

# Calculation of Method B and Method C Cleanup Levels for Petroleum Mixtures

## Introduction

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Under the Model Toxics Control Act (MTCA), site-specific cleanup levels for Total Petroleum Hydrocarbon (TPH) mixtures are determined using the fractionated analytical approach. This approach divides the petroleum mixture into equivalent hydrocarbon numbers. Use of the fractionated approach requires the determination of the composition of the petroleum mixture by analyzing for extractable and/or volatile petroleum hydrocarbons (EPH/VPH)<sup>1</sup>. **Note:** This guidance provides a general overview of how to calculate Method B and Method C cleanup levels for petroleum mixtures. More detailed guidance is provided in Section 8 of our [Guidance for Remediation of Petroleum Contaminated Sites, Revised June 2016](#)<sup>2</sup> (Ecology, 2016) and in our [User's Guide for MTCATPH 12.0](#)<sup>3</sup> (Ecology, 2023a).

Cleanup levels for petroleum mixtures are dependent on the composition of the mixture.

- **Method A cleanup levels** for petroleum mixtures provided in WAC 173-340-900, [Table 720-1](#) (Method A Groundwater Cleanup Levels), [Table 740-1](#) (Method A Soil Cleanup Levels for Unrestricted Land Use) and [Table 745-1](#) (Method A Soil Cleanup Levels for Industrial Land Use) are based on **assumed compositions**.
- **Method B and Method C cleanup levels** for petroleum mixtures are based on **site-specific compositions**. Identifying the composition requires a site-specific analysis of the contaminated medium. See WAC 173-340-900, [Table 830-1](#) for a list of contaminants to test for when establishing cleanup levels for petroleum mixtures.

**Note:** Method C cleanup levels may be used to set soil and air cleanup levels at qualifying industrial sites ([WAC 173-340-745](#)), and to set air cleanup levels in manholes and utility vaults ([WAC 173-340-750](#)). For groundwater, surface water, and air cleanup levels, Method C may also be used, with certain restrictions, when Method A or B cleanup levels are a) lower than is technically possible, or b) lower than area background, or c) when reaching those levels may result in a greater overall threat to human health and the environment, provided all practicable methods of treatment have been used and institutional controls are in place ([WAC 173-340-706](#)).

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<sup>1</sup> The detailed analytical methods, including EPH and VPH for petroleum hydrocarbons, are described in a separate Ecology document titled *Analytical Methods for Petroleum Hydrocarbons* (Ecology, 1997).

<https://apps.ecology.wa.gov/publications/SummaryPages/97602.html>

<sup>2</sup> <https://apps.ecology.wa.gov/publications/SummaryPages/1009057.html>

<sup>3</sup> <https://apps.ecology.wa.gov/publications/SummaryPages/0109073.html>

Because cleanup levels for petroleum mixtures are dependent of the composition of the mixture and because the composition must be determined on a site-specific basis, the Washington State Department of Ecology's (Ecology) **Cleanup Levels and Risk Calculations (CLARC) database does not provide pre-calculated standard Method B or C formula values for petroleum mixtures.**

Cleanup levels must be established for the TPH mixture as a whole, as well as for individual hazardous substances (TPH components) within the mixture, such as benzene, ethylbenzene, toluene, and xylene (BTEX)<sup>4</sup>. Under Method B and Method C, the cleanup levels for individual TPH components are established just like they would be for any other hazardous substance.

To calculate soil and groundwater cleanup levels for petroleum mixtures, the assessor should use the [MTCATPH 12.0 Excel Workbook and associated User's Guide](#)<sup>5</sup> provided by Ecology (Ecology, 2023a).

## Groundwater

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To establish a site-specific TPH cleanup level under Method B or Method C, the composition of the petroleum mixture in the groundwater must be determined. Determining the composition requires the analysis of the groundwater for petroleum fractions (using EPH/VPH methods) and other toxic components likely to be present. See WAC 173-340-900, [Table 830-1](#) for a list of contaminants to test for when establishing cleanup levels for petroleum mixtures.

The site-specific groundwater composition is used in MTCA WAC 173-340-720, [Equation 720-3](#) to calculate a TPH cleanup level that takes into account the combined noncarcinogenic effects of the petroleum mixture (i.e., petroleum fractions plus individual petroleum related components). This TPH cleanup level may need to be adjusted downward to account for multiple individual hazardous substances (i.e., individual petroleum related components) within the petroleum mixture as discussed in Section 2.2.3 of our [User's Guide for MTCATPH 12.0](#)<sup>6</sup> (Ecology, 2023a).

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<sup>4</sup> For petroleum mixtures, site-specific TPH cleanup levels are calculated taking into account the noncarcinogenic additive effects of the petroleum fractions and volatile organic compounds (e.g., BTEX, naphthalene, n-Hexane – see [Table 830-1](#)) present in the petroleum mixture.

<sup>5</sup> <https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Clean-up-petroleum-contamination>

<sup>6</sup> <https://apps.ecology.wa.gov/publications/SummaryPages/0109073.html>

**Note:** Site-specific TPH cleanup levels derived under Method B or Method C do not account for potential concentrations of non-petroleum polar organic metabolites from weathered petroleum groundwater plumes. Ecology's November 2023 [Guidance for Silica Gel Cleanup in Washington State](#) provides details on the use of silica gel cleanup (SGC) in analyzing diesel and heavy oil range organics when using Ecology's NWTPH-Dx analytical method, and when using the extractable petroleum hydrocarbons (EPH) and/or volatile petroleum hydrocarbons (VPH) methods to determine a site-specific TPH cleanup level (Ecology, 2023b).

See [WAC 173-340-720 \(4\)\(b\)\(iii\)\(C\) and \(5\)\(b\)\(iii\)\(C\)](#).

## Surface Water

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To establish a site-specific TPH cleanup level under Method B or Method C, the composition of the petroleum mixture in the surface water must be determined. Determining the composition requires the analysis of the surface water or groundwater (e.g., if evaluating groundwater discharge to surface water) for petroleum fractions (using EPH/VPH methods) and other toxic components likely to be present. See WAC 173-370-900, [Table 830-1](#) for a list of contaminants to test for when establishing cleanup levels for petroleum mixtures.

The site-specific water composition may be used in combination with WAC 173-340-730, [Equation 730-1](#) to derive a TPH cleanup level for surface water. However, this equation must be modified to calculate a TPH cleanup level that considers the combined noncarcinogenic effects of the petroleum mixture (i.e., petroleum fractions plus individual petroleum related components). This modified equation, which requires the identification of site-specific bioconcentration factors (BCFs), is not specified in the MTCA regulation. However, an acceptable equation may be proposed in coordination with Ecology. This TPH cleanup level may need to be adjusted downward to account for multiple individual hazardous substances (i.e., individual petroleum related components) within the petroleum mixture as discussed in Section 2.2.3 of our [User's Guide for MTCATPH 12.0](#)<sup>7</sup> (Ecology, 2023a).

**Alternative Method** – As an alternative to calculating a site-specific TPH cleanup level, the regulation allows for the use of the applicable TPH groundwater cleanup levels in WAC 173-370-900, [Table 720-1](#) (based on potable water consumption). Use of these values would avoid the need to conduct fractionated petroleum analyses (i.e., EPH/VPH).

The cleanup levels for TPH and the TPH components must also be at least as stringent as concentrations that are protective of fish and aquatic life, as well as wildlife, just as for any other hazardous substance. Ecology's [Implementation Memo No. 23](#)<sup>8</sup> (IM #23) contains gasoline and diesel surface water

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<sup>7</sup> <https://apps.ecology.wa.gov/publications/SummaryPages/0109073.html>

<sup>8</sup> <https://apps.ecology.wa.gov/publications/SummaryPages/1909043.html>

concentrations that are predicted to be protective of aquatic receptors in marine and freshwater using the NWTPH-Gx and -Dx methods<sup>9</sup> (Ecology, 2021).

See [WAC 173-340-730\(3\)\(b\)\(iii\)\(C\) and \(4\)\(b\)\(iii\)\(C\)](#).

## Soil

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To establish a site-specific TPH cleanup level under Method B or Method C, the composition of the petroleum mixture in the soil must be determined. Determining the composition requires the analysis of either the soil or the product released for petroleum fractions and other toxic components likely to be present. See WAC 173-340-900, [Table 830-1](#) for a list of contaminants to test for when establishing cleanup levels for petroleum mixtures.

- **Direct Contact Pathway:** For petroleum mixtures, the regulation requires a concurrent evaluation of ingestion and dermal absorption. The petroleum mixture composition is used in [Equation 740-3](#) (or, if using Method C, [Equation 745-3](#)) to calculate a protective concentration for TPH that takes into account the combined noncarcinogenic effects of the petroleum mixture. Protective concentrations for individual TPH components are established using [Equations 740-4](#) and [740-5](#) (or, if using Method C, [Equations 745-4](#) and [745-5](#)). This TPH cleanup level may need to be adjusted downward to account for multiple individual hazardous substances (i.e., individual petroleum related components) within the petroleum mixture. See [WAC 173-340-740\(3\)\(b\)\(iii\)\(B\)\(III\)](#) and [173-340-745\(5\)\(b\)\(iii\)\(B\)\(III\)](#).
- **Leaching Pathway:** Protective concentrations for TPH and the TPH components must be established using the methods described in [WAC 173-340-747](#).
- **Vapor Pathway:** Since TPH and TPH components contain volatile organic compounds, the vapor pathway must be evaluated whenever one of the conditions specified in the regulation exists at a site. See [WAC 173-340-740\(3\)\(b\)\(iii\)\(C\)](#). Protective concentrations may be determined using one or more of the methods described in the regulation<sup>10</sup>.

In addition to accounting for human health impacts, soil cleanup levels for TPH and the TPH components must also account for any potential impacts to terrestrial ecological receptors (plants and animals), just as for any other hazardous substance. See [WAC 173-340-7490](#).

See Section 2.2.2 of our [User's Guide for MTCATPH 12.0](#)<sup>11</sup> for additional information on soil pathways and potential adjustments to TPH soil cleanup levels (Ecology, 2023a).

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<sup>9</sup> Whole effluent toxicity (WET) testing may be used to demonstrate that a concentration is protective of fish and aquatic life (see [WAC 173-340-730\(3\)\(b\)\(iii\)\(C\)](#)). Other methods may need to be used to demonstrate that a concentration is protective of wildlife if this is a concern at the site.

<sup>10</sup> To assess the vapor pathway for petroleum mixtures, see Ecology's Guidance: [Guidance for Evaluating Vapor Intrusion in Washington State: Investigation and Remedial Action](#) (Ecology, 2022).

<sup>11</sup> <https://apps.ecology.wa.gov/publications/SummaryPages/0109073.html>

## Air

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To establish TPH cleanup levels under Method B or Method C, the composition of the petroleum mixture in the air must be determined<sup>12</sup>. Determining the composition requires the analysis of the ambient air and/or soil gas for petroleum fractions and other toxic components likely to be present. See WAC 173-370-900, [Table 830-1](#) for a list of contaminants to test for when establishing cleanup levels for petroleum mixtures.

The site-specific air composition may be used in combination with [Equation 750-1](#). However, this equation must be modified to calculate a TPH cleanup level that accounts for the combined noncarcinogenic effects of the petroleum mixture (i.e., petroleum fractions plus individual petroleum related components). This modified equation is not specified in the MTCA regulation. However, an acceptable equation is provided in Appendix E (Section E-8) of Ecology’s [Guidance for Evaluating Vapor Intrusion in Washington State: Investigation and Remedial Action](#) (Ecology, 2022). This TPH cleanup level may need to be adjusted downward to account for multiple individual hazardous substances (i.e., individual petroleum related components) within the petroleum mixture.

See [WAC 173-340-750\(3\)\(b\)\(ii\)\(C\) and \(4\)\(b\)\(ii\)\(C\)](#).

## Acronym List

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BCF	Bioconcentration factor
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CLARC	Cleanup Levels and Risk Calculation
Dx	Diesel range
Ecology	Washington State Department of Ecology
EPH	Extractable petroleum hydrocarbons
Gx	Gasoline range
MTCA	Model Toxics Control Act
NWTPH	Northwest Total Petroleum Hydrocarbon Method
SGC	Silica gel cleanup
TPH	Total petroleum hydrocarbon
VPH	Volatile Petroleum Hydrocarbon
WET	Whole effluent toxicity

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<sup>12</sup> To assess the vapor pathway for petroleum mixtures, see Ecology’s Guidance: [Guidance for Evaluating Vapor Intrusion in Washington State: Investigation and Remedial Action](#) (Ecology, 2022).

## References

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