.0 liter/day)
INH	=	Inhalation correction factor. ~~(use~~ Use a value of 2 for volatile organic compounds and 1 for all other substances (unitless).
DWF	=	Drinking water fraction (1.0) (unitless)
ED	=	Exposure duration (6 years)

Equation 720-2 (Carcinogens) [77]

$$\text{Groundwater cleanup level (ug/l)} = \frac{RISK \times ABW \times AT \times UCF}{CSF_O \times ELAF \times DWIR \times ED \times INH \times DWF}$$

Where:

RISK	=	Acceptable cancer risk level (1 in 1,000,000) (unitless)
ABW	=	Average body weight during the exposure duration (70 kg)
AT	=	Averaging time (~~75~~ 70 years)
UCF	=	Unit conversion factor (1,000 ug/mg)
CSF_O	=	Oral cancer slope ~~Carcinogenic potency~~ factor as specified in WAC 173-340-708(8) (kg-day/mg)
ELAF	=	Early life adjustment factor. Use 3 for carcinogens with a mutagenic mode of action. Use 1 for all other carcinogens (see WAC 173-340-708(8)). [78]
DWIR	=	Drinking water ingestion rate (2.0 liters/day)
ED	=	Exposure duration (30 years)
INH	=	Inhalation correction factor. ~~(use~~ Use a value of 2 for volatile organic compounds and 1 for all other substances (unitless).
DWF	=	Drinking water fraction (1.0) (unitless)

[76] Editorial changes only.

[77] Changed AT from 75 to 70 years to be consistent with EPA risk assessment guidance. Except for ELAF, the other changes are editorial.

[78] The basis for early life exposure adjustments is discussed in the March 22, 2009 MTCA/SMS Advisory Group materials. http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html The proposed adjustment factor is based on distillation of information in "Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens" EPA, 2005 and is still under evaluation.

Equation 720-3 (TPH Mixtures) [79]

$$C_w = \frac{HI \times AT}{\left[\frac{DWIR \times DWF \times ED}{ABW \times UCF}\right] \times \sum_{i=1}^{n} \frac{F_{(i)} \times INH_{(i)}}{RfDo_{(i)}}}$$

Where:

C_w = TPH groundwater cleanup level (ug/l)

HI = Hazard index (1) (unitless)

AT = Averaging time (6 years)

DWIR = Drinking water intake rate (1.0 liter/day)

DWF = Drinking water fraction (1.0) (unitless)

ED = Exposure duration (6 years)

ABW = Average body weight during the exposure duration (16 kg)

UCF = Unit conversion factor (1,000 ug/mg)

$F_{(i)}$ = Fraction by weight of petroleum component (i) (unitless) (Use site-specific groundwater composition data, provided the data is representative of present and future conditions at the site, or use the groundwater composition predicted under WAC 173-340-747(6))

$INH_{(i)}$ = Inhalation correction fraction for petroleum component (i). ~~(use~~ Use a value of 2 for volatile organic compounds and 1 for all other substances (unitless).

$RfD_{O(i)}$ = Oral Reference dose of petroleum component (i) as specified in WAC 173-340-708(7) (mg/kg-day)

n = The number of petroleum components ~~(petroleum fractions plus compounds with an RfD_O)~~ present in the petroleum mixture. ~~(See Table 830-1.)~~

i = Petroleum components consisting of aromatic and aliphatic fractions, and other compounds present in the petroleum mixture with an oral reference dose, measured using the methods specified WAC 173-340-830. See Table 830-1 for required tests for various petroleum products.

[79] Editorial changes only. NOTE: A spreadsheet is available from the department to facilitate this calculation. [Note to be added to rule]

NEW SECTION

WAC 173-340-7203 Method B cleanup standards for non-potable groundwater.

[Formerly WAC 173-340-720(6)] [80]

(1) Applicability.

(2) Concentration.

(3) Site-specific risk assessment requirements.

(4) Site-specific risk assessment limitations.

(5) Adjustments.

(6) Point of compliance.

(7) Determining compliance.

(1) Applicability. Method B non-potable groundwater cleanup standards may be established only at sites where the groundwater is not classified as potable under WAC 173-340-7200(5).

(2) Concentration. Method B nonpotable groundwater Cleanup levels shall be established in accordance with either of the following:

~~**(i)** The methods specified in subsections (3), (4) or (5) of this section, as applicable, for protection of drinking water beneficial uses; or~~

(a) Methods A or B cleanup levels for potable groundwater under WAC 173-340-7201 and 7202, as applicable; or [81]

(b) A site-specific risk assessment as provided for under subsections (3) and (4) of this section ~~for protection of other ground water beneficial uses~~.

(3) Site-specific risk assessment requirements. Where a site-specific risk assessment is used to establish a Method B groundwater ~~water~~ cleanup level under ~~(b)(ii)~~ (2)(b) of this subsection, the risk assessment shall conform to the requirements in WAC 173-340-702 and 173-340-708. The risk assessment shall evaluate all potential exposure pathways and groundwater ~~water~~ uses at the site, including potential impacts to persons engaged in site development or utility construction and maintenance activities. The risk assessment shall demonstrate the following:

~~**(A)**~~**(a)** The cleanup levels will meet any applicable state and federal laws (drinking water standards are not applicable to these sites).

~~**(B)**~~**(b)** The cleanup levels will result in no significant acute or chronic toxic effects on human health as demonstrated by not exceeding a hazard quotient of one (1) for individual hazardous substances.

~~**(C)**~~**(c)** The cleanup levels will result in an upper bound on the estimated individual lifetime excess cancer risk that is less than or equal to one in one million (1×10^{-6}) for individual hazardous substances.

~~**(D)**~~**(d)** For organic hazardous substances and petroleum products, the cleanup levels comply with the limitation on free product in ~~subsection (7)(d) of this section~~WAC 173-340-7205(4).

~~**(E)**~~**(e)** The cleanup levels will not exceed the surface water cleanup levels derived under WAC 173-340-730, or cause exceedances of sediment standards established under Chapter 173-204 WAC. This requirement applies unless it can be demonstrated that the hazardous substances have not reached surface water and are unlikely to reach surface water during the estimated restoration timeframe. When a cutoff wall, gradient control, or similar system is used to limit entry of contaminants into the surface water, this demonstration must be based on factors other than implementation of these systems at the site; and [82]

~~**(F)**~~**(f)** Where it is demonstrated that hazardous substances are ~~not likely~~ have not

[80] Edited to provide for Method B cleanup levels only. Method C is addressed in Section 7204. Not all deleted text is shown to facilitate review.

[81] Replaces deleted language in (i) with updated references to reflect the reorganization of Section 720 into multiple Sections.

[82] Changes to (e) and (f) to parallel language in Section 7202.

reached surface water and are unlikely to reach surface water during the estimated restoration timeframe, the use of a ground water cleanup level less stringent than a surface water cleanup level will not pose a threat to surface water through pathways that could result in ground water affected by the site entering surface water (such as use of the water for irrigation or discharges from foundation drains or utility corridors).

(g) Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7505. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion.[83]

(4) ~~Limitations on the use of s~~Site-specific risk assessment limitations. If the site-specific risk assessment results in a ~~Method B or Method C~~ groundwater ~~water~~ cleanup level that exceeds the ~~applicable~~ potable ground water cleanup level derived under ~~(b)(i) of this subsection~~ WAC 173-340-7202, then the potable groundwater ~~water~~ cleanup level shall be used unless the following conditions are met:

~~(A)~~(a) All potentially affected property owners, local governments, tribes and water purveyors with jurisdiction in the area potentially affected by the groundwater ~~water~~ contamination have been mailed a notice of the proposal and provided an opportunity to comment. The notice shall specifically ask for information on existing and planned uses of the groundwater ~~water~~. The notice ~~shall be in addition to~~ may be combined with[84] any notice provided under WAC 173-340-600. In determining whether it is appropriate to use a cleanup level less stringent than the potable groundwater ~~water~~ cleanup level, the department will give greater weight to information based on an adopted or pending plan or similar pre-existing document.

~~(B)~~(b) For sites where the groundwater ~~water~~ is classified as nonpotable under WAC 173-340-7200~~(2)(d)~~(5), the cleanup action includes institutional controls complying with WAC 173-340-440 that will prevent the use of contaminated groundwater ~~water~~ for drinking water purposes at any point between the source of hazardous substances and the point(s) of entry of groundwater ~~water~~ into the surface water.

~~(C)~~(c) For sites where the risk assessment includes assumptions of restricted use or contact with the groundwater ~~water~~ (other than for the reason of being non-potable), or restricted use of the land above the ground-water, the cleanup action includes institutional controls complying with WAC 173-340-440 that will implement the restrictions.

(5) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background, practical quantitation limit and non-aqueous phase limitations. See WAC 173-340-7205 for procedures for making these adjustments.[85]

(6) Point of compliance. The point of compliance for Method B cleanup levels for non-potable groundwater is specified in WAC 173-340-7206.

(7) Determining compliance. Compliance monitoring requirements and procedures for determining compliance with Method B cleanup standards for non-potable groundwater are specified in WAC 173-340-7207.

[83] Based on EPA research indicating very low groundwater concentrations of many chemicals have the potential to pose a vapor hazard in overlying structures.

[84] Combining of public notices to streamline public comment period.

[85] Subsections (5), (6) and (7) are added as a result of the reorganization of these Sections.

NEW SECTION

WAC 173-340-7204 Method C groundwater cleanup standards. *[Formerly 720(5)]* [86]

(1) Applicability.

(2) Potable groundwater cleanup levels.

(3) Nonpotable groundwater cleanup levels.

(4) Adjustments.

(5) Point of compliance.

(6) Determining compliance.

(1) Applicability. Method C groundwater cleanup standards may be used only at sites qualifying under WAC 173-340-706(1).

(2) Potable groundwater cleanup levels. The procedures specified in WAC 173-340-7202 shall be used to establish Method C potable groundwater cleanup levels except equations 720-4, 720-5 and 720-6 shall be used instead of equations 720-1, 720-2 and 720-3. [87]

(3) Non-potable groundwater cleanup levels. The procedures specified in WAC 173-340-7203 shall be used to establish Method C non potable groundwater cleanup levels except that the upper bound on the estimated individual lifetime excess cancer for a site-specific risk assessment shall be less than or equal to one in one hundred thousand (1×10^{-5}) for individual hazardous substances. [88]

(4) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background, practical quantitation limit and non-aqueous phase limitations. See WAC 173-340-7205 for procedures for making these adjustments. [89]

(5) Point of compliance. The point of compliance for Method C groundwater cleanup levels is specified in WAC 173-340-7506.

(6) Determining compliance. Compliance monitoring requirements and procedures for determining compliance with Method C groundwater cleanup standards are specified in WAC 173-340-7207.

[86] Substantially condensed to limit repetition.

[87] Instead of stating the changes to the default values in narrative form as is done in the current rule, the complete equations have been added at the end of this Section.

[88] Former 720(6)(ii), moved here and substantially condensed to limit repetition.

[89] Subsections (4), (5) and (6) are added as a result of the reorganization of these Sections.

Equation 720-4 (Noncarcinogens) [90]

$$\text{Groundwater cleanup level (ug/l)} = \frac{RfD_O \times ABW \times UCF \times HQ \times AT}{DWIR \times INH \times DWF \times ED}$$

Where:

- RFD_O = Oral reference dose as specified in WAC 173-340-708(7).
- AWB = Average body weight during the exposure duration (70 kg)
- UCF = Unit conversion factor (1,000 ug/mg)
- HQ = Hazard quotient (1) (unitless)
- AT = Averaging time (30 years)
- DWIR = Drinking water ingestion rate (2.0 liter/day)
- INH = Inhalation correction factor. Use a value of 2 for volatile organic compounds and 1 for all other substances (unitless).
- DWF = Drinking water fraction (1.0) (unitless)
- ED = Exposure duration (30 years)

Equation 720-5 (Carcinogens)

$$\text{Groundwater cleanup level (ug/l)} = \frac{RISK \times ABW \times AT \times UCF}{CSF_O \times ELAF \times DWIR \times ED \times INH \times DWF}$$

Where:

- RISK = Acceptable cancer risk level (1 in 100,000) (unitless)
- ABW = Average body weight during the exposure duration (70 kg)
- AT = Averaging time (70 years)
- UCF = Unit conversion factor (1,000 ug/mg)
- CSF_O = Oral cancer slope factor as specified in WAC 173-340-708(8) (kg-day/mg)
- ELAF = Early life adjustment factor. Use 3 for carcinogens with a mutagenic mode of action. Use 1 for all other carcinogens (see WAC 173-340-708(8)). [91]
- DWIR = Drinking water ingestion rate (2.0 liters/day)
- ED = Exposure duration (30 years)
- INH = Inhalation correction factor. Use a value of 2 for volatile organic compounds and 1 for all other substances (unitless).
- DWF = Drinking water fraction (1.0) (unitless)

Equation 720-6 (TPH Mixtures) [92]

$$C_w = \frac{HI \times AT}{\left[\frac{DWIR \times DWF \times ED}{ABW \times UCF}\right] \times \sum_{i=1}^{n} \frac{F(i) \times INH_{(i)}}{RfD_{O(i)}}}$$

Where:

- C_w = TPH groundwater cleanup level (ug/l)
- HI = Hazard index (1) (unitless)
- AT = Averaging time (30 years)
- DWIR = Drinking water intake rate (2.0 liter/day)
- DWF = Drinking water fraction (1.0) (unitless)
- ED = Exposure duration (30 years)
- ABW = Average body weight during the exposure duration (70 kg)
- UCF = Unit conversion factor (1,000 ug/mg)
- $F_{(i)}$ = Fraction by weight of petroleum component (i) (unitless) (Use site-specific groundwater composition data, provided the data is representative of present and future conditions at the site, or use the ground water composition predicted under WAC 173-340-747(6))
- $INH_{(i)}$ = Inhalation correction fraction for petroleum component (i). Use a value of 2 for volatile organic compounds and 1 for all other components (unitless).
- $RfD_{O(i)}$ = Oral Reference dose of petroleum component (i) as specified in WAC 173-340-708(7) (mg/kg-day)
- n = The number of petroleum components present in the petroleum mixture.
- i = Petroleum components consisting of aromatic and aliphatic fractions, and other compounds present in the petroleum mixture with an oral reference dose, measured using the methods specified WAC 173-340-830. See Table 830-1 for required tests for various petroleum products.

[90] ***720-4, 5 & 6 are new equations***. The differences from Method B for these three equations are highlighted in yellow. These differences are the same as the narrative description in the current rule.

[91] The basis for early life exposure adjustments is discussed in the March 22, 2009 MTCA/SMS Advisory Group materials. The proposed adjustment factor is based on distillation of information in "Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens" EPA, 2005 and is still under evaluation.

[92] NOTE: A spreadsheet is available from the department to facilitate this calculation. [This footnote will be in the rule.]

NEW SECTION

WAC 173-340-7205 Adjustments to groundwater cleanup levels.

[Formerly WAC 173-340-720(7)]

(1) Total site risk adjustments.

(2) Adjustments to applicable state and federal laws.

(3) Natural background and analytical considerations.

(4) Nonaqueous phase liquid limitation.

~~(a)~~(1) Total site risk adjustments. Groundwater ~~water~~ cleanup levels for individual hazardous substances developed ~~in accordance with subsections (4), (5) or (6) of this section~~ under WAC 173-340-7202 through 7204, [93] including those based on applicable state and federal laws, shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposures resulting from more than one pathway of exposure. These adjustments need to be made only if, without these adjustments, the hazard index would exceed one (1) or the total estimated individual lifetime excess cancer risk would exceed one in one hundred thousand (1×10^{-5}). These adjustments shall be made in accordance with the procedures in WAC 173-340-708 (5) and (6). In making these adjustments, the hazard index shall not exceed one (1) and the total estimated individual lifetime excess cancer risk shall not exceed one in one hundred thousand (1×10^{-5}).

~~(b)~~(2) Adjustments to applicable state and federal laws. Where a cleanup level developed under ~~subsection (3), (4), (5) or (6) of this section~~ WAC 173-340-7201 through 7204 is based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an estimated individual lifetime excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of one (1), the cleanup level shall be adjusted downward so that the total estimated individual lifetime excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}) and the hazard index does not exceed one (1) at the site. This adjustment may be made using the equations in WAC 173-340-7202 or 7204, as appropriate for the site. [94]

~~(c)~~(3) Natural background and ~~PQL~~ analytical considerations. Cleanup levels determined under ~~subsection (3), (4), (5) or (6) of this section~~ WAC 173-340-7201 through 7204, including cleanup levels adjusted under subsections (1) and (2) of this section, shall not be set at levels below the practical quantitation limit or natural background concentrations, whichever is higher. See WAC 173-340-707 and 173-340-709 for additional requirements pertaining to practical quantitation limits and natural background.

~~(d)~~(4) Nonaqueous phase liquid limitation. For organic hazardous substances and total petroleum hydrocarbons, the cleanup level determined under ~~subsection (3), (4), (5) or (6) of this section~~ WAC 173-340-7201 through 7204 and any adjustments under this section shall not exceed a concentration that would result in nonaqueous phase liquid being present in or on the groundwater ~~water~~. Physical observations of groundwater ~~water~~ at or above the cleanup level, such as the lack of a film, sheen, or discoloration of the groundwater or lack of sludge or emulsion in the groundwater ~~water~~, may be used to determine compliance with this requirement.

[93] Note that adjustment for additive risk does not need to be made for Method A cleanup levels, which is consistent with current rule.

[94] Reflects current practice.

NEW SECTION

WAC 173-340-7206 Groundwater point of compliance.

[Formerly WAC 173-340-720(8)]

(1) General requirements.

(2) Standard point of compliance.

(3) Conditional point of compliance.

(4) Off-property conditional point of compliance.

~~(a) Point of compliance defined.~~

(1) General requirements. For groundwater, the point of compliance is the point or points where the groundwater ~~water~~ cleanup levels established under WAC 173-340-7201 through 7205 must be attained for a site to be in compliance with the cleanup standards. Groundwater ~~water~~ cleanup levels shall be attained in all groundwater ~~waters~~ from the point of compliance to the outer boundary of the hazardous substance plume.[95]

~~(b)~~(2) Standard point of compliance ~~for all sites~~. The standard point of compliance shall be ~~established~~ throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site.

~~(c)~~(3) Conditional point of compliance. Where it can be demonstrated under WAC 173-340-350 through 173-340-390 that it is not practicable to meet the cleanup level throughout the site within a reasonable restoration time frame, the department may approve a conditional point of compliance that shall be as close as practicable to the source of hazardous substances, and except as provided under subsection (4) of this section, not to exceed the property boundary. Where a conditional point of compliance is proposed, the person responsible for undertaking the cleanup action shall demonstrate that all practicable methods of treatment are to be used in the site cleanup.

~~(d)~~(4) Off-property conditional point of compliance. A conditional point of compliance shall not exceed the property boundary except in the ~~three~~ situations described below. In each of these ~~three~~ situations the person responsible for undertaking the cleanup action shall demonstrate that, in addition to making the demonstration required by subsection (3) of this section, the following requirements are met:

~~(i) Properties abutting surface water.~~

(a) Sites with cleanup levels based on protection of surface water.[96] Where the groundwater ~~water~~ cleanup level is based on protection of surface water beneficial uses or sediment, ~~under subsection (3), (4), (5), or (6) and the property containing the source of contamination directly abuts the surface water,~~ the department may approve a conditional point of compliance that is located ~~within the surface water as close as technically possible to the point or points where~~ as close as practicable to the source, not to exceed the point or points where the groundwater ~~water~~ flows into the surface water, subject to the following conditions:[97]

~~(A)~~(i) It has been demonstrated that the contaminated groundwater ~~water~~ is entering the surface water and will continue to enter the surface water even after implementation of the selected cleanup action;

~~(B)~~(ii) It has been demonstrated under WAC 173-340-~~350 through 173-340-390~~

[95] Changes to subsections (1) - (4) are editorial only.

[96] The changes in this subsection are intended to simplify compliance options by combining the "directly abutting" and "near" surface water options.

[97] Monitoring has traditionally be required in near shore monitoring wells, at seeps, or within the sediment pore water to measure concentrations before dilution within the surface water has occurred. This is because this transition zone is particularly important for benthic organisms. This change reflects that practice and incorporates current language from the "near but not abutting" scenario.

360 that it is not practicable to meet the cleanup level at a point within the groundwater closer to the source ~~water~~ before entering the surface water, within a reasonable restoration time frame; [98]

~~(C)~~(iii) Use of a mixing zone under WAC 173-201A-~~100~~400 to demonstrate compliance with surface water cleanup levels shall not be allowed;

~~(D)~~(iv) Groundwater ~~water~~ discharges shall be provided with all known available and reasonable methods of treatment before being released into surface waters;

~~(E)~~(v) Groundwater ~~water~~ discharges shall not result in violations of sediment quality values published in chapter 173-204 WAC;

~~(F)~~(vi) Groundwater ~~water~~ and surface water monitoring shall be conducted to assess the long-term performance of the selected cleanup action including potential bioaccumulation problems resulting from surface water concentrations below method detection limits; and

~~(G)~~(vi) Before approving the conditional point of compliance, a notice of the proposal and invitation for comment shall be mailed to all persons in the potentially affected vicinity including: [99]

- Property owners;
- Local governments with land use jurisdiction within the potentially affected vicinity;
- Public and private water purveyors that serve the potentially affected vicinity;
- ~~t~~The natural resource trustees~~,~~;
- ~~t~~The Washington state department of natural resources; and
- ~~t~~The United States Army Corps of Engineers.

The notice ~~shall be in addition to any~~ may be combined with any other notice provided under this chapter ~~WAC 173-340-600 and invite comments on the proposal~~;. [100]

~~(ii) Properties near, but not abutting, surface water.~~ ~~Where the ground water cleanup level is based on protection of surface water beneficial uses under subsection (3), (4), (5), or (6) of this section and the property that is the source of the contamination is located near, but does not directly abut, a surface water body, the department may approve a conditional point of compliance that is located as close as practicable to the source, not to exceed the point or points where the ground water flows into the surface water.~~

~~For a conditional point of compliance to be approved under this provision the conditions specified in (d)(i) of this section must be met and the a~~

(vii) Affected property owners between the source of contamination and the surface water body must agree in writing to the use of the conditional point of compliance~~. Also, if~~; and,

(viii) If the groundwater ~~water~~ cleanup level is not exceeded in the groundwater ~~water~~ prior to its entry into the surface water, the conditional point of compliance cannot extend beyond the extent of groundwater contamination above the cleanup level at the time the department approves the conditional point of compliance.

~~(iii)~~(b) Area-wide conditional point of compliance. As part of remedy selection, the department may approve an area-wide conditional point of compliance to address an area-wide groundwater ~~water~~ contamination problem. The area-wide conditional point(s) of compliance shall be

[98] Changed to make consistent with change to (a).

[99] To insure adequate notice has been provided to all potentially affected persons and agencies, not just natural resource trustees, and to make this consistent with non-potable use and area-wide POC notification requirements.

[100] Combining notices helps streamline the review process and is intended to move sites forward quicker.

as close as practicable to each source of hazardous substances, not to exceed the extent of groundwater ~~water~~ contamination at the time the department approves an area-wide conditional point of compliance.

This provision may be applied only at areas that are affected by hazardous substances released from multiple sources that have resulted in commingled plumes of contaminated groundwater ~~water~~ that are not practicable to address separately. A site may have more than one area-wide conditional point of compliance to address multiple sources and types of contaminants. An area-wide conditional point of compliance may be approved under this provision only if all of the following conditions have been met:

~~(A)~~(i) The person conducting the cleanup action has complied with WAC 173-340-350 through 173-340-390, including a demonstration that it is not practicable to meet a point of compliance throughout the groundwater ~~water~~ contamination within a reasonable restoration time frame;

~~(B)~~(ii) A plan has been developed for implementation of the cleanup action, including a description of how any necessary access to the affected properties will be obtained;

~~(C)~~(iii) If the contaminated groundwater ~~water~~ is considered to be potable under WAC 173-340-7200~~(2)~~(5), current developments in the area encompassed by the area-wide conditional point of compliance and any other areas potentially affected by the groundwater ~~water~~ contamination are served by a public water system that obtains its water from an offsite source and it can be demonstrated that the water system has sufficient capacity to serve future development in these areas. This demonstration may be made by obtaining a written statement to this effect from the water system operator;

~~(D)~~(iv) All property owners, tribes, local governments, and water purveyors with jurisdiction in the area potentially affected by the groundwater ~~water~~ contamination, have been mailed a notice of the proposal to establish an area-wide conditional point of compliance and provided an opportunity to comment. The notice shall specifically ask for information on existing and planned uses of the groundwater ~~water~~. The notice ~~shall be in addition to~~ may be combined with any other notice provided under this chapter ~~WAC 173-340-600~~. [101] The department will give greater weight to information based on an adopted or pending plan or similar preexisting document. When the department is providing technical assistance under WAC 173-340-515, the department shall also provide an opportunity to comment to the public through the *Site Register* before issuing a written opinion.

~~(E)~~(v) Other conditions as determined by the department on a case-by-case basis.

~~(c) Monitoring wells and surface water compliance.~~

[Deleted subsection and moved to compliance monitoring, Section 727]

[101] Combining notices helps streamline the review process and is intended to move sites forward quicker.

NEW SECTION

WAC 173-340-7207 Demonstrating compliance with groundwater cleanup standards.

[Formerly WAC 173-340-720(9)]

~~(a)~~(1) Sampling required.[102] When ground-water cleanup ~~levels~~ standards have been established at a site, sampling of the groundwater ~~water~~ shall be conducted to determine if compliance with the groundwater ~~water~~ cleanup ~~levels~~ standards has been achieved. ~~Compliance with ground water cleanup levels shall be determined by analysis of ground water samples representative of the ground water.~~ Surface water and sediment analysis, bioassays or other biomonitoring methods may also be required by the department where the groundwater ~~water~~ cleanup ~~level~~ standard is based on protection of surface water.[103]

(2) Compliance monitoring plan. Sampling procedures, ~~and~~ analytical ~~procedures~~ methods, and data evaluation procedures shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. The sample design shall provide data that are representative of the site.[104]

~~(b)~~(3) Filtering. Analyses shall be conducted on unfiltered groundwater ~~water~~ samples, unless it can be demonstrated to the department's satisfaction that a filtered sample provides a more representative measure of groundwater ~~water~~ quality. ~~The department expects that filtering will generally be acceptable for~~ It is presumed that filtering of samples from groundwater monitoring wells (not water supply wells) ~~iron and manganese and other~~ for naturally occurring inorganic substances will be acceptable where all of the following conditions exist:[105]

(a) The aquifer material does not consist of materials where there is a high potential for colloidal transport of hazardous substances (such as fractured bedrock or poorly graded gravels (GP classification under ASTM D 2487));[106]

~~(i)~~(b) A properly constructed monitoring well cannot be sufficiently developed to provide ~~low turbidity~~ water samples with a turbidity less than 50 nephelometric turbidity units (NTUs) using low flow sampling methods (generally 0.1 to 0.5 liters per minute);[107]

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[102] Subtitles added for consistency with other sections.

[103] "Levels" replaced with "standards" to reflect that compliance monitoring takes into account point of compliance, not just concentration. The 2nd sentence is duplicative of a similar statement in (2) and was deleted. Sediment added as part of MTCA/SMS rule integration.

[104] Changed to parallel language in Section 410 better.

[105] Filtering is often useful to reduce sample to sample variability. Changes in this subsection are intended to clarify when filtered groundwater samples can be used for compliance testing. Filtering is generally not allowed for organic substances as they are absorbed by the filtering apparatus.

[106] Colloidal transport has been identified as a potential issue of concern in several publications. This is intended to address this concern.

[107] 50 NTU is used in WAC 173-201A to distinguish between turbid and clear surface water and is a standard used by other states to define when filtration is generally acceptable. This does not preclude filtration in other circumstances if suspended particulates are leading to highly variable test results but it will not be accepted by default. See EPA publication 540/S-95/504, April, 1996, for a discussion of low flow sampling methods.

Turbidity at 5, 50, and 500 NTU

~~**(ii)** Due to the natural background concentration of hazardous substances in the aquifer material, unfiltered samples would not provide a representative measure of ground water quality; and~~

~~**(iii)**~~**(c)** Filtering is performed in the field using a 0.45 micron filter, with all practicable measures taken to avoid exposing the groundwater ~~water~~ sample to the ambient air before filtering; and [108]

(d) Analysis of unfiltered samples is not required by an applicable state or federal law. [109]

(4) Use of no-purge sampling. No purge sampling methods can be used where it can be demonstrated to the department's satisfaction on a site-specific basis that the selected method provides comparable results to samples obtained using a department-approved low flow sampling method. [110]

(5) Data analysis and evaluation-general requirements. The data analysis and evaluation procedures used to evaluate compliance with groundwater ~~water~~ cleanup ~~levels~~ standards shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. These procedures shall meet the following general requirements:

~~**(i)**~~**(a)** Methods of data analysis shall be consistent with the sampling design;

~~**(ii)**~~**(b)** When cleanup levels are applied to a public water system regulated under WAC 246-290 ~~based on requirements specified in applicable state and federal laws~~, the procedures for evaluating compliance ~~that are~~ specified in WAC 246-290 ~~those requirements~~ shall be used to evaluate compliance with cleanup levels in that public water system ~~that unless those procedures conflict with the intent of this section~~; [111]

~~**(iii)**~~**(c)** ~~Where procedures for evaluating compliance are not specified in an applicable state and federal law,~~ sStatistical methods used shall be appropriate for the distribution of sampling data for each hazardous substance. If the distributions for different hazardous substances differ, more than one statistical method may be required;

~~**(iv)**~~**(d)** Compliance with groundwater ~~water~~ cleanup ~~levels~~ standards shall be determined for each groundwater ~~water~~ monitoring well or other monitoring points such as a spring or water supply well;

~~**(v)**~~**(e)** The data analysis procedures ~~identified~~ used to determine compliance with groundwater cleanup standards, including methods and criteria, shall be specified in the compliance monitoring plan ~~shall specify the statistical parameters to be used to determine compliance with ground-water cleanup levels~~. [112]

~~**(i)** For cleanup levels based on short-term or acute toxic effects on human health or the environment, an upper percentile concentration shall be used to evaluate~~

http://www.epa.gov/tio/tsp/download/lwflw2a.pdf

[108] A 0.45 micron filter is standard practice.

[109] RCRA sites generally require unfiltered samples.

[110] No purge methods are becoming more common. This is intended to allow these methods where it can be demonstrated they provide representative samples.

[111] Changed to clarify that public water systems have specific monitoring and compliance requirements that must be complied with. Those requirements were not intended for monitoring wells.

[112] Changed to reflect later proposed language allowing non-statistical compliance demonstrations.

~~compliance with ground water cleanup levels.~~ [113]

~~**(ii)** For cleanup levels based on chronic or carcinogenic threats, use the true mean concentration shall be used to evaluate compliance with groundwater water cleanup levels.~~

~~**(vi)**~~**(f)** When active groundwater ~~water~~ restoration is performed, or containment technologies are used that incorporate active pumping of groundwater ~~water~~, compliance with ground water cleanup ~~levels~~ standards shall be determined when the groundwater ~~water~~ characteristics at the site are no longer influenced by the cleanup action.

~~**(d)** When data analysis procedures for evaluating compliance are not specified in an applicable state or federal law, the following procedures shall be used:~~

(6) Data evaluation using direct comparison. Direct comparison may be used to demonstrate compliance with groundwater cleanup standards if: [114]

(a) Sufficient monitoring wells have been installed in the proper locations to detect contamination;

(b) Sufficient time has elapsed for contamination to reach the groundwater;

(c) There are no other conditions at the site indicating that future groundwater contaminant levels have the potential to be higher than measured concentrations; and [115]

(d) One of the following conditions exists:

(i) No groundwater contamination:

(A) Soil testing with depth indicates it is unlikely significant contamination has reached the groundwater;

(B) No contaminants were detected in any groundwater samples during site characterization;

(C) No contaminants have been detected in at least two samples per groundwater monitoring point collected during high and low groundwater conditions. Groundwater samples collected during site characterization can be used to make this demonstration; and

(D) A standard point of compliance (throughout the site) is being used.

(ii) Groundwater contamination found below cleanup levels:

(A) Any contaminants detected were below cleanup levels in all groundwater monitoring samples during site characterization;

(B) All samples from all groundwater monitoring points remain below cleanup levels in at least four samples per monitoring point, collected in consecutive quarters for one year. Groundwater samples collected during site characterization can be used to make this demonstration;

(C) The groundwater concentrations are stable or decreasing over time; and

(D) A standard point of compliance (throughout the site) is being used.

(iii) Groundwater contamination found above cleanup levels: [116]

(A) Contamination was detected above cleanup level(s) in one or more groundwater samples collected during site characterization or compliance monitoring;

(B) After remediation, all samples from all groundwater monitoring points at and

[113] The concepts in (i) and (ii) have been incorporated later in this Section.

[114] Sometimes, it can take several years of groundwater monitoring to statistically establish that cleanup levels are met. Direct comparison methods are being proposed to expedite decisions in cases with no or minor groundwater contamination. The proposed methods are based in part on "Guidance on Sampling and Data Analysis Methods", Ecology Publication No. 94-49, January, 1995.

[115] Such as: large fluctuations in groundwater concentrations; unusually dry or wet climatic conditions; or, water infiltration conditions that are significantly different than will be present after site redevelopment. [Footnote to be added to rule.]

[116] Expected to be used in situations with modest contamination and where restoration will be relatively easy.

beyond the point of compliance are below cleanup levels in at least eight samples per monitoring point, collected in consecutive quarters for at least two years;

(C) The groundwater concentrations are stable or decreasing over time; and

(D) A standard point of compliance (throughout the site) is being used.

(7) Data evaluation using statistical methods. A statistical analysis of groundwater data must be conducted if the conditions in subsection (6) for direct comparison are not met. The statistical analysis must be conducted for the wells located at and beyond the point of compliance and using at least the most recent three years of groundwater monitoring data. When using a statistical analysis to demonstrate compliance, the following methods shall be used: [117]

(a) For data that is normally or log-normally distributed, ~~**(i)** A~~ a confidence interval approach that meets the following requirements:

~~**(A)**~~**(i)** The upper one-sided ninety-five percent confidence limit on the true mean groundwater ~~water~~ concentration shall be less than or equal to[118] the groundwater ~~water~~ cleanup level. For lognormally distributed data, the upper one-sided ninety-five percent confidence limit shall be calculated using Land's method; and

~~**(B)**~~**(ii)** Data shall be assumed to be lognormally distributed unless this assumption is rejected by a statistical test. If a lognormal distribution is inappropriate, data shall be assumed to be normally distributed unless this assumption is rejected by a statistical test. The W test, D'Agostino's test, or~~,~~ censored probability plots, as appropriate for the data, shall be the statistical methods used to determine whether the data is lognormally or normally distributed.

(b) If the data conforms to neither a lognormal nor normal distribution, non parametric statistical methods may be used to determine compliance. When using a nonparametric method to calculate an upper confidence limit, the upper ninety-fifth percentile on the true mean shall be used to determine compliance.[119]

~~**(ii)** Evaluations conducted under subsection (5)(e)(i) of this subsection may use a parametric test for percentiles based on tolerance intervals to test the proportion of ground water samples having concentrations less than the ground water cleanup level. When using this method, the true proportion of samples that do not exceed the ground water cleanup level shall not be less than ninety percent. Statistical tests shall be performed with a Type I error level of 0.05; or~~ [120]

~~**(iii)**~~**(c)** Other statistical methods may be approved by the department on a site-specific basis.

~~**(c)**~~**(8) Method limitations.** All data analysis methods used, including those specified in state or federal law, must meet the following requirements:

~~**(i)**~~**(a)** No single sample concentration shall be greater than two times the groundwater ~~water~~ cleanup level. Higher exceedances to control false positive error rates at five percent may be approved by the department when the cleanup level is based on background concentrations; and

~~**(ii)**~~**(b)** Less than ten percent of the sample concentrations shall exceed the groundwater ~~water~~ cleanup level during a representative sampling period. Higher exceedances to control false positive error

[117] The three years is based on "Guidance on Sampling and Data Analysis Methods", Ecology Publication No. 94-49, January, 1995. It is intended to capture a range of climatic and site conditions.

[118] Clarification based on current practice.

[119] To provide a standard for non parametric methods comparable to other methods.

[120] The referenced section is proposed for deletion, so this language is unnecessary.

rates at five percent may be approved by the department when the cleanup level is based on background concentrations.

(9) Surface water compliance evaluations. [121]

(a) The department may require or approve the use of upland monitoring wells located between the surface water and the source of contamination to establish compliance where a conditional point of compliance has been established under WAC 173-340-7206(4)(a).

(b) Where such monitoring wells are used, the department may consider an estimate of natural attenuation between the monitoring well and the point or points where groundwater flows into the surface water in evaluating whether compliance has been achieved. When evaluating how much, if any, natural attenuation will occur, the department shall consider site-specific factors including:

(i) The sufficiency of the monitoring well locations, and the length and placement of well screens to detect contamination; [122]

(ii) Whether the groundwater could reach the surface water in ways that would not provide for natural attenuation within the groundwater flow system (such as short circuiting through high permeability zones, utility corridors or foundation drains);

(iii) Whether changes to the groundwater chemistry due to natural attenuation processes, such as biodegradation, would cause an exceedance of surface water or sediment standards;

(iv) The extent of dilution occurring as a result of interactions between the surface water and the groundwater; and [123]

(c) When using upland monitoring wells, the procedures in subsection (6) or (7) of this section shall be used to determine compliance.

~~**(f)** When using statistical methods to demonstrate compliance with ground water cleanup levels, the following procedures shall be used for measurements below the practical quantitation limit:~~

(10) Interpreting non-detect values. The following procedures shall be used for measurements below the practical quantitation limit. These methods shall be used unless a groundwater cleanup level is based on an applicable state or federal law that includes methods for handling non-detected measurements. [124]

~~**(i)**~~**(a)** Measurements below the method detection limit shall be assigned a value equal to one-half the method detection limit ~~when not more than fifteen percent of the measurements are below the practical quantitation limit~~.

~~**(ii)**~~**(b)** Measurements above the method detection limit but below the practical quantitation limit shall be assigned a value equal to one-half the practical quantitation limit ~~the method detection limit when not more than fifteen percent of the~~

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[121] This subsection was moved from Section 7206 with the changes noted.

[122] For example, fluctuating surface water levels, slight differences in the permeability of water bearing zones, and differences in groundwater density caused by salt water intrusion, contaminant characteristics, and temperature gradients can all influence where contaminants are likely to discharge into surface water and mass flux estimates. Factors like this need to be considered to ensure valid samples are obtained. [Footnote to be added to rule]

[123] Dilution is a common issue at tidally influenced sites. In saltwater environments, the amount of dilution can be estimated from salinity levels; in freshwater environments, a tracer test may need to be conducted to determine the amount of dilution occurring.

[124] These provisions were added in 2001. Experience since has shown these provisions are not practical and are not being implemented at sites. The proposed changes reflect current practice for handling of non-detects, generally provide a conservative (high) estimate of residual concentrations for determining compliance, and are intended to simplify these calculations. The Kaplan-Meier method has been added as an acceptable alternative method for handling non-detects.

~~measurements are below the practical quantitation limit~~.

~~**(iii)** When between fifteen and fifty percent of the measurements are below the practical quantitation limit and the data are assumed to be lognormally or normally distributed, Cohen's method shall be used to calculate a corrected mean and standard deviation for use in calculating an upper confidence limit on the true mean ground water concentration.~~

~~**(iv)** If more than fifty percent of the measurements are below the practical quantitation limit, the largest value in the data set shall be used in place of an upper confidence limit on the true mean ground water calculation.~~

(c) Measurements below the method detection limit and/or practical quantitation limit may also be evaluated using the Kaplan-Meier method. [125]

~~**(v)**~~**(d)** If a hazardous substance or petroleum fraction has never been detected in any sample at a site and these substances are not suspected of being present at the site based on site history and other knowledge, that hazardous substance or petroleum fraction may be excluded from the ~~statistical~~ compliance analysis.

~~**(vi)**~~**(e)** The department may approve alternate ~~statistical~~ procedures for handling ~~nondetected values or~~ values below the method detection limit and/or practical quantitation limit.

[125] See: USEPA's ProUCL statistical software http://www.epa.gov/esd/tsc/software.htm; and Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance; EPA 530-R-09-007, March, 2009 http://www.epa.gov/osw/hazard/correctiveaction/resources/guidance/sitechar/gwstats/unified-guid.pdf. *[Footnote to be added to rule.]*

Table 720-1
Method A Cleanup Levels for Groundwater.[a]

Hazardous Substance	CAS Number	Cleanup Level
Arsenic	7440-38-2	5 ug/liter[b]
Benzene	71-43-2	5 ug/liter[c]
Benzo(a)pyrene	50-32-8	0.1 ug/liter[d] *Under review*
Cadmium	7440-43-9	5 ug/liter[e-d]
Carcinogenic PAHs [e]		*Under review*
Benzo(a)anthacene	56-55-3	
Benzo(b)fluoranthene	205-99-2	
Benzo(k)fluoranthene	207-08-9	
Benzo(a)pyrene	50-32-8	
Chrysene	218-01-9	
Dibenzo(a,h)anthracene	53-70-3	
Indeno[1,2,3-cd]pyrene	193-39-5	
~~Chromium (Total)~~	~~7440-47-3~~	~~50 ug/liter~~[f]
Chromium III	16065-83-1	100 ug/liter[f]
Chromium VI	18540-29-9	50 ug/liter[f] *Under review*
DDT	50-29-3	0.3 ug/liter[g]
1,2 Dichloroethane (EDC)	107-06-2	5 ug/liter[h]
Ethylbenzene	100-41-4	700 ug/liter[j]
Ethylene dibromide (EDB)	106-93-4	0.01 ug/liter[j] *Under review*
Gross Alpha Particle Activity		15 pCi/liter[k]
Gross Beta Particle Activity		4 mrem/yr[l]
Lead	7439-92-1	15 ug/liter[m]
Lindane	58-89-9	0.2 ug/liter[n]
Methylene chloride	75-09-2	5 ug/liter[o] *Under review*
Mercury	7439-97-6	2 ug/liter[p]
MTBE	1634-04-4	20 ug/liter[q]
Naphthalene~~s~~	91-20-3	160 ug/liter *Under review*[r]
1-Methyl Naphthalene	90-12-0	3 ug/liter[s]
2-Methyl Naphthalene	91-57-6	32ug/liter[t]
~~PAHs (carcinogenic)~~		~~See benzo(a)pyrene~~[d]
PCB mixtures		0.1 ug/liter[s-u]
Perchlorate	7601-90-3	11 ug/liter[v]
Radium 226 and 228		5 pCi/liter[t,w]
Radium 226		3 pCi/liter[u,x]
Tetrachloroethylene	127-18-4	5 ug/liter[w-v] *Under review*
Toluene	108-88-3	1,000 ug/liter[w-z]
Total Petroleum Hydrocarbons[x] aa		*All TPH values under review*
[Note: Must also test for and meet cleanup levels for other petroleum components--see footnotes!]		
Gasoline Range Organics		
Benzene present in groundwater		800 ug/liter
No detectable benzene in groundwater		1,000 ug/liter
Diesel Range Organics		500 ug/liter
Heavy Oils		500 ug/liter
Mineral Oil		500 ug/liter
1,1,1 Trichloroethane	71-55-6	200 ug/liter[y-bb]
Trichloroethylene	79-01-6	5 ug/liter[z-cc] *Under review*
Vinyl chloride	75-01-4	0.2 ug/liter[aa-dd]
Xylenes	1330-20-7	1,000 ug/liter[bb-ee]

Footnotes:

NOTE: This table will remain in Section 900 of the rule but is shown here to facilitate review. Values highlighted in yellow are cleanup levels currently under review and may change as EPA completes IRIS updates.

a **Caution on misusing this table.** This table has been developed for specific purposes. It is intended to provide conservative cleanup levels for drinking water beneficial uses at sites with relatively few hazardous substances and where surface water is not potentially impacted. This table may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in this table should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes.

b **Arsenic.** Cleanup level based on background concentrations for state of Washington.

c **Benzene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

d **Benzo(a)pyrene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61), adjusted to a 1 x 10^{-5} risk. If other carcinogenic PAHs are suspected of being present at the site, test for them and use this value as the total concentration that all carcinogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8). *Under review*

~~e~~ **Cadmium.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.62).

e **Carcinogenic PAHs.** *Concept of listing separately under review*

f **Chromium ~~(Total)~~.** Chromium III based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.62). Chromium VI ~~Cleanup level based on concentration~~ derived using Equation 720-1 (non-carcinogen) ~~for hexavalent chromium. This is a total value for chromium III and chromium VI. If just chromium III is present at the site, a cleanup level of 100 ug/l may be used (based on WAC 246-290-310 and 40 C.F.R. 141.62).~~

g **DDT (dichlorodiphenyltrichloroethane).** Cleanup levels ~~based on concentration~~ derived using Equation 720-2 (carcinogen).

h **1,2 Dichloroethane (ethylene dichloride or EDC).** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

i **Ethylbenzene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

j **Ethylene dibromide (1,2 dibromoethane or EDB).** Cleanup level based on concentration derived using Equation 720-2, adjusted for the practical quantitation limit. *Under review*

k **Gross Alpha Particle Activity, excluding uranium.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. ~~141.15~~ 141.66)

l **Gross Beta Particle Activity, including gamma activity.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. ~~141.15~~ 141.66)

m **Lead.** Cleanup level based on applicable state and federal law (40.C.F.R. 141.80)

n **Lindane.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

o **Methylene chloride (dichloromethane).** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61). *Under review*

p **Mercury.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.62).

q **Methyl tertiary-butyl ether (MTBE).** Cleanup level based on federal drinking water advisory level (EPA-822-F-97-009, December 1997).

r **Naphthalenes.** Cleanup level based on concentration derived using Equation 720-1. This is a total value for naphthalene 1-methyl naphthalene and 2-methyl naphthalene. *Under review*

s **1-Methyl Naphthalene.** Cleanup level derived using equation 720-2 (carcinogen).

t **2-Methyl Naphthalene.** Cleanup level derived using equation 720-1 (non carcinogen).

~~s~~u **PCB mixtures.** Cleanup level based on concentration derived using Equation 720-2 (carcinogen), adjusted for the practical quantitation limit. This cleanup level is a total value for all PCBs.

v **Perchlorate.** Cleanup level derived using equation 720-1 (non carcinogen).

~~t~~**w** **Radium 226 and 228.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.15).

~~u~~**x** **Radium 226.** Cleanup level based on applicable state law (WAC 246-290-310).

~~v~~**y** **Tetrachloroethylene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61). *Under review*

~~w~~**z** **Toluene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

~~x~~**aa** **Total Petroleum Hydrocarbons (TPH).** TPH cleanup values have been provided for the most common petroleum products encountered at contaminated sites.

Where there is a mixture of products or the product composition is unknown, the product type must be identified using the HCID method. Where a 90% match can be achieved, use the cleanup level for that product. Where a 90% match cannot be achieved, samples must be tested using both the NWTPH-Gx and NWTPH-Dx methods and ~~the lowest applicable TPH cleanup level must be met~~ the cleanup levels for each product range in the mixture adjusted based on the percentage of that type of product in the mixture. (For example, a sample with a mixture of 20% weathered gasoline and 80% diesel would use a gasoline TPH cleanup level of 20% x 1000 = 200 ug/L and a diesel cleanup level of 80% x 500 = 400 ug/L; a sample with a mixture of 60% diesel and 40% heavy oil would use a diesel cleanup level of 60% x 500 = 300 ug/L and a heavy oil cleanup level of 40% x 500 = 200 ug/L).

In addition to TPH, the ground water cleanup level for any carcinogenic components of the petroleum [such as benzene and cPAHs] and any noncarcinogenic components [such as ethylbenzene, toluene and xylenes], if present at the site, must also be met.

See Table 830-1 for the minimum testing requirements for various petroleum releases.

- **Gasoline range organics** means ~~organic compounds~~ volatile petroleum products measured using ~~method~~ the NWTPH-Gx method. ~~Examples are aviation and automotive gasoline.~~ See Table 830-2 for products in this category. The cleanup level is based on protection of groundwater ~~water~~ for drinking water use. ~~The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene, EDB and EDC] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and MTBE], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for gasoline releases.~~
- **Diesel range organics** means ~~organic compounds~~ middle distillate petroleum products measured using the NWTPH-Dx method. ~~Examples are diesel, kerosene, and #1 and #2 heating oil.~~ See Table 830-2 for products in this category. The cleanup level is based on protection ~~from noncarcinogenic effects during~~ of groundwater for drinking water use assuming a product composition similar to diesel fuel. ~~The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and naphthalenes], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for diesel releases.~~
- **Heavy oils** means ~~organic compounds~~ heavy end petroleum products measured using the NWTPH-Dx method. ~~Examples are #6 fuel oil, bunker C oil, hydraulic oil and waste oil.~~ See Table 830-2 for products in this category. The cleanup level is based on protection ~~from noncarcinogenic effects during~~ of groundwater for drinking water use, assuming a product composition similar to ~~diesel fuel~~ heavy fuel oil. ~~The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs and PCBs] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and naphthalenes], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for heavy oil releases.~~
- **Mineral oil** means ~~non-PCB~~ mineral oil with less than 2 mg/liter (ppm) of PCBs~~, typically used as an insulator and coolant in electrical devices such as transformers and capacitors~~ measured using the NWTPH-Dx method. See Table 830-2 for products in this category. The cleanup level is based on protection ~~from noncarcinogenic effects during~~ of groundwater for drinking water use. ~~Sites using this cleanup level must analyze ground water samples for PCBs and meet the PCB cleanup level in this table unless it can be demonstrated that: (1) The release originated from an electrical device manufactured after July 1, 1979; or (2) oil containing PCBs was never used in the equipment suspected as the source of the release; or (3) it can be documented that the oil released was recently tested and~~

~~did not contain PCBs. Method B (or Method C, if applicable) must be used for releases of oils containing greater than 50 ppm PCBs. See Table 830-1 for the minimum testing requirements for mineral oil releases.~~

~~y~~bb **1,1,1 Trichloroethane.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

~~z~~cc **Trichloroethylene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61). *Under review*

~~aa~~dd **Vinyl chloride.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61), adjusted to a 1 x 10^{-5} risk.

~~bb~~ee **Xylenes.** Cleanup level based on prevention of adverse aesthetic characteristics. This is a total value for all xylenes.

EXPLANATORY NOTES:

a. Additional language added to clarify that these values are based on drinking water, not surface water protection.

e. Carcinogenic PAHs. There is still some confusion from users on how to calculate cleanup levels for cPAH mixtures. Ecology is considering changing from treating cPAH mixtures as a single substance to listing as separate substances to address this confusion. This would also be consistent with proposed early life stage amendments in Section 708.

f. Chromium. Chromium VI on hold pending completion of update to IRIS database. Preliminary calculations based on September 2010 draft IRIS documents (oral cancer slope factor of (0.5 $(mg/kg/day)^{-1}$ and application of early life stage adjustment factor) indicate the Method A value would be based on the PQL (2 ug/L).

j. EDB. The oral cancer slope factor for EDB has changed from 2 to 85 $(mg/kg/day)^{-1}$. If this doesn't change again, this would result in the drinking water standard of 0.05 ug/L becoming the Method A standard as it would fall within the acceptable level of risk.

o. Methylene Chloride. Value under review pending completion of update to IRIS database. Preliminary calculations based on March 2010 draft IRIS documents (oral cancer slope factor of (0.029 $(mg/kg/day)^{-1}$ and application of early life stage adjustment factor) indicate that Method A value would continue to be based on MCL.

r. Naphthalene. The IRIS database indicates that naphthalene is much more toxic via the inhalation pathway than previously assumed by Ecology. Consequently, the use of Equation 720-1 and INH value of 2 (which implies equal toxicity for the oral and inhalation pathway) underestimates the non-cancer risks associated with volatilization during showering and other domestic uses. If a more realistic adjustment is made for the inhalation pathway the cleanup level would decrease by about an order of magnitude.

y. Tetrachloroethylene. On hold pending completion of update to IRIS database.

aa. Total Petroleum Hydrocarbons. Changes to values under review pending calculations using latest spreadsheet and composition data.

The first change to the footnote, referring to 90% match, is to provide consistency between this table and Tables 830-1 & 830-2.

The second change is intended to clarify how the Method A cleanup levels apply to petroleum mixtures, which has been a point of confusion for some time. The adjustment language reflects that the TPH cleanup levels for individual products are based on a hazard index (HI) =1 and that the cleanup level for mixtures of petroleum products must be adjusted downward so the total risk doesn't exceed an HI of 1. This proportion approach is less stringent than the current language which requires applying the lowest applicable cleanup level to the entire mixture (for example a mixture of gasoline and diesel is currently required to use the gasoline cleanup level.).

A PCB concentration has been added to mineral oil to clarify what non-PCB mineral oil means. The 2 ppm is based on the dangerous waste rule PCB limit.

The remainder of the changes are editorial.

cc. Trichlorethylene. On hold pending completion of update to IRIS database. Preliminary calculations based on November 2009 draft IRIS documents (oral cancer slope factor of (0.05 $(mg/kg/day)^{-1}$ and application of early life stage adjustment factor for kidney cancers) indicate that Method A value would continue to be based on MCL.

WAC 173-340-7300 General considerations for surface water cleanup standards.

(1) Basis for surface water cleanup levels.
(2) When cleanup is required.
(3) Applicability to runoff.
(4) Protection of other environmental media.
(5) Cleanup levels for other beneficial uses and exposure pathways.
(6) Methods.

WAC 173-340-7302 Method B surface water cleanup standards.

(1) Applicability.
(2) Concentration.
  (a) Applicable state and federal laws.
  (b) Environmental effects.
  (c) Human health protection.
  (d) Drinking water considerations.
(3) Allowable Method B Modifications.
(4) Adjustments.
(5) Using Method B to evaluate surface water remediation levels.
(6) Point of compliance.
(7) Determining compliance.

WAC 173-340-7303 Method C surface water cleanup standards.

(1) Applicability.
(2) Method C surface water cleanup levels.
(3) Adjustments.
(4) Using Method C to evaluate surface water remediation levels.
(5) Point of compliance.
(6) Determining compliance.

WAC 173-340-7304 Adjustments to surface water cleanup levels.

(1) Total site risk adjustments.
(2) Adjustments to applicable state and federal laws.
(3) Natural background and analytical considerations.
(4) Nonaqueous phase liquid limitation.

WAC 173-340-7305 Surface water Point of compliance.

(1) Location.
(2) Mixing zones prohibited.

WAC 173-340-7306 Demonstrating compliance with surface water cleanup standards.

(1) Sampling required.
(2) Compliance monitoring plan.
(3) Filtering.
(4) Evaluating compliance.
(5) Interpreting non-detect values.

NEW SECTION

WAC 173-340-7300 General considerations for surface water cleanup standards. [126]

(1) Basis for surface water cleanup levels.

(2) When cleanup is required.

(3) Applicability to runoff.

(4) Protection of other environmental media.

(5) Cleanup levels for other beneficial uses and exposure pathways.

(6) Methods.

(1) ~~General considerations.~~

~~(a)~~Basis for surface water cleanup levels. [127] Surface water cleanup levels shall be based on estimates of the highest beneficial use and the reasonable maximum exposure expected to occur under both current and potential future site use conditions. The classification and the highest beneficial use of a surface water body, determined in accordance with chapter 173-201A WAC, shall be used to establish the reasonable maximum exposure for that water body. Surface water cleanup levels shall use this presumed exposure scenario and shall be established in accordance with this section.

~~(b)~~(2) When cleanup is required. In the event of a release of a hazardous substance to surface water from a site, a cleanup action that complies with this chapter shall be conducted to address all areas of the site where the concentration of the hazardous substances in the surface water exceeds cleanup levels.

~~(c)~~(3) Applicability to runoff. Surface water cleanup ~~levels~~ standards established under this section apply to those surface waters of the state affected or potentially affected by releases of hazardous substances from sites addressed under this chapter. The department does not expect that cleanup standards will be applied to storm water runoff that is ~~in the process of~~ being conveyed to or within a treatment system. [128]

~~(d)~~(4) Protection of other environmental media. Surface water cleanup levels shall be established at concentrations that do not directly or indirectly cause violations of ground water, soil, sediment, or air cleanup standards established under this chapter or other applicable state and federal laws. A site that qualifies for a Method C surface water cleanup level under this section does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium.

~~(e)~~(5) Cleanup levels for other beneficial uses and exposure pathways. The department may require more stringent cleanup levels than specified in ~~this~~ sections 7300 through 7304 where necessary to protect other beneficial uses or otherwise protect human health and the environment. Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708.

(6) Methods. This section does not provide procedures for establishing Method A surface water cleanup standards. Method B or C, as appropriate, shall be used to establish all surface water cleanup standards. [129]

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[126] Former Section 730 has been reorganized into smaller multiple Sections to facilitate readability and use. Because of this, the Code Reviser will likely publish these as new Sections. To facilitate review, changes from existing language are highlighted.

[127] Subsection titles added for consistency with other parts of the rule.

[128] To clarify that a wetland or roadside ditch designed as part of a stormwater treatment system isn't subject to the surface water standards in this Section.

[129] It is proposed to eliminate Method A as an option for surface water cleanup standards, since there are currently no Method A table values and values in

~~**(2) Method A surface water cleanup levels.**~~

[Deleted] [130]

applicable state and federal laws don't incorporate tribal fish consumption rates.

[130] As previously noted, it is proposed to eliminate Method A as an option for surface water cleanup standards.

NEW SECTION

WAC 173-340-7302 Method B surface water cleanup standards.

[Formerly WAC 173-340-730(3)]

~~**(a)**~~**(1) Applicability.** ~~Method B surface water cleanup levels consist of standard and modified cleanup levels as described in this subsection. Either standard or modified~~ Method B surface water cleanup ~~levels~~ standards may be used at any site.[131]

~~**(b)**~~**(2) Concentration.** ~~**Standard Method B surface water cleanup levels.** Standard~~ Method B cleanup levels for surface waters shall be at least as stringent as all of the following:

~~**(i)**~~**(a) Applicable state and federal laws.** Concentrations established under applicable state and federal laws, including the following requirements:

~~**(A)**~~**(i)** All water quality criteria published in the water quality standards for surface waters of the state of Washington, chapter 173-201A WAC;

~~**(B)**~~**(ii)** Water quality criteria based on the protection of aquatic organisms (acute and chronic criteria) and human health published under section 304 of the Clean Water Act unless it can be demonstrated that such criteria are not relevant and appropriate for a specific surface water body or hazardous substance; and

~~**(C)**~~**(iii)** National toxics rule (40 C.F.R. Part 131)

[131] Changes here and in (2) reflect proposed elimination of "standard" and "modified" Method B terminology.

~~**(ii)**~~**(b) Environmental effects.** For hazardous substances for which environmental effects-based concentrations have not been established under applicable state or federal laws, concentrations that are estimated to result in no adverse effects on the protection and propagation of wildlife, fish, and other aquatic life. Whole effluent toxicity testing using the protocols described in chapter 173-205 WAC may be used to make this demonstration for fish and aquatic life;

~~**(iii)**~~**(c) Human health protection.** For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, ~~those~~ concentrations that protect human health as determined by the following methods. These methods are applicable to surface waters that support, or have the potential to support, fish or shellfish populations.[132]

~~**(A)**~~**(i) Noncarcinogens.** For noncarcinogens ~~surface waters that support or have the potential to support fish or shellfish populations~~, concentrations which are estimated to result in no acute or chronic toxic effects on human health as determined using Equation 730-1.

~~**(B)**~~**(ii) Carcinogens.** For carcinogens ~~surface waters which support or have the potential to support fish or shellfish populations~~, concentrations that are estimated to result in an individual lifetime excess cancer risk less than or equal to one in one million (1×10^{-6}) as determined using Equation 730-2.

~~**(C)**~~**(iii) Petroleum mixtures.** ~~For noncarcinogenic effects of petroleum mixtures, a total petroleum hydrocarbon cleanup level shall be calculated using Equation 730-1 and by taking into account the additive effects of the petroleum fractions and volatile hazardous substances present in the petroleum mixture.~~

[132] Moved up from (i) and (ii).

For petroleum mixtures, total petroleum hydrocarbon (TPH) concentrations that result in no toxic effects on human health as determined using Equation 720-3. The total petroleum hydrocarbon concentration calculated using this equation must be adjusted downward if individual substances present in the mixture (for example, benzene) exceed acceptable cancer risk levels or applicable state and federal laws at the calculated TPH concentration. A spreadsheet is available from the department to facilitate these calculations. As an alternative to this calculation, the total petroleum hydrocarbon cleanup levels in Table 720-1 may be used. ~~Cleanup levels for other noncarcinogens and known or suspected carcinogens within the petroleum mixture shall be calculated using Equations 730-1 and 730-2.~~ See Table 830-1 for the analyses required for various petroleum products to use this method; [133]

(iv) Fish consumption rate. For sites impacting surface waters within the usual and accustomed fishing area for one or more tribes, or known to the department to be within an area regularly used by other high fish consuming populations, the department may adjust the default fish consumption rate and fish diet fraction used in equations 720-1, 720-2 and 720-3 as necessary to protect tribal members and other high fish consuming populations. *[Process for adjusting these values to be determined.];* and [134]

~~(iv)~~**(d) Drinking water considerations.** For surface waters that are classified as suitable for use as a domestic water supply under chapter 173-201A WAC, concentrations derived using the methods specified in WAC 173-340-7200 through 7205 for drinking water beneficial uses.

~~**(c) Modified Method B surface water cleanup levels.** Modified Method B surface water cleanup levels are standard Method B surface water cleanup levels modified with chemical-specific or site-specific data. When making these adjustments, the resultant cleanup levels shall meet applicable state and federal laws and health risk levels required for standard Method B surface water cleanup levels. Changes to exposure assumptions must comply with WAC 173-340-708(10). The following adjustments may be made to the default assumptions in the standard Method B equations to derive modified Method B surface water cleanup levels:~~ [135]

(3) Allowable Method B Modifications. The default assumptions in Equations 730-1, 730-2 and 730-3 can only be changed with chemical-specific or site-specific data as provided for in this subsection and WAC 173-340-708(10).

(a) The resultant cleanup levels shall meet applicable state and federal laws.

(b) The resultant cleanup levels must meet the hazard quotient, hazard index and cancer risk limitations in WAC 173-340-705.

~~(i)~~**(c)** Adjustments to the reference dose and cancer ~~potency~~ slope factor may be made if the requirements in WAC 173-340-708 (7) and (8) are met;

~~(ii)~~**(d)** Adjustments to the bioconcentration/bioaccumulation factor may be made if the requirements in WAC 173-340-708(9) are met;

[133] The narrative description has been replaced with a new equation and associated language to parallel other sections in this rule. Ecology will be making a spreadsheet available to facilitate this calculation.

[134] The default values may not be protective of high fish consuming populations and are currently under review. The process for adjusting these default values will reflect the outcome of the sediment rule discussions on this topic.

[135] Replaced with new language in (3) reflecting proposed elimination of "standard" and "modified" Method B terminology.

(e) Changes to exposure assumptions may be made as provided for in WAC 173-340-708(10). [136]

~~(iii)~~**(f)** Where a numeric environmental effects-based water quality standard does not exist, bioassays that use methods other than those specified in chapter 173-205 WAC may be approved by the department to establish concentrations for the protection of fish and other aquatic life; and

~~**(iv)** The toxicity equivalency factor procedures described in WAC 173-340-708(8) may be used for assessing the potential carcinogenic risk of mixtures of chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans and polycyclic aromatic hydrocarbons; and~~ [137]

~~(v)~~**(g)** Modifications incorporating new science as provided for in WAC 173-340-702 (14), (15) and (16).

(4) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background, practical quantitation limit and non-aqueous phase limitations. See WAC 173-340-7304 for procedures for making these adjustments. [138]

~~(d)~~**(5) Using ~~modified~~ Method B to evaluate surface water remediation levels.** In addition to the adjustments allowed under subsection (3)~~(c)~~ of this section, adjustments to the reasonable maximum exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357, and 173-340-708 (3)(d) and (10)(b).

(6) Point of compliance. The point of compliance for Method B surface water cleanup levels is specified in WAC 173-340-7305.

(7) Determining compliance. Compliance monitoring requirements and procedures for determining compliance with Method B surface water cleanup standards are specified in WAC 173-340-7306.

Equation 730-1 (Noncarcinogens) [139]

$$\text{Surface water cleanup level (ug/l)} = \frac{RfD_O \times ABW \times UCF1 \times UCF2 \times HQ \times AT}{BCF \times FCR \times FDF \times ED}$$

Where:

RfD_O	=	Oral Reference Dose as specified in WAC 173-340-708(7) (mg/kg-day)
ABW	=	Average body weight during the exposure duration (70 kg)
UCF1	=	Unit conversion factor (1,000 ug/mg)
UCF2	=	Unit conversion factor (1,000 grams/~~liter~~ kilogram)
BCF	=	Bioconcentration factor as defined in WAC 173-340-708(9) (liters/kilogram). Use of a bioaccumulation factor may be required when sufficient information is available, as provided in WAC 173-340-708(9).
FCR	=	Fish consumption rate (54 grams/day)
FDF	=	Fish diet fraction (0.5) (unitless)
HQ	=	Hazard quotient (1) (unitless)
AT	=	Averaging time (30 years)
ED	=	Exposure duration (30 years)

[136] Moved from (c), above.

[137] No longer needed since the 2007 rule amendments made TEFs the standard procedure for assessing the risk of dioxin, dibenzofuran, and cPAH mixtures.

[138] Subsections (4), (6) and (7) are added as a result of the reorganization of these Sections.

[139] Fish consumption & diet fraction may no longer be protective of high fish consuming populations and is currently under review. The requirement for using a bioaccumulation factor instead of a bioconcentration factor reflects changes in Section 708. The other changes are editorial.

Equation 730-2 (Carcinogens) [140]

$$\text{Surface water cleanup level (ug/l)} = \frac{\text{RISK x ABW x AT x UCF1 x UCF2}}{\text{CSF}_O \text{ x ELAF x BCF x FCR x FDF x ED}}$$

Where:

RISK = Acceptable cancer risk level (1 in 1,000,000) (unitless)

ABW = Average body weight during the exposure duration (70 kg)

AT = Averaging time (~~75~~ 70 years)

UCF1 = Unit conversion factor (1,000 ug/mg)

UCF2 = Unit conversion factor (1,000 grams/~~liter~~ kilogram)

CSF_O = Oral cancer slope factor ~~Carcinogenic Potency Factor~~ as specified in WAC 173-340-708(8) (kg-day/mg)

ELAF = Early life adjustment factor. Use 3 for carcinogens with a mutagenic mode of action. Use 1 for all other carcinogens (see WAC 173-340-708(8)). [141]

BCF = Bioconcentration factor as defined in WAC 173-340-708(9) (liters/kilogram). Use of a bioaccumulation factor may be required when sufficient information is available, as provided in WAC 173-340-708(9).

FCR = Fish consumption rate (54 grams/day)

FDF = Fish diet fraction (0.5) (unitless)

ED = Exposure duration (30 years)

Equation 730-3 (TPH Mixtures) [142]

$$C_w = \frac{HI}{\sum_{i=1}^{n}\left[\frac{F(i)\times BCF(i)}{RfDo(i)}\right]\times\left[\frac{FCR\times FDF\times ED}{ABW\times AT\times UCF1\times UCF2}\right]}$$

Where:

C_w = TPH surface water cleanup level (ug/l)

HI = Hazard index (1) (unitless)

$F_{(i)}$ = Fraction by weight of petroleum component (i) (unitless) (Use site-specific surface water composition data, provided the data is representative of present and future conditions at the site, or use the water composition predicted under WAC 173-340-747(6))

$BCF_{(i)}$ = Bioconcentration factor of petroleum component (i) as defined in WAC 173-340-708(9) (liters/kilogram). Use of a bioaccumulation factor may be required when sufficient information is available, as provided in WAC 173-340-708(9).

FCR = Fish consumption rate (54 grams/day)

FDF = Fish diet fraction (0.5) (unitless)

ED = Exposure duration (30 years)

$RfD_{O(i)}$ = Oral Reference dose of petroleum component (i) as specified in WAC 173-340-708(7) (mg/kg-day)

ABW = Average body weight during the exposure duration (70 kg)

AT = Averaging time (30 years)

UCF1 = Unit conversion factor (1,000 ug/mg)

UCF2 = Unit conversion factor (1,000 grams/kilogram)

n = The number of petroleum components present in the petroleum mixture.

i = Petroleum components consisting of aromatic and aliphatic fractions, and other compounds present in the petroleum mixture with an oral reference dose, measured using the methods specified WAC 173-340-830. See Table 830-1 for required tests for various petroleum products.

[140] Changed AT from 75 to 70 years to be consistent with EPA risk assessment guidance. The default fish consumption & diet fraction in equations 730-1, 730-2 and 730-3 may no longer be protective of tribes and other high fish consuming populations and is currently under review. The requirement for using a bioaccumulation factor instead of a bioconcentration factor reflects changes in Section 708.

[141] The basis for early life exposure adjustments is discussed in the March 22, 2009 MTCA/SMS Advisory Group materials. http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html The proposed adjustment factor is based on distillation of information in "Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens" EPA, 2005 and is still under evaluation.

[142] This is a ***new equation*** for calculating site-specific TPH surface water cleanup levels, derived from Equation 730-1, taking into account the additive noncancer effects of the various petroleum components. NOTE: A spreadsheet will be made available from the department to facilitate this calculation. *[Note to be added to rule]*

NEW SECTION

WAC 173-340-7303 Method C surface water cleanup levels.

[Formerly WAC 173-340-730(4)]

(1) Applicability. Method C cleanup levels may be approved by the department if the person undertaking the cleanup action can demonstrate that such levels are consistent with applicable state and federal laws, that all practicable methods of treatment have been used, that institutional controls are implemented in accordance with WAC 173-340-440, and that one or more of the conditions in WAC 173-340-706(1) exist.

(2) Concentration. The procedures specified in WAC 173-340-7302(2),(3) and (4) shall be used to establish Method C surface water cleanup levels, except equations 730-4, 730-5 and 730-6 shall be used instead of equations 730-1, 730-2 and 730-3. [143]

(3) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background, practical quantitation limit and non-aqueous phase limitations. See WAC 173-340-7304 for procedures for making these adjustments. [144]

(4) Using Method C to evaluate surface water remediation levels. In addition to the adjustments allowed under WAC 173-340-7302(3), adjustments to the reasonable maximum exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357, and 173-340-708 (3)(d) and (10)(b).

(5) Point of compliance. The point of compliance for Method C surface water cleanup levels is specified in WAC 173-340-7305.

(6) Determining compliance. Compliance monitoring requirements and procedures for determining compliance with Method C surface water cleanup standards are specified in WAC 173-340-7306.

[143] Instead of stating the changes to the default values in narrative form as is done in the current rule, the complete equations have been added at the end of this Section.

[144] Subsections (3), (5) and (6) are added as a result of the reorganization of these Sections.

Equation 730-4 (Noncarcinogens) [145]

$$\text{Surface water cleanup level (ug/l)} = \frac{RfD_O \times ABW \times UCF1 \times UCF2 \times HQ \times AT}{BCF \times FCR \times FDF \times ED}$$

Where:

- RfD_O = Oral Reference Dose as specified in WAC 173-340-708(7) (mg/kg-day)
- ABW = Average body weight during the exposure duration (70 kg)
- UCF1 = Unit conversion factor (1,000 ug/mg)
- UCF2 = Unit conversion factor (1,000 grams/ kilogram)
- BCF = Bioconcentration factor as defined in WAC 173-340-708(9) (liters/kilogram) Use of a bioaccumulation factor may be required when sufficient information is available, as provided in WAC 173-340-708(9).
- FCR = Fish consumption rate (54 grams/day)
- FDF = Fish diet fraction (0.2) (unitless)
- HQ = Hazard quotient (1) (unitless)
- AT = Averaging time (30 years)
- ED = Exposure duration (30 years)

Equation 730-5 (Carcinogens) [146]

$$\text{Surface water cleanup level (ug/l)} = \frac{RISK \times ABW \times AT \times UCF1 \times UCF2}{CSF_O \times ELAF \times BCF \times FCR \times FDF \times ED}$$

Where:

- RISK = Acceptable cancer risk level (1 in 100,000) (unitless)
- ABW = Average body weight during the exposure duration (70 kg)
- AT = Averaging time (70 years)
- UCF1 = Unit conversion factor (1,000 ug/mg)
- UCF2 = Unit conversion factor (1,000 grams/ kilogram)
- CSF_O = Oral cancer slope factor as specified in WAC 173-340-708(8) (kg-day/mg)
- ELAF = Early life adjustment factor. Use 3 for carcinogens with a mutagenic mode of action. Use 1 for all other carcinogens (see WAC 173-340-708(8)). [147]
- BCF = Bioconcentration factor as defined in WAC 173-340-708(9) (liters/kilogram). Use of a bioaccumulation factor may be required when sufficient information is available, as provided in WAC 173-340-708(9).
- FCR = Fish consumption rate (54 grams/day)
- FDF = Fish diet fraction (0.2) (unitless)
- ED = Exposure duration (30 years)

[145] ***New equation.*** The only difference from Equation 730-1 is the fish diet fraction has been reduced from 0.5 to 0.2. This is consistent with the current MTCA rule. The default fish consumption & diet fraction in equations 730-4, 730-5 and 730-6 may no longer be protective of tribes and other high fish consuming populations and is currently under review.

[146] ***New equation.*** The only differences from Equation 730-2 are the acceptable level of risk has been increased from $1X10^{-6}$ to $1X10^{-5}$ and the fish diet fraction has been reduced from 0.5 to 0.2. Both of these changes are consistent with the current MTCA rule.

[147] The basis for early life exposure adjustments is discussed in the March 22, 2009 MTCA/SMS Advisory Group materials. http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html The proposed adjustment factor is based on distillation of information in "Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens" EPA, 2005 and is still under evaluation.

Equation 730-6 (TPH Mixtures) [148]

$$C_w = \frac{HI}{\sum_{i=1}^{n}\left[\frac{F(i)\times BCF(i)}{RfDo(i)}\right]\times\left[\frac{FCR\times FDF\times ED}{ABW\times AT\times UCF1\times UCF2}\right]}$$

Where:

C_w =	TPH surface water cleanup level (ug/l)
HI =	Hazard index (1) (unitless)
$F_{(i)}$ =	Fraction by weight of petroleum component (i) (unitless) (Use site-specific surface water composition data, provided the data is representative of present and future conditions at the site, or use the water composition predicted under WAC 173-340-747(6))
$BCF_{(i)}$ =	Bioconcentration factor of petroleum component (i) as defined in WAC 173-340-708(9) (liters/kilogram). Use of a bioaccumulation factor may be required when sufficient information is available, as provided in WAC 173-340-708(9).
FCR =	Fish consumption rate (54 grams/day)
FDF =	Fish diet fraction (0.2) (unitless)
ED =	Exposure duration (30 years)
$RfD_{O(i)}$ =	Oral Reference dose of petroleum component (i) as specified in WAC 173-340-708(7) (mg/kg-day)
ABW =	Average body weight during the exposure duration (70 kg)
AT =	Averaging time (30 years)
UCF1 =	Unit conversion factor (1,000 ug/mg)
UCF2 =	Unit conversion factor (1,000 grams/kilogram)
n =	The number of petroleum components present in the petroleum mixture.
i =	Petroleum components consisting of aromatic and aliphatic fractions, and other compounds present in the petroleum mixture with an oral reference dose, measured using the methods specified WAC 173-340-830. See Table 830-1 for required tests for various petroleum products.

[148] ***New equation***. The only difference from Equation 730-3 is the fish diet fraction has been reduced from 0.5 to 0.2. This is consistent with the current MTCA rule.

NEW SECTION

WAC 173-340-7304 Adjustments to surface water cleanup levels.

[Formerly WAC 173-340-730(5)]

(1) Total site risk adjustments.

(2) Adjustments to applicable state and federal laws.

(3) Natural background and analytical considerations.

(4) Nonaqueous phase liquid limitation.

~~(a)~~(1) Total site risk adjustments. Surface water cleanup levels for individual hazardous substances developed ~~in accordance with subsections (3) and (4) of this section~~ under WAC 173-340-7302 and 7303, including those based on applicable state and federal laws, shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure. These adjustments need to be made only if, without these adjustments, the hazard index would exceed one (1) and the total estimated individual lifetime excess cancer risk would exceed one in one hundred thousand (1×10^{-5}). These adjustments shall be made in accordance with the procedures specified in WAC 173-340-708 (5) and (6). In making these adjustments, the hazard index shall not exceed one (1) and the total estimated individual lifetime excess cancer risk shall not exceed one in one hundred thousand (1×10^{-5}).

~~(b)~~(2) Adjustments to applicable state and federal laws. Where a cleanup level developed under ~~subsection (2), (3) or (4) of this section~~ WAC 173-340-7302 or 7303 is based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an estimated individual lifetime excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of one (1), the cleanup level shall be adjusted downward so that the total estimated individual lifetime excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}) and the hazard index does not exceed one (1) at the site. This adjustment may be made using the equations in WAC 173-340-7302 or 7303, as appropriate for the site.[149]

~~(c)~~(3) Natural background and ~~PQL~~ analytical considerations. Cleanup levels determined under ~~subsections (2), (3) and (4) of this section~~ WAC 173-340-7302 and 7303, including cleanup levels adjusted under subsections (1) and (2) of this section ~~(5)(a) and (b) of this subsection~~, shall not be set at levels below the practical quantitation limit or natural background concentration, whichever is higher. See WAC 173-340-707 and 173-340-709 for additional requirements pertaining to practical quantitation limits and natural background concentrations.

~~(d)~~(4) Nonaqueous phase liquid limitation. For organic hazardous substances and petroleum hydrocarbons, the cleanup level determined under WAC 173-340-7302 and 7303 shall not exceed a concentration that would result in nonaqueous phase liquid being present in or on the surface water. Physical observations of surface water at or above the cleanup level, such as the lack of a film, sheen, discoloration, sludge or emulsion in the surface water or adjoining shoreline, may be used to determine compliance with this requirement.

[149] Reflects current practice.

NEW SECTION

WAC 173-340-7305 Surface water point of compliance.

[Formerly WAC 173-340-730(6)]

(1) Location.

(2) Mixing zones prohibited.

~~(a)~~(1) Location. The point of compliance for the surface water cleanup levels shall be the point or points at which hazardous substances are released to surface waters of the state unless the department has authorized a mixing zone in accordance with chapter 173-201A WAC.

~~(b)~~(2) Mixing zones prohibited. Where hazardous substances are released to the surface water as a result of ground water flows, no mixing zone shall be allowed to demonstrate compliance with surface water cleanup levels. See WAC 173-340-~~720(8)(d)~~ 7206(3)(a) and 7207(8) for additional requirements for sites where contaminated ground water is flowing into surface water.

~~(c)~~ As used in this subsection, "mixing zone" means that portion of a surface water body adjacent to an effluent outfall where mixing results in dilution of the effluent with the receiving water. See chapter 173-201A WAC for additional information on mixing zones.

NEW SECTION

WAC 173-340-7306 Demonstrating compliance with surface water cleanup standards.

[Formerly WAC 173-340-730(7)]

(1) Sampling required.
(2) Compliance monitoring plan.
(3) Filtering.
(4) Evaluating compliance.
(5) Interpreting non-detect values.

~~(a)~~(1) Sampling required. When surface water cleanup ~~levels~~ standards have been established at a site, sampling of the surface water shall be conducted to determine if compliance with the surface water cleanup ~~levels~~ standards has been achieved. Sampling and analytical procedures shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. The sample design shall provide data that are representative of the site. [150]

~~(b)~~(2) Compliance monitoring plan. The data analysis and evaluation procedures used to evaluate compliance with surface water cleanup ~~levels~~ standards shall be defined in a compliance monitoring plan prepared under WAC 173-340-410.

~~(c)~~(3) Filtering. Compliance with surface water cleanup standards shall be determined by analyses of unfiltered surface water samples, unless it can be demonstrated that a filtered sample provides a more representative measure of surface water quality.

(4) Evaluating compliance. The following procedures shall apply when evaluating compliance with surface water cleanup standards:

~~(d)~~(i) When surface water cleanup levels are based on ~~requirements specified in~~ applicable state and federal laws, the procedures for evaluating compliance ~~that~~

[150] "Levels" replaced with "standards" to reflect that compliance monitoring takes into account point of compliance, not just concentration.

~~are~~ specified in those ~~requirements~~ laws shall be used to evaluate compliance with surface water cleanup standards ~~levels~~ unless those procedures conflict with the intent of this section.

~~(c)~~**(ii)** Where procedures for evaluating compliance are not specified in an applicable state and federal law, compliance with surface water cleanup levels shall be evaluated using procedures approved by the department. Where statistical methods are used to evaluate compliance, the statistical methods shall be appropriate for the distribution of the hazardous substance sampling data. If the distribution of the hazardous substance sampling data is inappropriate for statistical methods based on a normal distribution, then the data may be transformed. If the distributions of individual hazardous substances differ, more than one statistical method may be required.

~~(f)~~**(iii)** Sampling and analysis of fish tissue, shellfish, or other aquatic organisms and sediments may be required to supplement water column sampling during compliance monitoring.

(5) Interpreting non-detect values. [151] The following procedures shall be used for measurements below the practical quantitation limit. These methods shall be used unless a surface water cleanup level is based on an applicable state or federal law that includes methods for handling non-detected measurements.

(a) Measurements below the method detection limit shall be assigned a value equal to one-half the method detection limit.

(b) Measurements above the method detection limit but below the practical quantitation limit shall be assigned a value equal to one-half the practical quantitation limit.

(c) Measurements below the method detection limit and/or practical quantitation limit may also be evaluated using the Kaplan-Meier method. [152]

(d) If a hazardous substance or petroleum fraction has never been detected in any sample at a site and these substances are not suspected of being present at the site based on site history and other knowledge, that hazardous substance or petroleum fraction may be excluded from the compliance analysis.

(e) The department may approve alternate procedures for handling values below method detection limits or practical quantitation limits.

[151] Added to parallel language in other Sections of the MTCA rule.

[152] See USEPA's ProUCL statistical software. http://www.epa.gov/esd/tsc/software.htm and Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance; EPA 530-R-09-007, March, 2009. http://www.epa.gov/osw/hazard/correctiveaction/resources/guidance/sitechar/gwstats/unified-guid.pdf *[Footnote to be added to rule.]*

WAC 173-340-7400 General considerations for establishing soil cleanup standards.

(1) Basis for soil cleanup levels.
(2) When cleanup is required.
(3) Cleanup standards for other exposure pathways.
(4) Protection of other environmental media.
(5) Industrial property defined.

WAC 173-340-7401 Method A soil cleanup standards for unrestricted land use.

(1) Applicability.
(2) Concentration.
(3) Adjustments.
(4) Point of compliance.
(5) Determining compliance.

WAC 173-340-7402 Method B soil cleanup standards for unrestricted land use.

(1) Applicability.
(2) Concentration.
  (a) Applicable state and federal laws.
  (b) Environmental protection.
  (c) Groundwater protection.
  (d) Vapor intrusion.
  (e) Direct contact.
(3) Allowable Method B modifications.
(4) Adjustments.
(5) Using Method B to evaluate soil remediation levels.
(6) Point of compliance.
(7) Determining compliance.

WAC 173-340-7403 Method A industrial soil cleanup standards.

(1) Applicability.
(2) Concentration.
(3) Adjustments.
(4) Point of compliance.
(5) Determining compliance.

WAC 173-340-7404 Method C industrial soil cleanup standards.

(1) Applicability.
(2) Concentration.
(3) Adjustments.
(4) Using Method C to evaluate soil remediation levels.
(5) Point of compliance.
(6) Determining compliance.

WAC 173-340-7405 Adjustments to soil cleanup levels.

(1) Total site risk adjustments.
(2) Adjustments to applicable state and federal laws.
(3) Natural background and analytical considerations.

WAC 173-340-7406 Point of compliance.

(1) Definition.
(2) Groundwater Protection.
(3) Vapor Protection.
(4) Direct Contact.
(5) Terrestrial Ecological Evaluations.
(6) Point of compliance for containment remedies.

WAC 173-340-7407 Demonstrating Compliance with soil cleanup standards.

(1) Particle size.
(2) Sampling required.
(3) General data analysis and evaluation procedures.
(4) Data evaluation methods.
(5) Method limitations.
(6) Interpreting non-detect values.

Table 740-1

Table 745-1

Table 1: Comparison of Current Method B Soil Ingestion values vs. Proposed Soil Ingestion + Dermal Contact values

Table 2: Table 1 Comparison of Current Method C Soil Ingestion values vs. Proposed Soil Ingestion + Dermal Contact values

NEW SECTION

WAC 173-340-7400 General considerations for establishing soil cleanup standards. [153]

(1) Basis for soil cleanup levels.

(2) When cleanup is required.

(3) Cleanup standards for other exposure pathways.

(4) Protection of other environmental media.

(5) Industrial property defined.

(1) ~~General considerations~~ Basis for soil cleanup levels.

~~**(a) Presumed exposure scenario.**~~ Soil cleanup levels shall be based on estimates of the reasonable maximum exposure expected to occur under both current and future site use conditions. The department has determined that residential land use is generally the site use requiring the most protective cleanup levels ~~and that~~. Thus, exposure to hazardous substances under residential land use conditions ~~represents~~ is the presumed reasonable maximum exposure scenario. Cleanup levels based on this presumed exposure scenario are called unrestricted land use soil cleanup levels.

Unless a site qualifies for use of an industrial soil cleanup level under WAC 173-340-7400(5), this presumed exposure scenario and the procedures in WAC 173-340-7401 or 7402 shall be used to establish soil cleanup levels at a site ~~and be established in accordance with this section~~.

~~**(b)**~~**(2) When cleanup is required.** In the event of a release of a hazardous substance to the soil at a site, a cleanup action complying with this chapter shall be conducted to address all areas where the concentration of hazardous substances in the soil exceeds cleanup levels at the relevant point of compliance.

~~**(c)**~~**(3) Cleanup levels for other exposure scenarios.** The department may require more stringent soil cleanup ~~standards~~ levels than required by ~~this section~~ WAC 173-340-7401 through 7405 where, based on a site-specific evaluation, the department determines that this is necessary to protect human health and the environment. Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708. The following are examples of situations that may require more stringent cleanup levels.

~~**(i)**~~**(a)** Concentrations that eliminate or substantially reduce the potential for food chain contamination;

~~**(ii)**~~**(b)** Concentrations that eliminate or substantially reduce the potential for damage to soils or biota in the soils which could impair the use of soils for agricultural or silvicultural purposes;

~~**(iii)**~~**(c)** Concentrations ~~necessary to~~ that address the potential health risk posed by dust at a site; and

~~**(iv) Concentrations necessary to protect the ground water at a particular site;**~~ [154]

~~**(v)**~~**(d)** Concentrations ~~necessary to~~ that protect nearby surface waters from hazardous substances in runoff from the site~~; and~~

~~**(vi) Concentrations that eliminate or minimize the potential for the accumulation of vapors in buildings or other structures**~~. [155]

~~**(d)**~~**(4) Protection of other environmental media.** ~~Relationship between soil cleanup levels and other cleanup standards.~~ Soil cleanup levels shall be established at concentrations that do not directly or indirectly cause violations of groundwater, surface water, sediment, or air cleanup standards established under this chapter or applicable state and federal laws. ~~A property that qualifies for a Method C soil cleanup level under subsection (5) of this section does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium.~~ [156]

(5) Industrial property defined. ~~This section shall be used to establish soil cleanup levels where the department has determined that~~ The criteria in this subsection shall be used by

[153] Former Sections 740 and 745 have been combined and reorganized into smaller multiple Sections to facilitate readability and use. Because of this, the Code Reviser will likely publish these as new Sections without the changes highlighted. To facilitate review, changes from existing language are highlighted.

[154] Duplicative requirement addressed later in this Section.

[155] Duplicative requirement addressed later in this Section.

[156] Moved to (5).

the department to determine where industrial land use represents the reasonable maximum exposure. [157]

A property that qualifies for a Method C soil cleanup level under this subsection does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium. [158]

(a) Industrial site cleanup level options. Soil cleanup levels for industrial land use may be established under WAC 173-340-7403 or 7404. The person conducting the cleanup action also has the option of using unrestricted land use soil cleanup levels developed under WAC 173-340-7401 or 7402. This latter option may be used to avoid restricting the future use of the property to industrial uses. [159]

Soil cleanup levels for areas of the site beyond the industrial property boundary that do not qualify for industrial soil cleanup levels shall be established under WAC 173-340-7401 or 7402 ~~under this section (including implementation of institutional controls and a covenant restricting use of the property to industrial property uses) shall be established in accordance with subsection (1) of this section~~. [160]

(b) Criteria. To qualify as an industrial land use and to use an industrial soil cleanup level a site must meet the following criteria: [161]

(i) The area of the site where industrial property soil cleanup levels are proposed must meet the definition of an industrial property under WAC 173-340-200;

Industrial soil cleanup levels are based on an adult worker exposure scenario. It is essential to evaluate land uses and zoning for compliance with this definition in the context of this exposure scenario. Local governments use a variety of zoning categories for industrial land uses so a property does not necessarily have to be in a zone called "industrial" to meet the definition of "industrial property." Also, there are land uses allowed in industrial zones that are actually commercial or residential, rather than industrial, land uses. Thus, an evaluation to determine compliance with this definition should include a review of the actual text in the comprehensive plan and zoning ordinance pertaining to the site and a visit to the site to observe land uses in the zone. When evaluating land uses to determine if a property use not specifically listed in the definition is a "traditional industrial use" or to determine if the property is "zoned for industrial use," the following characteristics shall be considered:

(A) People do not normally live on industrial property. The primary potential exposure is to adult employees of businesses located on the industrial property;

(B) Access to industrial property by the general public is generally not allowed. If access is allowed, it is highly limited and controlled due to safety or security considerations;

(C) Food is not normally grown or ~~/~~raised on industrial property. (However, food processing operations are commonly considered industrial facilities);

(D) Operations at industrial properties are often (but not always) characterized by use and storage of chemicals, noise, odors and truck traffic;

(E) The surface of the land at industrial properties is often (but not always) mostly covered by buildings or other structures, paved parking lots, paved access roads and material storage areas--minimizing potential exposure to the soil; and

(F) Industrial properties may have support facilities consisting of offices, restaurants, and other facilities that are commercial in nature but are primarily devoted to administrative functions necessary for the industrial use and/or are primarily intended to serve the industrial facility employees and not the general public.

(ii) The cleanup action provides for appropriate institutional controls implemented in accordance with WAC 173-340-440 to limit potential exposure to residual hazardous substances. This shall include, at a minimum, placement of an environmental covenant complying with WAC 173-340-440 on the property restricting use of the area of the site where industrial soil cleanup levels are proposed to industrial property uses; and

[157] Criteria moved here from former Section 745(1)(a).
[158] Moved from (4).
[159] Moved from former 745(4) with substantial editing.
[160] Moved from former 745(2)(b).
[161] Criteria moved from former Section 745(1)(a).

(iii) Hazardous substances remaining at the property after remedial action would not pose a threat to human health or the environment at the ~~site~~ property or in adjacent nonindustrial areas. In evaluating compliance with this criterion, at a minimum the following factors shall be considered: [162]

(A) The potential for access to the industrial property by the general public, especially children. The proximity of the industrial property to residential areas, schools or childcare facilities shall be considered when evaluating access. In addition, the presence of natural features, man-made structures, arterial streets or intervening land uses that would limit or encourage access to the industrial property shall be considered. Fencing shall not be considered sufficient to limit access to an industrial property since this is insufficient to assure long term protection;

(B) The degree of reduction of potential exposure to residual hazardous substances by the selected remedy. Where the residual hazardous substances are to be capped to reduce exposure, consideration shall be given to the thickness of the cap and the likelihood of future site maintenance activities, utility and drainage work, or building construction reexposing residual hazardous substances;

(C) The potential for transport of residual hazardous substances to off-property areas, especially residential areas, schools and childcare facilities;

(D) The potential for significant adverse effects on wildlife caused by residual hazardous substances using the procedures in WAC 173-340-7490 through 173-340-7494; and

(E) The likelihood that these factors would not change for the foreseeable future.

~~(b)~~**(c) Expectations.** In applying the criteria in (a) of this subsection, the department expects the following results:

(i) The department expects that properties zoned for heavy industrial or high intensity industrial use and located within a city or county that has completed a comprehensive plan and adopted implementing zoning regulations under the Growth Management Act (chapter 36.70A RCW) will meet the definition of industrial property. For cities and counties not planning under the Growth Management Act, the department expects that spot zoned industrial properties will not meet the definition of industrial property but that properties that are part of a larger area zoned for heavy industrial or high intensity industrial use will meet the definition of an industrial property;

(ii) For both GMA and non-GMA cities and counties, the department expects that light industrial and commercial zones and uses should meet the definition of industrial property where the land uses are comparable to those cited in the definition of industrial property or the land uses are an integral part of a qualifying industrial use (such as, ancillary or support facilities). This will require a site-by-site evaluation of the zoning text and land uses;

(iii) The department expects that for portions of industrial properties in close proximity to (generally, within a few hundred feet) residential areas, schools or childcare facilities, residential soil cleanup levels will be used unless:

(A) Access to the industrial property is very unlikely or, the hazardous substances that are not treated or removed are contained under a cap of clean soil (or other materials) of substantial thickness so that it is very unlikely the hazardous substances would be disturbed by future site maintenance and construction activities (depths of even shallow footings, utilities and drainage structures in industrial areas are typically three to six feet); and

(B) The hazardous substances are relatively immobile (or have other characteristics) or have been otherwise contained so that subsurface lateral migration or surficial transport via dust or runoff to these nearby areas or facilities is highly unlikely; and

(iv) Note that a change in the reasonable maximum exposure to industrial site use primarily affects the direct contact exposure pathway. Thus, for example, for sites where the soil cleanup level is based primarily on the potential for the hazardous substance to leach and cause groundwater contamination, it is the department's expectation that an industrial land use will not affect the soil cleanup level. Similarly, where the soil cleanup level is based

[162] Changed to match statute wording (70.105D.030(2)(f)).

primarily on surface water protection or other pathways other than direct human contact, land use is not expected to affect the soil cleanup level.

NEW SECTION

WAC 173-340-7401 Method A soil cleanup standards for unrestricted land use.

[Formerly WAC 173-340-740(2)] [163]

(1) Applicability.
(2) Concentration.
(3) Adjustments.
(4) Point of compliance.
(5) Determining compliance.

(1) Applicability. Method A soil cleanup standards for unrestricted land uses may be used only at sites with few hazardous substances and where all of the following conditions are met: [164]

(a) Except as provided in subsection (2)(e) of this section, numeric standards are available in Table 740-1 or applicable state and federal laws for all indicator hazardous substances at the site;

(b) The site qualifies for either:

(i) An exclusion from conducting a terrestrial ecological evaluation under WAC 173-340-7491; or

(ii) A simplified terrestrial ecological evaluation under WAC 173-340-7492 and uses the procedures in WAC 173-340-7493 to set cleanup levels protective of soil biota, plants and animals; and,

(c) Hazardous substances have not reached surface water and are unlikely to reach surface water during the estimated restoration timeframe.

(2) Concentration. Method A soil cleanup levels shall be at least as stringent as all of the following:

(a) Concentrations in Table 740-1 and compliance with the corresponding footnotes;

(b) Concentrations established under applicable state and federal laws;

(c) Concentrations that result in no significant adverse effects on the protection and propagation of soil biota, plants and animals using the procedures specified in WAC 173-340-7490 through 173-340-7493, unless it is demonstrated under those sections that establishing a soil concentration is unnecessary; and

(d) Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7505. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion; [165]

(e) For a hazardous substance that is deemed an indicator hazardous substance under WAC 173-340-708(2) and for which there is no value in Table 740-1 or applicable state and federal laws, a concentration that does not exceed the natural background concentration or the practical quantification limit, subject to the limitations in this chapter.

(3) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background, practical quantitation limit and non-aqueous phase limitations. See WAC 173-340-7405 for procedures for making these adjustments. [166]

(4) Point of compliance. The point of compliance for Method A soil cleanup levels is specified in WAC 173-340-7406.

(5) Determining compliance. The compliance monitoring requirements and procedures for determining compliance with Method A soil cleanup standards are specified in WAC 173-340-7407.

[163] Changed to make a stand-alone section. Strikeouts not shown. No substantive changes intended except as noted.

[164] Reflects criteria in Section 704. The restriction limiting use of Method A to "routine sites" has been eliminated.

[165] Based on EPA research indicating very low concentrations of many chemicals have the potential to pose a vapor hazard in overlying structures.

[166] Subsections (3), (4) and (5) are added as a result of the reorganization of these Sections.

NEW SECTION

WAC 173-340-7402 Method B soil cleanup standards for unrestricted land use.

[Formerly WAC 173-340-740(3)] [167]

(1) Applicability.
(2) Concentration.
(3) Allowable Method B modifications.
(4) Adjustments.
(5) Using Method B to evaluate soil remediation levels.
(6) Point of compliance.
(7) Determining compliance.

(1) Applicability. Method B soil cleanup standards may be used at any site.

(2) Concentration. Method B cleanup levels for soils shall be at least as stringent as all of the following:

(a) Applicable state and federal laws. Concentrations established under applicable state and federal laws.

(b) Terrestrial ecological protection. Concentrations that result in no significant adverse effects on the protection and propagation of soil biota, plants and animals established using the procedures specified in WAC 173-340-7490 through 173-340-7494 unless it is demonstrated under those sections that establishing a soil concentration is unnecessary.

(c) Groundwater protection. Concentrations that will not cause groundwater concentrations to exceed groundwater cleanup levels established under WAC 173-340-7200 through 7205 as determined using the methods described in WAC 173-340-747.

(d) Vapor intrusion. Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7505. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion. [168]

(e) Direct contact. [169] For hazardous substances for which sufficiently protective, health-based concentrations have not been established under applicable state and federal laws to protect human health during direct contact with soil, concentrations determined using the following methods:

(i) Noncarcinogens. For noncarcinogenic effects of hazardous substances concentrations that result in no toxic effects on human health as determined using Equation 740-1.

(ii) Carcinogens. For carcinogenic effects of hazardous substances, concentrations for which the upper bound on the estimated individual lifetime excess cancer risk is less than or equal to one in one million (1×10^{-6}) as determined using Equation 740-2.

(iii) Petroleum mixtures. For petroleum mixtures, total petroleum hydrocarbon concentrations that result in no toxic effects on human health as determined using Equation 740-3. The total petroleum hydrocarbon concentration calculated using this equation must be adjusted downward if individual substances present in the mixture (for example benzene) exceed acceptable cancer risk levels or applicable state and federal laws at the calculated TPH concentration. A spreadsheet is available from the department to facilitate these calculations. See Table 830-1 for the analyses required for various petroleum products to use this method.

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[167] Significant reorganization and editorial changes including elimination of the "standard" and "modified" terminology. No substantive changes intended except as noted.

[168] Previous language requiring evaluation of the vapor exposure pathway at only some sites has been replaced with this provision. This is based on EPA research indicating very low concentrations of volatile chemicals have the potential to pose a vapor hazard in overlying structures.

[169] Equations 740-1 & 2 and associated text have been replaced with former equations 740-4 & 740-5 which are renumbered and moved to the end of this section, along with Equation 740-3. Dermal related provisions have been deleted and are subsumed in the new equations. Vapor-related provisions are also deleted and replaced with a reference to new vapor chapters. This is a change from the current rule which does not routinely include evaluation of the dermal exposure pathway except for TPH. See Table 1 for implications of this change.

(iv) Lead. For soil lead cleanup levels, either use the Method A value in Table 740-1 or the United States Environmental Protection Agency's Integrated Exposure Uptake Biokinetic Model (IEUBK Model) to develop site-specific cleanup levels. When using the IEUBK Model, the soil cleanup level shall be based on preventing a site-related increase in blood lead concentration due to soil exposure of 5 micrograms per deciliter or less in 99% of the potentially exposed population. When conducting this calculation, a residential exposure scenario shall be used. [170]

(3) Allowable Method B modifications. The default assumptions in Equations 740-1, 740-2 and 740-3 can be changed only with chemical-specific or site specific data as provided for in this subsection and WAC 173-340-708(10). [171]

(a) The resultant cleanup levels shall meet applicable state and federal laws.

(b) The hazard quotient and hazard index cannot exceed one (1) and the estimated individual lifetime excess cancer risk for individual hazardous substances cannot exceed one in one million (1×10^{-6}).

(c) For soil ingestion, the gastrointestinal absorption fraction, adherence factor, dermal absorption fraction and gastrointestinal RfD conversion factor may be modified if the requirements of WAC 173-340-702 (14), (15), (16), and 173-340-708(10) are met.

(d) The toxicity equivalent factors provided in Tables 708-1 through 708-4 may be modified provided the requirements of WAC 173-340-708(8)(g) and (h) are met.

(e) The reference dose and cancer slope factor may be modified if the requirements in WAC 173-340-708 (7) and (8) are met.

(f) Modifications incorporating new science as provided for in WAC 173-340-702 (14), (15) and (16).

(4) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background and practical quantitation limits. See WAC 173-340-7405 for procedures for making these adjustments. [172]

(5) Using Method B to evaluate soil remediation levels. In addition to the adjustments allowed under subsection (3) of this section, adjustments to the reasonable maximum exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357, and 173-340-708 (3)(d) and (10)(b) for requirements when conducting these evaluations.

(6) Point of compliance. The point of compliance for Method B soil cleanup levels is specified in WAC 173-340-7406.

(7) Determining compliance. The compliance monitoring requirements and procedures for determining compliance with Method B soil cleanup standards are specified in WAC 173-340-7407.

[170] ***New provision.*** Method A is expected to be protective of direct contact for nearly all situations and has been added as an option to facilitate cleanups. EPA's IEUBK Model has been added to provide an option for calculating site specific soil lead cleanup levels since neither a reference dose nor cancer slope factor is available for lead. For more information go to: http://www.epa.gov/superfund/health/contaminants/lead/index.htm

[171] Replaces "modified" Method B language in current regulation.

[172] Subsections (4), (6) and (7) are added as a result of the reorganization of these Sections.

Equation 740-1 (Noncarcinogens) [173]

$$C_{soil} = \frac{HQ \times ABW \times AT}{EF \times ED\left[\left(\frac{1}{RfDo} \times \frac{SIR \times ABS_{GI}}{10^6\, mg/kg}\right) + \left(\frac{1}{RfDd} \times \frac{SA \times AF \times ABS_d}{10^6\, mg/kg}\right)\right]}$$

Where:

C_{soil} = Soil cleanup level (mg/kg)

HQ = Hazard quotient (unitless)

ABW = Average body weight over the exposure duration (16 kg)

AT = Averaging time (6 years)

EF = Exposure frequency (1.0) (unitless)

ED = Exposure duration (6 years)

SIR = Soil ingestion rate (200 mg/day)

~~AB1~~ ABS_{GI} = Gastrointestinal absorption fraction (1.0) (unitless)

SA = Dermal surface area (2,200 cm^2)

AF = Adherence factor (0.2 mg/cm^2 – day)

ABS_d = Dermal absorption fraction (unitless). May use chemical-specific values or the following defaults:

- 0.01 for inorganic hazardous substances
- 0.0005 for volatile organic compounds with vapor pressure > = benzene
- 0.03 for volatile organic compounds with vapor pressure < benzene
- 0.1 for other organic hazardous substances

RfD_o = Oral reference dose as defined in WAC 173-340-708(7) (mg/kg-day)

RfD_d = Dermal reference dose (mg/kg-day) derived by RfD_o x GI

GI = Gastrointestinal absorption conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.2 for inorganic hazardous substances
- 0.8 for volatile organic compounds
- 0.5 for other organic hazardous substances

[173] Former Equation 740-4 with changes noted.

Equation 740-2 (Carcinogens) [174]

$$C_{soil} = \frac{RISK \times ABW \times AT}{EF \times ED\left[\left(\frac{SIR \times ABS_{GI} \times CSFoa}{10^6\, mg/kg}\right) + \left(\frac{SA \times AF \times ABS_d \times CSF_d}{10^6\, mg/kg}\right)\right]}$$

Where:

C_{soil} = Soil cleanup level (mg/kg)

RISK = Acceptable cancer risk (1 in 1,000,000) (unitless)

ABW = Average body weight over the exposure duration (16 kg)

AT = Averaging time (~~75~~70 years)

EF = Exposure frequency (1.0) (unitless)

ED = Exposure duration (6 years)

SIR = Soil ingestion rate (200 mg/day)

ABS_{GI} = Gastrointestinal absorption fraction (1.0) (unitless). May use 0.6 for mixtures of dioxins and/or furans

CSF_o = Oral cancer slope factor as defined in WAC 173-340-708(8) (kg-day/mg)

CSF_{oa} = Oral cancer slope factor adjusted for early life exposure, derived by CSFo x ELAF

ELAF = Early life adjustment factor. Use 5 for carcinogens with a mutagenic mode of action. Use 1 for all other carcinogens (see WAC 173-340-708(8)). [175]

CSF_d = Dermal cancer slope factor (kg-day/mg) derived by CPF_{oa} / GI

GI = Gastrointestinal absorption conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.2 for inorganic hazardous substances
- 0.8 for volatile organic compounds and for mixtures of dioxins and/or furans
- 0.5 for other organic hazardous substances

SA = Dermal surface area (2,200 cm^2)

AF = Adherence factor (0.2 mg/cm^2 – day)

[174] Former Equation 740-5 with changes noted. AT changed to be consistent with EPA risk assessment guidance.

[175] The basis for early life exposure adjustments is discussed in the March 22, 2009 MTCA/SMS Advisory Group materials. http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html The proposed adjustment factor is based on distillation of information in "Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens" EPA, 2005 and is still under evaluation.

ABS_d = Dermal absorption fraction (unitless). May use chemical-specific values or the following defaults:

- 0.01 for inorganic hazardous substances
- 0.0005 for volatile organic compounds with vapor pressure > = benzene
- 0.03 for volatile organic compounds with vapor pressure < benzene and for mixtures of dioxins and/or furans
- 0.1 for other organic hazardous substances

Equation 740-3 (TPH Mixtures) [176]

$$C_{soil} = \frac{HI \times ABW \times AT}{EF \times ED\left[\left(\frac{SIR \times ABS_{GI}}{10^6\ mg/kg}\sum_{i=1}^{n}\frac{F(i)}{RfD_o(i)}\right)+\left(\frac{SA \times AF}{10^6\ mg/kg}\sum_{i=1}^{n}\frac{F(i)\times ABS_d(i)}{RfD_d(i)}\right)\right]}$$

Where:

C_{soil} = TPH soil cleanup level (mg/kg)

HI = Hazard index (1) (unitless)

ABW = Average body weight over the exposure duration (16 kg)

AT = Averaging time (6 years)

EF = Exposure frequency (1.0) (unitless)

ED = Exposure duration (6 years)

SIR = Soil ingestion rate (200 mg/day)

~~AB1~~ ABS_{GI} = Gastrointestinal absorption fraction (1.0) (unitless)

F(i) = Fraction (by weight) of petroleum component (i) (unitless)

SA = Dermal surface area (2,200 cm^2)

AF = Adherence factor (0.2 mg/cm^2 – day)

$ABS_d(i)$ = Dermal absorption fraction for petroleum component (i) (unitless). May use chemical-specific values or the following defaults:

- 0.0005 for volatile petroleum components with vapor pressure > = benzene
- 0.03 for volatile petroleum components with vapor pressure < benzene
- 0.1 for other petroleum components

$RfD_o(i)$ = Oral reference dose of petroleum component (i) as defined in WAC 173-340-708(7) (mg/kg-day)

$RfD_d(i)$ = Dermal reference dose for petroleum component (i) (mg/kg-day) derived by RfD_o x GI

GI = Gastrointestinal absorption conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.8 for volatile petroleum components
- 0.5 for other petroleum components

n = The number of petroleum components (petroleum fractions plus volatile organic compounds with an RfD) present in the petroleum mixture. (See Table 830-1.)

[176] Same as equation 740-3 in current rule with changes noted.

NEW SECTION

WAC 173-340-7403 Method A industrial soil cleanup standards.

[Formerly WAC 173-340-745(3)] [177]

(1) Applicability.
(2) Concentration.
(3) Adjustments
(4) Point of compliance.
(5) Determining compliance.

(1) Applicability. Method A industrial soil cleanup standards may be used only at any industrial property qualifying under WAC 173-340-7400(5), with few hazardous substances and where all of the following conditions are met: [178]

(a) Except as provided for in subsection (2)(d) of this section, numeric standards are available in Table 740-1 or applicable state and federal laws for all indicator hazardous substances at the site.

(b) The site qualifies for either:

(i) An exclusion from conducting a terrestrial ecological evaluation under WAC 173-340-7491; or

(ii) A simplified terrestrial ecological evaluation under WAC 173-340-7492 and uses the procedures in WAC 173-340-7493 to set cleanup levels protective of soil biota, plants and animals; and,

(c) Hazardous substances have not reached surface water and are unlikely to reach surface water during the estimated restoration timeframe.

(2) Concentration. Method A industrial soil cleanup levels shall be at least as stringent as all of the following:

(a) Concentrations in Table 745-1 and compliance with the corresponding footnotes;

(b) Concentrations established under applicable state and federal laws;

(c) Concentrations that result in no significant adverse effects on the protection and propagation of wildlife using the procedures specified in WAC 173-340-7490 through 173-340-7493, unless it is demonstrated under those sections that establishing a soil concentration is unnecessary;

(d) Concentrations necessary to protect persons from exposure to vapors in excess of air cleanup standards developed under WAC 173-340-7500 through 7500. See WAC 173-340-3500 through 3520 for procedures for assessing vapor intrusion; and [179]

(d) For a hazardous substance that is deemed an indicator hazardous substance under WAC 173-340-708(2) and for which there is no value in Table 740-1 or applicable state and federal laws, a concentration that does not exceed the natural background concentration or the practical quantification limit, subject to the limitations in this chapter.

(3) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background, practical quantitation limit and non-aqueous phase limitations. See WAC 173-340-7405 for procedures for making these adjustments. [180]

(4) Point of compliance. The point of compliance for soil cleanup levels is specified in WAC 173-340-7406.

(5) Determining compliance. The compliance monitoring requirements and procedures for determining compliance with soil cleanup standards are specified in WAC 173-340-7407.

[177] Several changes to streamline language. No substantive changes intended except as noted.
[178] These criteria are based on the criteria in Section 704. The restriction limiting use of Method A to "routine sites" has been eliminated.
[179] Based on EPA research indicating very low concentrations of many chemicals have the potential to pose a vapor hazard in overlying structures.
[180] Subsections (3), (4) and (5) are added as a result of the reorganization of these Sections.

NEW SECTION

WAC 173-340-7404 Method C industrial soil cleanup standards.

[Formerly WAC 173-340-745(5)] [181]

(1) Applicability.
(2) Method C industrial soil cleanup levels.
(3) Adjustments.
(4) Using Method C to evaluate soil remediation levels.
(5) Point of compliance.
(6) Determining compliance.

(1) Applicability. Method C industrial soil cleanup standards may be used at any industrial property qualifying under WAC 173-340-7400(5).

(2) Concentration. The procedures specified in WAC 173-340-7402(2) shall be used to establish Method C soil cleanup levels except for the following:

(a) Direct contact. Equations 745-1, 745-2 and 745-3 shall be used instead of equations 740-1, 740-2 and 740-3.

(b) Lead. For soil lead cleanup levels, either use the Method A value in Table 745-1 or develop site-specific cleanup levels using the United States Environmental Protection Agency's Adult Lead Model. When using the Adult Lead Model, the soil cleanup level shall be based on preventing a site-related increase in blood lead concentration due to soil exposure of 5 micrograms per deciliter or less in 99% of the potentially exposed population. [182]

(3) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background and practical quantitation limit. See WAC 173-340-7405 for procedures for making these adjustments. [183]

(4) Using Method C to evaluate industrial soil remediation levels. In addition to the adjustments allowed under WAC 173-340-7402(3), adjustments to the reasonable maximum exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357, and 173-340-708 (3)(d) and (10)(b).

(5) Point of compliance. The point of compliance for Method C industrial soil cleanup levels is specified in WAC 173-340-7406.

(6) Determining compliance. The compliance monitoring requirements and procedures for determining compliance with Method C industrial soil cleanup standards are specified in WAC 173-340-7407.

[181] This Section has been substantially reorganized and condensed. The criteria for use of Method A industrial soils has been moved to Section 7400. No substantive changes are intended except as noted.

[182] ***New provision.*** The Method A industrial soil lead concentration is expected to be protective of direct contact for nearly all situations and has been added as an option to facilitate cleanups. EPA's Adult Lead Model has been added to provide an option for calculating site-specific soil lead cleanup levels since neither a reference dose nor cancer slope factor is available for lead. For more information go to: http://www.epa.gov/superfund/health/contaminants/lead/index.htm

[183] Subsections (3), (5) and (6) are added as a result of the reorganization of these Sections.

Equation 745-1 (Noncarcinogens) [184]

$$C_{soil} = \frac{HQ \times ABW \times AT}{EF \times ED\left[\left(\frac{1}{RfDo} \times \frac{SIR \times ABS_{GI}}{10^6\, mg/kg}\right) + \left(\frac{1}{RfDd} \times \frac{SA \times AF \times ABS_d}{10^6\, mg/kg}\right)\right]}$$

Where:

C_{soil} = Soil cleanup level (mg/kg)

HQ = Hazard quotient (unitless)

ABW = Average body weight over the exposure duration (70 kg)

AT = Averaging time (20 years)

EF = Exposure frequency (0.7) (unitless)

ED = Exposure duration (20 years)

SIR = Soil ingestion rate (50 mg/day)

~~AB1~~ ABS_{GI} = Gastrointestinal absorption fraction (1.0) (unitless)

SA = Dermal surface area (2,500 mg/cm^2)

AF = Adherence factor (~~0.2~~ 0.07 mg/cm^2 – day)

ABS_d = Dermal absorption fraction (unitless). May use chemical-specific values or the following defaults:

- 0.01 for inorganic hazardous substances
- 0.0005 for volatile organic compounds with vapor pressure > = benzene
- 0.03 for volatile organic compounds with vapor pressure < benzene
- 0.1 for other organic hazardous substances

RfD_o = Oral reference dose as defined in WAC 173-340-708(7) (mg/kg-day)

RfD_d = Dermal reference dose (mg/kg-day) derived by RfD_o x GI

GI = Gastrointestinal ~~absorption~~ RfD conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.2 for inorganic hazardous substances
- 0.8 for volatile organic compounds
- 0.5 for other organic hazardous substances

Equation 745-2 (Carcinogens) [185]

$$C_{soil} = \frac{RISK \times ABW \times AT}{EF \times ED\left[\left(\frac{SIR \times ABS_{GI} \times CSFo}{10^6\, mg/kg}\right) + \left(\frac{SA \times AF \times ABS_d \times CSF_d}{10^6\, mg/kg}\right)\right]}$$

Where:

C_{soil} = Soil cleanup level (mg/kg)

RISK = Acceptable cancer risk (1 in 100,000) (unitless)

ABW = Average body weight over the exposure duration (70 kg)

AT = Averaging time (~~75~~70 years)

EF = Exposure frequency (0.7) (unitless)

ED = Exposure duration (20 years)

SIR = Soil ingestion rate (50 mg/day)

ABS_{GI} = Gastrointestinal absorption fraction (1.0) (unitless). May use 0.6 for mixtures of dioxins and/or furans

CSF_o = Oral cancer slope factor as defined in WAC 173-340-708(8) (kg-day/mg)

CSF_d = Dermal cancer slope factor (kg-day/mg) derived by CPF_o/GI

GI = Gastrointestinal RfD conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.2 for inorganic hazardous substances
- 0.8 for volatile organic compounds and for mixtures of dioxins and/or furans
- 0.5 for other organic hazardous substances

SA = Dermal surface area (2,500 cm^2)

AF = Adherence factor (0.07 mg/cm^2 – day)

ABS_d = Dermal absorption fraction (unitless). May use chemical-specific values or the following defaults:

- 0.01 for inorganic hazardous substances
- 0.0005 for volatile organic compounds with vapor pressure > = benzene
- 0.03 for volatile organic compounds with vapor pressure < benzene and for mixtures of dioxins and/or furans
- 0.1 for other organic hazardous substances

[184] Former Equation 745-4. AF change based on EPA risk assessment guidance; other changes editorial. *Differences from equation 740-1 are highlighted.*

[185] Former Equation 745-5. AT & AF changed to be consistent with EPA risk assessment guidance. Note: No adjustment is included for early life exposure since this is adult only exposure.

Equation745-3 (TPH Mixtures) [186]

$$C_{soil} = \frac{HI \times ABW \times AT}{EF \times ED \left[\left(\frac{SIR \times ABS_{GI}}{10^6\, mg/kg} \sum_{i=1}^{n} \frac{F(i)}{RfD_o(i)} \right) + \left(\frac{SA \times AF}{10^6\, mg/kg} \sum_{i=1}^{n} \frac{F(i) \times ABS_d(i)}{RfD_d(i)} \right) \right]}$$

Where:

C_{soil} = TPH soil cleanup level (mg/kg)

HI = Hazard index (1) (unitless)

ABW = Average body weight over the exposure duration (70 kg)

AT = Averaging time (20 years)

EF = Exposure frequency (0.7) (unitless)

ED = Exposure duration (20 years)

SIR = Soil ingestion rate (50 mg/day)

~~AB1~~ ABS_{GI} = Gastrointestinal absorption fraction (1.0) (unitless)

F(i) = Fraction (by weight) of petroleum component (i) (unitless)

SA = Dermal surface area (2,500 cm^2)

AF = Adherence factor (~~0.2~~ 0.07 mg/cm^2 – day)

ABS_d = Dermal absorption fraction for petroleum component (i) (unitless). May use chemical-specific values or the following defaults:

- 0.0005 for volatile petroleum components with vapor pressure > = benzene
- 0.03 for volatile petroleum components with vapor pressure < benzene
- 0.1 for other petroleum components

$RfD_o(i)$ = Oral reference dose of petroleum component (i) as defined in WAC 173-340-708(7) (mg/kg-day)

$RfD_d(i)$ = Dermal reference dose for petroleum component (i) (mg/kg-day) derived by RfD_o x GI

GI = Gastrointestinal ~~absorption~~ RfD conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.8 for volatile petroleum components
- 0.5 for other petroleum components

n = The number of petroleum components (petroleum fractions plus volatile organic compounds with an RfD) present in the petroleum mixture. (See Table 830-1.)

[186] Same as previous equation 745-3. AF change based on EPA risk assessment guidance; other changes editorial. *Differences from equation 740-3 are highlighted.*

NEW SECTION

WAC 173-340-7405 Adjustments to soil cleanup levels.

[Formerly WAC 173-340-745(6)]

(1) Total site risk adjustments.

(2) Adjustments to applicable state and federal laws.

(3) Natural background and analytical considerations.

(1) Total site risk adjustments. Soil cleanup levels for individual hazardous substances developed ~~in accordance with subsection (3) of this section~~ under WAC 173-340-7402 and 7404,~~—~~including cleanup levels based on applicable state and federal laws, shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure. These adjustments need to be made only if, without these adjustments, the hazard index would exceed one (1) or the total estimated individual lifetime excess cancer risk would exceed one in one hundred thousand (1×10^{-5}). These adjustments shall be made in accordance with the procedures specified in WAC 173-340-708 (5) and (6). In making these adjustments, the hazard index shall not exceed one (1) and the total estimated individual lifetime excess cancer risk shall not exceed one in one hundred thousand (1×10^{-5}).

(2) Adjustments to applicable state and federal laws. Where a cleanup level developed under ~~subsection (2) or (3) of this section~~ under WAC 173-340-7401 through 7404 is based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an estimated individual lifetime excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of one (1), the cleanup level must be adjusted downward so that the total estimated individual lifetime excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}) and the hazard index does not exceed one (1) at the site. This adjustment may be made using the equations in WAC 173-340-7402 or 7404, as appropriate for the site.[187]

(3) Natural background and ~~PQL~~ analytical considerations. Cleanup levels determined under ~~subsection (2) or (3) of this section~~ under WAC 173-340-7401 through 7404, including cleanup levels adjusted under subsections (1) and (2) ~~(5)(a) and (b)~~ of this section, shall not be set at levels below the practical quantitation limit or natural background, whichever is higher. See WAC 173-340-707 and 173-340-709 for additional requirements pertaining to practical quantitation limits and natural background.

[187] Reflects current practice.

NEW SECTION

WAC 173-340-7406 Point of compliance.

[Formerly WAC 173-340-740(6)]

(1) Definition. The point of compliance is the point or points where the soil cleanup levels established under WAC 173-340-7401 through 7405 shall be attained.

(2) Groundwater Protection. For soil cleanup levels based on the protection of groundwater, the point of compliance shall be ~~established~~ in the soils throughout the site.

(3) Vapor Protection. For soil cleanup levels based on protection from vapors, the point of compliance shall be ~~established~~ in the soils throughout the site from the ground surface to the uppermost groundwater saturated zone (e.g., from the ground surface to the uppermost water table).

(4) Direct Contact. For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be ~~established~~ in the soils throughout the site from the ground surface to fifteen (15) feet below the ground surface. This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities.

(5) Terrestrial Ecological Evaluations. For soil cleanup levels based on ecological considerations, see WAC 173-340-7490 for the point of compliance.

(6) Point of compliance for containment remedies. The department recognizes that, for those cleanup actions selected under this chapter that involve containment of hazardous substances, the soil cleanup levels will typically not be met at the points of compliance specified in subsections (2) through (5) of this ~~sub~~section. In these cases, the cleanup action may be determined to comply with cleanup standards, provided:

(a) The selected remedy is permanent to the maximum extent practicable using the procedures in WAC 173-340-360;

(b) The cleanup action is protective of human health. The department may require a site-specific human health risk assessment conforming to the requirements of this chapter to demonstrate that the cleanup action is protective of human health;

(c) The cleanup action is demonstrated to be protective of terrestrial ecological receptors under WAC 173-340-7490 through 173-340-7494;

(d) Institutional controls are put in place under WAC 173-340-440 that prohibit or limit activities that could interfere with the long-term integrity of the containment system;

(e) Compliance monitoring under WAC 173-340-410 and periodic reviews under WAC 173-340-~~430~~ 420 are designed to ensure the long-term integrity of the containment system; and

(f) The types, levels and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the ~~draft~~ cleanup action plan or equivalent document for independent remedial actions and the documents implementing that plan.[188]

[188] This final plan is binding, not the draft plan. Also amended to address VCP sites and to make it clear that the implementation plans have to include this information too.

NEW SECTION

WAC 173-340-7407 Demonstrating compliance with soil cleanup standards

[Formerly WAC 173-340-740(7)]

(1) Particle size.
(2) Sampling required.
(3) General data analysis and evaluation procedures.
(4) Data evaluation methods.
(5) Method limitations.
(6) Interpreting non-detect values.

~~(a)~~**(1) Particle size.** Compliance with soil cleanup ~~levels~~ standards shall be based on total analyses of the soil fraction less than two millimeters in size. When it is reasonable to expect that larger soil particles could be reduced to two millimeters or less during current or future site use and this reduction could cause an increase in the concentrations of hazardous substances in the soil, soil cleanup ~~levels~~ standards shall also apply to these larger soil particles. The department may require that soil cleanup standards also apply to soil particles larger than 2 mm (nuggets) when these particles are enriched with contaminants and ingestion of these particles could result in a toxic dose.[189] Compliance with soil cleanup ~~levels~~ standards shall be based on dry weight concentrations. The department may approve the use of alternate procedures for stabilized soils.

~~(b)~~**(2) Sampling required.** When soil cleanup ~~levels~~ standards have been established at a site, sampling of the soil shall be conducted to determine if compliance with the soil cleanup ~~levels~~ standards has been achieved. The department may approve of other sampling methods meet the intent of this requirement. [190] Sampling and analytical procedures shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. The sample design shall provide data that are representative of the area where exposure to hazardous substances may occur.

~~(c)~~**(3) General data analysis and evaluation procedures.** The data analysis and evaluation procedures used to evaluate compliance with soil cleanup ~~levels~~ standards shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. These procedures shall meet the following general requirements:

~~(i)~~**(a)** Methods of data analysis shall be consistent with the sampling design. Separate methods may be specified for surface soils and deeper soils;

~~(ii)~~**(b)** When cleanup ~~levels~~ standards are based on ~~requirements specified in~~ applicable state and federal laws, the procedures for evaluating compliance that are specified in those ~~requirements shall~~ laws may be used to evaluate compliance with cleanup ~~levels~~ standards unless those procedures conflict with ~~the intent of~~ this section; [191]

~~(iii)~~**(c)** ~~Where procedures for evaluating compliance are not specified in an applicable state and federal law, s~~Statistical methods shall be appropriate for the distribution of sampling data for each hazardous substance. If the distributions for different hazardous substances differ, more than one statistical method may be required; and [192]

~~(iv)~~**(d)** The data analysis plan shall ~~specify which parameters are~~ describe the procedures to be used to determine compliance with soil cleanup ~~levels~~ standards.

~~(A) For cleanup levels based on short-term or acute toxic effects on human health or the environment, an upper percentile soil concentration shall be used to evaluate compliance with cleanup levels.~~ [193]

[189] Birds commonly ingest small stones to help with digestion and have been known to inadvertently ingest lead pellets, resulting in severe health impacts and death. Ingestion of lead pellets by children has also been reported in the literature. This addition is to address this concern.

[190] For example, groundwater monitoring may be more appropriate than soil testing when the contaminated soils are located below the water table and deeper than 15 feet. Another example would be soil vapor monitoring.

[191] Allows use of MTCA data evaluation procedures as an option in these instances.

[192] The requirements in (c) and (d) need to be met whether ARARs are used or not. Changes to (d) (i) & (ii) are editorial.

[193] Cleanup levels are based on chronic, not acute exposures, so this language is unnecessary.

~~**(B) For cleanup levels based on chronic or carcinogenic threats, the true mean soil concentration shall be used to evaluate compliance with cleanup levels.**~~ [194]

(4) Data evaluation using direct comparison. [195]

(a) Direct comparison of soil sample concentrations ~~with~~ to cleanup levels may be used to evaluate compliance with cleanup ~~levels~~ standards where:

(i) ~~s~~Selective sampling of soil can be reliably expected to find suspected soil contamination.

(ii) There ~~must be~~ is documented, reliable information that the soil samples have been taken from the appropriate locations.

(iii) ~~Persons using this method must~~ It can be demonstrated that the basis used for selecting the soil sample locations provides a high probability that any existing areas of soil contamination have been found.

(b) When using this method, soil samples taken at the point of compliance after remediation are compared to the appropriate soil cleanup levels. Values at or below the soil cleanup level are in compliance. Values above the soil cleanup level are not in compliance.

(5) Data evaluation using statistical methods.

~~(d)~~~~When data analysis procedures for evaluating compliance are not specified in an applicable state or federal law t~~ A statistical analysis must be conducted if the conditions in subsection (4) for direct comparison are not met. When conducting a statistical analysis, soil samples taken at the point of compliance after remediation are used in the analysis. The following procedures shall be used to demonstrate compliance with soil cleanup standards when using statistical methods:

~~(i)~~(a) Confidence limit method. A confidence interval approach that meets the following requirements:

~~(A)~~(i) The upper one sided ninety-five percent confidence limit on the true mean [196] soil concentration shall be less than or equal to the soil cleanup level. [197] For lognormally distributed data, the upper one-sided ninety-five percent confidence limit shall be calculated using Land's method; and

~~(B)~~(ii) Data shall be assumed to be lognormally distributed unless this assumption is rejected by a statistical test. If a lognormal distribution is inappropriate, data shall be assumed to be normally distributed unless this assumption is rejected by a statistical test. The W test, D'Agostino's test, or, censored probability plots, as appropriate for the data, shall be the statistical methods used to determine whether the data are lognormally or normally distributed;

~~**(ii)** For an evaluation conducted under (c)(iv)(A) of this subsection, a test for percentiles based on tolerance intervals to test the proportion of soil samples having concentrations less than the soil cleanup level. When using this method, the true proportion of samples that do not exceed the soil cleanup level shall not be less than ninety percent. Statistical tests shall be performed with a Type I error level of 0.05;~~ [198]

(b) Non parametric methods. If the data conforms to neither a lognormal nor normal distribution, non parametric statistical methods may be used to determine compliance. When using a non parametric method to calculate an upper confidence limit, the upper ninety-fifth percentile shall be used to determine compliance; or [199]

~~**(iii)** Direct comparison of soil sample concentrations with cleanup levels may be used to evaluate compliance with cleanup where selective sampling of soil can be reliably expected to find suspected soil contamination. There must be documented, reliable information that the soil samples have been taken from the appropriate locations. Persons using this method~~

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[194] Addressed in (4).

[195] Moved up from (iii), with changes shown. No substantive changes intended.

[196] NOTE: The true mean is a statistical term representing the actual average concentration present at the site if all the soil could be dug up and mixed together. It is not equal to the sample mean or average measured concentration. *[This footnote to be added to the rule.]*

[197] Minor but important change. If the cleanup standard is 100 mg/kg, the site needs to demonstrate the estimated true mean concentration is 100 or less, not 99 or less.

[198] The referenced provision has been eliminated, so this language is unnecessary.

[199] Intended to provide a standard for non parametric methods that is equivalent to parametric methods.

~~must demonstrate that the basis used for selecting the soil sample locations provides a high probability that any existing areas of soil contamination have been found; or~~

~~(iv)~~(c) **Other methods.** Other statistical methods approved by the department.

~~(e)~~**(6) Method limitations.** All data analysis methods used, including those specified in state and federal law, must meet the following requirements:

~~(i)~~**(a)** No single sample concentration shall be greater than two times the soil cleanup level. Higher exceedances to control false positive error rates at five percent may be approved by the department when the cleanup level is based on background concentrations; and

~~(ii)~~**(b)** Less than ten percent of the sample concentrations shall exceed the soil cleanup level. Higher exceedances to control false positive error rates at five percent may be approved by the department when the cleanup level is based on background concentrations.

~~(f)~~**(7) Interpreting non-detect values.** ~~When using statistical methods to demonstrate compliance with soil cleanup levels, the following procedures shall be used for measurements below the practical quantitation limit:~~

The following procedures shall be used for measurements below the practical quantitation limit. These methods shall be used unless a soil cleanup level is based on an applicable state or federal law that includes methods for handling non-detected measurements. [200]

~~(i)~~**(a)** Measurements below the method detection limit shall be assigned a value equal to one-half the method detection limit ~~when not more than fifteen percent of the measurements are below the practical quantitation limit~~.

~~(ii)~~**(b)** Measurements above the method detection limit but below the practical quantitation limit shall be assigned a value equal to the practical quantitation limit ~~the method detection limit when not more than fifteen percent of the measurements are below the practical quantitation limit.~~

~~(iii) When between fifteen and fifty percent of the measurements are below the practical quantitation limit and the data are assumed to be lognormally or normally distributed, Cohen's method shall be used to calculate a corrected mean and standard deviation for use in calculating an upper confidence limit on the true mean soil concentration.~~

~~(iv) If more than fifty percent of the measurements are below the practical quantitation limit, the largest value in the data set shall be used in place of an upper confidence limit on the true mean soil concentration.~~

~~(v) The department may approve alternate statistical procedures for handling nondetected values or values below the practical quantitation limit.~~ [201]

(c) Measurements below the method detection limit and/or practical quantitation limit may also be evaluated using the Kaplan-Meier method. [202]

~~(vi)~~**(d)** If a hazardous substance or petroleum fraction has never been detected in any sample at a site and these substances are not suspected of being present at the site based on site history and other knowledge, that hazardous substance or petroleum fraction may be excluded from the ~~statistical~~ compliance analysis. [203]

(e) The department may approve alternate procedures for handling values below the method detection limit and/or practical quantitation limit. [204]

[200] These provisions were added in 2001. Experience since has shown these provisions are not practical and are not being implemented at sites. The proposed changes reflect current practice for handling of non-detects, generally provide a conservative (high) estimate of residual concentrations for determining compliance, and are intended to simplify these calculations. The option of using EPA's Kaplan-Meier method has been added as an acceptable alternative method.

[201] Moved to end.

[202] See USEPA's ProUCL statistical software. http://www.epa.gov/esd/tsc/software.htm
Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance; EPA 530-R-09-007, March, 2009. *[Footnote to be added to rule.]* http://www.epa.gov/osw/hazard/correctiveaction/resources/guidance/sitechar/gwstats/unified-guid.pdf

[203] Includes direct comparison compliance demonstrations, not just statistical analyses.

[204] Moved here from earlier in the section. Reworded to allow for proposals for both statistical and non-statistical methods.

Table 740-1
Method A Soil Cleanup Levels for Unrestricted Land Uses.[a]

Hazardous Substance	CAS Number	~~Cleanup Level~~ Human Health	Plants & Animals[x]
Arsenic	7440-38-2	20 mg/kg[b]	20 mg/kg
Benzene	71-43-2	0.03 mg/kg[c]	
Benzo(a)pyrene	50-32-8	0.1 mg/kg[d] *Under review*	30 mg/kg
Cadmium	7440-43-9	2 mg/kg[e-d]	25 mg/kg
Carcinogenic PAHs [e]		*Under review*	
Benzo(a)anthracene	56-55-3		
Benzo(b)fluoranthene	205-99-2		
Benzo(k)fluoranthene	207-08-9		
Benzo(a)pyrene	50-32-8		
Chrysene	218-01-9		
Dibenzo(a,h)anthracene	53-70-3		
Indeno[1,2,3-cd]pyrene	193-39-5		
Total Chromium			42 mg/kg
Chromium VI	18540-29-9	19 mg/kg[f1] *Under review*	
Chromium III	16065-83-1	2,000 mg/kg[f2]	
DDT	50-29-3	3 mg/kg[g]	1 mg/kg
Ethylbenzene	100-41-4	6 mg/kg[h]	
Ethylene dibromide (EDB)	106-93-4	0.005 mg/kg[i]	
Lead	7439-92-1	250 mg/kg[j] *Under review*	220mg/kg
Lindane	58-89-9	0.01 mg/kg[k]	10 mg/kg
Methylene chloride	75-09-2	0.02 mg/kg[l] *Under review*	
Mercury (inorganic)	7439-97-6	2 mg/kg[m]	9 mg/kg
MTBE	1634-04-4	0.1 mg/kg[n]	
Naphthalene~~s~~	91-20-3	5 mg/kg[o] *Under review*	
1-Methyl Naphthalene	90-12-0	0.5 mg/kg [o]	
2-Methyl Naphthalene	91-57-6	2 mg/kg [o]	
~~PAHs (carcinogenic)~~		~~See benzo(a) pyrene[d]~~	
PCB Mixtures		1 mg/kg[p]	2 mg/kg
Perchlorate	7601-90-3	0.04 mg/kg[q]	
Tetrachloroethylene	127-18-4	0.05 mg/kg[q-t] *Under review*	
Toluene	108-88-3	7 mg/kg[r-s]	
Total Petroleum Hydrocarbons[s-t]			
[Note: Must also test for and meet cleanup levels for other petroleum components--see footnotes!]		*All TPH values under review*	
Gasoline Range Organics			
Gasoline mixtures without benzene and the total of ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture		100 mg/kg	200 mg/kg
All other gasoline mixtures		30 mg/kg	200 mg/kg
Diesel Range Organics		2,000 mg/kg	460 mg/kg
Heavy Oils		2,000 mg/kg	460 mg/kg
Mineral Oil		4,000 mg/kg	
1,1,1 Trichloroethane	71-55-6	2 mg/kg[t-u]	
Trichloroethylene	79-01-6	0.03 mg/kg[u-v] *Under review*	
Xylenes	1330-20-7	9 mg/kg[v-w]	

Footnotes:

NOTE: This table will remain in Section 900 of the rule but is included here to facilitate review. Values highlighted in yellow are cleanup levels currently under review and may change as EPA completes IRIS updates. In addition, Ecology is in the process of reviewing changes in Koc databases and this may result in minor adjustments to several other values.

a **Caution on misusing this table.** This table has been developed for specific purposes. It is intended to provide conservative cleanup levels ~~for sites undergoing routine cleanup actions or~~ for sites with relatively few hazardous substances, and where all of the following conditions are met:

(i) The site qualifies for either:

- An exclusion from conducting a terrestrial ecological evaluation under WAC 173-340-7491; or
- A simplified terrestrial ecological evaluation under WAC 173-340-7492 and uses the procedures in WAC 173-340-7493 to set cleanup levels protective of soil biota, plants and animals; and

(ii) Hazardous substances have not reached surface water and are unlikely to reach surface water during the estimated restoration timeframe.

~~and the site qualifies under WAC 173-340-7491 for an exclusion from conducting a simplified or site-specific terrestrial ecological evaluation, or it can be demonstrated using a simplified terrestrial ecological evaluation under WAC 173-340-7492 or 173-340-7493 that the values in this table are ecologically protective for the site.~~

This table may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in this table should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes.

b **Arsenic.** Cleanup level based on direct contact using Equation 740-2 and protection of groundwater ~~water~~ for drinking water use using the procedures in WAC 173-340-747(4), adjusted for natural background for soil.

c **Benzene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures in WAC 173-340-747(4) and (6).

d **Benzo(a)pyrene.** Cleanup level based on direct contact using Equation 740-2. If other carcinogenic PAHs are suspected of being present at the site, test for them and use this value as the total concentration that all carginogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8). *Under review*

e **Cadmium.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit for soil.

e **Carcinogenic PAHs.** *Concept of listing separately under review*

f1 **Chromium VI.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). *Under review*

f2 **Chromium III.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). Chromium VI must also be tested for and the cleanup level met when present at a site.

g **DDT (dichlorodiphenyltrichloroethane).** Cleanup level based on direct contact using Equation 740-2.

h **Ethylbenzene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

i **Ethylene dibromide (1,2 dibromoethane or EDB).** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4) and adjusted for the practical quantitation limit for soil.

j **Lead.** Cleanup level based on preventing unacceptable blood lead levels through direct contact. *Under review*

k **Lindane.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4)~~, adjusted for the practical quantitation limit~~.

l **Methylene chloride (dichloromethane).** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). *Under review*

m **Mercury.** Cleanup level based on protection of ground water ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

n **Methyl tertiary-butyl ether (MTBE).** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

o **Naphthalene~~s~~.** Cleanup levels for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). ~~This is a total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.~~ 1-Methyl naphthalene has been adjusted for the practical quantitation limit for soil. *Under review*

p **PCB Mixtures.** Cleanup level based on applicable federal law (40 C.F.R. 761.61). This is a total value for all PCBs.

q **Perchlorate.** Cleanup level based on protection of groundwater for drinking water use, using the procedures described in WAC 173-340-747(4).

~~q~~r **Tetrachloroethylene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). *Under review*

~~r~~s **Toluene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

~~s~~t **Total Petroleum Hydrocarbons (TPH).**
TPH cleanup values have been provided for the most common petroleum products encountered at contaminated sites.

Where there is a mixture of products or the product composition is unknown, the product type must be identified using the HCID method. Where a 90% match can be achieved, use the cleanup level for that product. Where a 90% match cannot be achieved, samples must be tested using both the NWTPH-Gx and NWTPH-Dx methods and ~~the lowest applicable TPH cleanup level must be met~~ the cleanup levels for each product range in the mixture adjusted based on the percentage of that type of product in the mixture. (For example, a sample with a mixture of 20% weathered gasoline and 80% diesel would use a gasoline TPH cleanup level of 20% x 100 = 20 mg/kg and a diesel cleanup level of 80% x 2000 = 1600 mg/kg; a sample with a mixture of 60% diesel and 40% heavy oil would use a diesel cleanup level of 60% x 2000 = 1200 mg/kg and a heavy oil cleanup level of 40% x 2000 = 800 mg/kg.

In addition to TPH, the soil cleanup level for any carcinogenic components of the petroleum [such as benzene and cPAHs] and any noncarcinogenic components [such as ethylbenzene, toluene and xylenes], if present at the site, must also be met.

See Table 830-1 for the minimum testing requirements for various petroleum releases.

- **Gasoline range organics** means ~~organic compounds~~ volatile petroleum products measured using ~~method~~ the NWTPH-Gx method. ~~Examples are aviation and automotive gasoline.~~ See Table 830-2 for products in this category. The cleanup level is based on protection of groundwater ~~water for noncarcinogenic effects~~ during drinking water use using the procedures described in WAC 173-340-747(6). Two cleanup levels are provided. The lower value of 30 mg/kg can be used at any site. ~~When using this lower value, the soil must also be tested for and meet the benzene soil cleanup level.~~ The higher value of 100 mg/kg can only be used if the soil is tested and found to contain no benzene and the total of ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture. No interpolation between these cleanup levels is allowed. ~~In both cases, the soil cleanup level for any other carcinogenic components of the petroleum [such as EDB and EDC], if present at the site, must also be met. Also, in both cases, soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes, naphthalene, and MTBE], also must be met if these substances are found to exceed ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for gasoline releases.~~
- **Diesel range organics** means ~~organic compounds~~ middle distillate petroleum products measured using ~~method~~ the NWTPH-Dx method. ~~Examples are diesel, kerosene, and #1 and #2 heating oil.~~ See Table 830-2 for products in this category. The cleanup level is based on preventing the accumulation of free product on the groundwater ~~water~~, as described in WAC 173-340-747(10). ~~The soil cleanup level for any carcinogenic components of the petroleum [such as benzene and PAHs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if these substances are found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for diesel releases.~~
- **Heavy oils** means ~~organic compounds~~ heavy end petroleum products measured using the NWTPH-Dx method. ~~Examples are #6 fuel oil, bunker C oil, hydraulic oil and waste oil.~~ See Table 830-2 for products in this category. The cleanup level is based on preventing the accumulation of free product on the groundwater ~~water~~, as described in WAC 173-340-747(10) and assuming a product composition similar to ~~diesel fuel~~ heavy fuel oil. ~~The soil cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs and PCBs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for heavy oil releases.~~
- **Mineral oil** means ~~non-PCB~~ mineral oil with less than 2 mg/liter (ppm) of PCBs, ~~typically used as an insulator and coolant in electrical devices such as transformers and capacitors,~~ measured using the NWTPH-Dx method. See Table 830-2 for products in this category. The cleanup level is based on preventing the accumulation of free product on the groundwater ~~water~~, as described in WAC 173-340-747(10). ~~Sites using this cleanup level must also analyze soil samples and meet the soil cleanup level for PCBs, unless it can be demonstrated that: (1) The release originated from an electrical device that was manufactured after July 1, 1979; or (2) oil containing PCBs was never used in the equipment suspected as the source of the release; or (3) it can be documented that the oil released was recently tested and did not contain PCBs. Method B must be used for releases of oils containing greater than 50 ppm PCBs. See Table 830-1 for the minimum testing requirements for mineral oil releases.~~

~~t~~u **1,1,1 Trichloroethane.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

~~u~~v **Trichloroethylene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). *Under review*

~~v~~w **Xylenes.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). This is a total value for all xylenes.

x From Table 749-2. These values are protective of soil biota, plants and animals for sites qualifying for a simplified terrestrial ecological evaluation. ***For sites not exempt from conducting a terrestrial ecological evaluation***, use the more stringent of the human health or plants and animal value as the cleanup level unless a different ecologically protective cleanup level can be justified under WAC 173-340-7493. *(NOTE: Several of these values are under review and are likely to change.)*

ADDITIONAL EXPLANATORY NOTES:

a. Reflects criteria in WAC 173-340-704.

e. **Carcinogenic PAHs.** There is still some confusion from users on how to calculate cleanup levels for cPAH mixtures. Ecology is considering changing from treating cPAH mixtures as a single substance to listing as separate substances to address this confusion. This would also be consistent with proposed early life stage amendments in Section 708.

f1 **Chromium VI.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

j. **Lead.** If derived using EPA's IEUBK model and a target blood lead concentration of 5 ug/deciliter for 99% of young children, the Method A value would decrease to 150 mg/kg. This is described in detail in the March 22, 2009 MTCA/SMS Advisory Group materials. http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html

l. **Methylene Chloride.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

l. **Naphthalene.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

r. **Tetrachloroethylene.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

t. **Total Petroleum Hydrocarbons.** Changes to values under review pending calculations using latest spreadsheet and composition data.

The first change in the footnote, referring to 90% match, is to provide consistency between this table and Tables 830-1 and 830-2.

The second change is intended to clarify how the Method A cleanup levels apply to petroleum mixtures, which has been a point of confusion for some time. The adjustment language reflects that the TPH cleanup levels for individual products are based on a hazard index (HI) = 1 or residual saturation. Thus, the cleanup level for mixtures of petroleum products must be adjusted downward so the total risk doesn't exceed an HI of 1 or residual saturation isn't exceeded. This proportion approach is less stringent than the current language which requires applying the lowest applicable cleanup level to the entire mixture (for example a mixture of gasoline and diesel is currently required to use the gasoline cleanup level).

A third change is the requirement that the petroleum components also always meet soil cleanup levels, not just when groundwater is contaminated. This reflects current practice.

Lastly, a PCB concentration has been added to mineral oil to clarify what non-PCB mineral oil means. The 2 ppm is based on the dangerous waste rule PCB limit.

The remainder of the changes are editorial.

v. **Trichloroethylene.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

Table 745-1
Method A Soil Cleanup Levels for Industrial Properties.[a]

Hazardous Substance	CAS Number	~~Cleanup Level~~ Human Health	Wildlife[x]
Arsenic	7440-38-2	20 mg/kg[b]	20 mg/kg
Benzene	71-43-2	0.03 mg/kg[c]	
Benzo(a)pyrene	50-32-8	2 mg/kg[d] *Under review*	
Cadmium	7440-43-9	2 mg/kg[e d]	36 mg/kg
Carcinogenic PAHs [e]		*Under review*	
Benzo(a)anthracene	56-55-3		
Benzo(b)fluoranthene	205-99-2		
Benzo(k)fluoranthene	207-08-9		
Benzo(a)pyrene	50-32-8		300 mg/kg
Chrysene	218-01-9		
Dibenzo(a,h)anthracene	53-70-3		
Indeno[1,2,3-cd]pyrene	193-39-5		
Total Chromium			135 mg/kg
Chromium VI	18540-29-9	19 mg/kg[f1] *Under review*	
Chromium III	16065-83-1	2,000 mg/kg[f2]	
DDT	50-29-3	4 mg/kg[g]	1 mg/kg
Ethylbenzene	100-41-4	6 mg/kg[h]	
Ethylene dibromide (EDB)	106-93-4	0.005 mg/kg[i]	
Lead	7439-92-1	1,000 mg/kg[j]	220 mg/kg
Lindane	58-89-9	0.01 mg/kg[k]	10 mg/kg
Methylene chloride	75-09-2	0.02 mg/kg[l] *Under review*	
Mercury (inorganic)	7439-97-6	2 mg/kg[m]	9 mg/kg
MTBE	1634-04-4	0.1 mg/kg[n]	
Naphthalene~~s~~	91-20-3	5 mg/kg[o] *Under review*	
1-Methyl Naphthalene	90-12-0	0.5 mg/kg[o]	
2-Methyl Naphthalene	91-57-6	2 mg/kg[o]	
~~PAHs (carcinogenic)~~		~~See benzo(a)pyrene[d]~~	
PCB Mixtures		10 mg/kg[p]	2 mg/kg
Tetrachloroethylene	127-18-4	0.05 mg/kg[q r] *Under review*	
Toluene	108-88-3	7 mg/kg[r s]	
Total Petroleum Hydrocarbons[s t]			
[Note: Must also test for and meet cleanup levels for other petroleum components--see footnotes!]		*All TPH values under review*	
Gasoline Range Organics			
Gasoline mixtures without benzene and the total of ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture		100 mg/kg	See Table 749-2
All other gasoline mixtures		30 mg/kg	See Table 749-2
Diesel Range Organics		2,000 mg/kg	See Table 749-2
Heavy Oils		2,000 mg/kg	See Table 749-2
Mineral Oil		4,000 mg/kg	
1,1,1 Trichloroethane	71-55-6	2 mg/kg[t u]	
Trichloroethylene	79-01-6	0.03 mg/kg[u v] *Under review*	
Xylenes	1330-20-7	9 mg/kg[v w]	

Footnotes:

NOTE: This table will remain in Section 900 of the rule but is included here to facilitate review. Values highlighted in yellow are cleanup levels currently under review and may change as EPA completes IRIS updates. In addition, Ecology is in the process of reviewing changes in Koc databases and this may result in minor adjustments to several other values.

a **Caution on misusing this table.** This table has been developed for specific purposes. It is intended to provide conservative cleanup levels ~~for sites undergoing routine cleanup actions or~~ for industrial properties with relatively few hazardous substances, and where all of the following conditions are met:

(i) The site qualifies for either:

- An exclusion from conducting a terrestrial ecological evaluation under WAC 173-340-7491; or
- A simplified terrestrial ecological evaluation under WAC 173-340-7492 and uses the procedures in WAC 173-340-7493 to set cleanup levels protective of wildlife;

(i) Hazardous substances have not reached surface water and are unlikely to reach surface water during the estimated restoration timeframe.

~~and the site qualifies under WAC 173-340-7491 for an exclusion from conducting a simplified or site-specific terrestrial ecological evaluation, or it can be demonstrated using a simplified terrestrial ecological evaluation under WAC 173-340-7492 or 173-340-7493 that the values in this table are ecologically protective for the site.~~

This table may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in this table should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes. Exceedances of the values in this table do not necessarily mean the soil must be restored to these levels at a site. The level of restoration depends on the remedy selected under WAC 173-340-350 through 173-340-390.

b **Arsenic.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures in WAC 173-340-747(4), adjusted for natural background for soil.

c **Benzene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4) and (6).

d **Benzo(a)pyrene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). If other carcinogenic PAHs are suspected of being present at the site, test for them and use this value as the total toxic equivalent concentration that all carginogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8). *Under review*

e **Cadmium.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit for soil.

e Carcinogenic PAHs. *Concept of listing separately under review*

f1 **Chromium VI.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). *Under review*

f2 **Chromium III.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). Chromium VI must also be tested for and the cleanup level met when present at a site.

g **DDT (dichlorodiphenyltrichloroethane).** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

h **Ethylbenzene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

i **Ethylene dibromide (1,2 dibromoethane or EDB).** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4) and adjusted for the practical quantitation limit for soil.

j **Lead.** Cleanup level based on ~~direct contact.~~ preventing unacceptable blood lead levels through direct contact.

k **Lindane.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4)~~, adjusted for the practical quantitation limit~~.

l **Methylene chloride (dichloromethane).** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). *Under review*

m **Mercury.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

n **Methyl tertiary-butyl ether (MTBE).** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

o **Naphthalenes.** Cleanup levels for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). ~~This is a total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.~~ 1-Methyl naphthalene has been adjusted for the practical quantitation limit. *Under review*

p **PCB Mixtures.** Cleanup level based on applicable federal law (40 C.F.R. 761.61). This is a total value for all PCBs. This value may be used only if the PCB contaminated soils are capped and the cap maintained as required by 40 C.F.R. 761.61. If this condition cannot be met, the value in Table 740-1 must be used.

q **Perchlorate.** Cleanup level based on protection of groundwater for drinking water use, using the procedures described in WAC 173-340-747(4).

~~q~~ r **Tetrachloroethylene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). *Under review*

~~r~~ s **Toluene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

~~s~~ t **Total Petroleum Hydrocarbons (TPH).**
TPH cleanup values have been provided for the most common petroleum products encountered at contaminated sites.

Where there is a mixture of products or the product composition is unknown, the product type must be identified using the HCID method. Where a 90% match can be achieved, use the cleanup level for that product. Where a 90% match cannot be achieved, samples must be tested using both the NWTPH-Gx and NWTPH-Dx methods and ~~the lowest applicable TPH cleanup level must be met~~ the cleanup levels for each product range in the mixture adjusted based on the percentage of that type of product in the mixture. (For example, a sample with a mixture of 20% weathered gasoline and 80% diesel would use a gasoline TPH cleanup level of 20% x 100 = 20 mg/kg and a diesel cleanup level of 80% x 2000 = 1600 mg/kg; a sample with a mixture of 60% diesel and 40% heavy oil would use a diesel cleanup level of 60% x 2000 = 1200 mg/kg and a heavy oil cleanup level of 40% x 2000 = 800 mg/kg.)

In addition to TPH, the soil cleanup level for any carcinogenic components of the petroleum [such as benzene and cPAHs] and any noncarcinogenic components [such as ethylbenzene, toluene and xylenes], if present at the site, must also be met.

See Table 830-1 for the minimum testing requirements for various petroleum releases.

- **Gasoline range organics** means ~~organic compounds~~ volatile petroleum products measured using ~~method~~ the NWTPH-Gx method. ~~Examples are aviation and automotive gasoline.~~ See Table 830-2 for products in this category. The cleanup level is based on protection of groundwater ~~water for noncarcinogenic effects during~~ drinking water use using the procedures described in WAC 173-340-747(6). Two cleanup levels are provided. The lower value of 30 mg/kg can be used at any site. ~~When using this lower value, the soil must also be tested for and meet the benzene soil cleanup level.~~ The higher value of 100 mg/kg can only be used if the soil is tested and found to contain no benzene and the total of ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture. No interpolation between these cleanup levels is allowed. ~~In both cases, the soil cleanup level for any other carcinogenic components of the petroleum [such as EDB and EDC], if present at the site, must also be met. Also, in both cases, soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes, naphthalene, and MTBE], also must be met if these substances are found to exceed ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for gasoline releases.~~
- **Diesel range organics** means ~~organic compounds~~ middle distillate petroleum products measured using ~~method~~ the NWTPH-Dx method. ~~Examples are diesel, kerosene, and #1 and #2 heating oil.~~ See Table 830-2 for products in this category. The cleanup level is based on preventing the accumulation of free product on the groundwater ~~water~~, as described in WAC 173-340-747(10). ~~The soil cleanup level for any carcinogenic components of the petroleum [such as benzene and PAHs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if these substances are found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for diesel releases.~~
- **Heavy oils** means ~~organic compounds~~ heavy end petroleum products measured using the NWTPH-Dx method. ~~Examples are #6 fuel oil, bunker C oil, hydraulic oil and waste oil.~~ See Table 830-2 for products in this category. The cleanup level is based on preventing the accumulation of free product on the groundwater ~~water~~, as described in WAC 173-340-747(10) and assuming a product composition similar to ~~diesel fuel~~ heavy fuel oil. ~~The soil cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs and PCBs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for heavy oil releases.~~
- **Mineral oil** means ~~non-PCB~~ mineral oil with less than 2 mg/liter (ppm) of PCBs, ~~typically used as an insulator and coolant in electrical devices such as transformers and capacitors,~~ measured using the NWTPH-Dx method. See Table 830-2 for products in this category. The cleanup level is based on preventing the accumulation of free product on the groundwater ~~water~~, as described in WAC 173-340-747(10). ~~Sites using this cleanup level must also analyze soil samples and meet the soil cleanup level for PCBs, unless it can be demonstrated that: (1) The release originated from an electrical device that was manufactured after July 1, 1979; or (2) oil containing PCBs was never used in the equipment suspected as the source of the release; or (3) it can be documented that the oil released was recently tested and did not contain PCBs. Method B must be used for releases of oils containing greater than 50 ppm PCBs. See Table 830-1 for the minimum testing requirements for mineral oil releases.~~

~~t~~ u **1,1,1 Trichloroethane.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4).

~~u~~ v **Trichloroethylene.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). *Under review*

~~v~~ w **Xylenes.** Cleanup level based on protection of groundwater ~~water~~ for drinking water use, using the procedures described in WAC 173-340-747(4). This is a total value for all xylenes.

x From Table 749-2. These values are protective of wildlife for sites qualifying for a simplified terrestrial ecological evaluation. ***For sites not exempt from conducting a terrestrial ecological evaluation***, use the more stringent of the human health or wildlife value as the cleanup level unless a different ecologically protective cleanup level can be justified under WAC 173-340-7493. *(NOTE: Several of these values are under review and are likely to change.)*

ADDITIONAL EXPLANATORY NOTES:

a. Reflects criteria in WAC 173-340-7451.

e. **Carcinogenic PAHs.** There is still some confusion from users on how to calculate cleanup levels for cPAH mixtures. Ecology is considering changing from treating cPAH mixtures as a single substance to listing as separate substances to address this confusion. This would also be consistent with proposed early life stage amendments in Section 708.

f1 **Chromium VI.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

l. **Methylene Chloride.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

l. **Naphthalene.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

r. **Tetrachloroethylene.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

t. **Total Petroleum Hydrocarbons.** Changes to values under review pending calculations using latest spreadsheet and composition data.

The first change in the footnote, referring to 90% match, is to provide consistency between this table and Tables 830-1 and 830-2.

The second change is intended to clarify how the Method A cleanup levels apply to petroleum mixtures, which has been a point of confusion for some time. The adjustment language reflects that the TPH cleanup levels for individual products are based on a hazard index (HI) = 1 or residual saturation. Thus, the cleanup level for mixtures of petroleum products must be adjusted downward so the total risk doesn't exceed an HI of 1 or residual saturation isn't exceeded. This proportion approach is less stringent than the current language which requires applying the lowest applicable cleanup level to the entire mixture (for example a mixture of gasoline and diesel is currently required to use the gasoline cleanup level).

A third change is the requirement that the petroleum components also always meet soil cleanup levels, not just when groundwater is contaminated. This reflects current practice.

Lastly, a PCB concentration has been added to mineral oil to clarify what non-PCB mineral oil means. The 2 ppm is based on the dangerous waste rule PCB limit.

The remainder of the changes are editorial.

v. **Trichloroethylene.** Value may change depending on the results of the groundwater cleanup level review in Table 720-1.

Table 1: Comparison of Existing Method B Unrestricted Land Use Soil Ingestion (SI) Values vs. Proposed Values for Soil Ingestion + Dermal Contact (SI + D)

Common Noncarcinogens

Chemical	CAS #	Method B SI Only mg/kg (1)	Method B SI + D mg/kg (2)	% Change
Cadmium	7440-43-9	80	74	-7.5%
Chromium III	16065-83-1	120,000	44,571	-62.9%
Copper	7740-50-8	3,200	2,883	-9.9%
Ethylbenzene	100-41-4	8,000	7,390	-7.6%
Mercury	7439-97-6	13	12	-7.7%
Naphthalene	91-20-3	1,600	1,179	-26.3%
Toluene	108-88-3	6,400	5,912	-7.6%
1,1,1 Trichloroethylene	71-55-6	160,000	159,780	-0.1%
Xylene	1330-20-7	16,000	14,871	-7.1%
Zinc	7440-66-6	24,000	21,662	-9.7%
Average				**-14.6%**

Common Carcinogens

Chemical	CAS #	Method B SI Only mg/kg (1)	Method B SI + D mg/kg (2)	% Change
Arsenic	7440-38-2	0.67	0.47	-29.9%
Benzene	71-43-2	18	17	-5.6%
B(a)P	50-32-8	0.14	0.081	-42.1%
DDT	50-29-3	2.9	2.4	-17.2%
2,3,7,8 TCDD (4)	1746-01-6	12.8	10.5	-18.0%
EDB	106-93-4	0.5	0.43	-14.0%
Methylene Chloride	75-09-2	133	124	-6.8%
PCBs-upper bound	1336-36-3	0.5	0.29	-42.0%
Pentachlorophenol	87-86-5	2.5	1.1	-56.0%
Tetrachloroethylene	127-18-4	1.85	1.6	-13.5%
Trichloroethylene	79-01-5	169	146	-13.6%
Vinyl Chloride	75-01-4	1.3	1.2	-7.7%
Average				**-22.2%**

NOTES:

This page will not be part of the regulation. It is included to illustrate impact of direct contact changes on selected chemicals to facilitate review. In many cases the leaching or vapor exposure pathway will control the cleanup level, not direct contact.

(1) Equation 740-1 (for noncarcinogens) or 740-2 (for carcinogens) under **current** regulation (soil ingestion only).
(2) Equation 740-1 (for noncarcinogens) or 740-2 (for carcinogens) under **proposed** regulation (soil ingestion plus dermal contact). Carcinogen values do not include early life adjustment factor.

Table 2: Comparison of Existing Method C Industrial Soil Ingestion (SI) Values vs. Proposed Values for Soil Ingestion + Dermal Contact (SI + D)

Common Noncarcinogens

Chemical	CAS #	Method C SI Only mg/kg (1)	Method C SI + D mg/kg (2)	% Change
Cadmium	7440-43-9	3,500	1,793	-48.8%
Chromium III	16065-83-1	No limit	830,375	-
Copper	7740-50-8	140,000	69,583	-50.3%
Ethylbenzene	100-41-4	350,000	180,685	-48.4%
Mercury	7439-97-6	560	278	-50.4%
Naphthalene	91-20-3	70,000	26,059	-62.8%
Toluene	108-88-3	280,000	144,548	-48.4%
1,1,1 Trichloroethylene	71-55-6	No limit	No limit	-
Xylene	1330-20-7	700,000	361,370	-48.4%
Zinc	7440-66-6	No limit	521,872	-
Average				**-51.0%**

Common Carcinogens

Chemical	CAS #	Method C SI Only mg/kg (1)	Method C SI + D mg/kg (2)	% Change
Arsenic	7440-38-2	88	31	-64.8%
Benzene	71-43-2	2,386	1,298	-45.6%
B(a)P	50-32-8	18	5.1	-71.7%
DDT	50-29-3	386	174	-54.9%
2,3,7,8 TCDD (4)	1746-01-6	1,010	753	-25.4%
EDB	106-93-4	66	32	-51.5%
Methylene Chloride	75-09-2	17,500	9,518	-45.6%
PCBs-upper bound	1336-36-3	66	18	-72.7%
Pentachlorophenol	87-86-5	328	65	-80.2%
Tetrachloroethylene	127-18-4	243	117	-51.9%
Trichloroethylene	79-01-5	22,246	10,719	-51.8%
Vinyl Chloride	75-01-4	175	95	-45.7%
Average				**-55.2%**

NOTES:

This page will not be part of the regulation. It is included to illustrate impact of direct contact changes on selected chemicals to facilitate review. In many cases the leaching or vapor exposure pathway will control the cleanup level, not direct contact.

(1) Equation 745-1 (for noncarcinogens) or 745-2 (for carcinogens) under **current** regulation (soil ingestion only).
(2) Equation 745-1 (for noncarcinogens) or 745-2 (for carcinogens) under **proposed** regulation (soil ingestion plus dermal contact).

WAC 173-340-747 Deriving soil concentrations for ground water protection.

(1) Purpose. The purpose of this section is to establish soil concentrations that will not cause contamination of groundwater ~~water~~ at levels that exceed the groundwater ~~water~~ cleanup levels established under WAC 173-340-720. Soil concentrations established under this section are used to establish either Method B soil cleanup levels ~~(see WAC 173-340-740 (3)(b)(iii)(A))~~ or Method C soil cleanup levels ~~(see WAC 173-340-745(5)(b)(iii) (A))~~ that are protective of groundwater. These procedures may also be used to evaluate if a soil remediation level will be protective of groundwater.[205]

For the purposes of this section, "soil concentration" means the concentration in the soil that will not cause an exceedance of the groundwater ~~water~~ cleanup level established under WAC 173-340-720.

(2) General requirements. The soil concentration established under this section for each hazardous substance shall meet the following two criteria:

(a) The soil concentration shall not cause an exceedance of the groundwater ~~water~~ cleanup level established under WAC 173-340-720. To determine if this criterion is met, one of the methodologies specified in subsections (4) through (9) of this section shall be used; and

(b) To ensure that the criterion in (a) of this subsection is met, the soil concentration shall not result in the accumulation of non-aqueous phase liquid (NAPL) on or in groundwater ~~water~~. To determine if this criterion is met, one of the methodologies specified in subsection (10) of this section shall be used.

(3) Overview of methods. This subsection provides an overview of the methods specified in subsections (4) through (10) of this section for deriving soil concentrations that meet the criteria specified in subsection (2) of this section. Certain methods are tailored for particular types of hazardous substances or sites. Certain methods are more complex than others and certain methods require the use of site-specific data. The specific requirements for deriving a soil concentration under a particular method may also depend on the hazardous substance.

(a) Fixed parameter three-phase partitioning model. The three-phase partitioning model with fixed input parameters may be used to establish a soil concentration for any hazardous substance. Site-specific data are not required for use of this model. See subsection (4) of this section.

(b) Variable parameter three-phase partitioning model. The three-phase partitioning model with variable input parameters may be used to establish a soil concentration for any hazardous substance. Site-specific data are required for use of this model. See subsection (5) of this section.

(c) Four-phase partitioning model. The four-phase partitioning model may be used to derive soil concentrations for any site where hazardous substances are present in the soil as a non-aqueous phase liquid (NAPL). The department expects that this model will be used at sites contaminated with petroleum hydrocarbons. Site-specific data are required for use of this model. See subsection (6) of this section.

(d) Leaching tests. Leaching tests may be used to establish soil concentrations for certain metals. Leaching tests may also be used to establish soil concentrations for other hazardous substances, including petroleum hydrocarbons, provided sufficient information is available to demonstrate that the leaching test can accurately predict groundwater ~~water~~ impacts. Testing of

[205] For example, if a soil containment remedy will be protective of groundwater. The other changes are editorial.

soil samples from the site is required for use of this method. See subsection (7) of this section.

(e) Alternative fate and transport models. Fate and transport models other than those specified in subsections (4) through (6) of this section may be used to establish a soil concentration for any hazardous substance. Site-specific data are required for use of such models. See subsection (8) of this section.

(f) Empirical demonstration. An empirical demonstration may be used to show that measured soil concentrations will not cause an exceedance of the applicable groundwater ~~water~~ cleanup levels established under WAC 173-340-720. This empirical demonstration may be used for any hazardous substance. Site-specific data (for example ~~e.g.~~, groundwater ~~water~~ samples and soil samples) are required under this method. If the required demonstrations cannot be made, then a protective soil concentration shall be established under one of the methods specified in subsections (4) through (8) of this section. See subsection (9) of this section.

(g) Residual saturation. To ensure that the soil concentration established under one of the methods specified in subsections (4) through (9) of this section will not cause an exceedance of the groundwater ~~water~~ cleanup level established under WAC 173-340-720, the soil concentration must not result in the accumulation of non-aqueous phase liquid (NAPL) on or in groundwater ~~water~~. The methodologies and procedures specified in subsection (10) of this section shall be used to determine if this criterion is met.

(4) Fixed parameter three-phase partitioning model.

(a) Overview. This subsection specifies the procedures and requirements for establishing soil concentrations through the use of the fixed parameter three-phase partitioning model. The model may be used to establish soil concentrations for any hazardous substance. The model may be used to calculate both unsaturated and saturated zone soil concentrations.

This method provides default or fixed input parameters for the three-phase partitioning model that are intended to be protective under most circumstances and conditions; site-specific measurements are not required. In some cases it may be appropriate to use site-specific measurements for the input parameters. Subsection (5) of this section specifies the procedures and requirements to establish site-specific input parameters for use in the three-phase partitioning model.

(b) Description of the model. The three-phase partitioning model is described by the following equation:

[Equation 747-1]

$$C_s = C_w(UCF)DF\left[K_d + \frac{(\theta_w + \theta_a H_{cc})}{\rho_b}\right]$$

Where:

C_s = Soil concentration (mg/kg)

C_w = groundwater ~~water~~ cleanup level established under WAC 173-340-720 (ug/l)

UCF = Unit conversion factor (1 mg/1,000 ug)

DF = Dilution factor (dimensionless: 20 for unsaturated zone soil; see (e) of this subsection for saturated zone soil)

K_d = Distribution coefficient (L/kg; see (c) of this subsection)

θ_w = Water-filled soil porosity (ml water/ml soil: 0.3 for unsaturated zone soil; see (e) of this subsection for saturated zone soil)

θ_a = Air-filled soil porosity (ml air/ml soil: 0.13 for unsaturated zone soil; see (e) of this subsection for saturated zone soil)

H_{cc} = Henry's law constant (dimensionless; see (d) of this subsection)

ρ_b = Dry soil bulk density (1.5 kg/L)

(c) Distribution coefficient (K_d). The default K_d values for organics and metals used in Equation 747-1 are as follows:

(i) Organics. For organic hazardous substances, the K_d value shall be derived using Equation 747-2. The K_{oc} (soil organic carbon-water partition coefficient) parameter specified in Equation 747-2 shall be derived as follows:

(A) Nonionic organics. ~~For individual non-ionic hydrophobic organic hazardous substances (e.g., benzene and naphthalene), the K_{oc} values in Table 747-1 shall be used. For hazardous substances not listed in Table 747-1, K_d values may be developed as provided in subsection (5) of this section (variable three-phase partitioning model).~~

For petroleum fractions and other common petroleum constituents, the K_{oc} values in Table 747-4 shall be used. For other non-ionizing organic hazardous substances, the K_{oc} values in Table 747-1 shall be used. [206]

(B) Ionizing organics. For ionizing organic hazardous substances (such as~~e.g.,~~ pentachlorophenol and benzoic acid), the K_{oc} values in Table 747-2 shall be used. Table 747-2 provides K_{oc} values for three different pHs. To select the appropriate K_{oc} value, the soil pH must be measured. The K_{oc} value for the corresponding soil pH shall be used. If the soil pH falls between the pH values provided, an appropriate K_{oc} value shall be selected by interpolation between the listed K_{oc} values.

[Equation 747-2]

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

Where:

K_d = Distribution coefficient (L/kg)

K_{oc} = Soil organic carbon-water partitioning coefficient (~~ml~~L/~~k~~g). See (c)(i) of this subsection.

f_{oc} = Soil fraction of organic carbon (0.1% or 0.001 g/g)

(ii) Metals. For metals, the K_d values in Table 747-3 shall be used. ~~For metals not listed in Table 747-3, K_d values may be developed as provided in subsection (5) of this section (variable three-phase partitioning model).~~ [207]

(d) Henry's law constant. ~~For petroleum fractions, the values for Henry's law constant in Table 747-4 shall be used in Equation 747-1. For individual organic hazardous substances, the value shall be based on values in the scientific literature. For all metals present as inorganic compounds except mercury, zero shall be used. For mercury, either 0.47 or a value derived from the scientific literature shall be used. Derivation of Henry's law constant from the scientific literature shall comply with WAC 173-340-702 (14), (15) and (16).~~ [208]

(i) Organics. For petroleum fractions and other common petroleum constituents, the values for Henry's law constant in Table 747-4 shall be used. For other organic hazardous substances, the values for Henry's law constant in Table 747-1 shall be used. [209]

(ii) Metals. For all metals present as inorganic compounds except mercury, a Henry's law constant of zero shall be used. For mercury, a Henry's law constant of 0.47 shall be used. [210]

(e) Saturated zone soil concentrations. Equation 747-1 may also be used to derive concentrations for soil that is located at or below the groundwater ~~water~~ table (the saturated zone). The following input parameters shall be changed if Equation 747-1 is used to derive saturated zone soil concentrations:

(i) The dilution factor shall be changed from 20 to 1;

(ii) The water-filled soil porosity value shall be changed from 0.3 ml water/ml soil to 0.43 ml water/ml soil; and

(iii) The air-filled soil porosity value shall be changed from 0.13 ml air/ml soil to zero.

(5) Variable parameter three-phase partitioning model.

(a) Overview. This section specifies the procedures and requirements to derive site-specific input parameters for use in the three-

[206] Editorial, no substantive change intended. The reference to subsection (5) is duplicative of language in (4)(a) and unnecessary.

[207] Editorial, no substantive change intended. The reference to subsection (5) is duplicative of language in (4)(a) and unnecessary.

[208] Deleted language replaced with (i) and (ii), with minor rewording changes. No substantive change intended. Directions for developing a Henry's law constant from the literature has been moved to (5).

[209] A new column in table 747-1 containing default H_{cc} values is proposed to be added to the rule to facilitate leaching calculations.

[210] Moved here from above.

phase partitioning model. This method may be used to establish soil concentrations for any hazardous substance. This method may be used to calculate both unsaturated and saturated zone soil concentrations.

This method allows for the substitution of site-specific values for the default values in Equation 747-1 and, derivation of model input variables for substances without default values in this chapter,[211] for one or more of the following five input parameters: Distribution coefficient, soil bulk density, soil volumetric water content, soil air content, and dilution factor. The methods that may be used and the requirements that shall be met to derive site-specific values for each of the ~~five~~ input parameters are specified in (b) through (f) of this subsection.

(b) Methods for deriving a distribution coefficient (K_d). To derive a site-specific distribution coefficient, one of the following methods shall be used:

(i) Deriving K_d from soil fraction of organic carbon (foc) measurements. Site-specific measurements of soil organic carbon may be used to derive distribution coefficients for nonionic hydrophobic organics using Equation 747-2.

(A) Soil organic carbon measurements shall be based on uncontaminated soil below the root zone (such as~~i.e.~~, soil greater than one meter in depth) that is representative of site conditions or in areas through which contaminants are likely to migrate.

(B) The laboratory protocols for measuring soil organic carbon in the Puget Sound Estuary Program (March, 1986) may be used. Other methods may also be used if approved by the department. All laboratory measurements of soil organic carbon shall be based on methods that do not include inorganic carbon in the measurements.

(C) Soil samples shall be obtained from uncontaminated areas of the same formations the contaminants are located in and expected to migrate through. [212]

(ii) Deriving K_d from site data. Site-specific measurements of the hazardous substance concentrations in the soil and the soil pore water or ground water may be used, subject to department approval, to derive a distribution coefficient. Distribution coefficients that have been derived from site data shall be based on measurements of soil and groundwater ~~water~~ hazardous substance concentrations from the same depth and location. Soil and groundwater ~~water~~ samples that have hazardous substances present as a non-aqueous phase liquid (NAPL) shall not be used to derive a distribution coefficient and measures shall be taken to minimize biodegradation and volatilization during sampling, transport and analysis of these samples.

(iii) Deriving K_d from batch tests. A site-specific distribution coefficient may be derived by using EPA's 1992 batch equilibrium test~~s~~ method,[213] subject to department approval, to measure hazardous substance adsorption and desorption. The results from the batch equilibrium test may be used to derive K_d from the sorption/desorption relationship between hazardous substance concentrations in the soil and water. Samples that have hazardous substances present as a non-aqueous phase liquid (NAPL) shall not be used to derive a distribution coefficient and measures shall be taken to minimize biodegradation and volatilization during testing.

(iv) Deriving K_{oc} and K_d from the scientific literature.[214] The scientific literature may be used to ~~derive a~~ develop a site-specific K_{oc} for use in equation 747-2 or a site-specific distribution coefficient (K_d) for any hazardous substance, provided the requirements in WAC 173-340-702 (14), (15) and (16) are met.

(c) Deriving H_{cc} from the scientific literature. The scientific literature may be used to derive a site-specific Henry's law constant, provided the requirements in WAC 173-340-702 (14), (15) and (16) are met. When using a literature value, the value should be adjusted for

[211] Editorial to clarify that the methods in this subsection can also be used to develop Kds and Kocs for substances for which default values haven't been provided.

[212] Uncontaminated areas are specified to avoid the potential that organic contamination biases the test results.

[213] USEPA. 1992. Batch type procedures for estimating soil adsorption of chemicals. Report no: EPA/530/SW-87/006F. *[Footnote to be added to rule]*

[214] K_{oc} has been added since K_{oc} can be used to derive K_d.

the actual soil or groundwater temperature at the site using the procedure specified in "Users Guide for Evaluating Subsurface Vapor Intrusion into Buildings", USEPA, 2004.[215] In most cases this will be equal to the average annual temperature at the site. Thirteen degrees centigrade (13° C) may be used as a default temperature for shallow soil and groundwater in Washington State unless site-specific data indicates this is inappropriate.[216]

(d) Deriving soil bulk density.[217] ASTM Method ~~2049~~ D 4253 or D 1556 or other methods approved by the department may be used to derive site-specific soil bulk density values.

(~~d~~e) Deriving soil volumetric water content using laboratory methods. ASTM Method 2216 or other methods approved by the department may be used to derive site-specific soil volumetric water content values.

(~~e~~f) Estimating soil air content. An estimate of the site-specific soil air content may be determined by calculating soil porosity and subtracting the volumetric water content.

(~~f~~g) Deriving a dilution factor from site-specific estimates of infiltration and groundwater ~~water~~ **flow volume.** Site-specific estimates of infiltration and groundwater ~~water~~ flow volume may be used in the following equation to derive a site-specific dilution factor:

[Equation 747-3]

$$DF = (Q_p + Q_a)/Q_p$$

Where:

DF = Dilution factor (dimensionless)

Q_p = Volume of water infiltrating (m^3/yr)

Q_a = Ground water flow (m^3/yr)

(i) Calculating groundwater ~~water~~ **flow volume.** The following equation shall be used under this method to calculate the volume of groundwater ~~water~~ flow (Q_a):

[Equation 747-4]

$$Q_a = K \times A \times I$$

Where:

Q_a = Groundwater ~~water~~ flow volume (m^3/year)

K = Hydraulic conductivity (m/year). Site-specific measurements shall be used to derive this parameter.

A = Aquifer mixing zone (m^2). The aquifer mixing zone thickness shall not exceed 5 meters in depth and be equal to a unit width of 1 meter, unless it can be demonstrated empirically that the mixing zone thickness exceeds 5 meters.

I = Gradient (m/m). Site-specific measurements shall be used to derive this parameter.

(A) Equation 747-4 assumes the ground water concentrations of hazardous substances of concern upgradient of the site are not detectable. If this assumption is not true, the dilution factor may need to be adjusted downward in proportion to the upgradient concentration.

(B) Direct measurement of the flow velocity of ground water using methods approved by the department may be used as a substitute for measuring the groundwater ~~water~~ hydraulic conductivity and gradient.

(ii) Calculating or estimating infiltration. The following equation shall be used under this method to calculate the volume of water infiltrating (Q_p):

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215 http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm

216 13° C is based on the 2004 EPA Vapor Intrusion guidance. This is the average annual temperature for most of WA State and is generally considered representative of deeper soil (>5 feet) and groundwater temperatures. An exception would be areas with heated discharges or natural geothermal activity.

217 D4256 is for determining the maximum density of cohesionless, free-draining soils (clean sands and gravels). D1556 is for determining the in-situ density of soil using the sand cone method.

[Equation 747-5]

$$Q_p = L \times W \times Inf$$

Where:

Q_p = Volume of water infiltrating (m^3/year)

L = Estimated length of contaminant source area parallel to ground water flow (m)

W = Unit width of contaminant source area (1 meter)

Inf = Infiltration (m/year)

(A) If a default annual infiltration value (Inf) is used, the value shall meet the following requirements. For sites west of the Cascade Mountains, the default annual infiltration value shall be 70 percent of the average annual precipitation amount. For sites east of the Cascade Mountains, the default annual infiltration value shall be 25 percent of the average annual precipitation amount.

(B) If a site-specific measurement or estimate of infiltration (Inf) is made, it shall be based on site conditions without surface caps (for example~~e.g.~~, pavement) or other structures that would control or impede infiltration. The presence of a cover or cap may be considered when evaluating the protectiveness of a remedy under WAC 173-340-350 through 173-340-360. If a site-specific measurement or estimate of infiltration is made, then it must comply with WAC 173-340-702 (14), (15) and (16).

(6) Four-phase partitioning model.

(a) Overview. This subsection specifies the procedures and requirements for establishing soil concentrations through the use of the four-phase partitioning model. This model may be used to derive soil concentrations for any site where hazardous substances are present in the soil as a non-aqueous phase liquid (NAPL). The model is described in (c) of this subsection. Instructions on how to use the model to establish protective soil concentrations are provided in (d) of this subsection.

(b) Restrictions on use of the model for alcohol enhanced fuels. The four-phase partitioning model may be used on a case-by-case basis for soil containing fuels (for example~~e.g.,~~ gasoline) that have been enhanced with alcohol. If the model is used for alcohol enhanced fuels, then it shall be demonstrated that the effects of cosolvency have been adequately considered and, where necessary, taken into account when applying the model. Use of the model for alcohol enhanced fuels without considering the effects of cosolvency and increased ground water contamination is prohibited.

(c) Description of the model. The four-phase partitioning model is based on the following ~~three~~ four equations:

(i) Conservation of volume equation.

[Equation 747-6]

$$n = \theta_w + \theta_a + \theta_{NAPL}$$

Where:

n = Total soil porosity (ml total pore space/ml total soil volume). Use a default value of 0.43 ml/ml or use a value determined from site-specific measurements.

θ_w = Volumetric water content (ml water/ml soil). For unsaturated soil use a default value of 0.3 or a value determined from site-specific measurements. For saturated soil this value is unknown and must be solved for. Volumetric water content equals the total soil porosity minus volume occupied by the NAPL.

θ_a = Volumetric air content (ml air volume/ml total soil volume). For unsaturated soil this value is unknown and must be solved for. Volumetric air content equals the total soil porosity minus the volume occupied by the water and NAPL. For saturated soil this value is zero.

θ_{NAPL} = Volumetric NAPL content (ml NAPL volume/ml total soil volume). For both unsaturated and saturated soil this value is unknown and must be solved for.

(ii) ~~Four-phase partitioning~~ Conservation of mass equation.

[Equation 747-7] [218]

$$\frac{M^i_T}{m_{soil}} = \frac{x_i S_i}{\rho_b}\left[\theta_w + K^i_{oc} f_{oc} \rho_b + H^i_{cc}\theta_a + \frac{GFW_i}{S_i}\rho_{NAPL}\theta_{NAPL}\right]$$

Where:

M^i_T = Total mass of each component in the system (mg). This value is derived from site-specific measurements.

m_{soil} = Total soil mass (kg).

x_i = Mole fraction (at equilibrium) of each component (dimensionless). This value is unknown and must be solved for.

S_i = Solubility of each component (mg/l). See Table 747-4 for petroleum hydrocarbons; see the scientific literature for other hazardous substances.

ρ_b = Dry soil bulk density (1.5 kg/l).

K^i_{oc} = Soil organic carbon-water partitioning coefficient for each component (l/kg). See Table 747-4 for petroleum hydrocarbons; see subsection (4)(b) of this section for other hazardous substances.

f_{oc} = Mass fraction of soil natural organic carbon (0.001 g soil organic/g soil).

H^i_{cc} = Henry's law constant for each component (dimensionless). See Table 747-4 for petroleum hydrocarbons; see subsection (4)(c) of this section for other hazardous substances.

GFW_i = Gram formula weight, or molecular weight of each component (mg/mol). See Table 747-4 for petroleum hydrocarbons; see the scientific literature for other hazardous substances.

~~ρ~~~~θ~~$_{NAPL}$ = Molar density of the mixture (mol/l). See Equation 747-8.

θ_{NAPL} = Volumetric NAPL content (ml NAPL volume/ml total soil volume). For both unsaturated and saturated soil this value is unknown and must be solved for.

~~Component~~ i = NAPL component. For petroleum mixtures, this means the petroleum fractions, and other organic hazardous substances ~~with a reference dose~~ present in the petroleum mixture; for other hazardous substances, this means each organic hazardous substance that is found in the NAPL.

(iii) Molar density equation.

[Equation 747-8]

$$\rho_{NAPL} = \frac{\left[\sum x_i GFW_i \Big/ \left(\sum x_i GFW_i / \rho_i\right)\right]}{\sum x_i GFW_i} = \frac{1}{\sum\left(x_i GFW_i / \rho_i\right)}$$

Where:

GFW_i = Gram formula weight, or molecular weight of each component (mg/mol). See Table 747-4 for petroleum hydrocarbons; see the scientific literature for other hazardous substances.

x_i = Mole fraction (at equilibrium) of each component (dimensionless). This value is unknown and must be solved for.

ρ_i = Density of each component (mg/l). See Table 747-4 for petroleum hydrocarbons; see the scientific literature for other hazardous substances.

Component = For petroleum mixtures, this means the petroleum fractions plus organic hazardous substances with a reference dose; for other hazardous substances, this means each organic hazardous substance that is found in the NAPL.

(iv) Conservation of mole fractions equation. [219]

[Equation 747-9]

$$\sum x_i = 1$$

Where:

x_i = Mole fraction (at equilibrium) of each component (dimensionless). This value is unknown and must be solved for.

[218] Editorial changes.

[219] Moved up from step 4 for clarity.

(d) Instructions for using the model. This subsection provides instructions for using the four-phase partitioning model to predict groundwater ~~water~~ concentrations and to establish protective soil concentrations. The model uses an iterative process to simultaneously solve multiple equations for several unknowns (see step 4 for the number of equations). To predict a groundwater ~~water~~ concentration, the mole fraction of each component (at equilibrium) must be known. The predicted groundwater ~~water~~ concentration is obtained by multiplying the water solubility of each component by the equilibrated mole fraction (Equation 747-7). The following procedure shall be conducted for each soil sample.

(i) Step 1: Measure hazardous substance soil concentrations. Collect and analyze soil samples and, if appropriate, samples of the product released, for each component. For petroleum hydrocarbons, see Table 830-1 for a description of what to analyze for. The recommended minimum number of soil samples to adequately characterize a site using the VPH and EPH methods is specified in Table 747-6. [220]

(ii) Step 2: Derive physical/chemical data. For each of the components, determine the Henry's law constant, water solubility, soil organic carbon-water partitioning coefficient, density and molecular weight values. For petroleum hydrocarbons, see Table 747-4.

(iii) Step 3: Derive soil parameters. Derive a value for each of the following soil parameters as follows:

(A) Soil organic carbon content. Use the default value (0.001 g soil organic/g soil) or a site-specific value derived under subsection (5)(b)(i) of this section.

(B) Soil volumetric water content. Use the default value (0.43 minus the volume of NAPL and air) or a site-specific value derived under subsection (5)(d) of this section.

(C) Soil volumetric air content. Use the default value (0.13 ml/ml for unsaturated zone soil; zero for saturated zone soil) or a site-specific value derived under subsection (5)(e) of this section.

(D) Soil bulk density and porosity. Use the default values of 1.5 kg/l for soil bulk density and 0.43 for soil porosity or use site-specific values. If a site-specific value for bulk density is used, the method specified in subsection (5)(c) of this subsection shall be used. If a site-specific bulk density value is used, a site-specific porosity value shall also be used. The site-specific soil porosity value may be calculated using a default soil specific gravity of 2.65 g/ml or measuring the soil specific gravity using ASTM Method D 854.

(iv) Step 4: Predict a soil pore water concentration. Equation 747-7 shall be used to predict the soil pore water concentration for each component. To do this, multiple versions of Equation 747-7 shall be constructed, one for each of the components using the associated parameter inputs for K_{oc}, H_{cc}, GFW, and S. These equations shall then be combined with Equations 747-6, ~~and~~ 747-8 and 747-9 ~~the condition that $\sum x_i = 1$~~ [221] and solved simultaneously for the unknowns in the equations (mole fraction of each component (x_i), volumetric NAPL content (θ_{NAPL}), and either the volumetric water content (θ_w) or the volumetric air content (θ_a).

(v) Step 5: Derive a dilution factor. Derive a dilution factor using one of the following two methods:

(A) Use the default value of 20 for unsaturated soils and 1 for saturated soils); or

(B) Derive a site-specific value using site-specific estimates of infiltration and groundwater ~~water~~ flow volume under subsection (5)(f) of this section.

(vi) Step 6: Calculate a predicted ground water concentration. Calculate a predicted groundwater ~~water~~ concentration for each component by dividing the predicted soil pore water concentration for each component by a dilution factor to account for the dilution that occurs once the component enters ground water.

[220] Experience to date has shown that petroleum fraction analyses are quite variable and multiple samples are needed to adequately characterize a site. Table 747-6 is based on a review of site testing data.

[221] Moved up to new equation (equation 747-9).

(vii) Step 7: Establishing protective soil concentrations.

(A) Petroleum mixtures. For petroleum mixtures, compare the predicted groundwater ~~water~~ concentration for each component and for the total petroleum hydrocarbon mixture (sum of the petroleum components in the NAPL) with the applicable groundwater ~~water~~ cleanup level established under WAC 173-340-720.

(I) If the predicted groundwater ~~water~~ concentration for each of the components and for the total petroleum hydrocarbon mixture is less than or equal to the applicable groundwater ~~water~~ cleanup level, then the soil concentrations measured at the site are protective.

(II) If the condition in (d)(vii)(A)(I) of this subsection is not met, then the soil concentrations measured at the site are not protective. In this situation, the four-phase partitioning model can be used in an iterative process to calculate protective soil concentrations.

(B) Other mixtures. For mixtures that do not include petroleum hydrocarbons, compare the predicted groundwater ~~water~~ concentration for each hazardous substance in the mixture with the applicable groundwater ~~water~~ cleanup level established under WAC 173-340-720.

(I) If the predicted groundwater ~~water~~ concentration for each of the hazardous substances in the mixture is less than or equal to the applicable groundwater ~~water~~ cleanup level, then the soil concentrations measured at the site are protective.

(II) If the condition in (d)(vii)(B)(I) of this subsection is not met, then the soil concentrations measured at the site are not protective. In this situation, the four-phase partitioning model can be used in an iterative process to calculate protective soil concentrations.

(7) Leaching tests.

(a) Overview. This subsection specifies the procedures and requirements for deriving soil concentrations through the use of leaching tests. Leaching tests may be used to establish soil concentrations for the following specified metals: Arsenic, cadmium, total chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium, and zinc (see (b) and (c) of this subsection). Leaching tests may also be used to establish soil concentrations for other hazardous substances, including petroleum hydrocarbons, provided sufficient information is available to correlate leaching test results with groundwater ~~water~~ impacts (see (d) of this subsection). Testing of soil samples from the site is required for use of this method.

(b) Leaching tests for specified metals. If leaching tests are used to establish soil concentrations for the specified metals, the following two leaching tests may be used:

(i) EPA Method 1312, Synthetic Precipitation Leaching Procedure (SPLP). Fluid #3 (pH = 5.0), representing acid rain in the western United States, shall be used when conducting this test. This test may underestimate groundwater ~~water~~ impacts when acidic conditions exist due to significant biological degradation or for other reasons. Underestimation of groundwater ~~water~~ impacts may occur, for example, when soils contaminated with metals are located in wood waste, in municipal solid waste landfills, in high sulfur content mining wastes, or in other situations with a pH <6. Consequently, this test shall not be used in these situations and the TCLP test should be used instead.

(ii) EPA Method 1311, Toxicity Characteristic Leaching Procedure (TCLP). Fluid #1 (pH = 4.93), representing organic acids generated by biological degradation processes, shall be used when conducting this test. This test is intended to represent situations where acidic conditions are present due to biological degradation such as in municipal solid waste landfills. Thus, it may underestimate groundwater ~~water~~ impacts where this is not the case and the metals of interest are more soluble under alkaline conditions. An example of this would be arsenic occurring in alkaline (pH 8) waste or soils. Consequently, this test shall not be used in these situations and the SPLP test should be used instead.

(c) Criteria for specified metals. When using either EPA Method 1312 or 1311, the analytical methods used for analysis of the leaching test effluent shall be sufficiently sensitive to quantify hazardous substances at concentrations at the groundwater ~~water~~ cleanup level established under WAC 173-340-720. For a soil metals concentra-

tion derived under (b) of this subsection to be considered protective of groundwater ~~water~~, the leaching test effluent concentration shall meet the following criteria:

(i) For cadmium, lead and zinc, the leaching test effluent concentration shall be less than or equal to ten (10) times the applicable groundwater ~~water~~ cleanup level established under WAC 173-340-720.

(ii) For arsenic, total chromium, hexavalent chromium, copper, mercury, nickel and selenium, the leaching test effluent concentration shall be less than or equal to the applicable groundwater ~~water~~ cleanup level established under WAC 173-340-720.

(d) Leaching tests for other hazardous substances. Leaching tests using the methods specified in this subsection may also be used for hazardous substances other than the metals specifically identified in this subsection, including petroleum hydrocarbons. Alternative leaching test methods may also be used for any hazardous substance, including the metals specifically identified in this subsection. Use of the leaching tests specified in (b) and (c) of this subsection for other hazardous substances or in a manner not specified in (b) and (c) of this subsection, or use of alternative leaching tests for any hazardous substance, is subject to department approval and the user must demonstrate with site-specific field or laboratory data or other empirical data that the leaching test can accurately predict groundwater ~~water~~ impacts. The department will use the criteria in WAC 173-340-702 (14), (15) and (16) to evaluate the appropriateness of these alternative methods under WAC 173-340-702 (14), (15) and (16).

(8) Alternative fate and transport models.

(a) Overview. This subsection specifies the procedures and requirements for establishing soil concentrations through the use of fate and transport models other than those specified in subsections (4) through (6) of this section. These alternative models may be used to establish a soil concentration for any hazardous substance. Site-specific data are required for use of these models.

(b) Assumptions. When using alternative models, chemical partitioning and advective flow may be coupled with other processes to predict contaminant fate and transport, provided the following conditions are met:

(i) Sorption. Sorption values shall be derived in accordance with either subsection (4)(c) of this section or the methods specified in subsection (5)(b) of this section.

(ii) Vapor phase partitioning. If Henry's law constant is used to establish vapor phase partitioning, then the constant shall be derived in accordance with subsection (4)(d) of this section.

(iii) Natural biodegradation. Rates of natural biodegradation shall be derived from site-specific measurements.

(iv) Dispersion. Estimates of dispersion shall be derived from either site-specific measurements or literature values.

(v) Decaying source. Fate and transport algorithms may be used that account for decay over time.

(vi) Dilution. Dilution shall be based on site-specific measurements or estimated using a model incorporating site-specific characteristics. If detectable concentrations of hazardous substances are present in upgradient groundwater ~~water~~, then the dilution factor may need to be adjusted downward in proportion to the background (upgradient) concentration.

(vii) Infiltration. Infiltration shall be derived in accordance with subsection (5)(f)(ii)(A) or (B) of this section.

(c) Evaluation criteria. Proposed fate and transport models, equations, input parameters, and assumptions shall comply with WAC 173-340-702 (14), (15) and (16). The department may require submission of the model code and a demonstration that the model has been validated and calibrated to the site. [222]

(9) Empirical demonstration.

(a) Overview. This subsection specifies the procedures and requirements for demonstrating empirically that soil concentrations measured at the site will not cause an exceedance of the applicable groundwater ~~water~~ cleanup levels established under WAC 173-340-720. This

[222] As models become more sophisticated, Ecology needs to have access to the underlying equations and code to insure the model is being properly used.

empirical demonstration may be used for any hazardous substance. Site-specific data (such ase.g., groundwater ~~water~~ and soil samples) are required under this method. If the demonstrations required under (b) of this subsection cannot be made, then a protective soil concentration shall be established under one of the other methods specified in subsections (4) through (8) of this section.

(b) Requirements. To demonstrate empirically that measured soil concentrations will not cause an exceedance of the applicable groundwater ~~water~~ cleanup levels established under WAC 173-340-720, the following shall be demonstrated:

(i) The measured groundwater ~~water~~ concentration is less than or equal to the applicable groundwater ~~water~~ cleanup level established under WAC 173-340-720; and

(ii) The measured soil concentration will not cause an exceedance of the applicable groundwater ~~water~~ cleanup level established under WAC 173-340-720 at any time in the future. Specifically, it must be demonstrated that a sufficient amount of time has elapsed for migration of hazardous substances from soil into groundwater ~~water~~ to occur and that the characteristics of the site (such ase.g., depth to ground water and infiltration) are representative of future site conditions. This demonstration may also include a measurement or calculation of the attenuating capacity of soil between the source of the hazardous substance and the groundwater ~~water~~ table using site-specific data.

(c) Evaluation criteria. Empirical demonstrations shall be based on methods approved by the department. Those methods shall comply with WAC 173-340-702 (14), (15) and (16).

(10) Residual saturation.

(a) Overview. To ensure the soil concentrations established under one of the methods specified in subsections (4) through (9) of this section will not cause an exceedance of the groundwater ~~water~~ cleanup level established under WAC 173-340-720, the soil concentrations must not result in the accumulation of non-aqueous phase liquid on or in groundwater ~~water~~ (see subsection (2)(b) of this section). To determine if this criterion is met, either an empirical demonstration must be made (see (c) of this subsection) or residual saturation screening levels must be established and compared with the soil concentrations established under one of the methods specified in subsections (4) through (9) of this section (see (d) and (e) of this subsection). This subsection applies to any site where hazardous substances are present as a non-aqueous phase liquid (NAPL), including sites contaminated with petroleum hydrocarbons.

(b) Definition of residual saturation. When a non-aqueous phase liquid (NAPL) is released to the soil, some of the NAPL will be held in the soil pores or void spaces by capillary force. For the purpose of this subsection, the concentration of hazardous substances in the soil at equilibrium conditions is called residual saturation. At concentrations above residual saturation, the NAPL will continue to migrate due to gravimetric and capillary forces and may eventually reach the groundwater ~~water~~, provided a sufficient volume of NAPL is released.

(c) Empirical demonstration. An empirical demonstration may be used to show that soil concentrations measured at the site will not result in the accumulation of non-aqueous phase liquid on or in groundwater ~~water~~. An empirical demonstration may be used for any hazardous substance. Site-specific data (such ase.g., groundwater ~~water~~ and soil samples) are required under this method. If the demonstrations required under (c)(i) of this subsection cannot be made, then a protective soil concentration shall be established under (d) and (e) of this subsection.

(i) Requirements. To demonstrate empirically that measured soil concentrations will not result in the accumulation of non-aqueous phase liquid on or in groundwater ~~water~~, the following shall be demonstrated:

(A) Non-aqueous phase liquid has not accumulated on or in groundwater ~~water~~; and

(B) The measured soil concentration will not result in non-aqueous phase liquid accumulating on or in groundwater ~~water~~ at any time in the future. Specifically, it must be demonstrated that a sufficient amount of time has elapsed for migration of hazardous substances from soil into groundwater ~~water~~ to occur and that the

characteristics of the site (that ise.g., depth to groundwater water and infiltration) are representative of future site conditions. This demonstration may also include a measurement or calculation of the attenuating capacity of soil between the source of the hazardous substance and the groundwater water table using site-specific data.

(iii) Evaluation criteria. Empirical demonstrations shall be based on methods approved by the department. Those methods shall comply with WAC 173-340-702 (14), (15) and (16).

(d) Deriving residual saturation screening levels. Unless an empirical demonstration is made under (c) of this subsection, residual saturation screening levels shall be derived and compared with the soil concentrations derived under the methods specified in subsections (4) through (9) of this subsection to ensure that those soil concentrations will not result in the accumulation of non-aqueous phase liquid on or in groundwater water. Residual saturation screening levels shall be derived using one of the following methods.

(i) Default screening levels for petroleum hydrocarbons. Residual saturation screening levels for petroleum hydrocarbons may be obtained from the values specified in Table 747-5.

(ii) Site-specific screening levels. Residual saturation screening levels for petroleum hydrocarbons and other hazardous substances may be derived from site-specific measurements. Site-specific measurements of residual saturation shall be based on methods approved by the department. Laboratory measurements or theoretical estimates (i.e., those that are not based on site-specific measurements) of residual saturation shall be supported and verified by site data. This may include an assessment of groundwater water monitoring data and soil concentration data with depth and an analysis of the soil's texture (grain size), porosity and volumetric water content.

(e) Adjustment to the derived soil concentrations. After residual saturation screening levels have been derived under (d) of this subsection, the screening levels shall be compared with the soil concentrations derived under one of the methods specified in subsections (4) through (9) of this subsection. If the residual saturation screening level is greater than or equal to the soil concentration derived using these methods, then no adjustment for residual saturation is necessary. If the residual saturation screening level is less than the soil concentration derived using these methods, then the soil concentration shall be adjusted downward to the residual saturation screening level.

(11) Timing of empirical demonstrations. It is the department's expectation that in most cases empirical demonstrations under subsections (9) and (10)(c) of this section will be made prior to conducting the cleanup using data from the remedial investigation. However, in some cases it may be more appropriate to conduct the empirical demonstration using performance monitoring data after the cleanup is completed. In this later case, the department may approve of the empirical demonstration provided a post-remediation monitoring program and plan for contingent remedial action (should the cleanup not perform as expected) is established. In these cases, the cleanup shall be considered an interim action until adequate groundwater monitoring has been conducted demonstrating that the residual soil concentrations after cleanup are protective of groundwater. [223]

(12) Ground water monitoring requirements. The department may, on a case-by-case basis, require groundwater water monitoring to confirm that hazardous substance soil concentrations derived under this section meet the criterion specified in subsection (2) of this section.

[223] Making an up-front demonstration can be difficult at sites with extensive contamination. Allowing a post-remediation demonstration would be helpful in these cases. However, this means a cleanup level cannot be specified prior to beginning the cleanup. To address this concern, it is proposed to allow post-remediation demonstrations but to classify these cleanups as interim actions until an adequate empirical demonstration has been made. This is consistent with how this has been done at some sites to date.

Table 747-1 [224]
Soil Organic Carbon-Water Partitioning Coefficient (Koc) and Henry's Constant (Hcc) Values~~: Nonionizing Organics.~~

CAS Number	Hazardous Substance	Koc (ml/g)	Hcc (@13°C) (unitless)
83-32-9	Acenapthene	4,898	2.11E-03
75-07-0	Acetaldehyde		2.15E-03
75-05-8	Acetonitrile		8.37E-04
98-86-2	Acetophenone		1.61E-04
107-02-8	Acrolein		3.11E-03
107-13-1	Acrylonitrile		2.34E-03
309-00-2	Aldrin	48,685	1.60E-03
120-12-7	Anthracene	23,493	
56-55-3	Benz(a)anthracene	357,537	
71-43-2	Benzene	62	1.33E-01
50-32-8	Benzo(a)pyrene	968,774	
205-99-2	Benzo(b)fluoranthene		7.73E-04
207-08-9	Benzo(k)fluoranthene		
100-44-7	Benzylchloride		8.25E-03
92-52-4	Biphenyl		4.73E-03
111-44-4	Bis(2-chloroethyl)ether	76	2.93E-04
117-81-7	Bis(2-ethylhexyl)phthalate	111,123	
75-27-4	Bromodichloromethane		3.69E-02
75-25-2	Bromoform	126	1.16E-02
106-99-0	1,3-Butadiene		2.17E+00
85-68-7	Butyl benzyl phthalate	13,746	
75-15-0	Carbon disulfide		8.03E-01
56-23-5	Carbon tetrachloride	152	7.42E-01
57-74-9	Chlordane	51,310	5.15E-04
108-90-7	Chlorobenzene	224	7.87E-02
126-99-8	2-Chloro-1,3-butadiene		2.75E-01
124-48-1	Chlorodibromomethane		2.06E-02
75-45-6	Chlorodifluoromethane		8.61E-01
75-00-3	Chloroethane (ethyl chloride)		2.47E-01
67-66-3	Chloroform	53	9.15E-02
95-57-8	2-Chlorophenol		7.25E-03
75-29-6	2-Chloropropane		3.87E-01
218-01-9	Chrysene		7.13E-04
123-73-9	Crotonaldehyde (2-butenal)		4.37E-04
98-82-8	Cumene		2.55E-01

[224] This and other tables affiliated with Section 747 will remain in Section 900 of the rule. They are placed here to facilitate review. It is proposed to expand this table to include temperature adjusted Hcc values and add additional substances identified in the vapor intrusion guidance. Ecology is in the process of updating this table and compiling missing values.

CAS Number	Hazardous Substance	Koc (ml/g)	Hcc (@13°C) (unitless)
72-54-8	DDD	45,800	
72-55-9	DDE	86,405	1.87E-04
50-29-3	DDT	677,934	
53-70-3	Dibenzo(a,h)anthracene	1,789,101	
95-50-1	1,2-Dichlorobenzene (o)	379	3.54E-02
106-46-7	1,4-Dichlorobenzene (p)	616	4.61E-02
75-71-8	Dichlorodifluoromethane		8.10E+00
75-34-3	Dichloroethane-1,1 (1,1 DCA)	53	1.41E-01
107-06-2	Dichlororthane-1,2 (1,2 DCA)	38	2.28E-02
75-35-4	Dichloroethylene-1,1 (1,1 DCE)	65	7.06E-01
156-59-2	cis-1,2-Dichloroethylene		1.00E-01
156-60-5	Trans-1,2 Dichloroethylene	38	2.41E-01
78-87-5	Dichloropropane-1,2	47	6.47E-02
542-75-6	1,3-Dichloropropene	27	3.96E-01
60-57-1	Dieldrin	25,546	1.13E-04
84-66-2	Diethyl phthalate	82	
84-74-2	Di-n-butyl phthalate	1,567	
106-93-4	Ethylene dibromide (EDB)	66	1.54E-02
108-20-3	DiisopropylEther (isopropyl ether)		
72-20-8	Endrin	10,811	
115-29-7	Endosulfan	2,040	1.14E-04
60-29-7	Ethyl ether		8.76E-01
100-41-4	Ethyl benzene	204	1.63E-01
75-21-8	Ethylene oxide		1.54E-02
206-44-0	Fluoranthene	49,096	
86-73-7	Fluorene	7,707	8.58E-04
110-00-9	Furan		1.43E-01
76-44-8	Heptachlor	9,528	1.72E+01
118-74-1	Hexachlorobenzene	80,000	1.36E-02
319-84-6	a-HCH (a-BHC)	1,762	1.02E-04
319-85-7	b-HCH (b-BHC)	2,139	
58-89-9	g-HCH (Lindane)	1,352	1.34E-04
87-68-3	Hexachloro-1,3-butadiene		1.41E-01
67-72-1	Hexachloroethane		7.24E-02
77-47-4	Hexachlorocyclopentadiene		4.18E-01
110-54-3	Hexane		4.11E+01
74-90-8	Hydrogen cyanide		3.47E-03
193-39-5	Indeno(1,2,3-cd)pyrene		
7439-97-6	Mercury (elemental)		1.55E-01
1634-04-4	Methyl tert-butyl ether (MTBE)	11	1.59E-02
72-43-5	Methoxychlor	80,000	1.18E-04
126-98-7	Methacrylonitrile		5.70E-03
74-83-9	Methyl bromide (bromomethane)	9	1.78E-01

CAS Number	Hazardous Substance	Koc (ml/g)	Hcc @13°C)[1] (unitless)
74-87-3	Methyl chloride (chloromethane)	6	2.68E-01
74-95-3	Methylene bromide		1.96E-02
75-09-2	Methylene chloride	10	5.67E-02
108-87-2	Methylcyclohexane		2.39E+00
78-93-3	Methyl ethyl ketone (2-butanone)		1.31E-03
108-10-1	Methyl isobutyl ketone		2.92E-03
80-62-6	Methyl methacrylate		6.90E-03
90-12-0	1-methylnaphthalene		6.99E-03
91-57-6	2-Methylnaphthalene		6.99E-03
91-20-3	Naphthalene	1,191	8.24E-03
98-95-3	Nitrobenzene	119	3.96E-04
79-46-9	2-Nitropropane		2.60E-03
12674-11-2	PCB-Arochlor 1016	107,285	
12672-29-6	PCB-Arochlor 1248		
11097-69-1	PCB-Arochlor 1254		
11096-82-5	PCB-Arochlor 1260	822,422	
608-93-5	Pentachlorbenzene	32,148	
129-00-0	Pyrene	67,992	1.08E-04
100-42-5	Styrene	912	5.59E-02
630-20-6	1,1,1,2-Tetrachloroethane		4.59E-02
79-34-5	1,1,2,2,-Tetrachloroethane		6.96E-03
127-18-4	Tetrachloroethylene	265	3.98E-01
108-88-3	Toluene	140	1.48E-01
8001-35-2	Toxaphene	95,816	
120-82-1	1,2,4-Trichlorobenzene	1,659	2.37E-02
71-55-6	Trichloroethane-1,1,1	135	4.19E-01
79-00-5	Trichloroethane-1,1,2	175	1.97E-02
79-01-6	Trichloroethylene (TCE)	94	2.39E-01
75-69-4	Trichlorofluoromethane		2.67E+00
96-18-4	1,2,3-Trichloropropane		7.94E-03
76-13-1	1,1,2-Trichloro-1,2,2-		1.25E+01
95-63-6	1,2,4-Trimethylbenzene		1.15E-01
108-67-8	1,3,5-Trimethylbenzene		1.10E-01
108-05-4	Vinyl acetate		1.17E-02
75-01-4	Vinyl chloride (chloroethene)		8.07E-01
95-47-6	o-Xylene	241	1.06E-01
108-38-3	m-Xylene	196	1.51E-01
106-42-3	p-Xylene	311	1.58E-01

Sources: Except as noted below, the source of the Koc values is the 1996 *EPA Soil Screening Guidance: Technical Background Document and EPA Estimation Programs Interface (EPI) Suite, V.3.12, December 2005.* The values obtained from ~~this~~ these documents represent the geometric mean of a survey of values published in the scientific literature. ~~Sample populations ranged from 1-65.~~ EDB value from *ATSDR Toxicological Profile* (TP 91/13). MTBE value from *USGS Final Draft Report on Fuel Oxygenates* (March 1996). PCB-Arochlor values from 1994 *EPA Draft Soil Screening Guidance*.

1. 13°C is the average annual temperature for most of WA State which is generally considered representative of deeper soil (>5 feet) and groundwater temperatures.

Table 747-2
Predicted Soil Organic Carbon-Water Partitioning Coefficient (Koc) as a Function of pH: Ionizing Organics.

CAS Number	Hazardous Substance	Koc Value (ml/g)		
		pH = 4.9	pH = 6.8	pH = 8.0
65-85-0	Benzoic acid	5.5	~~0.6~~ 1.4	0.5
95-57-8	2-Chlorophenol	398	388	286
120-83-2	2-4-Dichlorophenol	159	147	72
25550-58-7	2-4-Dinitrophenol	0.03	0.01	0.01
87-86-5	Pentachlorophenol	9,055	592	410
4901-51-3	2,3,4,5-Tetrachlorophenol	17,304	4,742	458
58-90-2	2,3,4,6-Tetrachlorophenol	4,454	280	105
95-95-4	2,4,5-Trichlorophenol	2,385	1,597	298
88-06-2	2,4,6-Trichlorophenol	1,040	381	131

Source: 1996 *EPA Soil Screening Guidance: Technical Background Document and EPA Estimation Programs Interface (EPI) Suite, V.3.12, December 2005*. The predicted Koc values in this table were derived using a relationship from thermodynamic equilibrium considerations to predict the total sorption of an ionizable organic compound from the partitioning of its ionized and neutral forms.

Table 747-3
Metals Distribution Coefficients (Kd).

CAS Number	Hazardous Substance	Kd (L/kg)
7440-38-2	Arsenic	29
7440-43-9	Cadmium	6.7
7440-47-3	Total Chromium	1,000
18540-29-9	Chromium VI	19
7440-50-8	Copper	22
7439-97-6	Mercury	52
7440-02-0	Nickel	65
7439-92-1	Lead	10,000
7784-49-2	Selenium	5
7440-66-6	Zinc	62

Source: Multiple sources compiled by the Department of Ecology.

Table 747-4
Petroleum EC Fraction Physical / Chemical Values.

Fuel Fraction	Equivalent Carbon Number[1]	Water Solubility[2] (mg/L)	Molecular Weight[3] (g/mol)	Henry's Constant[4] (cc/cc)	Gram Formula Weight[5] (mg/mol)	Density[6] (mg/l)	Soil Organic Carbon-Water Partitioning Coefficient Koc[7] (L/kg)
ALIPHATICS							
EC 5 – 6	5.5	36.0	81.0	33.0	81,000	670,000	800
EC > 6 – 8	7.0	5.4	100.0	50.0	100,000	700,000	3,800
EC > 8 – 10	9.0	0.43	130.0	80.0	130,000	730,000	30,200
EC > 10 – 12	11.0	0.034	160.0	120.0	160,000	750,000	234,000
EC > 12 – 16	14.0	7.6E-04	200.0	520.0	200,000	770,000	5.37E+06
EC > 16 – 21	19.0	1.3 E-06	270.0	4,900	270,000	780,000	9.55E+09
EC > 21 – 34	28.0	1.5E-11	400.0	100,000	400,000	790,000	1.07E+10
AROMATICS							
EC > 8 – 10	9.0	65.0	120.0	0.48	120,000	870,000	1,580
EC > 10 – 12	11.0	25.0	130.0	0.14	130,000	900,000	2,510
EC > 12 – 16	14.0	5.8	150.0	0.053	150,000	1,000,000	5,010
EC > 16 – 21	19.0	0.51	190.0	0.013	190,000	1,160,000	15,800
EC > 21 – 34	28.0	6.6E-03	240.0	6.7E-04	240,000	1,300,000	126,000
TPH COMPONENTS							
Benzene	6.5	1,750	78.0	0.228	78,000	876,500	62.0
Toluene	7.6	526.0	92.0	0.272	92,000	866,900	140.0
Ethylbenzene	8.5	169.0	106.0	0.323	106,000	867,000	204.0
Total Xylenes[8] (average of 3)	8.67	171.0	106.0	0.279	106,000	875,170	233.0
n-Hexane[9]	6.0	9.5	86.0	74.0	86,000	659,370	3,410
MTBE[10]		50,000	88.0	0.018	88,000	744,000	10.9
Naphthalene	11.69	31.0	128.0	0.0198	128,000	1,145,000	1,191
1-Methyl Naphthalene[11]	13.0	25.0	142.0	0.021	142,000	1,025,000	2,530
2-MethylNaphthalene[11]	12.8	24.6	142.0	0.0212	142,000	990,000	2,480

Sources:

1 **Equivalent Carbon Number.** Gustafson, J.B. et al., *Selection of Representative TPH Fractions Based on Fate and Transport Considerations. Total Petroleum Hydrocarbon Criteria Working Group Series*, Volume 3 (1997) [hereinafter *Criteria Working Group*].

2 **Water Solubility.** For aliphatics and aromatics EC groups, *Criteria Working Group*. For TPH components except n-hexane, 1 & 2 methyl naphthalenes, and MTBE, *1996 EPA Soil Screening Guidance: Technical Background Document.*

3 **Molecular Weight.** *Criteria Working Group*.

4 **Henry's Constant.** For aliphatics and aromatics EC groups, *Criteria Working Group*. For TPH components except n-hexane, 1 & 2 methyl naphthalenes, and MTBE, *1996 EPA Soil Screening Guidance: Technical Background Document*.

5 **Gram Formula Weight (GFW).** Based on 1000 x Molecular Weight.

6 **Density.** For aliphatics and aromatics EC groups, based on correlation between equivalent carbon number and data on densities of individual hazardous substances provided in *Criteria Working Group*. For TPH components except n-hexane, 1 & 2 methyl naphthalenes, and MTBE, *1996 EPA Soil Screening Guidance: Technical Background Document.*

7 **Soil Organic Carbon-Water Partitioning Coefficient.** For aliphatics and aromatics EC groups, *Criteria Working Group.* For TPH components except n-hexane, 1 & 2 methyl naphthalenes, and MTBE, *1996 EPA Soil Screening Guidance: Technical Background Document.*

8 **Total Xylenes.** Values for total xylenes are a weighted average of m, o and p xylene based on gasoline composition data from the *Criteria Working Group* (m= 51% of total xylene; o = 28% of total xylene; and p = 21% of total xylene).

9 **n-Hexane.** For values other than density, *Criteria Working Group*. For the density value, *Hawley's Condensed Chemical Dictionary*, 11th ed., revised by N. Irving Sax and Richard J. Lewis (1987).

10 **MTBE.** *USGS Final Report on Fuel Oxygenates* (March 1996).

11 Density of 1-methy and 2-methyl sources: Verschueren, K.: Handbook of Environmental Data on Organic chemicals, volume 1-2, 4th ed., John Wiley & Sons, New York, NY, 2001, p42, V2 1513. Source of all other 1 & 2-methyl values is Oak Ridge National Laboratory. http://rais.ornl.gov/

Table 747-6 *[New Table]*
Recommended Minimum Number of Soil Samples to Adequately Characterize Petroleum Contaminated Soil using the VPH and EPH Methods

Soil Volume (cubic yards)[1]	Number of Soil Samples Tested for VPH/EPH [2]
0 to 100	2
101 to 1,000	3
1,001 to 50,000	5
50,001 to 100,000	10
>100,000	10 + 1 for each additional 50,000 cubic yards

1. Estimated soil stockpile volume or in-situ volume of petroleum contaminated soil.

2. Where a sites includes distinct areas contaminated with different products, this number of samples should be tested in each area.

NOTE: Additional samples may be required at sites with highly variable test results. Samples need to also be tested for the required hazardous substances in Table 830-1, in addition to analyzing for equivalent carbon (EC) fractions using the EPH and VPH methods. Each sample should also be tested using the NWTPH method for future compliance monitoring purposes.

WAC 173-340-7490 Terrestrial ecological evaluation procedures.
(1) Purpose
(2) Process overview
(3) Requirements
(4) Point of compliance
(5) Determining compliance
(6) Institutional controls
(7) Additional measures

WAC 173-340-7491 Terrestrial ecological evaluation exclusions.
(1) Criteria for determining that no further evaluation is required
- (a) Depth
- (b) Physical barriers
- (c) Developed areas
- (d) Background

WAC 173-340-7492 Applicability of a simplified terrestrial ecological evaluation.
(1) Natural areas
(2) Vulnerable species
(3) Extensive habitat
(4) Other

WAC 173-340-7493 Simplified terrestrial ecological evaluation procedures.
(1) Purpose.
(2) Applicability
(3) Evaluation process
- (a) Exposure analysis
- (b) Pathway analysis
- (c) Toxicity analysis

(4) Establishing ecologically protective soil concentrations

WAC 173-340-7494 Site-specific terrestrial ecological evaluation procedures.
(1) Purpose
(2) Applicability
(3) Procedure overview
(4) Step 1: Problem formulation
- (a) Contaminants of ecological concern
- (b) Exposure pathways
- (c) Terrestrial ecological receptors of concern
- (d) Toxicological assessment
- (e) Example
- (f) Relationship to remedy selection
- (g) Endpoints

(5) Step 2: Selecting appropriate evaluation methods
- (a) Table values
- (b) Soil bioassays
- (c) Wildlife exposure model
- (d) Biomarkers
- (e) Site-specific field studies
- (f) Weight of evidence
- (g) Literature survey
- (h) Other methods

(6) Uncertainty analysis
(7) Step 3: Establishing ecologically protective soil concentrations

WAC 173-340-7490 Terrestrial ecological evaluation procedures.

(1) Purpose.

(a) WAC 173-340-7490 through 173-340-~~7494~~ 7494 define the ~~goals~~ requirements and procedures the department will use for: [225]

(i) Determining whether a release of hazardous substances to soil may pose a threat to the terrestrial environment;

(ii) Characterizing existing or potential threats to soil biota and terrestrial plants ~~or~~ and animals exposed to hazardous substances in soil; ~~and~~

(iii) Establishing ~~site-specific cleanup standards for the protection of~~ soil concentrations that are protective of soil biota and terrestrial plants and animals~~.~~; and [226]

~~**(b)**~~**(iv)** ~~Information collected during a terrestrial ecological evaluation shall also be used in developing~~ Developing and evaluating cleanup action alternatives and ~~in~~ selecting a cleanup action protective of soil biota and terrestrial plants and animals. ~~under WAC 173-340-350 through 173-340-390. WAC 173-340-7490 through 173-340-7494 do not necessarily require a cleanup action for terrestrial ecological protection separate from a human health-based cleanup action. Where appropriate, a terrestrial ecological evaluation may be conducted so as to avoid duplicative studies of soil contamination that will be remediated to address other concerns, as provided in WAC 173-340-350(7)(c)(iii)(F)(II).~~ [227]

~~**(c)** These~~ **(b)** Detailed procedures are not ~~intended to be used~~ provided in WAC 173-340-7490 through 7494 to evaluate potential threats to ecological receptors in sediments, surface water, or wetlands. Procedures for sediment evaluations are described in WAC 173-340-760 and Chapter 173-240 WAC, and for surface water evaluations in WAC 173-340-730. Procedures for wetland evaluations shall be determined by the department on a case-by-case basis.

[Former 2 deleted and replaced with the following overview and figure 7490-1.]

(2) Process Overview. Terrestrial ecological evaluations must be conducted as part of the remedial investigation and feasibility study. The terrestrial ecological evaluation process includes the following steps (see figure 7490-1):

(a) Step 1 – Characterize the site. In the remedial investigation, identify and define the extent of habitat at a site and the surrounding areas, including wetlands, parks, natural forested areas, riparian areas, greenbelts, buffer zones and, fish and wildlife habitat conservation areas. Also identify any state or federally designated "endangered" or "threatened" species and state "priority species", "species of concern" or "sensitive" species that may be present on or near the site.

(b) Step 2 – Evaluate exclusions: Evaluate and document whether the site qualifies for an exclusion using the criteria in WAC 173-340-7491. Most sites in intensively developed areas are expected to qualify for an exclusion;

(c) Step 3 – Select evaluation method:

(i) Evaluate whether the site qualifies for a simplified terrestrial ecological evaluation using the criteria in WAC 173-340-7492. The simplified terrestrial ecological evaluation process is designed for addressing terrestrial ecological risk at sites with limited quality habitat and potential for soil biota, and terrestrial plants and animals to be exposed to hazardous substances.

(ii) If a site does not meet the criteria for a simplified evaluation, a site-specific terrestrial ecological evaluation must be conducted. The site-specific evaluation process is designed for addressing terrestrial ecological risk at any site, including sites with endangered or threatened

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[225] Rules establish requirements, not goals.

[226] The use of the term "concentrations" is intentional and is intended to clarify that values developed under these Sections only address the TEE pathway. This is different from a "cleanup standard" which considers all human health and ecological exposure pathways.

[227] The deleted language is now addressed in subsection (2), Step 5.

species. The person conducting the evaluation may also voluntarily elect to conduct a site specific terrestrial ecological evaluation at any site.

(d) Step 4 – Conduct the terrestrial ecological evaluation:

(i) Step 4a – Simplified evaluation. If the site is eligible for a simplified evaluation, conduct the evaluation using the procedures under WAC 173-340-7493.

(A) If the evaluation can be "ended" under WAC 173-340-7493(3)(a) or (b), document this in the remedial investigation and no further evaluation of terrestrial ecological risks is needed. *NOTE: Institutional controls are necessary where the evaluation relies on physical barriers to keep plants and animals from being exposed to residual contamination, or a conditional point of compliance is used. See WAC 173-340-7490(6).*

(B) If the evaluation cannot be "ended," use the values in table 749-2 as screening levels in the remedial investigation to identify all areas of the site posing a potential terrestrial ecological risk. If no value is provided in this table for a hazardous substance of concern, conduct bioassays and simplified wildlife exposure modeling to establish a screening level.

(ii) Step 4b – Site specific evaluation. If the site is ineligible for a simplified terrestrial ecological evaluation, conduct a site-specific evaluation using the procedures in WAC 173-340-7494.

(A) If the evaluation can be "ended" under WAC 173-340-7494(3)(c)(i), document this in the remedial investigation and no further evaluation of terrestrial ecological risks is needed.

(B) If the evaluation cannot be "ended," use the values in table 749-3 as screening levels in the remedial investigation to identify all areas of the site posing a potential terrestrial ecological risk. If no value is provided in this table for a hazardous substance of concern, use the procedures in WAC 173-340-7494 to establish a screening level.

(e) Step 5 – Identify areas of potential ecological concern. The terrestrial ecological risks are just one exposure pathway that must be considered in a site cleanup. In many cases, concentrations needed to protect human health, aquatic organisms, or other media like groundwater will be more stringent than those needed to protect soil biota and terrestrial plants and animals. At these sites, cleanup alternatives addressing these other exposure pathways will usually also address terrestrial ecological risks.

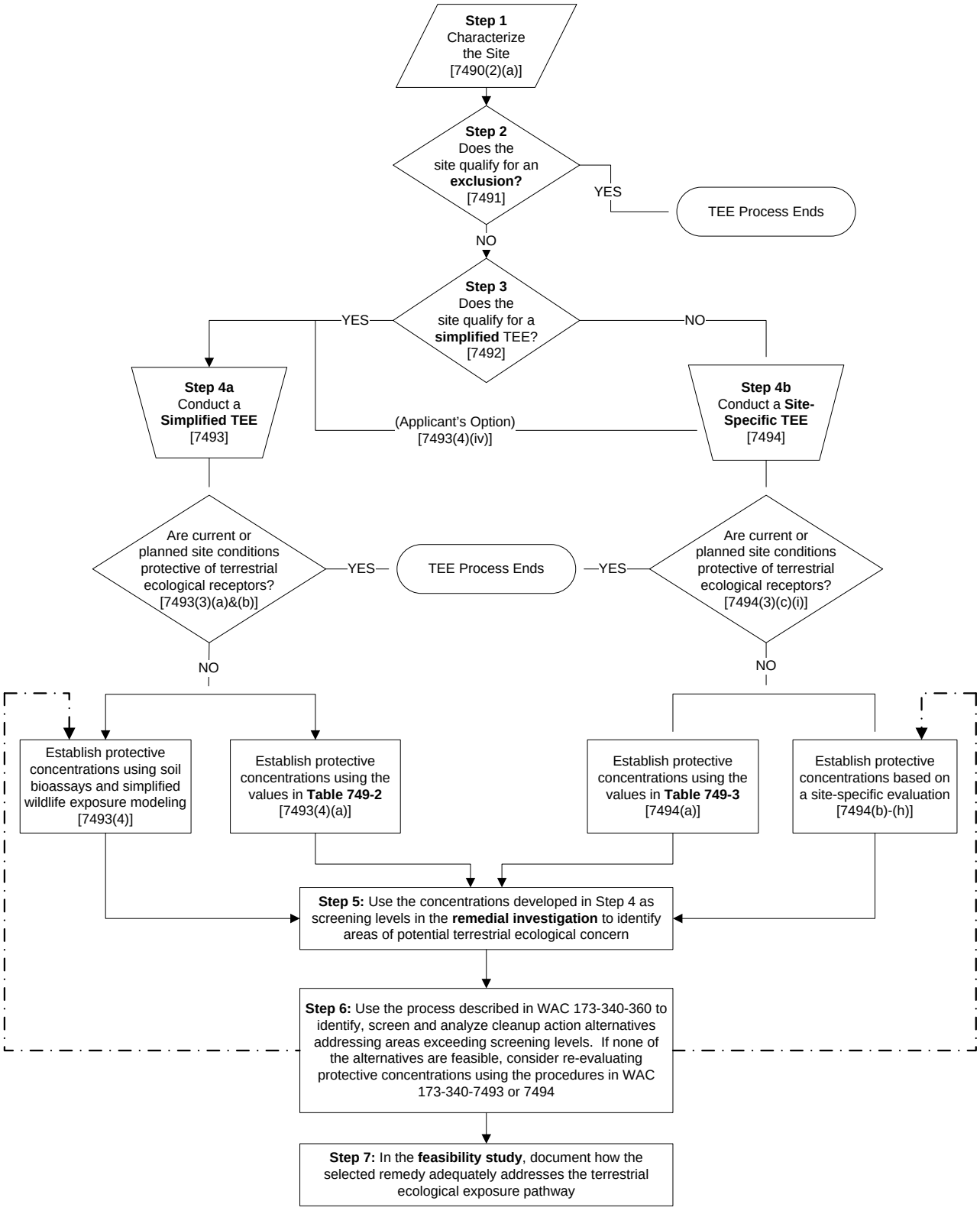
For substances or areas of the site where this is not the case, use the screening levels developed in Step 4 to identify cleanup alternatives to be evaluated in the feasibility study.

(f) Step 6 – Conduct the feasibility study. Follow the process described in WAC 173-340-360 to identify, screen and analyze cleanup action alternatives. If at any time in the process it is concluded that there are no feasible [228] alternatives meeting the screening levels established under steps 4 or 5 above, consider using other methods described in WAC 173-340-7493 (for simplified sites) or WAC 173-340-7494 (for any site) to establish different concentrations that are still protective of the terrestrial ecological exposure pathway.

(g) Step 7 – Document the process. In the feasibility study, document how the selected remedy adequately addresses the terrestrial ecological exposure pathway.

[228] "Feasible" in this context means meets the minimum requirements for cleanup actions under WAC 173-340-360, including being "permanent to the maximum extent practicable". *[this footnote will be added to the rule]*

Figure 7490-1: Schematic Diagram of the Terrestrial Ecological Evaluation (TEE) Process



NOTE: This figure is intended to help explain the terrestrial ecological evaluation process under this chapter. It does not establish or modify regulatory requirements. *[this footnote will be added to the rule]*

(3) Ecological Receptors. The following ecological receptors shall be addressed by terrestrial ecological evaluations: [229]

(a) The terrestrial ecological evaluation process is intended to protect terrestrial ecological receptors from exposure to contaminated soil with the potential to cause significant adverse effects.

For species protected under the Endangered Species Act or other applicable laws that extend protection to individuals of a species, a significant adverse effect means an impact that would significantly disrupt normal behavior patterns such as breeding, feeding, or sheltering. For all other species, significant adverse effects are effects that impair reproduction, growth or survival.

(b) For unrestricted land uses, the focus of the terrestrial ecological evaluation shall be on assessment and protection of terrestrial plants, wildlife, and ecologically important functions of soil biota that affect plants or wildlife.

(c) For industrial or commercial properties, the focus of the terrestrial ecological evaluation shall be on assessment and protection of terrestrial wildlife protection. Plants and soil biota need not be considered unless:

(i) The species is protected under the federal Endangered Species Act, Title 77 RCW, or Title 79 RCW; or [230]

(ii) The soil contamination is located on an area of an industrial or commercial property where vegetation must be maintained to comply with local government land use regulations.

d) Any terrestrial remedy, including exclusions, based at least in part on future land use assumptions shall include a completion date for such future development acceptable to the department.

(e) The potential impact of cleanup on existing especially valuable habitat, and established species in these areas, may be considered, along with the other requirements in WAC 173-340-360, when selecting a remedy. [231]

(i) Where a cleanup is selected under this provision that leaves residual concentrations in excess of cleanup levels based on a terrestrial ecological evaluation, an institutional control shall be required to preserve the habitat.

(ii) The department may require mitigation for the impacts on the environment (such as a reduction in habitat productivity) resulting from residual contamination left on-site under this provision.

(4) Point of compliance. [232]

(a) Standard point of compliance. The standard point of compliance for concentrations

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[229] Sections (3) - (7) have been extensively edited and supplemented. No substantive changes intended except as noted.

[230] New provision reflecting State protected species are provided the same protections under WA State law as federally protected species. Including them reflects current practice.

[231] New provision proposed to allow more explicit consideration of "net environmental benefit" in certain circumstances. This is an issue that has arisen during implementation of the TEE process. If included, the following definition will be added to Section 200.

"Especially valuable habitat" means:

(i) Habitat for threatened or endangered species protected under the federal Endangered Species Act;

(ii) Habitat for "priority species" or "species of concern" designated under Title 77 RCW;

(iii) Habitat for plant species classified as "endangered", "threatened", or "sensitive" under Title 79 RWC;

(iv) Wetlands and Fish and Wildlife habitat conservation areas designated as critical areas under Chapter 36.70A.170 RCW; and

(v) Areas designated as especially valuable habitat by the department in consideration of factors such as:

- The rarity of the habitat for the geographic area the site is located in;
- The size of the habitat;
- Whether the habitat functions as a wildlife corridor;
- Whether the habitat functions as a refuge or feeding area for migratory species;
- The structural diversity of the habitat;
- Surrounding habitat and land uses;
- Whether the habitat is manmade or natural;
- Whether cleanup would significantly disturb the ecological functions of the habitat;
- The level of human activity in the area; and,
- The length of time for recovery of the habitat after cleanup.

Examples of especially valuable habitat include some riparian areas and mature forested areas.

[232] (a) moved up from later in this subsection with editorial changes. Both (a) and (b) parallel language in Section 7406 (soil cleanup standards point of compliance).

developed under WAC 173-340-7490 through 7494 is throughout the soil at the site from the ground surface to a depth of fifteen feet. This represents a reasonable estimate of the depth of soil that could be excavated and re-distributed at the soil surface as a result of site development activities, potentially resulting in ecological receptors being exposed to contamination.

(b) Conditional point of compliance. A conditional point of compliance is throughout the soil at the site from the ground surface to the depth of the biologically active zone. The biologically active zone is assumed to extend to a depth of six feet. The department may approve a site-specific depth based on a demonstration that an alternative depth is more appropriate for the site. In making this demonstration, the following shall be considered:

(i) Depth to which soil macro-invertebrates are likely to occur;

(ii) Depth to which soil turnover (bioturbation) is likely to occur due to the activities of soil invertebrates;

(iii) Depth to which animals likely to occur at the site are expected to burrow;

(iv) Depth to which plant roots are likely to extend; and

(v) The presence of a manmade subsurface biological barrier (such as a geomembrane cap or cobble barrier designed to limit penetration by plant roots and burrowing animals).[233]

(5) Determining Compliance. Compliance with cleanup levels based on WAC 173-340-7490 through 7494 shall be determined using the procedures in WAC 173-340-7407.

(6) Institutional Controls. Institutional controls complying with WAC 173-340-440 shall be established whenever any of the following conditions exist: [234]

(a) The terrestrial ecological evaluation is based on an industrial or commercial land use, including use of values for industrial or commercial properties in tables 749-2 or 749-3. The institutional controls shall restrict future uses to industrial or commercial land uses;

(b) A conditional point of compliance has been established. The institutional controls shall restrict site uses and activities to prevent deeper hazardous substances from reaching the biologically active zone. This includes an exclusion under WAC 173-340-7491(2);

(c) The terrestrial ecological evaluation is based on man-made physical barriers (such as pavement and buildings) intended to prevent exposure of terrestrial ecological receptors to soil contamination. This includes an exclusion under WAC 173-340-7491(3). The institutional controls shall ensure the man-made barriers are not breached and are maintained as long as contamination remains on the site;

(d) The selected remedy is based on the presence of especially valuable habitat under provision (3)(e) of this section. The institutional controls shall ensure that this habitat remains intact as long as contamination remains on the site; or

(e) Other conditions where the department determines an institutional control is necessary to protect the environment.

(7) Additional measures. The department may require additional measures beyond those specified in WAC 173-340-7490 through 7494 to evaluate and address potential threats to terrestrial ecological receptors when, based upon a site-specific review, the department determines that such measures are necessary to protect the environment.

[233] New provision to explicitly acknowledge landfill caps and other forms of barriers to plant root penetration and burrowing animals as effective methods for establishing an alternative point of compliance.

[234] Moved up from Sections 7491-7493 to consolidate in one location.

WAC 173-340-7491 ~~Exclusions from a t~~Terrestrial ecological evaluation exclusions.

(1) Criteria. No further evaluation of risks to terrestrial ecological receptors is required if the department determines that a site meets any of the following criteria ~~in (a) through (d) of this subsection~~: [235]

(2) Depth. All soil contaminated with hazardous substances is, or will be, located below the point of compliance established under WAC 173-340-7490(4); [236]

(3) Physical barriers. All soil contaminated with hazardous substances is, or will be, covered by buildings, paved roads, pavement, thick crushed rock or gravel layers, or other physical barriers that are maintained to ~~will~~ prevent plants or wildlife from being exposed to the soil contamination; [237]

(4) Developed areas.

(a) For sites contaminated with hazardous substances other than those specified in ~~(c)(ii)~~(b) of this subsection, there is less than 1.5 acres of contiguous undeveloped land on ~~the site~~ or within 500 feet of any area of contaminated soil; and [238]

(b) For sites contaminated with chlorinated dioxins or furans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor or heptachlor epoxide, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, or pentachlorobenzene, there is less than 1/4 acre of contiguous undeveloped land, on or within 500 feet of any area of ~~the site affected by hazardous substances~~ soil contaminated with these hazardous substances. This list does not imply that sampling must be conducted for each of these ~~chemicals~~ substances at every site. Sampling should be conducted for ~~chemicals~~ these substances when they might be present based on available information, such as current and past uses of ~~chemicals~~ these substances at the site; or

(5) Background. Concentrations of all hazardous substances in soil do not exceed natural background levels, as determined under WAC 173-340-709.

~~(2) Procedure for a site that does not qualify for an exclusion.~~

[Deleted and moved to Section 7492]

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[235] This section has been substantially edited to make it more readable. The discussion of institutional controls and definition of "undeveloped land" has been moved to other sections and these provisions are not shown to facilitate review.

[236] Institutional control language moved to 7490(6)(c).

[237] Crushed rock added as a potentially effective physical barrier to plants and wildlife as this has been found effective as some sites. For barriers to be effective, they must be maintained, and this is reflected in the added language. Institutional control language has been moved to 7490(6)(c).

[238] There has been some confusion as to whether "site" means the entire property or multiple properties making up the site or just the area of contaminated soil. These changes and similar changes in (ii) are intended to clarify that the "site" as used here means the area of contaminated soil.

[Section 7492 has been deleted and replaced with the following from Section 7491(2).] [239]

WAC 173-340-7492 Applicability of a simplified terrestrial ecological evaluation.

(1) Criteria. A simplified terrestrial ecological evaluation may be conducted at a site unless any of the following conditions exist:

(2) Natural areas. The site is located on, or directly adjacent to, an area where management or land use plans will maintain or restore native or seminative vegetation (e.g., green-belts, protected wetlands, forestlands, riparian areas, locally designated environmentally sensitive areas, open space areas managed for wildlife, and some parks or outdoor recreation areas. This does not include park areas used for intensive sport activities such as baseball or football); [240]

(3) Vulnerable species. The site is used by:

(i) A threatened or endangered species protected under the federal Endangered Species Act;

(ii) A wildlife species classified by the Washington state department of fish and wildlife as a "priority species" or "species of concern" under Title 77 RCW; or

(iii) A plant species classified by the Washington state department of natural resources natural heritage program as "endangered," "threatened," or "sensitive" under Title 79 RCW.

For plants, "used" means that a plant species grows at the site or has been found growing at the site. For animals, "used" means that individuals of a species have been observed to live, feed or breed at the site;

(4) Extensive habitat. ~~The site is located on a property that contains~~ There is at least ten acres of native vegetation on or within 500 feet of ~~the site~~ any area of contaminated soil; or [241]

(5) Other. The department determines that the site may present a risk to significant wildlife populations.

[239] Original 7492 deleted and the criteria moved here from 7491(2) with changes highlighted. Deleted Section not shown to facilitate review. Except as noted, no substantive changes from current practice are intended.

[240] Riparian areas are added since these are prime habitat areas

[241] This total applies whether or not the 10 acres is fragmented into smaller areas. *[Footnote to be in rule.]* There has been some confusion as to whether "site" as used here means the entire property or multiple properties making up the site or just the area of contaminated soil. These changes are intended to clarify that the "site" as used here means the area of contaminated soil. Also, the 10 acres no longer is limited to the property that the source of contaminated is located on as ecological receptors are not limited by property boundaries.

[Section 7493 has been deleted and replaced with the following from Section 7492.] [242]

WAC 173-340-7493 Simplified terrestrial ecological evaluation procedures.

(1) Purpose. The purpose of this section is to establish procedures for conducting simplified terrestrial ecological evaluations and establishing soil concentrations protective of soil biota, plants and animals, as applicable, at these sites.

(2) Applicability. The simplified terrestrial ecological evaluation process is designed for assessing terrestrial ecological risk at sites with limited habitat and potential for plants and animals to be exposed to hazardous substances. A simplified terrestrial ecological evaluation process may only be used at sites eligible under WAC 173-340-7492 or where the department has determined under WAC 173-340-7494(3)(c)(ii) that a simplified evaluation can be conducted.

(3) Evaluation Process. The simplified evaluation process includes three steps that can be conducted in any order. The evaluation process can be ended if any one step indicates that no further evaluation is necessary.

(a) Exposure analysis. The evaluation may be ended where:

(i) The total area of soil contamination at the site is not more than 350 square feet; or [243]

(ii) Land use within the area of contaminated soil and surrounding area makes substantial wildlife exposure unlikely. Table 749-1 shall be used to make this evaluation.

(b) Pathways analysis. The evaluation may be ended if there are no potential exposure pathways from soil contamination to soil biota, plants or wildlife. For a commercial or industrial property, only potential exposure pathways to wildlife (such as small mammals and birds) need be considered. Only exposure pathways for priority contaminants of ecological concern listed in Table 749-2 at or above the concentrations provided must be considered. Incomplete pathways may be due to the presence of man-made physical barriers, either currently existing or to be placed (within a time frame acceptable to the department) as part of a remedy or land use.

(c) Toxicity analysis. The evaluation may be ended if all of the following conditions are met at the site:

(i) For hazardous substances with a value listed in Table 749-2, soil concentrations at the point of compliance do not exceed the applicable concentrations in this table;

(ii) For hazardous substances listed in Table 749-2 but without a value, it is demonstrated that soil concentrations at the point of compliance are unlikely to be toxic or bioaccumulate based on bioassay procedures and wildlife exposure modeling described in subsection 4 of this section and approved by the department; and,

(iii) For other hazardous substances, the substances are not listed in Table 749-2.

(4) Establishing ecologically protective soil concentrations. Soil concentrations shall be established to protect soil biota and terrestrial plants and animals, as appropriate, at sites not meeting the criteria in subsection (3) of this section for ending the evaluation. The soil concentrations can be established using the following methods. [244]

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[242] The existing language in Section 7492 has been substantially reorganized and edited to improve readability. Changes are not shown to facilitate review. Except as noted, no substantive changes from current practice are intended.

[243] This total applies whether or not the area of contamination is fragmented into smaller areas. *[Footnote to be in rule.]*

[244] The current rule is confusing regarding options for setting cleanup levels for simplified TEEs. This is intended to more explicitly describe options for setting concentration protective of terrestrial ecological receptors. Bioassays can be used to determine if a substance is toxic to soil biota (worms) and plants. But to determine if a substance will bioaccumulate to levels that harm animals, wildlife exposure modeling must be conducted. Since table values are based on a mixture of toxicity and bioaccumulation, both exposures must be addressed to override a table value or fill in blank values in the table. A site-specific TEE should be used if other modifications to the equations or other methods are proposed as that involves a more complex set of

(a) Concentrations in Table 749-2;

(b) Concentrations derived using bioassay procedures described in WAC 173-340-7494(5) to determine concentrations toxic to soil biota and plants, and concentrations likely to bioaccumulate to toxic levels in animals as follows. Consult with the department before conducting bioassays;

(i) For values in Table 749-2 based on toxicity to soil biota or plants, bioassays may be used to override the concentrations in that table.

(ii) Bioassays may also be used to develop site-specific concentrations based on toxicity to soil biota and plants for substances listed in Table 749-2 but without a value.

(iii) For values in Table 749-2 based on modeling of bioaccumulation in wildlife and for substances listed in Table 749-2 but without a value, bioassays can be used to develop a site-specific earthworm bioaccumulation and/or plant uptake factor for use in the model described in Table 749-4. When using this model to develop protective soil concentrations for simplified ecological evaluations under this provision, all the other default values in the model must be used; or [245]

(c) The person conducting the evaluation may also voluntarily elect to develop protective soil concentrations using a site specific terrestrial ecological evaluation under WAC 173-340-7494 instead of under this section.

considerations not suitable for the simplified approach addressed here.

[245] Modeling is constrained to changing the BAF for simplicity. If further model changes are proposed, they should be conducted under the site-specific risk assessment process.

[Section 7494 has been deleted and replaced with the following from Section 7493.] [246]

WAC 173-340-7494 Site-specific terrestrial ecological evaluation procedures.

(1) Purpose. The purpose of this section is to establish procedures for conducting site-specific terrestrial ecological evaluations. The site-specific evaluation process is designed for assessing terrestrial ecological risk at any site, including sites with protected status species.

(2) Applicability. A site-specific terrestrial ecological evaluation is required if the site meets any of the conditions in WAC 173-340-7492. The person conducting the evaluation may also voluntarily elect to conduct a site-specific terrestrial ecological evaluation.

(3) Procedure overview. A site-specific terrestrial ecological evaluation shall include the following steps. Implementation of these steps shall be done in consultation with the department and must be approved by the department.

(a) Problem formulation as described in subsection (4) of this section.

(b) Selection of one or more appropriate evaluation methods under subsection (5) of this section for addressing issues identified in the problem formulation.

(c) Conducting the evaluation using the procedures in subsections (5) through (9) of this section.

(d) After reviewing information developed in the problem formulation, the department may at its discretion determine that:

(i) The cleanup planned to address human health or aquatic impacts will also adequately protect soil biota, plants and animals. In this case, no further evaluation of terrestrial ecological risk is required; or

(ii) A simplified, rather than a site-specific, terrestrial ecological evaluation may be conducted under WAC 173-340-7493 because a simplified evaluation will adequately identify and address any existing or potential threats to ecological receptors.

~~(2)~~(4) Step 1: Problem formulation ~~step~~. [247]

~~(a)~~ To define the focus of the site-specific terrestrial ecological evaluation, identify issues to be addressed in the evaluation, specifying:

~~(i)~~(a) ~~The chemicals~~ Contaminants of ecological concern. Identify the contaminants of ecological concern at the site. The person conducting the evaluation may eliminate hazardous substances from further consideration where the ~~maximum or the upper ninety-five percent confidence limit~~ soil concentrations found at the site do~~es~~ not exceed ~~ecological indicator concentrations described~~ the screening levels in Table 749-3. [248] For industrial or commercial land uses, only the wildlife values need to be considered. Any ~~chemical~~ contaminant that exceeds ~~the ecological indicator concentrations~~ these screening levels shall be included as a ~~chemical~~ contaminant of ecological concern in the evaluation unless it can be eliminated based on the factors listed in WAC 173-340-~~708 (2)(b)~~703. *(Caution on the use of ecological indicator concentrations: These numbers are not cleanup levels, unless selected as such on a site-specific basis, and concentrations that exceed the number do not necessarily require remediation.)* [249]

~~(ii)~~(b) Exposure pathways. Identify any complete potential pathways for exposure of

[246] Subsections (1) – (3) have been heavily edited and the changes are not shown to facilitate review. No substantive changes are intended.

[247] All changes to this subsection are intended to be editorial unless otherwise noted.

[248] Section 7490(5) describes the statistical and other procedures for determining compliance with soil cleanup standards. The UCL is only one allowable method.

[249] The term "screening levels" has been substituted for "indicator concentrations" to more accurately reflect their role in the TEE process. As stated in earlier sections, the screening levels in Table 749-3 can be used as cleanup levels if the person doing the cleanup elects to do so. The note has been changed to reflect this possible outcome.

plants or animals to the ~~chemicals~~ contaminants of concern. If there are no complete exposure pathways then no further evaluation is necessary. Incomplete pathways may be due to the presence of man-made physical barriers, either currently existing or to be placed (within a time frame acceptable to the department) as part of a remedy or land use.

~~To ensure that such man-made barriers are maintained, a restrictive covenant shall be required by the department under WAC 173-340-440 under a consent decree, agreed order or enforcement order, or as a condition to a written opinion regarding the adequacy of an independent remedial action under WAC 173-340-515(3).~~ [250]

~~(iii)~~(c) Terrestrial ecological receptors of concern. Identify current or potential future terrestrial ~~species~~ ecological receptor groups reasonably likely to live or feed at the site. Groupings should represent taxonomically related species with similar exposure characteristics. Examples of potential terrestrial species groups include: ~~V~~ Soil-associated invertebrates, vascular plants, ground-feeding birds, ground-feeding small mammal predators, and herbivorous small mammals.

~~(A)~~(i) From these terrestrial species groups, select those groups to be included in the evaluation. If appropriate, individual terrestrial receptor species may also be included. In selecting species groups or individual species, the following shall be considered:

~~(I)~~(A) Receptors that may be most at risk for significant adverse effects based on the toxicological characteristics of the ~~chemicals~~ contaminants of concern, the sensitivity of the receptor, and on the likely degree of exposure.

~~(II)~~(B) Public comments.

~~(III)~~(C) Species protected under applicable state or federal laws that may potentially be exposed to ~~soil contaminants~~ hazardous substances in the soil at the site.

~~(IV)~~(D) Receptors to be considered under different land uses, described under WAC 173-340-7490 (3)~~(b)~~.

~~(B)~~(ii) Surrogate species for which greater information is available, or that are more suitable for site-specific studies, may be used in the analysis when appropriate for addressing issues raised in the problem formulation step. Selection of surrogate species must conform to subsection (9) of this section. [251]

~~(iv)~~(d) Toxicological assessment. Identify significant adverse effects in the receptors of concern that may result from exposure to the ~~chemicals~~ contaminants of concern, based on information from the toxicological literature.

~~(b)~~(e) Example. The following is an example of a site-specific issue developed in this step: Is dieldrin contamination a potential threat to reproduction in birds feeding on invertebrates and ingesting soil at the site? If so, what measures will eliminate any significant adverse effects?

~~(c)~~(f) Relationship to remedy selection. If there are identified information needs for remedy selection ~~or remedial design~~, these should also be developed as issues for the problem formulation process. [252]

~~(d)~~(g) Endpoints. The use of assessment and measurement endpoints, as defined in USEPA *Ecological Risk Assessment Guidance for Superfund*, 1997, ~~should~~ shall be considered to clarify the logical structure of the site-specific terrestrial ecological evaluation under this chapter. Assessment endpoints shall be consistent with the ~~policy objectives described~~ requirements in WAC 173-340-7490 (3)~~(b)~~.

~~(3)~~(5) ~~Selection of~~ Step 2: Selecting appropriate ~~terrestrial ecological~~ evaluation methods. If it is determined during ~~the~~ problem formulation ~~step~~ that further evaluation is necessary, ~~the soil concentrations listed in Table 749-3 may be used as the cleanup level at the discretion of the person conducting the evaluation. Alternatively,~~ one or more of the following methods shall be used to further evaluate terrestrial ecological effects and, if necessary, establish soil concentrations protective of terrestrial ecological receptors. ~~listed in (a)~~

[250] Now addressed in 7490.

[251] To clarify the standard used to evaluate surrogate species.

[252] Remedial design has been deleted since problem formulation occurs well before this stage of the process.

~~through (g) of this subsection that are relevant~~ When selecting a method, consideration shall be given to the relevance of the method to the issues identified ~~in the~~ during problem formulation ~~step and that meet the requirements of WAC 173-340-7490 (1)(a) shall be conducted~~. The alternative methods available for conducting a site-specific terrestrial ecological evaluation include the following: [253]

(a) Table values. At the discretion of the person conducting the evaluation, the values in Table 749-3 may be used as the cleanup level where terrestrial ecological risk controls the cleanup level. [254]

~~**Literature survey.** An analysis based on a literature survey shall be conducted in accordance with subsection (4) of this section and may be used for purposes including the following:~~

~~**(i)** Developing a soil concentration for chemicals not listed in Table 749-3.~~

~~**(ii)** Identifying a soil concentration for the protection of plants or soil biota more relevant to site-specific conditions than the value listed in Table 749-3.~~

~~**(iii)** Obtaining a value for any of the wildlife exposure model variables listed in Table 749-5 to calculate a soil concentration for the protection of wildlife more relevant to site-specific conditions than the values listed in Table 749-3.~~ [255]

(b) Soil bioassays.

(i) Bioassays may use sensitive surrogate organisms not necessarily found at the site provided that the test adequately addresses the issues raised in the problem formulation ~~step~~. For issues where existing or potential threats to plant life are a concern, use the test described in *Early Seedling Growth Protocol for Soil Toxicity Screening* ~~.~~, Ecology Publication No. 96-324 ~~may be used~~. For sites where risks to soil biota are a concern, use the test described in *Earthworm Bioassay Protocol for Soil Toxicity Screening* ~~.~~, Ecology Publication No. 96-327 ~~may be used~~. Other bioassay tests approved by the department may also be used.

(ii) Soil concentrations protective of soil biota or plants may also be established with soil bioassays that use species ecologically relevant to the site rather than standard test species. Species that do or could occur at the site are considered ecologically relevant.

(c) Wildlife exposure model. Modeling may be used to determine soil concentrations protective of terrestrial wildlife using the ~~E~~equations and exposure parameters ~~to be used in calculating soil concentrations protective of terrestrial wildlife are provided~~ in Tables 749-4 and 749-5. Changes to this model may be approved by the department under the following conditions:

(i) Alternative values for parameters listed in Table 749-5 may be used if they can be demonstrated to be more relevant to site-specific conditions (for example, the value is based on a chemical form of a hazardous substance actually present at the site). A~~n a~~lternative value~~s~~ obtained from the literature shall be supported by a literature survey conducted in accordance with ~~subsection (4)~~ provision (5)(g) of this section and are subject to the new scientific information requirements in WAC 173-340-702 (14), (15) and (16). [256]

(ii) Receptor species of concern or exposure pathways identified in the problem formulation step may be added to the model if appropriate on a site-specific basis.

(iii) ~~A substitution for one or more of the receptor species listed in Table 749-4 may be made under subsection (7) of this section.~~ Substitutions of receptor species and the associated values in the wildlife exposure model described in Table 749-4 may be made subject to the following conditions: [257]

(A) There is scientifically supportable evidence that a receptor identified in Table 749-4 is not characteristic or a reasonable surrogate for a receptor that is characteristic of the ecoregion where the site is located. "Ecoregions" are defined using EPA's *Ecoregions of the Pacific Northwest* Document No. 600/3-86/033 July 1986 by Omernik and Gallant.

[253] All changes to this subsection are editorial changes.
[254] Moved from (5).
[255] Moved to later in this subsection.
[256] Moved up from former subsection (6).
[257] Moved up from former subsection (7).

(B) The proposed substitute receptor is characteristic of the ecoregion where the site is located and will serve as a surrogate for wildlife species that are, or may become exposed to hazardous substances in the soil at the site. The selected surrogate shall be a species that is expected to be vulnerable to the effects of soil contamination relative to the current default species because of high exposure or known sensitivity to hazardous substances found in soil at the site.

(C) Scientific studies concerning the proposed substitute receptor species are available in the literature to select reasonable maximum exposure estimates for variables listed in Table 749-4.

(D) In choosing among potential substitute receptor species that meet the criteria in provisions (iii)(B) and (C) of this subsection, preference shall be given to the species most ecologically similar to the default receptor being replaced.

(E) Unless there is clear and convincing evidence that they are not characteristic of the ecoregion where the site is located, the following groups shall be included in the wildlife exposure model: A small mammalian predator on soil-associated invertebrates, a small avian predator on soil-associated invertebrates, and a small mammalian herbivore. Selected groups should have a small foraging range.

(F) To account for uncertainties in the level of protection provided to substitute receptor species and toxicologically sensitive species, the department may require any of the following:

(I) Use of toxicity reference values based on no observed adverse effects levels.

(II) Use of uncertainty factors to account for extrapolations between species in toxicity or exposure parameter values; or

(III) Use of a hazard index approach for multiple hazardous substances to account for additive toxic effects.

(d) Biomarkers. Biomarker methods may be used if the measurements have clear relevance to issues raised in the problem formulation and the approach has a high probability of detecting a significant adverse effect if it is occurring at the site. The person conducting the evaluation may elect to use criteria such as biomarker effects that serve as a sensitive surrogate for significant adverse effects.

(e) Site-specific field studies. Site-specific empirical studies that involve hypothesis testing should use a conventional "no difference" null hypothesis (that is, H_0: Earthworm densities are the same in the contaminated area and the reference (control) area. H_A: Earthworm densities are higher in the reference area than in the contaminated area). In preparing a work plan, consideration shall be given to the adequacy of the proposed study to detect an ongoing adverse effect and this issue shall be addressed in reporting results from the study.

(f) Weight of evidence. A weight of evidence approach shall include a balance in the application of literature, field, and laboratory data, recognizing that each has particular strengths and weaknesses. Site-specific data shall be given greater weight than default values or assumptions where appropriate.

(g) ~~Other methods approved by the department.~~ ~~This may include a qualitative evaluation if relevant toxicological data are not available and cannot be otherwise developed (e.g., through soil bioassay testing).~~ [258]

~~(4)~~ Literature surveys.

(i) An analysis based on a literature survey may be used for: [259]

(A) Developing a soil concentration for contaminants of concern not listed in Table 749-3.

(B) Identifying a soil concentration for the protection of plants or soil biota more relevant to site-specific conditions than the value listed in Table 749-3.

(C) Obtaining a value for any of the wildlife exposure model variables listed in Table 749-5 to calculate a soil concentration for the protection of wildlife more relevant to site-specific conditions than the values listed in Table 749-3.

~~(a)~~(ii) When using a literature survey, the following requirements must be met:

(A) Toxicity reference values or soil concentrations established from the literature shall represent the lowest relevant LOAEL found in the

[258] Moved to later in this subsection.
[259] Moved here from former subsection(3)(a).

literature. Bioaccumulation factor values shall represent a reasonable maximum value from relevant information found in the literature. In assessing relevance, the following principles shall be considered:

~~(i)~~**(B)** Literature benchmark values should be obtained from studies that have test conditions as similar as possible to site conditions.

~~(ii)~~**(C)** The literature benchmark values or toxicity reference values should correspond to the exposure route being assessed.

~~(iii)~~**(D)** The toxicity reference value or bioaccumulation factor value shall be as appropriate as possible for the receptor being assessed. The toxicity reference value should be based on a significant endpoint, as described in subsection ~~(2)~~(4)(g) of this section.

~~(iv)~~**(E)** The literature benchmark value or toxicity reference value should preferably be based on chronic exposure.

~~(v)~~**(F)** The literature benchmark value, toxicity reference value, or bioaccumulation factor should preferably correspond to the chemical form being assessed. Exceptions may apply for toxicity reference values where documented biological transformations occur following uptake of the chemical or where chemical transformations are known to occur in the environment under conditions appropriate to the site.

(b) A list of relevant journals and other literature consulted in the survey shall be provided to the department. A table summarizing information from all relevant studies shall be provided to the department in a report, and the studies used to select a proposed value shall be identified. Copies of literature cited in the table that are not in the possession of the department shall be provided with the report. The department may identify relevant articles, books or other documents that shall be included in the survey.

(h) Other methods. The department may approve of other methods for conducting a terrestrial ecological evaluation. This may include a qualitative evaluation if relevant toxicological data are not available and cannot be otherwise developed (e.g., through soil bioassay testing).[260]

~~(5)~~**(6) Uncertainty analysis.** If a site-specific terrestrial ecological evaluation includes an uncertainty analysis, the discussion of uncertainty shall identify and differentiate between uncertainties that can and cannot be quantified, and natural variability. The discussion shall describe the range of potential ecological risks from the hazardous substances present at the site, based on the toxicological characteristics of the hazardous substances present, and evaluate the uncertainty regarding these risks. Potential methods for reducing uncertainty shall also be discussed, such as additional studies or post-remedial monitoring. If multiple lines of independent evidence have been developed, a weight of evidence approach may be used in characterizing uncertainty.

~~**(6) New scientific information.** The department shall consider proposals for modifications to default values provided in this section based on new scientific information in accordance with WAC 173-340-702 (14), (15) and (16).~~[261]

~~**(7) Substitute receptor species.** Substitutions of receptor species and the associated values in the wildlife exposure model described in Table 749-4 may be made subject to the following conditions:~~[262]

~~**(a)** There is scientifically supportable evidence that a receptor identified in Table 749-4 is not characteristic or a reasonable surrogate for a receptor that is characteristic of the ecoregion where the site is located. "Ecoregions" are defined using EPA's *Ecoregions of the Pacific Northwest* Document No. 600/3-86/033 July 1986 by Omernik and Gallant.~~

~~**(b)** The proposed substitute receptor is characteristic of the ecoregion where the site is located and will serve as a surrogate for wildlife species that are, or may become exposed to soil contaminants at the site. The selected surrogate shall be a species that is expected to be vulnerable to the effects of soil contamination relative to the current default species because of high exposure or known sensitivity to hazardous substances found in soil at the site.~~

[260] Moved here from earlier in this Section.

[261] Subsection (6) moved up to earlier in this Section.

[262] Subsection (7) moved up to earlier in this Section.

~~**(c)** Scientific studies concerning the proposed substitute receptor species are available in the literature to select reasonable maximum exposure estimates for variables listed in Table 749-4.~~

~~**(d)** In choosing among potential substitute receptor species that meet the criteria in (b) and (c) of this subsection, preference shall be given to the species most ecologically similar to the default receptor being replaced.~~

~~**(e)** Unless there is clear and convincing evidence that they are not characteristic of the ecoregion where the site is located, the following groups shall be included in the wildlife exposure model: A small mammalian predator on soil-associated invertebrates, a small avian predator on soil-associated invertebrates, and a small mammalian herbivore.~~

~~**(f)** To account for uncertainties in the level of protection provided to substitute receptor species and toxicologically sensitive species, the department may require any of the following:~~

~~**(i)** Use of toxicity reference values based on no observed adverse effects levels.~~

~~**(ii)** Use of uncertainty factors to account for extrapolations between species in toxicity or exposure parameter values; or~~

~~**(iii)** Use of a hazard index approach for multiple contaminants to account for additive toxic effects.~~

(7) Step 3: Establishing ecologically protective soil concentrations. Soil concentrations shall be established to protect soil biota and terrestrial plants and animals, as appropriate, at sites not meeting the criteria in subsection (3) of this section for ending the evaluation or conducting a simplified evaluation. The soil concentrations shall be established using one or a combination of the following methods as provided for in this section: [263]

(a) The values in Table 749-3;

(b) Soil bioassays;

(c) Wildlife exposure modeling;

(d) Biomarkers;

(e) Site-specific field studies;

(f) Weight of the evidence;

(g) Literature survey;

and,

(h) Other methods approved by the department.

[263] Summarizes methods described in this Chapter.

~~**WAC 173-340-7494 Priority contaminants of ecological concern.** When the department determines that such measures are necessary to protect the environment, the department may revise the hazardous substances and corresponding concentrations included in Table 749-2, subject to the following:~~

~~**(1)** The data indicate a significant tendency of the hazardous substance to persist, bioaccumulate, or be highly toxic to terrestrial ecological receptors;~~

~~**(2)** The concentrations for hazardous substances listed in Table 749-2 shall be based on protection of wildlife for industrial and commercial land uses, and upon protection of plants and animals for other land uses.~~

~~[Statutory Authority: Chapter 70.105D RCW. 01-05-024 (Order 97-09A), § 173-340-7494, filed 2/12/01, effective 8/15/01.]~~ [264]

[264] Unnecessary provision proposed for deletion. Any changes to the Tables require rulemaking and cannot be done administratively as suggested by this Section.

Table 749-1
Simplified Terrestrial Ecological Evaluation – Exposure Analysis Procedure under WAC 173-340-~~7492(2)(a)(ii)~~ 7493(3)(a)(ii).[a]

Estimate the area of contiguous (connected) undeveloped land on ~~the site~~ or within 500 feet of any area of ~~the site~~ contaminated soil to the nearest 1/2 acre (1/4 acre if the area is less than 0.5 acre). "Undeveloped land" means land that is not covered by existing buildings, roads, paved areas or other barriers that will prevent wildlife from feeding on plants, earthworms, insects or other food in or on the soil. [265]	
1) From the table below, find the number of points corresponding to the area and enter this number in the box to the right.	
Area (acres) / Points 0.25 or less 4 0.5 5 1.0 6 1.5 7 2.0 8 2.5 9 3.0 10 3.5 11 4.0 or more 12	
2) Is this an industrial or commercial property? See the definition in WAC 173-340-~~7490(3)(c)~~200. If yes, enter a score of 3 in the box to the right. If no, enter a score of 1.	
3) Enter a score in the box to the right for the habitat quality of the ~~site~~ area of contaminated soil and surrounding area, using the rating system shown below[b]. (High = 1, Intermediate = 2, Low = 3)	
4) Is the undeveloped land likely to attract wildlife? If yes, enter a score of 1 in the box to the right. If no, enter a score of 2. See footnote c.	
5) Are there any of the following soil ~~contaminants~~ hazardous substances present: Chlorinated dioxins/furans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, pentachlorobenzene? If yes, enter a score of 1 in the box to the right. If no, enter a score of 4.	

6) Add the numbers in the boxes on lines 2 through 5 and enter this number in the box to the right. If this number is larger than the number in the box on line 1, the simplified terrestrial ecological evaluation may be ended under WAC 173-340- ~~7492 (2)(a)(ii)~~ 7493(3)(a)(ii).	

[265] For larger properties, "site" doesn't necessarily equate to the entire property. For smaller sites, the "site" may extend to off-property areas. The changes here and in question 3 are intended to clarify what area is to be included in the analysis.

Footnotes:

a It is expected that this habitat evaluation will be undertaken by an experienced field biologist. If this is not the case, enter a conservative score (1) for questions 3 and 4.

b **Habitat rating system.** Rate the quality of the habitat as high, intermediate or low based on your professional judgment as a field biologist. The following are suggested factors to consider in making this evaluation:

Low: Early successional vegetative stands; vegetation predominantly noxious, nonnative, exotic plant species or weeds. Areas severely disturbed by human activity, including intensively cultivated croplands. Areas isolated from other habitat used by wildlife.

High: Area is ecologically significant for one or more of the following reasons: Late-successional native plant communities present; relatively high species diversity; used by an uncommon or rare species; priority habitat (as defined by the Washington Department of Fish and Wildlife); part of a larger area of habitat where size or fragmentation may be important for the retention of some species.

Intermediate: Area does not rate as either high or low.

c Indicate "yes" if the area attracts wildlife or is likely to do so. Examples: Birds frequently visit the area to feed; evidence of high use by mammals (tracks, scat, etc.); habitat "island" in an industrial area; unusual features of an area that make it important for feeding animals; heavy use during seasonal migrations.

Table 749-2
Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure.[a]

Priority contaminant	Soil concentration (mg/kg)	
	Unrestricted land use[b]	Industrial or commercial ~~site~~ property
METALS:[c]		
Antimony	See note d	See note d
Arsenic III	20 mg/kg	20 mg/kg
Arsenic V	95 mg/kg	260 mg/kg
Barium	1,250 mg/kg	1,320 mg/kg
Beryllium	25 mg/kg	See note d
Cadmium	25 mg/kg	36 mg/kg
Chromium (total)	42 mg/kg	135 mg/kg
Cobalt	See note d	See note d
Copper	100 mg/kg	550 mg/kg
Lead	220 mg/kg	220 mg/kg
Magnesium	See note d	See note d
Manganese	See note d	mg/kg 23,500
Mercury, inorganic	9 mg/kg	9 mg/kg
Mercury, organic	0.7 mg/kg	0.7 mg/kg
Molybdenum	See note d	71 mg/kg
Nickel	100 mg/kg	1,850 mg/kg
Selenium	0.8 mg/kg	0.8 mg/kg
Silver	See note d	See note d
Tin	275 mg/kg	See note d
Vanadium	26 mg/kg	See note d
Zinc	270 mg/kg	570 mg/kg
PESTICIDES:		
Aldicarb/aldicarb sulfone (total)	See note d	See note d
Aldrin	0.17 mg/kg	0.17 mg/kg
Benzene hexachloride (including lindane)	10 mg/kg	10 mg/kg
Carbofuran	See note d	See note d
Chlordane	1 mg/kg	7 mg/kg
Chlorpyrifos/chlorpyrifos-methyl (total)	See note d	See note d
DDT/DDD/DDE (total)	1 mg/kg	1 mg/kg
Dieldrin	0.17 mg/kg	0.17 mg/kg
Endosulfan	See note d	See note d
Endrin	0.4 mg/kg	0.4 mg/kg
Heptachlor/heptachlor epoxide (total)	0.6 mg/kg	0.6 mg/kg
Hexachlorobenzene	31 mg/kg	31 mg/kg
Parathion/methyl parathion (total)	See note d	See note d
Pentachlorophenol	11 mg/kg	11 mg/kg
Toxaphene	See note d	See note d
OTHER CHLORINATED ORGANICS:		
Chlorinated dibenzofurans (total) (e)	3E-06 mg/kg	3E-06 mg/kg
Chlorinated dibenzo-p-dioxins (total) (e)	5E-06 mg/kg	5E-06 mg/kg
Hexachlorophene	See note d	See note d
PCB mixtures (total)	2 mg/kg	2 mg/kg
Pentachlorobenzene	168 mg/kg	See note d
OTHER NONCHLORINATED ORGANICS:		
Acenaphthene	See note d	See note d
Benzo(a)pyrene	30 mg/kg	300 mg/kg
Bis (2-ethylhexyl) phthalate	See note d	See note d
Di-n-butyl phthalate	200 mg/kg	See note d
PETROLEUM:		
Gasoline Range Organics	200 mg/kg	12,000 mg/kg except that the concentration shall not exceed residual saturation ~~at the soil surface~~.
Diesel Range Organics (f)	460 mg/kg	15,000 mg/kg except that the concentration shall not exceed residual saturation ~~at the soil surface~~.

(NOTE: Several values are currently under review and are likely to change as a result of new ecological toxicity information.)

Footnotes:

a Caution on misusing these values ~~chemical concentration numbers~~. ~~These values~~ They have been developed for use at sites where a site-specific terrestrial ecological evaluation is not required. They are not intended to be protective of terrestrial ecological receptors at every site. Exceedances of the values in this table do not necessarily trigger requirements for cleanup action under this chapter. The table is not intended for purposes such as evaluating sludges or wastes.
This list does not imply that sampling must be conducted for each of these chemicals at every site. Sampling should be conducted for those chemicals that might be present based on available information, such as current and past uses of chemicals at the site.

b Applies to any site that does not meet the definition of industrial or commercial property under WAC 173-340-200.

c For arsenic, use the valence state most likely to be appropriate for site conditions, unless laboratory information is available. Where soil conditions alternate between saturated, anaerobic and unsaturated, aerobic states, resulting in the alternating presence of arsenic III and arsenic V, the arsenic III concentrations shall apply.

d Safe concentration has not yet been established. See WAC 173-340-~~7492(2)(c)~~ 7493(4) for procedures for establishing values for these substances.

e These values represent a total toxic equivalent concentration of all furan or dioxin congeners. Use the toxicity equivalency

factors in Table 749-6 to convert congener mixtures to a total toxic equivalent concentration.

f Values apply to the total of both diesel range organics and heavy oils. Mineral oil is not considered sufficiently toxic to soil biota, plants and animals to require establishment of an ecologically-based concentration.

Table 749-3

Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Soil Biota, Plants and Animals.[a]

For ~~chemicals~~ hazardous substances where a value is not provided, see footnote b.

Note: These values represent soil concentrations that are expected to be protective at any MTCA site and are provided for use in eliminating hazardous substances from further consideration under WAC 173-340-~~7493(2)(a)(i)~~ 7494(4)(a). Where these values are exceeded, WAC 173-340-7494 provides various options ~~are provided~~ for demonstrating that the hazardous substance does not pose a threat to ecological receptors at a site, or for developing site-specific ~~remedial standards for eliminating threats to~~ soil concentrations protective of ecological receptors. ~~See WAC 173-340-7493(1)(b)(i), 173-340-7493(2)(a)(ii) and 173-340-7493(3).~~

Hazardous Substance[b]	Plants[c]	Soil Biota[d]	Wildlife[e]
METALS:[f]			
Aluminum (soluble salts)	50		
Antimony	5		
Arsenic III			7
Arsenic V	10	60	132
Barium	500		102
Beryllium	10		
Boron	0.5		
~~Bromine~~ Bromide	10		
Cadmium	4	20	14
Chromium (total)	42[g]	42[g]	67
Cobalt	20		
Copper	100	50	217
~~Fluorine~~ Fluoride	200		
~~Iodine~~ Iodide	4		
Lead	50	500	118
Lithium	35[g]		
Manganese	1,100[g]		1,500
Mercury, inorganic	0.3	0.1	5.5
Mercury, organic			0.4
Molybdenum	2		7
Nickel	30	200	980
Selenium	1	70	0.3
Silver	2		
Technetium	0.2		
Thallium	1		
Tin	50		
Uranium	5		
Vanadium	2		
Zinc	86[g]	200	360
PESTICIDES:			
Aldrin			0.1
Benzene hexachloride (including lindane)			6
Chlordane		1	2.7
DDT/DDD/DDE (total)			0.75
Dieldrin			0.07
Endrin			0.2
Hexachlorobenzene			17
Heptachlor/heptachlor epoxide (total)			0.4
Pentachlorophenol	3	6	4.5
OTHER CHLORINATED ORGANICS:			
1,2,3,4-Tetrachlorobenzene		10	
1,2,3-Trichlorobenzene		20	
1,2,4-Trichlorobenzene		20	
1,2-Dichloropropane		700	
1,4-Dichlorobenzene		20	
2,3,4,5-Tetrachlorophenol		20	
2,3,5,6-Tetrachloroaniline	20	20	
2,4,5-Trichloroaniline	20	20	
2,4,5-Trichlorophenol	4	9	
2,4,6-Trichlorophenol		10	
2,4-Dichloroaniline		100	
3,4-Dichloroaniline		20	
3,4-Dichlorophenol	20	20	
3-Chloroaniline	20	30	
3-Chlorophenol	7	10	
Chlorinated dibenzofurans (total) (h)			2E-06
Chloroacetamide		2	
Chlorobenzene		40	
Chlorinated dibenzo-p-dioxins (total) (h)			2E-06
Hexachlorocyclo-pentadiene	10		
PCB mixtures (total)	40		0.65
Pentachloroaniline		100	
Pentachlorobenzene		20	
OTHER NONCHLORINATED ORGANICS:			
2,4-Dinitrophenol	20		
4-Nitrophenol		7	
Acenaphthene	20		
Benzo(a)pyrene			12
Biphenyl	60		
Diethylphthalate	100		
Dimethylphthalate		200	
Di-n-butyl phthalate	200		
Fluorene		30	
Furan	600		

[Editor's Note: Table 749-3 continues on the next page.]

Hazardous Substance[b]	Plants[c]	Soil Biota[d]	Wildlife[e]
Nitrobenzene		40	
N-nitrosodiphenylamine		20	
Phenol	70	30	
Styrene	300		
Toluene	200		
PETROLEUM:			
Gasoline Range Organics		100	5,000 mg/kg except that the concentration shall not exceed residual saturation at the soil surface
Diesel Range Organics (i)		200	6,000 mg/kg except that the concentration shall not exceed residual saturation at the soil surface

(NOTE: Several values are currently under review and are likely to change as a result of new ecological toxicity information.)

Footnotes:

a Caution on misusing ecological indicator concentrations. Exceedances of the values in this table do not necessarily trigger requirements for cleanup action under this chapter. Natural background concentrations may be substituted for ecological indicator concentrations provided in this table. The table is not intended for purposes such as evaluating sludges or wastes.
This list does not imply that sampling must be conducted for each of these chemicals at every site. Sampling should be conducted for those chemicals that might be present based on available information, such as current and past uses of chemicals at the site.

b For hazardous substances where a value is not provided, plant and soil biota indicator concentrations shall be based on a literature survey conducted in accordance with WAC 173-340-~~7493(4)~~ 7494(5)(g) and calculated using methods described in the publications listed below in footnotes c and d. Methods to be used for developing wildlife indicator concentrations are described in Tables 749-4 and 749-5.

c Based on benchmarks published in *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1997 Revision*, Oak Ridge National Laboratory, 1997. *[Update reference]*

d Based on benchmarks published in *Toxicological Benchmarks for Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process*, Oak Ridge National Laboratory, 1997. *[Update reference]*

e Calculated using the exposure model provided in Table 749-4 and chemical-specific values provided in Table 749-5. Where both avian and mammalian values are available, the wildlife value is the lower of the two.

f For arsenic, use the valence state most likely to be appropriate for site conditions, unless laboratory information is available. Where soil conditions alternate between saturated, anaerobic and unsaturated, aerobic states, resulting in the alternating presence of arsenic III and arsenic V, the arsenic III concentrations shall apply.

g ~~Benchmark replaced by~~ Based on Washington state natural background concentration or practical quantitation limit, whichever is higher.

h These values represent a total toxic equivalent concentration of all furan or dioxin congeners. Use the toxicity equivalency factors in Table 749-6 to convert congener mixtures to a total toxic equivalent concentration.

i Values apply to the total of both diesel range organics and heavy oils. Mineral oil is not considered sufficiently toxic to soil biota, plants and animals to require establishment of an ecologically-based concentration.

Table 749-4
Wildlife Exposure Model for Site-specific Evaluations.[a]

PLANT	
K_{Plant}	Plant uptake coefficient (dry weight basis)
	Units: mg/kg plant / mg/kg soil
	Value: chemical-specific (see Table 749-5)
SOIL BIOTA Surrogate receptor: Earthworm	
BAF_{Worm}	Earthworm bioaccumulation factor (dry weight basis)
	Units: mg/kg worm / mg/kg soil
	Value: chemical-specific (see Table 749-5)
MAMMALIAN PREDATOR Surrogate receptor: Shrew (*Sorex*)	
$P_{SB\ (shrew)}$	Proportion of contaminated food (earthworms) in shrew diet
	Units: unitless
	Value: 0.50
$FIR_{Shrew,DW}$	Food ingestion rate (dry weight basis)
	Units: kg dry food / kg body weight – day
	Value: 0.45
$SIR_{Shrew,DW}$	Soil ingestion rate (dry weight basis)
	Units: kg dry soil / kg body weight – day
	Value: 0.0045
$RGAF_{Soil,\ shrew}$	Gut absorption factor for a hazardous substance in soil expressed relative to the gut absorption factor for the hazardous substance in food.
	Units: unitless
	Value: chemical-specific (see Table 749-5)
T_{Shrew}	Toxicity reference value for shrew
	Units: mg/kg - day
	Value: chemical-specific (see Table 749-5)
Home range	0.1 Acres
AVIAN PREDATOR Surrogate receptor: American robin (*Turdus migratorius*)	
$P_{SB\ (Robin)}$	Proportion of contaminated food (soil biota) in robin diet
	Unit: unitless
	Value: 0.52
$FIR_{Robin,DW}$	Food ingestion rate (dry weight basis)
	Units: kg dry food / kg body weight – day
	Value: 0.207
$SIR_{Robin,DW}$	Soil ingestion rate (dry weight basis)
	Units: kg dry soil / kg body weight – day
	Value: 0.0215
$RGAF_{Soil,\ robin}$	Gut absorption factor for a hazardous substance in soil expressed relative to the gut absorption factor for the hazardous substance in food.
	Units: unitless
	Value: chemical-specific (see Table 749-5)
T_{Robin}	Toxicity reference value for robin
	Units: mg/kg – day
	Value: chemical-specific (see Table 749-5)
Home range	0.6 acres
MAMMALIAN HERBIVORE Surrogate receptor: Vole (*Microtus*)	
$P_{Plant,\ vole}$	Proportion of contaminated food (plants) in vole diet
	Units: unitless
	Value: 1.0
$FIR_{Vole,DW}$	Food ingestion rate (dry weight basis)
	Units: kg dry food / kg body weight – day
	Value: 0.315
$SIR_{Vole,DW}$	Soil ingestion rate (dry weight basis)
	Units: kg dry soil / kg body weight – day
	Value: 0.0079
$RGAF_{Soil,\ vole}$	Gut absorption factor for a hazardous substance in soil expressed relative to the gut absorption factor for the hazardous substance in food.
	Units: unitless
	Value: chemical-specific (see Table 749-5)
T_{Vole}	Toxicity reference value for vole
	Units: mg/kg – day
	Value: chemical-specific (see Table 749-5)
Home range	0.08 acres
SOIL CONCENTRATIONS FOR WILDLIFE PROTECTION[b]	
(1) Mammalian predator: $SC_{MP} = (T_{Shrew})/[(FIR_{Shrew,DW} \times P_{SB\ (shrew)} \times BAF_{Worm}) + (SIR_{Shrew,DW} \times RGAF_{Soil,\ shrew})]$	
(2) Avian predator: $SC_{AP} = (T_{Robin})/[(FIR_{Robin,DW} \times P_{SB\ (Robin)} \times BAF_{Worm}) + (SIR_{Robin,DW} \times RGAF_{Soil,\ robin})]$	
(3) Mammalian herbivore: $SC_{MH} = (T_{Vole})/[(FIR_{Vole,DW} \times P_{Plant,vole} \times K_{Plant}) + (SIR_{Vole,DW} \times RGAF_{Soil,\ vole})]$	

Footnotes:

a Substitutions for default receptors may be made as provided for in WAC 173-340-~~7493(7)~~7494(5)(c). If a substitute species is used, the values for food and soil ingestion rates, and proportion of contaminated food in the diet, may be modified to reasonable maximum exposure estimates for the substitute species based on a literature search conducted in accordance with WAC 173-340-~~7493(4)~~ 7494(5)(g).
Additional species may be added on a site-specific basis as provided in WAC 173-340-~~7493 (2)(a)~~ 7494(5)(c).
The department shall consider proposals for modifications to default values provided in this table based on new scientific information in accordance with WAC 173-340-702(14), (15) & (16).

b Use the lowest of the three concentrations calculated as the wildlife value.

Table 749-5
Default Values for Selected Hazardous Substances for use with the Wildlife Exposure Model in Table 749-4.[a]

Hazardous Substance	Toxicity Reference Value (mg/kg - d)				
	BAF_{Worm}	K_{Plant}	Shrew	Vole	Robin
METALS:					
Arsenic III	1.16	0.06	1.89	1.15	
Arsenic V	1.16	0.06	35	35	22
Barium	0.36		43.5	33.3	
Cadmium	4.6	0.14	15	15	20
Chromium	0.49		35.2	29.6	5
Copper	0.88	0.020	44	33.6	61.7
Lead	0.69	0.0047	20	20	11.3
Manganese	0.29		624	477	
Mercury, inorganic	1.32	0.0854	2.86	2.18	0.9
Mercury, organic	1.32		0.352	0.27	0.064
Molybdenum	0.48	1.01	3.09	2.36	35.3
Nickel	0.78	0.047	175.8	134.4	107
Selenium	10.5	0.0065	0.725	0.55	1
Zinc	3.19	0.095	703.3	537.4	131
PESTICIDES:					
Aldrin	4.77	0.007[b]	2.198	1.68	0.06
Benzene hexachloride (including lindane)	10.1				7
Chlordane	17.8	0.011[b]	10.9	8.36	10.7
DDT/DDD/ DDE	10.6	0.004[b]	8.79	6.72	0.87
Dieldrin	28.8	0.029[b]	0.44	0.34	4.37
Endrin	3.6	0.038[b]	1.094	0.836	0.1
Heptachlor/ heptachlor epoxide	10.9	0.027[b]	2.857	2.18	0.48
Hexachloro-benzene	1.08				2.4
Pentachloro-phenol	5.18	0.043[b]	5.275	4.03	
OTHER CHLORINATED ORGANICS:					
Chlorinated dibenzofurans	48				1.0E-05
Chlorinated dibenzo-p-dioxins	48	0.005[b]	2.2E-05	1.7E-05	1.4E-04
PCB mixtures	4.58	0.087[b]	0.668	0.51	1.8
OTHER NONCHLORINATED ORGANICS:					
Benzo(a)pyrene	0.43	0.011	1.19	0.91	

(NOTE: Several values are currently under review and are likely to change as a result of new ecological toxicity information.)

Footnotes:

a For hazardous substances not shown in this table, use the following default values. Alternatively, use values established from a literature survey conducted in accordance with WAC 173-340-~~7493(4)~~ 7494(5)(g) and approved by the department.

K_{Plant}:
- Metals (including metalloid elements): 1.01
- Organic chemicals: $K_{Plant} = 10^{(1.588-(0.578 \log Kow))}$, where $\log K_{ow}$ is the logarithm of the octanol-water partition coefficient.

BAF_{Worm}:
- Metals (including metalloid elements): 4.6
- Nonchlorinated organic chemicals:
  - $\log K_{ow} < 5$: 0.7
  - $\log K_{ow} \geq 5$: 0.9
- Chlorinated organic chemicals:
  - $\log K_{ow} < 5$: 4.7
  - $\log K_{ow} \geq 5$: 11.8

$RGAF_{Soil}$ (all receptors): 1.0

Toxicity reference values (all receptors): Values established from a literature survey conducted in accordance with WAC 173-340-~~7493(4)~~ 7494(5)(g).

Site-specific values may be substituted for default values, as described below:

K_{Plant}: Value from a literature survey conducted in accordance with WAC 173-340-~~7493(4)~~ 7494(5)(g) or from empirical studies at the site.

BAF_{Worm}: Value from a literature survey conducted in accordance with WAC 173-340-~~7493(4)~~ 7494(5)(g) or from empirical studies at the site.

$RGAF_{Soil}$ (all receptors): Value established from a literature survey conducted in accordance with WAC 173-340-~~7493(4)~~ 7494(5)(g).

Toxicity reference values (all receptors): Default toxicity reference values provided in this table may be replaced by a value established from a literature survey conducted in accordance with WAC 173-340-~~7493(4)~~ 7494(5)(g).

b Calculated from $\log K_{ow}$ using formula in footnote a.

Table 749-6 [266]
Toxicity Equivalency Factors for Chlorinated dibenzo-p-dioxins and Chlorinated Dibenzofurans Congeners For Terrestrial Ecological Analyses [(3)]

CAS Number	Hazardous Substance	Mammals TEF [(1)] (unitless)	Birds TEF [(2)] (unitless)
Dioxin Congeners			
1746-01-6	2,3,7,8-Tetrachloro dibenzo-p-dioxin	1	1
40321-76-4	1,2,3,7,8-Pentachloro dibenzo-p-dioxin	1	1
39227-28-6	1,2,3,4,7,8-Hexachloro dibenzo-p-dioxin	0.1	0.05
57653-85-7	1,2,3,6,7,8-Hexachloro dibenzo-p-dioxin	0.1	0.01
19408-74-3	1,2,3,7,8,9-Hexachloro dibenzo-p-dioxin	0.1	0.1
35822-46-9	1,2,3,4,6,7,8-Heptachloro dibenzo-p-dioxin	0.01	<0.001
3268-87-9	1,2,3,4,6,7,8,9-Octachloro dibenzo-p-dioxin	0.0003	0.0001
Furan Congeners			
51207-31-9	2,3,7,8-Tetrachloro dibenzofuran	0.1	1
57117-41-6	1,2,3,7,8-Pentachloro dibenzofuran	0.03	0.1
57117-31-4	2,3,4,7,8-Pentachloro dibenzofuran	0.3	1
70648-26-9	1,2,3,4,7,8-Hexachloro dibenzofuran	0.1	0.1
57117-44-9	1,2,3,6,7,8-Hexachloro dibenzofuran	0.1	0.1
72918-21-9	1,2,3,7,8,9-Hexachloro dibenzofuran	0.1	0.1
60851-34-5	2,3,4,6,7,8-Hexachloro dibenzofuran	0.1	0.1
67562-39-4	1,2,3,4,6,7,8-Heptachloro dibenzofuran	0.01	0.01
55673-89-7	1,2,3,4,7,8,9-Heptachloro dibenzofuran	0.01	0.01
39001-02-0	1,2,3,4,6,7,8,9-Octachloro dibenzofuran	0.0003	0.01

(1) Source: Van den Berg et al. (2006). The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds. Toxicological Sciences 2006 93(2):223-241; doi:10.1093/toxsci/kfl055.

(2) Source: Van den Berg, et al. (1998). Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environmental. Health Perspectives. 106, 775–792.

(3) Use these toxicity equivalency factors to convert dioxin and furan mixtures to a total toxic equivalent concentration to determine compliance with the dioxin and furan values in tables 749-2 and 749-3.

[266] To reflect current practice and science in evaluating dioxin and furan mixtures.

WAC 173-340-7500 Cleanup standards to protect air quality.

(1) Applicability.

(2) Basis for air cleanup levels.

(3) When cleanup is required.

(4) Protection of other environmental media.

(5) Cleanup standards for other exposure scenarios.

WAC 173-340-7501 Method B air cleanup levels.

(1) Applicability.

(2) Method B air cleanup levels.

(3) Allowable Method B modifications.

(4) Using Method B to evaluate air remediation levels.

(5) Adjustments.

(6) Point of compliance.

(7) Determining compliance

WAC 173-340-7502 Method C air cleanup levels.

(1) Applicability.

(2) Method C air cleanup levels.

(3) Lower explosive limit limitation.

(4) Using Method C to evaluate air remediation levels.

(5) Adjustments.

(6) Point of compliance.

(7) Determining compliance.

WAC 173-340-7503 Adjustments to air cleanup levels.

(1) Total site risk adjustments.

(2) Adjustments to applicable state and federal laws.

(3) Natural background and analytical considerations.

WAC 173-340-7504 Points of compliance.

(1) Ambient air.

(2) Within structures.

(3) Indirect point of compliance

(4) Air discharges from remedial actions

WAC 173-340-7505 Demonstrating compliance with air cleanup standards.

(1) Monitoring required.

(2) Compliance monitoring plan.

(3) Applicable state and federal laws.

(4) Sample duration.

(5) Timing of Evaluations.

(6) Sample representativeness.

(7) Evaluating compliance.

(a) Indirect measures of compliance.

(b) Direct comparison.

(c) Statistical methods.

(d) Multiple lines of evidence.

(8) Area background.

(a) Defining area background.

(b) Subtraction method.

(c) Statistical method.

(d) Alternative methods.

(9) Interpreting non-detect values.

NOTE: These (vapor-related) Sections have been somewhat revised since fall, 2010, when they were last circulated to the vapor subcommittee of the MTCA/SMS workgroup. Several issues were identified in that process that have not been fully vetted or addressed yet in this draft including:

- What site conditions should trigger an interim action to address vapors
- The role of multiple lines of evidence in determining compliance
- The extent of a vapor evaluation, if any, needed under Method A
- The degree of confidence that screening levels and modeling results can be relied upon for decision-making
- How to factor in urban background levels of many contaminants in vapor evaluations
- How to evaluate non-detected values

Reviewers are invited for provide input on these and other issues related to vapor evaluations.

WAC 173-340-7500 Cleanup standards to protect air quality. [267]

(1) ~~General considerations.~~ Applicability.

(a) ~~This section applies~~ WAC 173-340-7500 through 7505 apply whenever it is necessary to establish air cleanup standards to determine if air emissions at a site pose a threat to human health or the environment. ~~It applies~~ They apply to ambient (outdoor) air and air within any building, utility vault, manhole or other structure large enough for a person to fit into. ~~This section does not apply to concentrations of hazardous substances in the air originating from an industrial or commercial process or operation or to hazardous substances in the air originating from an off-site source. This section does~~ These sections apply to concentrations of hazardous substances in the air originating from other contaminated media or a remedial action at the site.

(b) These sections do not apply to concentrations of hazardous substances in the air within a structure originating from an industrial or commercial process or operation within that structure. [268] These sections also do not apply to concentrations of hazardous substances in the air within a structure originating from ambient air background concentrations. [269]

(c) Air cleanup standards shall be established at the following sites:

(i) Where a ~~nonpotable~~ ground water cleanup level is being established for volatile organic compounds ~~using a site-specific risk assessment under WAC 173-340-720(6)~~. [270]

(ii) Where a soil cleanup level that addresses vapors or dust is being established under WAC 173-340-7400 through 7407 ~~or 173-340-745~~.

(iii) Where it is necessary to establish air emission limits for a remedial action.

(iv) Where it is necessary to evaluate the need for an interim action or the protectiveness of a remedy. [271]

(v) At other sites as determined by the department.

~~(b)~~(2) Basis for air cleanup levels. Cleanup levels to protect air quality shall be based on estimates of the reasonable maximum exposure expected to occur under both current and future site use conditions.

(a) Method A. This chapter does not provide procedures for establishing Method A air cleanup levels. Method B or C, as appropriate, shall be used to establish air cleanup levels. [272]

(b) Method B. The department has determined that residential site use will generally require the most protective air cleanup levels and that exposure to hazardous substances under these conditions represents the reasonable maximum exposure. Air cleanup levels shall use this presumed exposure scenario and be established in accordance with ~~subsection (3) of this section~~ WAC 173-340-7501 unless the site qualifies for a Method C air cleanup level.

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[267] Former 750(1) with changes shown.

[268] However, they do apply to air concentrations resulting from releases from these processes to the ground or groundwater. *[Footnote to be added to rule.]*

[269] Expansion and clarification of language deleted in (1)(a).

[270] To reflect changes to groundwater cleanup levels chapter.

[271] For example, to determine if a containment remedy will result in vapors accumulating in overlying structures.

[272] Existing provision, moved up from later in this Section.

(c) Method C. Method C air cleanup levels may be used if the site meets the criteria for use of Method C under WAC 173-340-706(1). If a site qualifies for a Method C air cleanup level, ~~subsection (4) of this section~~ WAC 173-340-7502 shall be used to establish air cleanup levels. A site that qualifies for a Method C air cleanup level does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium.[273]

~~(c)~~**(3) When cleanup is required.** In the event of a release or potential release of hazardous substances into the air at a site at which this section applies ~~under (a) of this subsection~~, a cleanup action that complies with this chapter shall be conducted to address all areas of the site where the concentration of the hazardous substances in the air exceeds cleanup levels.

~~(d)~~**(4) Protection of other environmental media.** Air cleanup levels shall be established at concentrations that do not directly or indirectly cause violations of ground water, surface water, or soil cleanup standards established under this chapter or applicable state and federal laws. ~~A site that qualifies for a Method C air cleanup level under this section does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium.~~[274]

~~(e)~~**(5) Cleanup standards for other exposure scenarios.** The department may require more stringent air cleanup standards than required by ~~this~~ sections 7500 through 7505 where, based on a site-specific evaluation, the department determines that this is necessary to protect human health and the environment. Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708.

~~**(2) Method A air cleanup levels.** This section does not provide procedures for establishing Method A cleanup levels. Method B or C, as appropriate, shall be used to establish air cleanup levels.~~[275]

[273] Moved up from later in this Section.
[274] Moved to earlier in this Section.
[275] Moved to earlier in this Section.

NEW SECTION

WAC 173-340-7501 Method B air cleanup levels. [276]

~~(a)~~(1) Applicability. ~~Method B air cleanup levels consist of standard and modified cleanup levels as described in this subsection. Either standard or modified~~ Method B air cleanup levels may be used at any site.

~~(b) Standard~~ (2) Method B air cleanup levels. ~~Standard~~ Method B air cleanup levels ~~for air~~ shall be at least as stringent as all of the following:

~~(i)~~(a) Applicable state and federal laws. Concentrations established under applicable state and federal laws; ~~and~~

~~(ii)~~(b) Human health protection. For hazardous substances for which sufficiently protective health-based criteria or standards have not been established under applicable state and federal laws, those concentrations which protect human health and the environment as determined by the following methods:

~~(A)~~(i) Noncarcinogens. For noncarcinogenic hazardous substances, concentrations that are estimated to result in no acute or chronic toxic effects on human health as ~~and are~~ determined using equation 750-1; ~~the following equation and standard exposure assumptions:~~

[Equation 750-1 moved to end of Section]

~~(B)~~(ii) Carcinogens. For known or suspected carcinogens, concentrations for which the upper bound on the estimated individual lifetime excess cancer risk is less than or equal to one in one million (1×10^{-6}) as ~~and are~~ determined using ~~the following equation and standard exposure assumptions:~~ equation 750-2;

[Equation 750-2 moved to end of Section]

~~(C)~~(iii) Petroleum mixtures. ~~For noncarcinogenic effects of petroleum mixtures, a total petroleum hydrocarbon cleanup level shall be calculated using Equation 750-1 and by taking into account the additive effects of the petroleum fractions and volatile organic compounds present in the petroleum mixture. Cleanup levels for other noncarcinogens and known or suspected carcinogens within the petroleum mixture shall be calculated using Equations 750-1 and 750-2.~~ For petroleum mixtures, total petroleum hydrocarbon concentrations that result in no toxic effects on human health as determined using Equation 750-3. This equation takes into account the noncarcinogenic health effects of exposure through inhalation of petroleum vapors.

The total petroleum hydrocarbon concentration calculated using this equation must be adjusted downward if individual compounds present in the mixture at the calculated total petroleum hydrocarbon concentration exceed acceptable cancer risk levels or applicable state and federal laws. A spreadsheet is available from the department to facilitate these calculations. [277]

[276] Former 750(3) with changes shown.

[277] Editorial changes. Ecology's MTCATPH 11.1 workbook automatically adjusts the calculated TPH concentration to insure individual substances, like benzene, meet their air cleanup level.

See Table 830-1 for the analyses required for various petroleum products to use this method~~.~~ ; and

~~(iii)~~**(c) Lower explosive limit limitation.** ~~Standard~~ Method B air cleanup levels shall not exceed ten percent (10%) of the lower explosive limit for any hazardous substance or mixture of hazardous substances.

~~**(c) Modified Method B air cleanup levels.** Modified Method B air cleanup levels are standard Method B air cleanup levels modified with chemical-specific or site-specific data. When making these adjustments, the resultant cleanup levels shall meet applicable state and federal laws, health risk levels and explosive limit limitations required for standard Method B air cleanup levels. Changes to exposure assumptions must comply with WAC 173-340-708(10). The following adjustments may be made to the default assumptions in the standard Method B equations to derive modified Method B cleanup levels:~~

~~**(i)** The inhalation absorption percentage may be modified if the requirements of WAC 173-340-702 (14), (15), (16) and WAC 173-340-708(10) are met;~~

~~**(ii)** Adjustments to the reference dose and cancer potency factor may be made if the requirements in WAC 173-340-708 (7) and (8) are met;~~

~~**(iii)** The toxicity equivalency factor procedures described in WAC 173-340-708(8) may be used for assessing the potential carcinogenic risk of mixtures of chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans and polycyclic aromatic hydrocarbons;~~ [278]

~~**(iv)** Modifications incorporating new science as provided for in WAC 173-340-702 (14), (15) and (16); and~~

(3) Allowable Method B modifications. The default assumptions in Equations 750-1, 750-2 and 750-3 can only be changed with chemical-specific or site-specific data as provided in WAC 173-340-708(10). The resultant cleanup levels shall meet the other requirements in subsection (2) of this section. [279]

~~**(d)**~~**(4) Using ~~modified~~ Method B to evaluate air remediation levels.** ~~In addition to the adjustments allowed under subsection (3)(c) of this section, a~~ Adjustments to the reasonable maximum exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357 and 173-340-708 (3)(d) and (10)(b).

(5) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background and practical quantitation limit. See WAC 173-340-7503for procedures for making these adjustments.

(6) Point of compliance. The point of compliance for air cleanup levels is specified in WAC 173-340-7404.

(7) Determining compliance. Compliance monitoring requirements and procedures for determining compliance with air cleanup standards are specified in WAC 173-340-7405. [280]

[278] No longer needed since the 2007 rule amendments made TEFs the standard procedure for assessing the risk of dioxin and dibenzofuran mixtures.

[279] Editorial changes reflecting elimination of "modified" Method B language.

[280] Provisions (4), (5) and (6) are added as a result of the reorganization of these Sections.

[Equation 750-1] [281]

$$\text{Air cleanup level } (ug/m^3) = \frac{Rfc \times UCF \times HQ \times AT}{ED \times EF}$$

Where:

RfC = Inhalation reference concentration as specified in WAC 173-340-708(7) (mg/m^3)

UCF = Unit conversion factor (1,000 ug/mg)

HQ = Hazard quotient (1) (unitless)

AT = Averaging time (6 years)

ED = Exposure duration (6 years)

EF = Exposure frequency ((1) (unitless)

[Equation 750-2]

$$\text{Air cleanup level } (ug/m^3) = \frac{RISK \times AT}{IuR \times ELAF \times ED \times EF \times ET}$$

Where:

RISK = Acceptable cancer risk level (1 in 1,000,000) (unitless)

AT = Averaging time (70 years)

IuR = Inhalation unit risk factor as specified in WAC 173-340-708(8) (ug/m^3)

ELAF = Early life adjustment factor. Use 3 for carcinogens with a mutagenic mode of action. Use 1 for all other carcinogens (see WAC 173-340-708(8)). [282]

ED = Exposure duration (30 years)

EF = Exposure frequency (1.0) (unitless)

ET = Exposure time (1) (unitless)

[Equation 750-3] [283]

$$C_a = \frac{HI}{\left[\frac{ED \times EF}{AT \times UCF}\right] \times \sum_{i=1}^{n} \frac{F_{(i)}}{Rf_c}}$$

Where:

C_a = TPH air cleanup level (ug/m^3)

HI = Hazard index (1) (unitless)

AT = Averaging time (6 years)

ED = Exposure duration (6 years)

EF = Exposure frequency (1.0) (unitless)

UCF = Unit conversion factor (1,000 ug/mg)

$F_{(i)}$ = Fraction by weight of petroleum component (i) (unitless) (Use site-specific air composition data, provided the data is representative of present and future conditions at the site, or use the air composition predicted under WAC 173-340-747(6))

$Rfc_{(i)}$ = Inhalation reference concentration of petroleum component (i) as specified in WAC 173-340-708(7) (mg/m^3)

n = The number of petroleum components (petroleum fractions measured using the VPH method plus other volatile substances with an Rfc) present in the petroleum mixture. (See Table 830-1.)

[281] Equations 750-1 & 2 revised to reflect current EPA risk assessment methods. The exposure assumptions used in these equations are identical to those used in the current rule except the averaging time for carcinogens has been changed from 75 years to 70 years to conform to EPA guidance.

[282] The basis for early life exposure adjustments is discussed in the March 22, 2009 MTCA/SMS Advisory Group materials. http://www.ecy.wa.gov/programs/tcp/regs/2009MTCA/AdvGrpMeetingInfo/AdvGrpMtgSchedule.html The proposed adjustment factor is based on distillation of information in "Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens" EPA, 2005 and is still under evaluation.

[283] This is a ***new equation*** calculates a total TPH cleanup level, which is different than the draft vapor guidance. We can limit it to the fractions measured using the VPH method plus BTEX and naphathalenes. This approach takes into account the additive effects of multiple TPH fractions and compounds, something the draft guidance doesn't do.

NEW SECTION

WAC 173-340-7502 Method C air cleanup levels. [284]

~~**(a)**~~**(1) Applicability.** Method C air cleanup levels may be used only at sites qualifying under WAC 173-340-706(1). ~~Method C air cleanup levels consist of standard and modified cleanup levels as described in this subsection. Method C air cleanup levels may be approved by the department if the person undertaking the cleanup action can demonstrate that the site qualifies for use of Method C under WAC 173-340-706(1).~~ [285]

~~**(b)**~~**(2)** ~~**Standard**~~ **Method C air cleanup levels.** The procedures specified in WAC 173-340-7501 shall be used to establish Method C air cleanup levels except that equations 750-4, 750-5 and 750-6 shall be used. ~~Standard Method C air cleanup levels for ambient air shall be at least as stringent as all of the following:~~

~~**(i) Applicable state and federal laws.** Concentrations established under applicable state and federal laws;~~

~~**(ii) Human health protection.** For hazardous substances for which sufficiently protective health-based criteria or standards have not been established under applicable state and federal laws, concentrations that protect human health and the environment as determined by the following methods:~~

~~**(A) Noncarcinogens.** Concentrations that are anticipated to result in no significant acute or chronic effects on human health and are estimated in accordance with Equation 750-1 except that the average body weight shall be 70 kg and the estimated breathing rate shall be 20 m^3/day;~~

~~**(B) Carcinogens.** For known or suspected carcinogens, concentrations for which the upper bound on the estimated excess cancer risk is less than or equal to one in one hundred thousand (1×10^{-5}) and are determined in accordance with Equation 750—2.~~

~~**(C) Petroleum mixtures.** Cleanup levels for petroleum mixtures shall be calculated as specified in subsection (3)(b)(ii)(C) of this section, except that the average body weight shall be 70 kg and the estimated breathing rate shall be 20m^3/day.~~

~~**(iii)**~~**(3) Lower explosive limit limitation.** ~~Standard~~ Method C air cleanup levels shall not exceed ten percent (10%) of the lower explosive limit for any hazardous substance or mixture of hazardous substances.

~~**(c) Modified Method C air cleanup levels.** Modified Method C air cleanup levels are standard Method C air cleanup levels modified with chemical-specific or site-specific data. The same limitations and adjustments specified in subsection (3)(c) of this section apply to modified Method C cleanup levels.~~

~~**(d)**~~**(4) Using** ~~**modified**~~ **Method C to evaluate air remediation levels.** ~~In addition to the adjustments allowed under subsection (4)(c) of this section, a~~ Adjustments to the reasonable maximum exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357 and 173-340-708 (3)(d) and (10)(b).

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[284] Former 750(4) with changes shown.

[285] 706(1) limits use of Method C air CULs to industrial properties and utility vaults/manholes. This is because the Method C equations are based on an 8-hour worker exposure scenario.

(5) Adjustments. Cleanup levels developed under this section may need to be adjusted for risk limitations, natural background and practical quantitation limit. See WAC 173-340-7503for procedures for making these adjustments. [286]

(6) Point of compliance. The point of compliance for air cleanup levels is specified in WAC 173-340-7404.

(7) Determining compliance. Compliance monitoring requirements and procedures for determining compliance with air cleanup standards are specified in WAC 173-340-7405.

[Equation 750-4] [287]

$$\text{Air cleanup level (ug/m}^3\text{)} = \frac{\text{Rfc x UCF x HQ x AT}}{\text{ED x EF}}$$

Where:

RfC = Inhalation reference concentration as specified in WAC 173-340-708(7) (mg/m^3)

UCF = Unit conversion factor (1,000 ug/mg)

HQ = Hazard quotient (1) (unitless)

AT = Averaging time (20 years)

ED = Exposure duration (20 years)

EF = Exposure frequency ((0.4) (unitless)

[Equation 750-5]

$$\text{Air cleanup level (ug/m}^3\text{)} = \frac{\text{RISK x AT}}{\text{IuR x ED x EF x ET}}$$

Where:

RISK = Acceptable cancer risk level (1 in 100,000) (unitless)

AT = Averaging time (70 years)

IuR = Inhalation unit risk factor as specified in WAC 173-340-708(8) (ug/m^3)

ED = Exposure duration (20 years)

EF = Exposure frequency (0.4) (unitless)

ET = Exposure time (1) (unitless)

[Equation 750-6] [288]

$$C_a = \frac{HI}{\left[\frac{ED \times EF}{AT \times UCF}\right] \times \sum_{i=1}^{n} \frac{F_{(i)}}{Rf_c}}$$

Where:

C_a = TPH air cleanup level (ug/m^3)

HI = Hazard index (1) (unitless)

AT = Averaging time (20 years)

ED = Exposure duration (20 years)

EF = Exposure frequency (0.4) (unitless)

UCF = Unit conversion factor (1,000 ug/mg)

$F_{(i)}$ = Fraction by weight of petroleum component (i) (unitless) (Use site-specific air composition data, provided the data is representative of present and future conditions at the site, or use the air composition predicted under WAC 173-340-747(6))

$Rfc_{(i)}$ = Inhalation reference concentration of petroleum component (i) as specified in WAC 173-340-708(7) (mg/m^3)

n = The number of petroleum components (petroleum fractions measured using the VPH method plus other volatile substances with an Rfc) present in the petroleum mixture. (See Table 830-1.)

[286] Provisions (5), (6) and (7) are added as a result of the reorganization of these Sections.

[287] Equations 750-3 & 4 revised to reflect current EPA risk assessment methods. The exposure assumptions used in these equations are identical to those used in the current rule except the averaging time for carcinogens has been changed from 75 years to 70 years to conform to EPA guidance. *Note: No adjustment is included in Equation 750-5 for early life exposure since this is adult worker only exposure.*

[288] This is a ***new equation*** that calculates a total TPH cleanup level, which is different than the draft vapor guidance. Limited to the fractions measured using the VPH method plus BTEX and naphathalenes. This approach takes into account the additive effects of multiple TPH fractions and compounds, consistent with other exposure pathways, something the draft guidance doesn't do.

NEW SECTION

WAC 173-340-7503 ~~(5)~~ Adjustments to air cleanup levels. [289]

(1) Total site risk adjustments

(2) Adjustments to applicable state and federal laws

(3) Natural background and analytical considerations

~~(a)~~(1) Total site risk adjustments. Air cleanup levels for individual hazardous substances developed in accordance with ~~subsections (3) and (4) of this section~~, WAC 173-340-7501 and 7502, including cleanup levels based on applicable state and federal laws, shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure.

These adjustments need to be made only if, without these adjustments, the hazard index would exceed one (1) or the total excess cancer risk would exceed one in one hundred thousand (1×10^{-5}).

These adjustments shall be made in accordance with the procedures in WAC 173-340-708 (5) and (6).

In making these adjustments, the hazard index shall not exceed one (1) and the total excess cancer risk shall not exceed one in one hundred thousand (1×10^{-5}).

This adjustment may be made using the Method B or Method C equations, as applicable. [290]

~~(b)~~(2) Adjustments to applicable state and federal laws. Where a cleanup level developed under ~~subsections (3) and (4) of this section~~, WAC 173-340-7501 and 7502 is based on an applicable state or federal law, and the level of risk upon which the standard is based exceeds an excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of one (1), the cleanup level must be adjusted downward so that the total excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}) and the hazard index does not exceed one (1) at the site.

~~(c)~~(3) Natural background and ~~PQL~~ analytical considerations. Cleanup levels determined under ~~subsection (3) or (4) of this section~~ WAC 173-340-7501 and 7502, including cleanup levels adjusted under ~~(a) or (b)~~ subsections (1) and (2) of this ~~sub~~section, shall not be set at levels below the practical quantitation limit or natural background, whichever is higher. See WAC 173-340-709 and 173-340-707 for additional requirements pertaining to practical quantitation limits and natural background.

[289] Former 750(5) with changes shown.
[290] Reflects current practice.

NEW SECTION

WAC 173-340-7504 Points of compliance. [291]

(1) Ambient air

(2) Within structures

(3) Indirect point of compliance

(4) Discharges from remedial actions

(1) Ambient air. Cleanup levels established under this section shall be attained in the outdoor ambient air throughout the site.

(2) Within structures. Cleanup levels established under this section shall be attained for indoor air throughout the air within a structure. This applies to air within any building, utility vault, manhole or other structure large enough for a person to fit into. [292]

(3) Indirect point of compliance. Where concentrations in other media such as soil gas or groundwater concentrations are used as an indirect measure of compliance, as provided for in WAC 173-340-7505(7)(a), the point of compliance shall be as follows: [293]

(a) For groundwater, throughout the site in the groundwater nearest the ground surface; and

(b) For soil gas, throughout the site unsaturated zone (typically from the ground surface to the uppermost water table).

(4) Air discharges from remedial actions. For air discharges from remedial actions, when cleanup levels are based on an applicable state and federal law, the evaluation requirements in that law shall be used to demonstrate compliance with that law. Otherwise, the procedures in this section shall be used to demonstrate compliance. [294]

[291] This is a ***new Section*** replacing former 750(6). The option of using a point of compliance at the property boundary for industrial property has been eliminated as this could result in workers being exposed to concentrations significantly higher than Method C air cleanup levels within the industrial property and the public beyond the property boundary exposed to concentrations in excess of Method B air cleanup levels.

[292] From 7500(1)(a).

[293] These indirect points of compliance reflect current practice.

[294] For example, stack emissions monitoring for air discharges from treatment facilities or vapor extraction systems. *[Note: This footnote will be in the rule]*

NEW SECTION

WAC 173-340-7505 Demonstrating compliance with air cleanup standards. [295]

(1) Monitoring required

(2) Compliance monitoring plan

(3) Applicable state and federal laws

(4) Sample duration

(5) Timing of evaluations

(6) Sample representativeness

(7) Evaluating compliance

(8) Area background

(9) Interpreting non detect values

(1) Monitoring required. Where air cleanup levels have been established at a site, monitoring shall be required to be conducted to determine if compliance with the air cleanup levels has been achieved.

(2) Compliance monitoring plan.

(a) Sampling and analytical procedures shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. The sample design shall provide data that are representative of the site.

(b) Data analysis and evaluation procedures used to evaluate compliance with air cleanup levels shall also be defined in the compliance monitoring plan prepared under WAC 173-340-410.

(3) Applicable state and federal laws. When cleanup levels are based on an applicable state and federal law, the evaluation requirements in that law shall be used to demonstrate compliance with that law. Otherwise, the procedures in this section shall be used to demonstrate compliance. [296]

(4) Sample duration. The following sampling durations shall be used to determine compliance:

(a) For ambient and indoor air sampling, compliance with Method B air cleanup levels shall be based on a twenty-four-hour sampling duration collected at a constant flow rate;

(b) For ambient and indoor air sampling, compliance with Method C air cleanup levels (worker exposure) shall be based on an eight-hour sampling duration collected at a constant flow rate;

(c) For soil gas samples, including sub-slab samples, compliance shall be based on a sampling duration sufficient to obtain a representative sample of subsurface conditions when vapor intrusion is likely to occur. [297]

(d) Where long sample durations are not practical based on site-specific conditions, or shorter duration samples are determined by the department to more likely measure peak concentrations, the department may approve of shorter duration samples on a case-by-case basis.

(e) Compliance shall be determined for each sampling location/structure. Averaging of samples throughout a site, structure or portion of a site or structure, or of multiple samples at the same location over different time periods, shall not be allowed.

(5) Timing of Evaluations. When active vapor control systems are used to limit entry of vapors into structures, and sampling of indoor/outdoor air or vapor probes is being used, compliance with air cleanup levels shall be determined when the vapors are no longer influenced by such systems. [298]

(6) Sample representativeness. Many factors can influence whether or not vapors will enter into a structure. Samples from existing structures are useful for determining if remedial actions are needed to protect the occupants of those structures. However, the

[295] This is a ***new Section*** replacing former 750(7).

[296] For example, stack emissions monitoring for air discharges from treatment facilities. *[Note: This footnote will be in the rule]*

[297] That is, during periods of steady or falling (not rising) barometric pressure. *[Note: This footnote will be in the rule]*

[298] Subsections (5) – (8) are all new to address a variety of issues that have come up on sites with vapor issues.

lack of vapor intrusion into existing structures does not necessarily mean future vapor intrusion will not occur or that new structures will be protected. Determining compliance will require the exercise of judgment regarding the representativeness of samples for both current and future site conditions. Typically, indoor air samples alone will be insufficient to determine compliance. The department retains authority to determine the representativeness of sampling data.

(7) Evaluating compliance. Compliance with air cleanup levels can be determined using the following methods. When using these methods, the number of samples, sample locations, and timeframe for samples shall be approved by the department on a site-specific basis.

(a) Indirect measures of compliance. Compliance can be determined using indirect measurements of groundwater or soil gas concentrations, as provided in WAC 173-340-3513.

(i) For groundwater samples, compliance shall be determined using the methods specified in WAC 173-340-720;

(ii) For soil gas vapor samples, compliance shall be determined using the methods specified in provisions (b) or (c) in this subsection.

(b) Direct comparison. In the direct comparison method, individual sample results from indoor air samples and/or vapor probes are directly compared to the air cleanup levels or other relevant standards.[299] When using direct comparison, all samples at all locations must be less than or equal to air cleanup levels or other relevant standard to be in compliance.

(c) Statistical methods. Where sufficient samples exist within a structure or for a vapor probe sampling location, statistics may be used to determine compliance for that structure/location with air cleanup levels. When using statistics to determine compliance, the following standards shall apply:[300]

(i) Statistical methods shall be appropriate for the distribution of sampling data.

(ii) The upper one sided ninety-five percent confidence limit on the true mean shall be less than or equal to the air cleanup level;

(iii) To account for seasonal variations, the statistical analysis must be conducted on sampling results spanning at least one year of the most recent air monitoring data;

(iv) No single sample concentration shall be greater than two times the air cleanup level; and

(v) Less than ten percent (10%) of the sample concentrations shall exceed the air cleanup level.

(d) Multiple lines of evidence.

Many volatile organic compounds that are common site contaminants are also ubiquitous in ambient, outdoor air and also commonly occur indoors due to their use in everyday products. Furthermore, often only limited data is available and air concentrations can vary considerably between samples due to a variety of factors. As such, it may be difficult to determine compliance by directly comparing monitoring results to air cleanup levels or other relevant standards, or using statistical methods to determine compliance.

As an alternative to the other methods described in this subsection, a multiple lines of evidence approach may be proposed for approval by the department to determine compliance. A typical approach using multiple lines of evidence will include consideration of factors such as:

(i) Measured indoor air, ambient outdoor air, soil and groundwater concentrations;

[299] As used in this context, "other relevant standard" is the standard developed for vapor probes. *[Note: This footnote will be in the rule]*

[300] Parallels requirements in other parts of the MTCA rule.

(ii) Vapor probe and subslab soil gas concentrations;

(iii) Sampling and analysis quality assurance and control procedures;

(iv) An inventory of potential alternative interior sources and attempts to remove those sources during indoor air measurements;

(v) Building construction (type of foundation, vapor entry pathways);

(vi) Heating and ventilation systems design and operating parameters;

(vii) Weather conditions during measurements;

(viii) Extent of remediation;

(ix) The results of modeling; and

(x) Other relevant factors depending on site-specific conditions.

(8) Area background. When area background air concentrations are above air cleanup levels, it can be difficult to determine if exceedances are due to vapor intrusion or background. In these cases, the following methods can be used to determine if measured vapor concentrations are due to area background concentrations or vapor infiltration:

(a) Defining area background. To determine area background concentrations, sufficient samples must be collected and analyzed to provide a reasonable estimate of area background conditions. The following procedures shall be followed when conducting area background air sampling:

(i) The background samples must be located in the vicinity of the compliance sample locations.

(ii) The background samples must be located upwind of the compliance sample location, and taken in the ambient air at a sufficiently high enough elevation to minimize the any influence by the release of vapors from the ground or through nearby structures.

(iii) The background samples must be collected at the same time and over the same duration as compliance samples.

(b) Subtraction method. Area background concentrations can be subtracted from indoor air and vapor probe compliance sample concentrations to determine if air cleanup standards have been met when using the procedures in subsection (7) of this section. When using this method, the following procedures shall be used:

(i) Subtraction can only be used for when the background and compliance samples were taken at the same time;

(ii) The air cleanup level for which compliance is measured against after subtraction cannot be adjusted upward for natural or area background concentrations;

(iii) For duplicate or split samples, the lower concentration in the duplicate or split background samples shall be used for the evaluation; and

(iv) Background samples shall be measured at the same or lower method detection limits than compliance samples.

(c) Statistical method. Where sufficient samples are available from within a structure or from a vapor probe, and in background areas, the department may approve of a statistical comparison of the two data sets to determine if there is a significant difference in concentrations. When conducting such a statistical test, a Type I error level of 0.1 (90% confidence level) shall be used. [301]

(d) Alternative methods. The department may approve of alternative methods of accounting for area background concentrations.

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[301] Generally, at least 10 samples each of background air and indoor air will be necessary to conduct such a comparison. The most commonly accepted statistical method for testing in the means of site and background dataset is "Two-sample "***t***" Test" assuming both datasets are normally distributed and have equal variances. *[Note: This footnote will be in the rule]*

(9) Interpreting non-detect values. [302] The following procedures shall be used for measurements below the practical quantitation limit. These methods shall be used unless an air cleanup level is based on an applicable state or federal law that includes methods for handling non-detected measurements.

(a) Measurements below the method detection limit shall be assigned a value equal to one-half the method detection limit.

(b) Measurements above the method detection limit but below the practical quantitation limit shall be assigned a value equal to one-half the practical quantitation limit.

(c) Measurements below the method detection limit and/or practical quantitation limit may also be evaluated using the Kaplan-Meier method. [303]

(d) If a hazardous substance or petroleum fraction has never been detected in any sample at a site and these substances are not suspected of being present at the site based on site history and other knowledge, that hazardous substance or petroleum fraction may be excluded from the compliance analysis.

(e) The department may approve alternate procedures for handling values below method detection limits or practical quantitation limits.

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[302] Added to parallel language in other Sections of the MTCA rule.

[303] See USEPA's ProUCL statistical software. http://www.epa.gov/esd/tsc/software.htm and, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance; EPA 530-R-09-007, March, 2009. http://www.epa.gov/osw/hazard/correctiveaction/resources/guidance/sitechar/gwstats/unified-guid.pdf *[Footnote to be added to rule.]*

WAC 173-340-3500 Vapor intrusion evaluation procedures - general considerations. [304]

(1) Purpose.

(2) Tiered evaluation process.

(3) Information needs for vapor intrusion evaluations.

(4) Factors to consider in vapor intrusion evaluations.

(5) Use of institutional controls to limit exposure to vapor intrusion.

WAC 173-340-3505 Vapor intrusion evaluation procedures – interim actions.

(1) When required.

(2) Emergency response.

(3) Monitoring response.

(4) Active vapor control system response.

(5) Other interim actions.

WAC 173-340-3510 Preliminary assessment of the vapor intrusion pathway.

(1) Purpose.

(2) Information needs.

(3) Decisions.

WAC 173-340-3515 Tier I evaluation of the vapor intrusion pathway.

(1) Purpose.

(2) Timing.

(3) Information needs.

(4) Decisions.

WAC 173-340-3520 Tier II evaluation of the vapor intrusion pathway.

(1) Purpose.

(2) Timing.

(3) Information needs.

(4) Decisions.

[304] These Sections are all new. The numbering and location of these chapters has yet to be determined. For review convenience, they have been paired with the air cleanup levels chapters.

NEW SECTION

WAC 173-340-3500 Vapor intrusion evaluation and response procedures - general considerations.

(1) Purpose. The purpose of a vapor intrusion evaluation is to determine whether hazardous substances present in waste materials, groundwater, or subsurface soils could result in the accumulation of unacceptable indoor air concentrations in buildings or other structures in excess of air cleanup levels established under WAC 173-340-750. The vapor intrusion evaluation can be used to support decisions on groundwater cleanup levels (WAC 173-340-720), soil cleanup levels (WAC 173-340-740) and selection of cleanup actions (WAC 173-340-360).

(2) Tiered Evaluation Process. Vapor intrusion evaluations can be organized as a series of decision points that allow investigators to efficiently collect and evaluate this exposure pathway. These steps are described in WAC 173-340-3510 through 173-340-3520. These steps can be performed sequentially or in any order and, as a separate investigation or concurrent with other investigations.

(3) Information needs for vapor intrusion evaluations. The information required for a remedial investigation is also needed for a vapor intrusion evaluation. Particularly relevant elements include:

(a) An existing site conditions map;

(b) Identification of volatile hazardous substances present in soil or groundwater at the site;

(c) A conceptual site model;

(d) Characterization of the subsurface soils, soil gas,[305] and groundwater actually or potentially affected by volatile hazardous substance releases. Use maps and cross-sections, as appropriate, to illustrate the location and concentrations of volatile hazardous substances present at the site; and

(e) The location of existing and potential future buildings, underground utilities and other structures where vapors could potentially accumulate, and relevant construction and heating and ventilation system information on these structures. This includes structures in areas where volatile hazardous substances have been found and other nearby properties.

(4) Factors to consider in vapor intrusion evaluations. There are many site-specific conditions that can affect vapor migration into buildings or other structures. These include, for example, seasonal weather patterns, barometric pressure, the type of soil underlying a structure, soil moisture conditions, depth to groundwater, changing groundwater levels, the presence of preferential migration pathways, building construction (e.g. type of foundation, vapor entry pathways), and heating and cooling systems operations.

Similarly, ambient air background concentrations, indoor sources of volatile hazardous substances, the location of vapor measurements, construction of vapor probes, sample collection procedures and analytical methods can significantly influence measured concentrations.

Thus, it is important that the evaluator identify and understand how these factors can affect vapor migration and

[305] Soil gas concentrations are not needed to screen out sites based on a preliminary assessment under WAC 173-340-3510 but will be necessary for evaluations under WAC 173-340-3515 and 3520. *[Note: This footnote will be in the rule]*

measurements when conducting a vapor evaluation. [306]

(5) Use of institutional controls to limit exposure to vapor intrusion. Where the vapor intrusion pathway has been identified as a completed exposure pathway, or a likely future completed exposure pathway, and one of the following conditions exists, an institutional control complying with WAC 173-340-440 must be placed on affected properties.

(a) There no current or potential future structures (including underground utilities) on the site where vapors could accumulate. In this case, the institutional control would prohibit future structure development on the affected properties.

(b) There are building construction requirements intended to limit infiltration of vapors into buildings from the soil or groundwater in the vicinity of the buildings. In this case the institutional control would specify building construction requirements on the affected properties (for example, requirements for vapor control systems or positive pressure HVAC systems).

(c) An active vapor control system [307] has been installed to limit infiltration of vapors into structures. In this case, the institutional control must be placed on the property where the vapor control system and performance monitoring devices are located; it may not need to be placed on other properties within the influence of the system if it can be demonstrated that vapors can be adequately controlled and monitored without maintaining access to these other properties.[308] The institutional control shall address access, operation, and performance monitoring of the vapor control system; and

(d) Other situations where the department determines institutional controls are necessary to protect human health or the environment.

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[306] For a good discussion of these factors, consult the following references:

- The Interstate Technology Regulatory Council (ITRC) Vapor Intrusion Pathway: A Practical Guideline (2007). http://www.itrcweb.org/guidancedocument.asp?TID=49
- EPA's Draft Subsurface Vapor Intrusion Guidance (2002) http://www.epa.gov/osw/hazard/correctiveaction/eis/vapor.htm
- EPA Brownfields Technology Primer: Vapor Intrusion Consideration for Redevelopment: http://www.brownfieldstsc.org/pdfs/BTSC%20Vapor%20Intrusion%20Considerations%20for%20Redevelopment%20EPA%20542-R-08-0011.pdf
- Ecology's Vapor Intrusion Guidance, October 2009 Draft, Publication No. 09-09-047. http://www.ecy.wa.gov/programs/tcp/policies/VaporIntrusion/vig.html

[Note: This footnote will be in the rule]

[307] **"Active vapor control system"** means a system that uses a vacuum pump to create an air pressure in the soil pores that is consistently less than that in the ambient air and buildings and other structures within the zone of influence of the system. *[definition to be added to Section 200]*

[308] For example, if an active vapor control system is adequately protecting areas off the PLP's property, there is no need to have an institutional control on these off-property areas. *[Note: This footnote will be in the rule]*

NEW SECTION

WAC 173-340-3505 Vapor intrusion evaluation and response procedures – interim actions.

(1) When required.

(2) Emergency response.

(3) Monitoring response.

(4) Active vapor control system response.

(5) Other interim actions.

(1) When required. Whenever volatile hazardous substances are found to be infiltrating an existing structure from groundwater, soils or waste materials in the vicinity of the structure, an interim action shall be conducted to reduce the threat to human health and the environment in accordance with this section.

(2) Emergency response. The local emergency response authorities shall be notified and an emergency remedial action consisting of at least monitoring the air within and ventilating affected structures shall begin immediately upon discovery of any of the following conditions.

(i) Combustible vapors attributable to a release are found in any occupied structure on the site in measureable concentrations using a portable combustion meter. [309]

(ii) Concentrations of combustible vapors above the lower explosive limit are found in soil gas in the vicinity of any occupied structure on the site.

(iii) Concentrations of a volatile hazardous substance attributable to a release are found in the indoor air in any occupied structure on the site exceeding 1% of the acute exposure guideline levels (AEGLs) developed by the United States Environmental Protection Agency, or 10% of the threshold limit values (TLVs) developed by the American Conference of Governmental Industrial Hygienists (ACGIH). [310]

(3) Monitoring response. Whenever any of the following conditions are found, an interim action consisting of monitoring to determine if vapors attributable to a release are entering any existing occupied structure on the site shall be conducted. The monitoring shall be conducted as soon as practical.

(i) Free product of a volatile hazardous substance is present within 100 feet of any structure.

(ii) Concentrations of a volatile hazardous substance are present within groundwater within 100 feet of any structure at greater than 50 times the screening levels calculated using equation 351-1.

(iii) Concentrations of a volatile hazardous substance are present within soil gas within 100 feet of any structure at greater than 50 times the screening levels calculated using equation 351-2. [311]

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309 Based on OSHA Section 1915.12(b)(3) Flammable atmospheres. Atmospheres with a concentration of flammable vapors at or above 10 percent of the lower explosive limit (LEL) are considered hazardous when located in confined spaces. However, atmospheres with flammable vapors below 10 percent of the LEL are not necessarily safe. Such atmospheres are too lean to burn. Nevertheless, when a space contains or produces measurable flammable vapors below the 10 percent LEL, it might indicate that flammable vapors are being released or introduced into the space and could present a hazard in time. Therefore, the cause of the vapors should be investigated and, if possible, eliminated prior to entry.

310 A 1% safety factor has been built into the AEGL levels since these values are intended for 1 time accidental exposures, which would not be the case for vapor intrusion. A 10% safety factor has been built into the TLV values since these are intended to be applied to healthy adult workers, not residential settings. *Ecology is interested in suggestions for other standards that could be used to trigger the need for an interim action.*

311 The 50 times factor for (ii) and (iii) is based on substituting a 6 month exposure timeframe in equations 750-2 and 750-4. Ecology is interested in

(iv) Other monitoring data, odors, or observations indicate vapors from a release of a volatile hazardous substance to the groundwater or soil are entering any occupied structure on the site.

(4) Active vapor control system response. Where the monitoring in subsection (3) of this section or other air monitoring finds concentrations of volatile hazardous substance attributable to a release in any occupied structure in excess of air cleanup levels, follow-up remedial actions shall be conducted to address the threat. If it is anticipated that a remedial action identifying and, if necessary, remediating the source, will not be completed within six months, an active vapor control system, or other remedy acceptable to the department, shall be installed to prevent vapors from entering the structure.

(d) Other interim actions. The department may require interim actions in other situations where the department determines vapor intrusion poses a threat to human health or the environment.

comments on the practicality of using a 50 times factor, or some alternative method, to determine when indoor air monitoring is needed.

NEW SECTION

WAC 173-340-3510 Preliminary assessment of the vapor intrusion pathway.

(1) Purpose.

(2) Information needs.

(3) Decisions.

(1) Purpose. The purpose of the preliminary assessment is to quickly identify whether the potential for vapor intrusion exists at a site.

(2) Information needs. The information in WAC 173-340-3500 is needed to support a preliminary assessment of the vapor intrusion pathway.

(3) Decisions. The information from the preliminary assessment may support one or more of the following decisions:

(a) No further actions are needed to address the vapor intrusion pathway because the hazardous substances present at the site are not sufficiently volatile. For purposes of this evaluation, a hazardous substance is considered to be "sufficiently volatile" if the hazardous substance meets the definition of a volatile hazardous substance in WAC 173-340-200. [312]

(b) No further actions are needed to address the vapor intrusion pathway because no structures are, or will be, located in areas where vapors are likely to accumulate. This includes:

- Current buildings on and within 100 feet (horizontally) of soil or groundwater contaminated with volatile hazardous substances.
- Potential future building pads in these same areas.
- Underground utilities in these same areas where vapors could accumulate or migrate along.

(c) No further actions are needed because the source of the volatile hazardous substances has been remediated (destroyed through treatment or removed).

(d) Further information is needed to make decisions on the potential threats posed by the vapor intrusion pathway.

(e) An interim action is needed to reduce human health risks and/or explosion hazards.

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[312] The following definition will be included in Section 200:

"Volatile hazardous substance" means hazardous substances that have the following characteristics:

- Substances listed in EPA methods 502.2, 524.2, 551, 601, 602, 603, 624, 1624C, 1666, 1671, 8011, 8015B, 8021B, 8031, 8032A, 8033, 8260B;
- Substances not listed in the above methods but with a vapor pressure greater than 6.75 X 10^{-3} mmHg;
- Substances not listed in the above methods but with a boiling point less than 218.5 degrees Celsius;
- Substances not listed in the above methods and without vapor pressure or boiling point information but with a Henrys Law Constant greater than 10^{-5} atm-m^3/mol;
- Elemental mercury; and,
- For petroleum, aliphatic and aromatic constituents up to and including equivalent carbon fraction 12, plus naphthalene, 1-methylnaphthalene and 2-methylnaphthalene.

NEW SECTION

WAC 173-340-3515 Tier I evaluation of the vapor intrusion pathway.

(1) Purpose.

(2) Timing.

(3) Information needs.

(4) Decisions.

(1) Purpose. The purpose of the tier I evaluation is to determine whether concentrations of hazardous substances in the subsurface groundwater or soil are high enough to pose a potential vapor intrusion threat at a site.[313]

(2) Timing. A tier I evaluation shall be conducted when potential vapor threats cannot be ruled out with a preliminary assessment.

(3) Information needs. In addition to the information required under WAC 173-340-3500, the following information is needed to support a tier I evaluation of the vapor intrusion pathway:

(a) Concentrations of hazardous substances present in groundwater, soil, and soil gas samples collected at the site.

(4) Decisions. The information from the tier I evaluation may support one or more of the following decisions:

(a) Where only groundwater is contaminated, no further actions are needed to address the vapor intrusion pathway because volatile hazardous substances in the groundwater are present at concentrations below groundwater screening levels established using equation 351-1.

(b) As an alternative to (a), where only groundwater is contaminated, no further actions are needed to address the vapor intrusion pathway because volatile hazardous substances in the soil gas are present at concentrations below the soil gas screening levels established using equations 351-2.

(c) Where only the soil, and not the groundwater is contaminated, no further actions are needed to address the vapor intrusion pathway because volatile hazardous substances in the soil are below Method A soil cleanup levels in WAC 173-340-7401. [314]

(d) As an alternative to (c), where only the soil, and not groundwater, is contaminated, no further actions are needed to address the vapor intrusion pathway because volatile hazardous substances in the soil gas are present at concentrations below the soil gas screening levels established using equation 351-2.

(d) If both soil and groundwater are contaminated with volatile hazardous substances, no further actions are needed to address the vapor intrusion pathway because the conditions in (a) or (b) plus (c) or (d) have been met.

(e) Further information is needed to make decisions on the potential threats posed by the vapor intrusion pathway.

(f) An interim action is needed to reduce human health risks and/or explosion hazards.

[313] Soil gas (not soil) concentrations are used to evaluate vapor threats posed by contaminated soil because of the current inability to correlate soil concentrations with indoor air concentrations. Soil gas may also be used to evaluate vapor threats posed by groundwater. *[Note: Using the 3-phase model, and assuming a correlation existed, it would take soil concentrations 100 to 1000 times or more lower than current Method A soil CUL to screen out on the basis of soil concentration, so this doesn't appear to be a practical approach.]*

[314] The protectiveness of the Method A soil cleanup levels for the vapor exposure pathway has not been fully evaluated yet. Note that where there are no Method A table values, this screening level would become the PQL for that chemical.

Equation 351-1. Groundwater vapor intrusion screening levels

$$SL_{GW} = \frac{SL_{IA}}{VAF * BD * UCF * H_{cc}}$$

Where:

SL_{GW} = Screening level in groundwater protective of indoor air (µg/L)

SL_{IA} = Acceptable indoor air screening level (µg/m^3). These levels are concentrations protective of human health and can be calculated using the methods and parameters in WAC 173-340-7500 through 7503.

VAF = Vapor attenuation factor (0.001)(unitless) [315]

BD = Biodegradation factor (unitless)

A value of 0.1 may be used for readily biodegradable petroleum components, such as benzene, toluene, ethyl benzene and xylene provided all of the following conditions are met:

- The soil gas samples were deep measurements. That is, the soil gas samples were collected at least 15 feet below the ground surface, crawlspace, or lowest floor of the structure, whichever is deeper;
- The vadose zone oxygen content is 4% or higher; and
- The moisture content of the soil is greater than its wilting point.

A value of 1.0 shall be used for all other substances and circumstances.

H_{cc} = Henry's Law constant (unitless) [316]

UCF = Unit conversion factor (1000 L/m^3)

NOTE: This equation shall NOT be used if any of the following conditions are present:

- The groundwater is at least 15 feet beneath the ground surface, crawlspace or lowest floor of the structure, whichever is deeper;
- The vadose zone consists of fractured bedrock; or
- The building has an earthen floor or large, unsealed areas (e.g. sumps).

[315] The VAF is the reciprocal of attenuation. It is the indoor air concentration of a substance, due to vapor intrusion, divided by its subsurface soil gas concentration. The VAF in Equation 351-1 assumes that soil gas primarily enters a building through small cracks in the floor and at the building perimeter. It is based on empirical evidence from the USEPA and is estimated to be protective most of the time. If a building has significantly larger openings, this VAF may not be protective and indoor air monitoring will need to be conducted. [This footnote to be in the rule.]

[316] Henry's Law constants (Hcc) constants are temperature dependent. Screening levels must be calculated using Hcc values adjusted to 13°C (average Washington shallow groundwater temperature) unless site-specific groundwater temperatures indicate correction to another temperature is more appropriate for the site. This adjustment shall be made using the procedures in the USEPA's vapor intrusion guidance.
http://www.epa.gov/osw/hazard/correctiveaction/eis/vapor.htm
[This footnote to be in the rule.]

Equation 351-2. Soil gas vapor intrusion screening levels

$$SL_{SG} = \frac{SL_{IA}}{VAF * BD}$$

Where:

SL_{SG} = Screening level in soil gas protective of indoor air ($\mu g/m^3$)

SL_{IA} = Acceptable indoor air screening level ($\mu g/m^3$). These levels are concentrations protective of human health and can be calculated using the methods and parameters in WAC 173-340-7500 through 7503.

VAF = Vapor attenuation factor (unitless). [317]

- A value of 0.1 shall be used when SL_{SG} is compared to a subslab or shallow soil gas measurement.
- A value of 0.01 shall be used when SL_{SG} is compared to a deep soil gas measurement. That is, the soil gas sample was collected at least 15 feet below the ground surface, crawlspace, or lowest floor of the structure, whichever is deeper.

BD = Biodegradation factor (unitless)

A value of 0.1 may be used for readily biodegradable petroleum components, such as benzene, toluene, ethyl benzene and xylene provided all of the following conditions are met:

- The soil gas samples were deep measurements. That is, the soil gas samples were collected at least 15 feet below the ground surface, crawlspace, or lowest floor of the structure, whichever is deeper. (this factor shall not be applied to sub-slab or shallow soil gas measurements);
- The vadose zone oxygen content is 4% or higher;
- The moisture content of the soil is greater than its wilting point.

A value of 1.0 shall be used for all other substances and circumstances.

[317] "Subslab" means vapor measurements from a gas probe installed through the floor of a building with a basement or slab on grade construction and into the soil immediately underneath the floor slab.

The VAF is the reciprocal of attenuation. It is the indoor air concentration of a substance, due to vapor intrusion, divided by its subsurface soil gas concentration. The VAFs in Equation 351-2 assume that soil gas primarily enters a building through small cracks in the floor and at the building perimeter. They are based on empirical evidence from the USEPA and the literature and are estimated to be protective most of the time. If a building has significantly larger openings, this VAF may not be protective and indoor air monitoring will need to be conducted. *[This footnote to be in the rule.]*

NEW SECTION

WAC 173-340-3520 Tier II evaluation of the vapor intrusion pathway.

(1) Purpose.

(2) Timing.

(3) Information needs.

(4) Decisions.

(1) Purpose. The purpose of the tier II evaluation is to determine whether concentrations of hazardous substances in the subsurface groundwater or soil have caused, of have the potential to cause, vapor intrusion at concentrations exceeding air cleanup levels established under WAC 173-340-750 and therefore, require remedial action.

(2) Timing. A tier II evaluation shall be conducted when potential vapor threats cannot be ruled out with a preliminary assessment or tier I assessment.

(3) Information needs. In addition to the information required under WAC 173-340-3500 and 3515, the following information is needed to support a tier II evaluation of the vapor intrusion pathway:

(a) Concentrations of hazardous substances present in indoor air, crawl-space and/or sub-slab gas samples collected from buildings at the site. Such measurements must be taken under site conditions when vapors are likely to enter and accumulate in structures;

(b) Concentrations of hazardous substances present in outdoor air samples collected upwind and in the vicinity of buildings at the site;

(c) Fate and transport modeling results.

(4) Decisions. Because of the nature of vapor intrusion, multiple lines of evidence likely will be needed in a tier II evaluation to determine if vapor concentrations measured in a building are a result of vapor intrusion. See WAC 173-7504 for additional information on determining compliance using multiple lines of evidence and other methods. The information from the tier II evaluation may support one or more of the following decisions:

(a) No further actions are needed to address the vapor intrusion pathway because compliance has been demonstrated using the procedures in WAC 173-340-7505;

(b) Further information is needed to make decisions on the potential threats posed by the vapor intrusion pathway.

(c) An interim action is needed to reduce human health risks and/or explosion hazards.

Part IX Tables

The Tables in this Section with proposed changes have been incorporated into the previous Sections to facilitate review.