STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

April 18, 2016

Estate of Sophie Sussman
Portland Avenue Associates, LLC
Attention: Mr. Loren Dunn
Riddell Williams
1001 Fourth Ave. STE 4500
Seattle, Washington 98154-1192

Re: Ecology Comments on the *Revised Augmented Remedial Investigation and Feasibility Report,* dated September 2014, prepared by Kennedy/Jenks, Former Tacoma Metals Site, Agreed Order DE 97-5435, Facility/Site No. 1257, Cleanup Site ID No. 3910.

Ref: *Feasibility Study Addendum, B-36 Area, Tacoma Metals Site, Tacoma, Washington,* dated June 2015, prepared by AECOM.

E-mail from Mary Henley, city of Tacoma to Ty Schreiner, Kennedy/Jenks, February 12, 2015, *re: Former Tacoma Metals Site.*

Dear Mr. Dunn:

Thank you for submitting the above-referenced Remedial Investigation and Feasibility Study Report (RI/FS) for our review. Please revise the RI/FS to incorporate the following comments and then resubmit for our review within 75 days of the date of this letter.

1. **Section 1, Introduction:**

   a. Please add text to clarify that references in the report to "creosote", "creosote-related compounds", "creosote-related chemicals of concern", "creosote impacts", "creosote-impacted soil", and "creosote-affected soil" refer to contamination that includes a group of chemicals consisting of benzene, toluene, ethylbenzene and total xylenes (BTEX), naphthalenes, polycyclic aromatic hyrdrocarbons (PAHs), and carcinogenic PAHs (cPAHs) in various proportions. The term "creosote" is used for convenience in the report instead of listing all of these chemicals.

   b. Also, the text refers to the "creosoting plant" and the "creosoting plant area." Clarify that these terms refer to a specific area of the Site but not necessarily to a specific

source since there were two separate facilities (creosoting plant and coke plant) that operated in this area and both of these facilities had the potential to release creosote-related compounds.

2. **Section 1.3, Site Areas and Nomenclature:**

    a. Please revise to indicate that the Site includes both the Tacoma Metals "On-Property" area (used for metals recycling by General Metals of Tacoma and Tacoma Metals, Incorporated), APNs 8950000352, 0320032043, and 8950000390 and the "Off-Property" areas including the City of Tacoma 18th Street right-of-way and the Simpson Tacoma Land Company parcel (Simpson Property; APN 8950000390).

    b. According to Kennedy/Jenks, there appears to be some question about whether or not the contamination extends onto JJ Port, LLC property because the contamination is located on a wedge-shaped parcel of unknown ownership (*see* Sheet 1 in Attachment 1 of the "Response to Comments Provided in Ecology's 3 January 2014 Letter", prepared by Kennedy/Jenks Consultants, April 30, 2014). Please also discuss this in the report.

    c. **Creosoting Plant Area:** Add that the coke plant also operated in this area and that the historic releases were discovered beneath the area that the facilities occupied rather than specifying that the release was from a particular facility.

3. The FS Addendum referenced above will be a companion document to the RI/FS. Please reference it accordingly in the text. Please also note that the FS Addendum will need to be revised to incorporate Ecology's comments. Ecology's comments on the FS Addendum will be transmitted in a separate letter.

4. **Figure 3, Sample Location and Affected Soil Area Map:** Please separate this figure into two figures: one that only shows the sample locations and another that consists of the current Figure 3. This is necessary because some of the sample locations are hard to read on the current figure.

5. **Section 2.3.2.3, Interim Remedial Actions:**

    a. In the last sentence of this section, correct the section reference for the description of interim remedial actions from "3.4" to "4.3".

    b. Please also mention in this section the polychlorinated biphenyls (PCBs) cleanup that was done in 1988-89 by Chempro and show the location of the cleanup on a figure.

6. **Soil Cleanup Levels (text and Table 3):**

Table 3 shows proposed industrial soil cleanup levels for direct contact human exposure and terrestrial ecological exposure (TEE) with a TEE conditional point of compliance of the uppermost 6 feet.
The human health soil cleanup levels (CULs) shown in this table are not sufficient because they do not account for additive risk (as required by WAC 173-340-706[4]). Additionally, the preferred alternative in the RI/FS (Alternative 2, excavation, buffer, off-site disposal, asphalt cap and institutional controls) proposes to leave contamination in place above the direct contact CUL but it is not clear that the cleanup action will be protective of human health for the likely human health exposure scenario (excavation worker) within potential industrial development areas. As stated in WAC 173-340-740(6)(f), for cleanup actions that involve containment of hazardous substances, the cleanup action still needs to be protective of human health.

Ecology suggests the use of soil remediation levels (RELs) that will be protective for the direct contact pathway for the likely human health exposure scenario (excavation worker) in industrial development areas. Ecology has developed potential human health direct contact (excavation worker) RELs that also account for additive risk. These RELs are summarized in Table 1 below and are presented in more detail in Attachment A of this letter.

Table 1 - Remediation Levels (RELs) for Industrial Use, Excavation Worker Scenario, Tacoma Metals Site

Chemical	REL (mg/kg)
Benzene	6,900
Toluene	150,000
Ethylbenzene	190,000
Total xylenes	770,000
Naphthalenes	54,000
Benzo(a)pyrene	18/12*
PCBs	810
Arsenic	670
Barium	370,000
Cadmium	1,900
Total chromium (Cr VI)	22,000
Copper	300,000
Lead	2,000
Mercury	87
Selenium	3,700

Silver	26,000
TPH-D/O	2,000

From Table A-3, rounded to two significant digits.
*See below comment #6f.

Please revise the text and table to include the RELs and also make the following changes:

a. Please revise the proposed Alternatives 1, 2, and 3 to include the treatment and/or removal of soils that exceed the RELs within areas of the Site that where industrial development be allowed and permitted. Please note below comment #8 regarding restrictions on industrial use for some areas of the Site and comment #9 regarding stormwater issues.

b. Please prepare a figure that shows the locations of samples that exceed the lead REL of 2,000 milligrams per kilogram (mg/kg) within the direct contact point of compliance (15 feet below ground surface). Based on our review of the data, the locations that exceed the lead REL include: TP-1, -16, -20 through -22, -27, -28, -30, -32 through -35, -38, -40, -43, -45, -46, and -57 through -61.

c. Because the CULs shown in Table 3 were not adjusted for additive risk, some of the CULs shown in the table exceed the RELs. These include: toluene, ethylbenzene, naphthalenes, barium, and selenium. Please adjust the CULs for the chemicals in Table 3 so that they are equal to or lower than the RELs.

d. The TEE CUL for total petroleum hydrocarbons – diesel range (TPH-D) that is shown in Table 3 is incorrect. According to WAC 173-340-900, Table 749-3, the TPH-D TEE indicator soil concentration for wildlife is 6,000 mg/kg except that the TEE concentration shall not exceed residual saturation. Since the residual saturation screening level for TPH in WAC 173-340-900, Table 747-5 is 2,000 mg/kg, then the wildlife TEE indicator concentration that should be used is 2,000 mg/kg. Therefore, the corresponding CUL for TEE wildlife shall be 2,000 mg/kg instead of 5,000 mg/kg.

e. Table 3 shows total petroleum hydrocarbons – diesel range (TPH-D) and –oil range (TPH-O) cleanup levels of 2,000 mg/kg, each. However, to ensure that residual saturation is not exceeded and to also be in compliance with Toxics Cleanup Program Implementation Memorandum #4 (available at: https://fortress.wa.gov/ecy/publications/summarypages/0409086.html), the REL is a combined TPH value of 2,000 mg/kg. Therefore, the TPH-D and –O cleanup levels for non-pyrogenic sources also need to be adjusted downward to a combined TPH value of 2,000 mg/kg. Please revise the table accordingly.

f. For protection of groundwater, the REL for carcinogenic polycyclic aromatic hydrocarbons (cPAHs) for the Site (on-property and off-property) shall be equal to the CULs shown in Table 3 (12 mg/kg for depths less than 6 feet below ground surface and 18 mg/kg for depths from 6 to 15 feet below ground surface).

The excavation worker cPAH REL of 220 mg/kg that is shown in Attachment A is not considered to be sufficiently protective of groundwater.

g. Please prepare a figure that shows the locations of samples that exceed the cPAH CUL and REL of 18 mg/kg within the direct contact point of compliance (15 feet below ground surface) and also show the areas of the Site where the TEE CUL/REL is applicable (12 mg/kg for depths less than 6 feet below ground surface). Based on our review of the data, the locations that exceed the cPAH REL of 18 mg/kg within a depth of 15 feet include: TP-2, -5, -40, -49, B-1, MW-18, B-12, B-14, B-23, and the B-36 area (described in more detail in the FS Addendum).

7. **Draft Groundwater Cleanup Levels (text and Table 3):**

Table 3 shows the following freshwater CULs: MTCA Method B, WAC 173-201A, EPA National Recommended Ambient Water Quality Criteria (Section 304[a] of the Clean Water Act, CWA), and the National Toxics Rule (NTR), 40 CFR 131. However, the proposed CULs shown in this table are not sufficient because they do not account for additive risk [as required by WAC 173-340-708(5)] and/or do not reflect the lowest state, federal, or Tribal criteria. Additionally, the CWA criteria were updated by EPA in June 2015.

Ecology has calculated draft CULs for the groundwater-to-surface water pathway that also include additive risk. These CULs are presented in Attachment A, Table A-1 of this letter. However, further adjustments for additive risk may be needed depending on the results of chromium speciation testing (*see* below comment e). Please revise the text and Table 3 to make the following changes:

a. Change the CUL for arsenic from 0.098 micrograms per liter (µg/L) to 5 µg/L so that it is equal to the background concentration for the state of Washington (WAC 173-900, Table 720-1, footnote b).

b. Change the CUL for lead from 4.74 µg/L to 4.62 µg/L to match the Water Quality Standard for Surface Waters of the Puyallup Tribe (WQSPT, May 21, 2007).

c. Delete "/PQL" and the associated footnote for the mercury CUL. The mercury CUL shall be 0.012 µg/L.

d. Change the cadmium CUL from 1.59 µg/L to 0.37 µg/L to reflect the CWA criteria (corrected for a site-specific hardness value of 180).

e. **Chromium and Selenium**:

i. Cleanup levels for both chromium (III) and chromium (VI) are shown on the table. However, it is not known whether chromium (III) or chromium (VI) is present at the Site because an analysis to determine which species of chromium is present was never performed. The applicable groundwater CUL for chromium (VI) is 10 µg/L. Dissolved chromium groundwater sample results from December 2003 (Table 5E) exceeding 10 µg/L were observed at wells MW-1, --4(R), -5, -6, -7, -8(R), -9, and -11 through -22. However, total (unfiltered) chromium groundwater sample results from December 2003 (Table 5D) exceeding 10 µg/L were only observed at well MW-20. Before an appropriate CUL for chromium can be determined, groundwater samples from selected wells need to be analyzed for total and dissolved chromium (VI). Ecology recommends that the following shoreline wells be sampled for this: MW-4R, -5, -6, -9, -19, and -20.

ii. Following the determination of which chromium species is present, if the chromium (III) CUL is applicable, change the CUL from 288 µg/L to 120 µg/L to reflect the CWA criteria (corrected for a site-specific hardness value of 180).

iii. Please also analyze MW-9 and -20 for total and dissolved selenium because total and dissolved selenium groundwater sample results from December 2003 (Tables 5D and 5E) exceeding the 5 µg/L CUL were observed at these wells.

f. Change the cadmium CUL from 1.59 µg/L to 0.37 µg/L to equal the CWA criteria (corrected for a site-specific hardness value of 180).

g. Change the copper CUL from 18.76 µg/L to 14.8 µg/L to equal the CWA criteria (corrected for a site-specific hardness value of 180).

h. Please add silver to the list of groundwater chemicals of concern. The applicable CUL for silver is 8.8 µg/L (WAC 173-201A, corrected for a site-specific hardness value of 180).

i. Please revise the table to indicate that for total polychlorinated biphenyls (PCBs), the CUL is equal to the laboratory practical quantitation limit (PQL) and the PQL is 0.01 µg/L.

j. Change the CUL for naphthalenes from 4,940 µg/L to 13 µg/L to match the CUL shown in Attachment A. This CUL is based on the MTCA Method B groundwater CUL (for protection of Puyallup River domestic water supply designated use) and adjusted for additive risk.

k. Please revise the table to show the updated CWA (human health, water + organism) criteria for cPAHs (benzo[a]pyrene) of 1.2E-04 µg/L. Adjusting up to the PQL (0.01 µg/L) makes the applicable CUL equal to 0.01 µg/L. Please change the table accordingly.

l. Change the CUL for benzene from 23 µg/L to 1.2 µg/L to match the WQSPT, NTR, and CWA.

m. Change the CUL for toluene from 15,000 µg/L to 14 µg/L to match the updated CWA criteria (human health, water + organism) and adjusted for additive risk.

n. Change the CUL for ethylbenzene from 2,100 µg/L to 14 µg/L to match the updated CWA criteria (human health, water + organism) and adjusted for additive risk.

o. Change the CUL for total xylenes from 1,000 µg/L to 5 µg/L to match the CUL shown in Attachment A, Table A-1. This CUL is based on the MTCA Method B groundwater CUL (for protection of Puyallup River domestic water supply designated use) and adjusted for additive risk.

p. Change the CUL for TPH-D and TPH-O from 10,000 µg/L, each to a combined cleanup level of 450 µg/L to match the CUL shown in Attachment A. This CUL is based on the MTCA Method A groundwater CUL (for protection of Puyallup River domestic water supply designated use) and adjusted for additive risk.

8. **Critical Areas, Buffers, Floodways, and Floodplain:**

a. As noted by Henley (2015, referenced above), portions of the site are impacted by critical areas, buffers, floodways, and floodplain. Please add maps that illustrate the locations of these areas. These factors need to be considered in designing cleanup alternatives.

b. According to Henley (2015), the Site is located within the S-9 Puyallup River Shoreline District. "The intent of the S-9 Puyallup River Shoreline District is to encourage recreational development of the riverfront, ecological restoration activities that restore historic floodplain processes and functions, while allowing industrial development of adjacent upland areas, and to encourage preservation of Clear Creek,

its associated wetlands, and related ecosystems. Permitted industrial uses will develop and operate in a manner that is compatible with shoreline ecological functions." Please discuss this in the FS and include this consideration in the cleanup alternatives.

c. Floodways restrictions are particularly significant because residual contamination above unrestricted land use CULs will not be allowed to remain within a mapped floodway area. Therefore, unrestricted land use CULs should also be shown on Table 3 if contamination is located within a mapped floodway area. Unrestricted land use CULs and RELs also need to be account for additive risk as required by WAC 173-340-708[5]).

d. Industrial CULs may also not be appropriate for some buffer areas because industrial uses will not be allowed. Please revise the cleanup alternatives and the discussion of cleanup levels to take these factors into account.

9. **Stormwater:**

a. Henley (2015) notes that the existing storm sewer in Portland Avenue (from Lincoln Avenue north) already surcharges during a 100-yr, 24-hour Type IA event. When additional development (on the Tacoma Metals Site and other properties that are undeveloped/underutilized) occurs, the existing issues will get worse. There are limited alternatives to solve this problem and the best solution appears to be detaining stormwater flows on-site so that discharge from the Site matches pre-development conditions. This would require the construction of a stormwater detention system.

b. One of the standard boilerplate provisions in Ecology's Environmental Covenant (EC) boilerplate is to not allow the construction of stormwater infiltration facilities in contaminated areas in order to minimize the potential for mobilization of contaminants remaining in the soil. Therefore, the EC for the Site will not allow the construction of stormwater infiltration facilities or ponds shall be within any area of the Site that contains contamination above unrestricted use CULs. This needs to be considered in developing and revising the cleanup alternatives.

c. The EC for the Site will also require that all stormwater catch basins, conveyance systems, and other appurtenances located within any area of the Site that contains contamination above unrestricted use CULs shall be of water-tight construction.

10. **Section 4.2, 1st sentence:**

    Insert "area" after "plant".

11. **Section 4.2.1, 1st and 2nd sentences:**

    Insert "area" after "plant".

12. **Section 4.2.2, page 4-7, 1st paragraph, next to last sentence:**

    This sentence states that samples were collected from MW-8(R) in August 2002 to check for the presence of PCBs. However, Table 7E shows that well MW-13 was sampled instead. Please correct the text and state why MW-13 was sampled instead of MW-8(R).

13. **Section 5.2.2.1, Site Stratigraphy, 3rd paragraph, last sentence:**

    Delete "although creosote was last used at the site during the 1930s" and reword to state that the number of years since creosote and/or coke was used at the Site is "approximately 72" because the coke production enterprise was liquidated in 1944.

If you have questions about this letter, please contact me at (360) 407-6247 or at steve.teel@ecy.wa.gov.

Sincerely,

SS Teel

Steve Teel, LHG
Cleanup Project Manager/Hydrogeologist
Toxics Cleanup Program
Southwest Regional Office

By certified mail: 9171999991703646815068

Enclosure: Attachment A

cc: See distribution list

CC Distribution List:

Bill Hengemihle, LECG, LLC

Clark Davis, Davis Law Office, PLLC

Jim Jakubiak, Schnitzer Steel Industries, INC

John Cermak, Jr., BakerHostetler

Kathryn Navarro, Simpson Tacoma Land Company

M. Edward Spring, Osteran, Hahn, Spring, Straight, & Watts, P.S.

Mark Meyers, Williams Kastner

Mary Henley, City of Tacoma

Mr. Robert Pollack, Tacoma Metals, INC.

Paul E. Kalina, P.E., URS Corporation

Philip J. Slowiak, International Paper Company

Ryan D. Fischbach, BakerHostetler

Stuart C. Morgan, Eisenhower & Carlson, PLLC

Ty Schreiner, Kennedy/Jenks Consultants

John Level, ATG

Rebecca Lawson, Ecology

Nick Acklam, Ecology

Attachment A
Draft Cleanup Levels and Remediation Levels

This appendix documents the derivation of draft ground water cleanup levels (CULs), and soil remediation levels (RELs) for the Tacoma Metals site. The process involved the following three steps:

1. Derivation of preliminary CULs or RELs.
2. Evaluation of additive cancer risks and adjustment as needed to achieve a total cancer risk of $1x10^{-5}$ across the carcinogens.
3. Evaluation of additive noncancer hazard quotients (HQs) across chemicals affecting the same target organ and adjustment as needed to achieve a total noncancer hazard index (HI) of 1 for each target organ.

The CULs and RELs in Step 1 were considered preliminary because they did not consider additive cancer risks (Step 2) and HIs (Step 3). The final RELs developed in Step 3 are summarized in text Table 1.

Ground Water Cleanup Levels

Preliminary ground water CULs (Step 1) were developed as follows (Table A-1). Ground water at the Site is not a current source of drinking water and is unlikely to be used as a future source of drinking water. Therefore, the groundwater CULs shown in Table A-1 is based on the protection of surface water (Puyallup River) to meet the minimum of the following applicable state, federal, and tribal criteria:

- State Freshwater Criteria – Washington Administrative Code (WAC) 173-201A
- Federal Freshwater Criteria – National Toxics Rule (NTR), 40 CFR Part 131 and Clean Water Act Section 304(a) criteria for the protection of aquatic organisms (acute and chronic) and human health for the consumption of water + organism.
- Tribal Freshwater Criteria – Water Quality Standards for Surface Waters of the Puyallup Tribe, May 21, 2007.
- Arsenic Groundwater Background – WAC 173-340-900, Table 720-1, footnote (b).
- Drinking Water Considerations – As stated in WAC 173-340-730(3)(b)(iv), for surface waters that are classified as a domestic water supply under WAC 173-201A, the cleanup levels that are derived need to be protective of drinking water beneficial uses. According to WAC 173-201A-602, the designated uses for the Puyallup River adjacent to the Site (river mile 1.7) consist of aquatic life (core summer salmonid habitat), recreation (primary contact), water supply (domestic, industrial, agricultural, and stock water), and miscellaneous uses.

If the minimum CUL was associated with a cancer risk higher than $1x10^{-5}$, it was reduced to a risk level of $1x10^{-5}$. If the minimum CUL was associated with a noncancer HQ higher than 1, it was reduced to an HQ of 1. For total xylenes, no surface water CUL was available, so the MTCA Method B groundwater CUL was used as a preliminary CUL. The MTCA Method B groundwater CUL was also used as a preliminary CUL for naphthalenes in order to be protective of drinking water beneficial uses. The preliminary CUL for TPH in the diesel and oil ranges combined (TPH-D/O) was set to the Method A value of 500 µg/L.

However, it is unknown if hexavalent chromium is present in groundwater at the Site because existing chromium groundwater data only consists of total chromium. Before the calculation of groundwater CULs can be completed, sampling of groundwater for total and dissolved hexavalent chromium needs to be performed at selected wells. Additional adjustments to the CULs may then be necessary to ensure that the noncancer HQ does not exceed 1.

There are multiple ways to address additive risks and hazards, the most flexible of which involves establishing a set of criteria that allow concentrations to vary within a limited range, as long as the total cancer risk and the total HI for each target organ meet the MTCA targets.

The total cancer risk for the preliminary ground water CULs (Step 2) for benzene was 1.51×10^{-6}, which is less than the MTCA limit of 1×10^{-5}. The carcinogens consisting of polychlorinated biphenyls (PCBs) and benzo(a)pyrene were not included in the additive risk calculation because the cleanup level is based on the PQL.

Target organs were identified from EPA's Integrated Risk Information System (IRIS) database (Step 3). HQs were summed across each chemical affecting the same target organ to calculate an HI for that target organ. Toluene and ethylbenzene each affect the kidney. Xylenes and naphthalenes affect body weight. CUL adjustments were made to ensure that the HI for each target organ did not exceed 1. Rather than adjusting each CUL by the same proportion, adjustments were determined based on the magnitudes of the CULs and the anticipation of which CULs would be most difficult to meet.

It was not possible to calculate an HQ for lead because the necessary toxicity data are not available. Lead affects the nervous system, but without a numerical HQ available, it was not included in the evaluation of additive hazards. The HQ for TPH-D/O was assumed to be 1 because of the way Method A values are calculated. TPH-D/O is a complex mixture of chemicals with multiple target organs. It was assumed to affect both the kidney and body weight.

If it is desired to evaluate compliance for ground water using criteria, they are summarized in the table below. A ground water compliance sample must meet all of the criteria in the table to be considered in compliance. Please note that chromium would also need to be added to the table (after determination of chromium species testing).

Criteria for Ground Water Compliance

	Goal	**Criterion**
1	Each chemical meets its preliminary CUL	See concentrations in Table A-1
2	Total cancer risk meets 1×10^{-5}	1×10^{-6} x ([Benzene]/0.795 $\leq 1 \times 10^{-5}$ *Simplified*: [Benzene]/7.95 $\leq$ 1
3	HI for body weight meets 1	[Total xylenes]/1,600 + [Total naphthalenes]/160 + [selenium]/80 + [TPH-D/O]/500 $\leq$ 1
4	HI for kidney meets 1	[Toluene]/640 + [Ethylbenzene]/800 + [cadmium]/8 + [selenium]/80 + [TPH-D/O]/500 $\leq$ 1

[chemical] = concentration of chemical measured in ground water compliance sample

Soil Remediation Levels

Step 1: Preliminary Soil Remediation Levels

Preliminary RELs were calculated based on direct soil contact for an excavation worker, considering incidental soil ingestion and dermal absorption from soil on the skin (Table A-2). In the REL calculations, leaching to ground water was not considered because soil with concentrations between the CULs and the RELs will be covered with pavement, thus reducing leaching. However, the excavation worker benzo(a)pyrene (carcinogenic polycyclic aromatic hydrocarbons, cPAH) REL of 220 mg/kg that is shown in Table A-3 is not considered to be sufficiently protective of groundwater. Therefore, as stated in comment #6f, the benzo(a)pyrene/cPAH REL for the Site (on-property and off-property) shall be equal to the CULs shown in RI/FS Table 3 (12 mg/kg for depths less than 6 feet below ground surface and 18 mg/kg for depths from 6 to 15 feet below ground surface).

Soil exceeding the RELs will be need to be removed/treated in order to protect human health. MTCA does not have an excavation worker scenario, but guidance from the Oregon Department of Environmental Quality (ODEQ 2010) provides a standard excavation worker scenario similar to scenarios evaluated under CERCLA and RCRA.

RELs were calculated using MTCA equations 745-4 (noncancer effects) and 745-5 (cancer effects), which combine ingestion and dermal exposures. Because RELs based on an excavation worker scenario are much higher than CULs for an industrial worker scenario, it was deemed prudent to include the dermal pathway. The ODEQ (2010) excavation worker scenario describes a worker with intense soil exposures for a nine-day excavation project on a one-time basis. The table below compares MTCA Method C default parameter values for industrial workers with those recommended by ODEQ (2010) for excavation workers.

Parameter Values for Industrial and Excavation Workers

Parameter	MTCA Method C Industrial Worker	ODEQ Excavation Worker	Units
Exposure duration	20	1	years
Exposure frequency	146 (0.4 unitless)	9	days/year
Soil ingestion rate	50	330	mg/day
Dermal surface area	2,500	3,300	cm^2
Soil adherence factor	0.2	0.3	mg/cm^2-day

Values for the remaining parameters (e.g., body weight) were the default values provided in MTCA equations 745-4 and 745-5. Default values for chemical-specific parameters (e.g., dermal absorption fraction, gastrointestinal absorption conversion factor) were also obtained from equations 745-4 and 745-5. The preliminary soil REL was the minimum of the values from the two equations.

It was not possible to calculate preliminary RELs for lead and mercury due to a lack of oral toxicity data, but it was desirable to have RELs for these chemicals. ODEQ (2003) derived their lead risk-based screening levels (RBSLs) for occupational scenarios using EPA's adult lead model (ALM), which considers protection of a fetus in a pregnant worker. ODEQ uses the same RBSL for general workers, construction workers, and excavation workers. However, this approach does not consider the very short exposure duration for excavation work. Preliminary soil RELs for most of the metals are approximately twice their soil CULs. The preliminary REL for lead was set to twice its industrial Method A CUL. ODEQ's mercury RBSL for excavation workers is 2,900 mg/kg. This value was chosen for the mercury

REL. HQs are not shown for lead and mercury in Table A-3, but hazard apportionment was conducted as described below.

It was not possible to calculate a preliminary REL for TPH-D/O due to a lack of fractionation data. The Method A industrial value of 2,000 mg/kg is applicable for the REL because it is based on residual saturation, which can be of concern even under pavement. The Method A value was used as the REL for TPH-D/O.

Steps 2 and 3: Additive Risks and Hazards

The total cancer risk for the preliminary soil RELs (Step 2) across the four carcinogens (benzene, benzo(a)pyrene, PCBs, and arsenic) was 4.0×10^{-5} (Table A-3). The preliminary RELs were adjusted to reduce the total risk to 1×10^{-5}.

Target organs were identified from IRIS. Four target organs are affecting by multiple chemicals, as follows:

- Body weight: xylenes and naphthalenes
- Kidney: toluene, ethylbenzene, barium, and cadmium
- Nervous system: lead, mercury, and selenium
- Skin: arsenic and silver.

HIs were evaluated for each of these target organs (Step 3). Benzene, benzo(a)pyrene, PCBs, chromium, and copper each affect unique target organs, so they were not included in the additive hazard evaluation. TPH-D/O likely affects multiple target organs, but it was not included in the calculation of HIs because the REL was set to the Method A industrial value of 2,000 mg/kg, which is based on residual saturation. The REL for direct contact would likely be much higher than 2,000 mg/kg, so the contribution to the HI, the exact value of which is unknown, would be very low.

The HIs for body weight, the kidney, and the skin each exceeded 1. The RELs for chemicals affecting these target organs were adjusted as necessary to achieve an HI of 1 for each target organ. Although HIs were not calculated for lead and mercury, the CULs for lead, mercury, and selenium were adjusted down to account for additive effects on the nervous system. The RELs resulting from Step 3 were the final soil RELs.

References

ODEQ. 2003. Risk-Based Decision Making for Petroleum-Contaminated Sites. Oregon Department of Environmental Quality, Portland, OR.

ODEQ. 2010. Human health risk assessment guidance. Oregon Department of Environmental Quality, Portland, OR.

Table A-1. Draft Groundwater Water Cleanup Levels (Groundwater to Surface Water Pathway), Tacoma Metals

	Step 1		Step 2					Step 3						Target Organs for Multiple Chemicals	
Chemical	Preliminary Cleanup Level (ug/L)	Basis for Preliminary CUL	Lowest of Method B Ground or Surface Water (Cancer) (ug/L)	Cancer Risk at Preliminary CUL (unitless)	Assigned Risk Reduction (a) (unitless)	CUL Adjusted for Cancer Risk (ug/L)	Cancer Risk at Adjusted CUL (unitless)	Lowest of Method B SW or GW (Noncancer) (ug/L)	Noncancer Hazard at Adjusted CUL (unitless)	Assigned Hazard Reduction (b) (unitless)	Final Ground Water CUL (ug/L)	Hazard at Final CUL (unitless)	Target Organ (c)	Body Weight	Kidney
Benzene	1.2	WQSPT, upper range of HH CWA, NTR	7.95E-01	1.51E-06	1.00	1.2	1.51E-06	32	3.75E-02	1.00	1.2	3.75E-02	Immune system		
Toluene	57	HH CWA water + organism	--	--	--	--	--	6.40E+02	8.91E-02	0.25	14	2.23E-02	Kidney		2.23E-02
Ethylbenzene	68	HH CWA water + organism	--	--	--	--	--	8.00E+02	8.50E-02	0.20	14	1.70E-02	Liver, kidney		1.70E-02
Total xylenes	1,600	GW Method B	--	--	--	--	--	1.60E+03	1.00E+00	0.003	5	3.00E-03	Body weight	3.00E-03	
Naphthalenes	160	GW Method B	--	--	--	--	--	160	1.00E+00	0.080	13	8.00E-02	Body weight	8.00E-02	
Benzo(a)pyrene	0.01	HH CWA (water + organism) = 1.2E-04. Adjusted up to the PQL (0.01).	NA	NA	1.00	0.01	NA	--	--	--	0.01	--	--		
Polychlorindated biphenyls (PCBs)	0.01	HH CWA (water + organism) = 6.4E-05. Adjusted up to PQL (0.01)	NA	NA	1.00	0.01	NA	--	--	--	0.01	--	--		
Arsenic	5	WA State GW background	NA	NA	--	5	NA	NA	--	--	5	--	NA		
Cadmium	0.37	CWA*	--	--	--	--	--	8	4.63E-02	1.00	0.37				4.63E-02
Chromium (III or VI?)	?		--	--	--	--	--	?	?	?	?	?			
Copper	14.8	AL CWA, chronic*	--	--	--	--	--	6.40E+02	2.31E-02	1.00	14.8	2.31E-02	Not available		
Lead	4.62	WQSPT*	--	--	--	--	--	--	--	--	4.62	--	Not available		
Mercury	0.012	WAC 173-201A, WQSPT						--	--	--	0.012	--	Not available		
Selenium	5	CWA, NTR 40 CFR 131, WQSPT	--	--	--	--	--	8.00E+01	6.25E-02	1.00	5	6.25E-02	Blood, gastrointestinal tract, hair/nail	6.25E-02	6.25E-02
Silver	8.8	WAC 173-201A*						8.00E+01	1.10E-01	1.00	8.8	1.10E-01	Skin		
TPH-D/O (d)	500	GW Method A	--	--	--	--	--	--	1.00E+00	0.90	450	9.00E-01	Multiple	9.00E-01	9.00E-01
Total				1.5E-06			1.5E-06							1.0	1.0

NA = Not applicable because cleanup level is based on background groundwater concentrations for the State of Washington or PQL

(a) Applicable only to carcinogens. Other combinations of risk adjustments are possible.

(b) Shading indicates chemicals contributing to a hazard index greater than 1. Chemicals without shading were not adjusted. Other combinations of hazard adjustments are possible.

(c) From EPA's Integrated Risk Information System database.

(d) MTCA Method A value used for preliminary CUL.

* Calculated using a site-specific hardness of 180.

AL = Aquatic Life

CWA = EPA National Recommended Ambient Water Quality Criteria, updated June 2015 [Section 304(a) of the Clean Water Act]

GW = ground water

HH = human health

HQ = hazard quotient

MCL = maximum contaminant level

NTR = National Toxics Rule, 40 CFR 131

PQL = Laboratory Practical Quantitation Limit

SW = Surface Water

WQSPT = Water Quality Standards for Surface Waters of the Puyallup Tribe, May 21, 2007

Table A-2. Preliminary Soil Remediation Levels Based on the Excavation Worker Scenario (Step 1), Tacoma Metals

Chemical	Oral Reference Dose (RfDo) (a) (mg/kg-day)	Oral Carcinogenic Potency Factor (CPFo) (a) (risk per mg/kg-day)	Gastrointest. Absorption Fraction (AB1) (b) (unitless)	Gastrointest. Absorption Conversion Factor (GI) (b) (unitless)	Dermal Reference Dose (RfDd) (c) (mg/kg-day)	Dermal Carcinogenic Potency Factor (CPFd) (d) (risk per mg/kg-day)	Dermal Absorption Fraction (ABS) (b) (unitless)	REL for Incidental Soil Ingestion (RELi) Noncancer (e) (mg/kg)	REL for Incidental Soil Ingestion (RELi) Cancer (f) (mg/kg)	REL for Dermal Soil Contact (RELd) Noncancer (g) (mg/kg)	REL for Dermal Soil Contact (RELd) Cancer (h) (mg/kg)	Soil REL for Excavation Worker Noncancer (i) (mg/kg)	Soil REL for Excavation Worker Cancer (i) (mg/kg)	Preliminary REL for Excavation Worker (j) (mg/kg)
Benzene	4.00E-03	5.50E-02	1	0.8	3.20E-03	6.88E-02	0.0005	3.44E+04	1.17E+05	1.84E+07	6.26E+07	3.43E+04	1.17E+05	3.43E+04
Toluene	8.00E-02	--	1	0.8	6.40E-02	--	0.03	6.88E+05	--	6.12E+06	--	6.19E+05	--	6.19E+05
Ethylbenzene	1.00E-01	--	1	0.8	8.00E-02	--	0.03	8.60E+05	--	7.65E+06	--	7.73E+05	--	7.73E+05
Total xylenes	2.00E-01	--	1	0.8	1.60E-01	--	0.03	1.72E+06	--	1.53E+07	--	1.55E+06	--	1.55E+06
Naphthalenes	2.00E-02	--	1	0.5	1.00E-02	--	0.1	1.72E+05	--	2.87E+05	--	1.08E+05	--	1.08E+05
Benzo(a)pyrene	--	7.30E+00	1	0.5	--	1.46E+01	0.1	--	8.84E+02	--	1.47E+03	--	5.52E+02	5.52E+02
PCBs	--	2.00E+00	1	0.5	--	4.00E+00	0.1	--	3.23E+03	--	5.38E+03	--	2.02E+03	2.02E+03
Arsenic	3.00E-04	1.50E+00	1	0.2	6.00E-05	7.50E+00	0.01	2.58E+03	4.30E+03	1.72E+04	2.87E+04	2.24E+03	3.74E+03	2.24E+03
Barium	2.00E-01	--	1	0.2	4.00E-02	--	0.01	1.72E+06	--	1.15E+07	--	1.50E+06	--	1.50E+06
Cadmium	1.00E-03	--	1	0.2	2.00E-04	--	0.01	8.60E+03	--	5.74E+04	--	7.48E+03	--	7.48E+03
Total chromium (Cr VI)	3.00E-03	--	1	0.2	6.00E-04	--	0.01	2.58E+04	--	1.72E+05	--	2.24E+04	--	2.24E+04
Copper	4.00E-02	--	1	0.2	8.00E-03	--	0.01	3.44E+05	--	2.29E+06	--	2.99E+05	--	2.99E+05
Lead (k)	--	--	1	0.2	--	--	0.01	--	--	--	--	--	--	2.00E+03
Mercury (l)	--	--	1	0.2	--	--	0.01	--	--	--	--	--	--	2.90E+03
Selenium	5.00E-03	--	1	0.2	1.00E-03	--	0.01	4.30E+04	--	2.87E+05	--	3.74E+04	--	3.74E+04
Silver	5.00E-03	--	1	0.2	1.00E-03	--	0.01	4.30E+04	--	2.87E+05	--	3.74E+04	--	3.74E+04
TPH-D/O (m)	--	--	1	0.5	--	--	0.1	--	--	--	--	--	--	2.00E+03

(a) From CLARC.
(b) Default values from MTCA Equations 745-4 and 745-5.
(c) RfDd = RfDo x GI
(d) CPFd = CPFo / GI
(e) RELi noncancer = HQ x ABW x ATn x RfDo x UCF / (EF x ED x SIR x AB1)
(f) RELi cancer = RISK x ABW x ATc x UCF / (CPFo x EF x ED x SIR x AB1)
(g) RELd noncancer = HQ x ABW x ATn x RFdD x UCF / (EF x ED x SA x AF x ABS)
(h) RELd cancer = RISK x ABW x ATc x UCF / (CPFd x EF x ED x SA x AF x ABS)
(i) REL = 1 / (1/RELo + 1/RELd)
(j) Minimum of values for noncancer and cancer health effects.
(k) The preliminary REL for lead was set to twice the Method A CUL as discussed in the text.
(l) The preliminary REL for mercury was obtained from ODEQ as discussed in the text.
(m) The preliminary REL for TPH was set to the Method A CUL for industrial soil.

Exposure Parameter Values

Parameter	Abbrev.	Value	Units	Source
Target hazard quotient	HQ	1	unitless	MTCA Eqs. 745-4 and 745-5
Target cancer risk	RISK	1E-05	unitless	MTCA Eqs. 745-5 and 745-5
Average body weight	ABW	70	kg	MTCA Eqs. 745-4 and 745-5
Averaging time noncancer	ATn	365	days	ODEQ (2010) Table A-1
Averaging time cancer	ATc	27,375	days	MTCA Eqs. 745-4 and 745-5
Unit conversion factor	UCF	1E+06	mg/kg	MTCA Eqs. 745-4 and 745-5
Exposure frequency	EF	9	days/yr	ODEQ (2010) Table A-1
Exposure duration	ED	1	yr	ODEQ (2010) Table A-1
Soil ingestion rate	SIR	330	mg/day	ODEQ (2010) Table A-1
Dermal surface area	SA	3,300	cm2/day	ODEQ (2010) Table A-1
Soil adherence factor	AF	0.3	mg/cm2	ODEQ (2010) Table A-1

ODEQ (2010). Human Health Risk Assessment Guidance. Oregon Department of Environmental Quality, Portland, OR.

Table A-3. Additive Cancer Hazards for Soil Remediation Levels, Tacoma Metals

	Step 1	Step 2					Step 3						Target Organs			
Chemical	Preliminary Chemical REL Excav.Worker (a) (mg/kg)	Excav.Worker Soil Contact REL (Cancer) (a) (mg/kg)	Cancer Risk at Preliminary REL (unitless)	Assigned Risk Reduction (b) (unitless)	REL Adjusted for Additive Cancer Risk (mg/kg)	Cancer Risk at Adjusted REL (unitless)	Excav.Worker Soil Contact REL (Noncancer) (a) (mg/kg)	Hazard Quotient at Preliminary/ Adjusted REL (unitless)	Assigned Hazard Reduction (c) (unitless)	Final REL for Excavation Worker (mg/kg)	Hazard Quotient at Final REL (unitless)	Target Organ (d)	Body Weight	Kidney	Nervous System	Skin
Benzene	3.43E+04	1.17E+05	2.93E-06	2.00E-01	6.87E+03	5.87E-07	3.43E+04	2.00E-01	1.00	6,869	2.00E-01	Immune system				
Toluene	6.19E+05	--	--	--	--	--	6.19E+05	1.00E+00	0.25	154,655	2.50E-01	Kidney		2.50E-01		
Ethylbenzene	7.73E+05	--	--	--	--	--	7.73E+05	1.00E+00	0.25	193,319	2.50E-01	Liver, kidney		2.50E-01		
Total xylenes	1.55E+06	--	--	--	--	--	1.55E+06	1.00E+00	0.50	773,276	5.00E-01	Body weight	5.00E-01			
Naphthalenes	1.08E+05	--	--	--	--	--	1.08E+05	1.00E+00	0.50	53,767	5.00E-01	Body weight	5.00E-01			
Benzo(a)pyrene	5.52E+02	5.52E+02	1.00E-05	4.00E-01	2.21E+02	4.00E-06	--	--	1.00	221	--	--				
PCBs	2.02E+03	2.02E+03	1.00E-05	4.00E-01	8.07E+02	4.00E-06	--	--	1.00	807	--	--				
Arsenic	2.24E+03	3.74E+03	6.00E-06	3.00E-01	6.73E+02	1.80E-06	2.24E+03	3.00E-01	1.00	673	3.00E-01	Skin, vascular system				3.00E-01
Barium	1.50E+06	--	--	--	--	--	1.50E+06	1.00E+00	0.25	374,030	2.50E-01	Kidney		2.50E-01		
Cadmium	7.48E+03	--	--	--	--	--	7.48E+03	1.00E+00	0.25	1,870	2.50E-01	Kidney		2.50E-01		
Total chromium (Cr VI)	2.24E+04	--	--	--	--	--	2.24E+04	1.00E+00	1.00	22,442	1.00E+00	None reported				
Copper	2.99E+05	--	--	--	--	--	2.99E+05	1.00E+00	1.00	299,224	1.00E+00	None found				
Lead	2.00E+03	--	--	--	--	--	--	--	1.00	2,000	--	Nervous system			--	
Mercury	2.90E+03	--	--	--	--	--	--	--	0.03	87	--	Nervous system			--	
Selenium	3.74E+04	--	--	--	--	--	3.74E+04	1.00E+00	0.10	3,740	1.00E-01	GI tract, hair & nails, nervous system			1.00E-01	
Silver	3.74E+04	--	--	--	--	--	3.74E+04	1.00E+00	0.70	26,182	7.00E-01	Skin				7.00E-01
TPH-D/O (e)	2.00E+03	--	--	--	--	--	--	--	1.00	2,000	--	Multiple, but HI likely much lower than 1				
Total			2.9E-05			1.0E-05						Total Hazard Index	1.0E+00	1.0E+00	--	1.0E+00

(a) From Table A-2.
(b) Applicable only to carcinogens. Other combinations of risk adjustments are possible.
(c) Shading indicates chemicals contributing to a hazard index greater than 1. Chemicals without shading were not adjusted. Other combinations of hazard adjustments are possible.
(d) From EPA's Integrated Risk Information System database.
(e) The preliminary TPH REL was set to the Method A industrial value, which is based on residual saturation. The HI for soil contact was assumed to be less than 1, so it was not included in the hazard indices for target organs.