Time Oil Site:
Upland Ecological Risk Assessment

To: Mark Adams, LHG
Toxics Cleanup Program
Northwest Regional Office

From: Arthur Buchan, Toxicologist
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Information & Policy Section

Date: June 26, 2020

This memorandum represents a Department of Ecology recommendation specific to the Time Oil Cleanup Site, located in the city of Seattle, King Co., WA.

Determination:

It is recommended that a site-specific terrestrial ecological evaluation (site-specific TEE) is conducted at this site and the protective concentrations included in Appendix C are used for the purposes of the Remedial Investigation and Feasibility Study.

For questions or concerns regarding this memorandum, please contact:

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Regulatory Context

If a site is not excluded from the terrestrial ecological evaluation (TEE) process, a site-specific TEE shall be conducted at the site if the following criterion apply:

WAC 173-340-7491(2)(a)(i) 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, 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).

Site Location in Relation to Designated Environmentally Sensitive Area

Appendix A (Floyd Snider 2020) indicates that the site is either on, or directly adjacent to BNSF Parcel ID #42379000240. BNSF Parcel ID #42379000240 contains a Great Blue Heron Breeding area with management plans (Appendix B) (PHS 2020 - Found at: http://apps.wdfw.wa.gov/phsontheweb/).

"Management Recommendations for Washington's Priority Species, Volume IV: Birds is the third published volume in a series containing species management recommendations, and includes most birds on the Priority Habitats and Species (PHS) List. Each species account within this volume provides information on the bird's geographic distribution and the rationale for its inclusion on the PHS List. The habitat requirements and limiting factors for each species are discussed, and management recommendations addressing the issues in these sections are based on the best available science. Each species document includes a bibliography of the literature used for its development, and each has a key points section that summarizes the habitat requirements and management recommendations for the species."

Specifically, the management recommendation have been attached electronically to this file: https://wdfw.wa.gov/sites/default/files/publications/00026/wdfw00026.pdf

Upland Ecological Receptor Protective Values

Upland ecological receptor protective values have been included in Appendix C. Under the site-specific evaluation, the environmental investigation required under a site-specific TEE is not limited to those contaminants included in Table 749-3.

Under WAC 173-340-7493(3) (a) 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.

As a result, Appendix C has proposed protective values that could be used for the purposes of the Remedial investigation and feasibility study.

Summary

- It does not appear that the site would be excluded from the TEE process; and
- It is recommended that a site-specific TEE is conducted at this site because of the proximity to a priority species (Great Blue Heron) and the management recommendations designated for that area; and
- Proposed protective values have been included in Appendix C; and
- Upward adjustments to the Diesel + Heavy Oil protective concentration have been upward adjusted (based on a weight of evidence approach), and are included in Appendix D.

Note: Under the Ecology Publication: *Guidance for the Remediation of Petroleum Contaminated Sites,* Table 6.14, Footnote (2) States - Diesel range organics includes the sum of diesel fuels and heavy oil measured using method (Ecology, 2016).

References

Ecology. (2013). *Model Toxics Control Act Regulation and Statute.* Chapter 173-340 WAC. Publication No. 94-06. Retrieved from: http://apps.leg.wa.gov/wac/default.aspx?cite=173-340 and https://fortress.wa.gov/ecy/publications/summarypages/9406.html

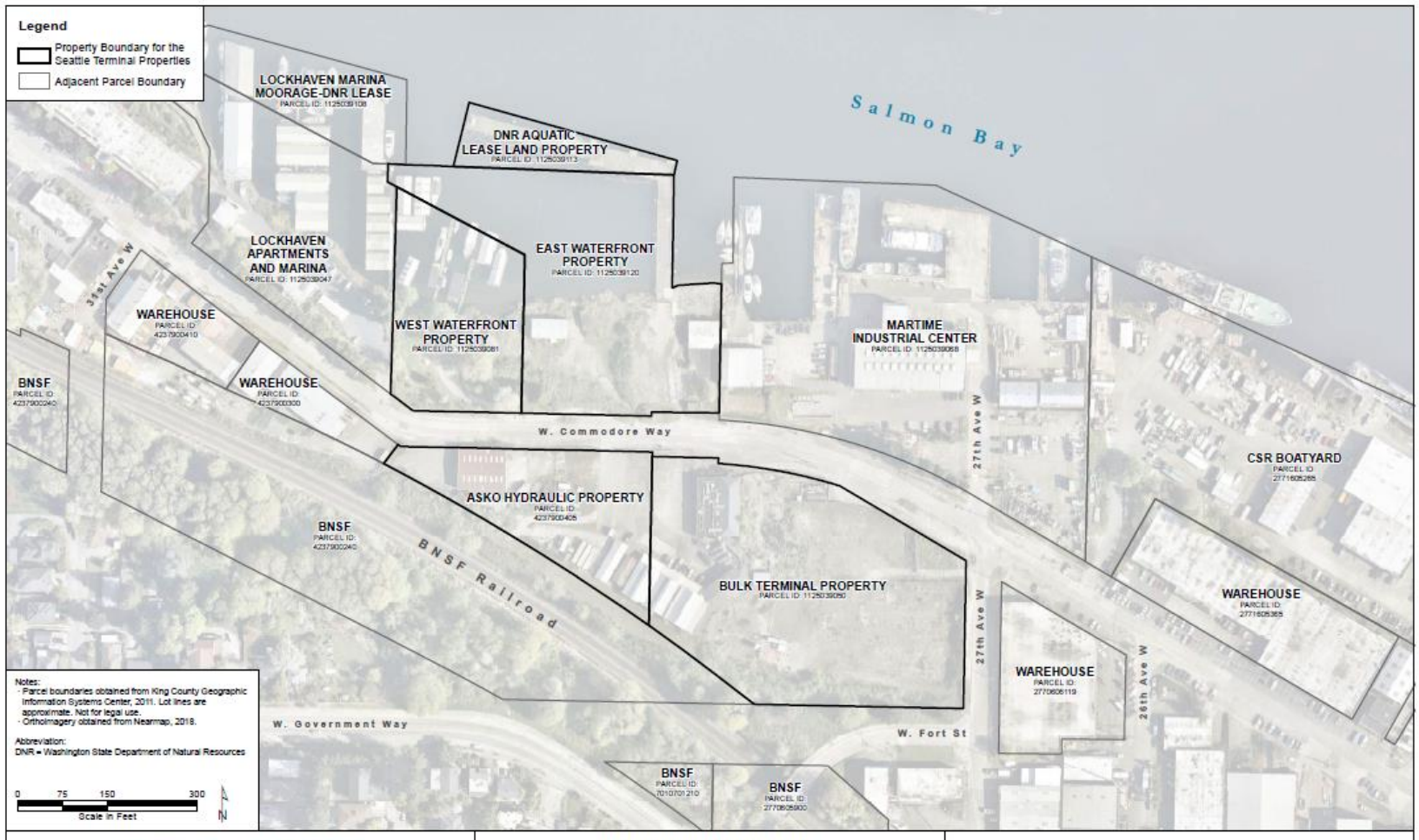
Ecology. (2016). *Guidance for the Remediation of Petroleum Contaminated Sites*. Table 6.14, Footnote (2). Publication No. 10-09-057. Retrieved from: https://fortress.wa.gov/ecy/publications/documents/1009057.pdf

Floyd Snider. (2020). Time Oil Bulk Terminal PPA: Supplemental Upland Remedial Investigation and Feasibility Study. Public Review Draft. Site Vicinity Map: Figure 1.2.

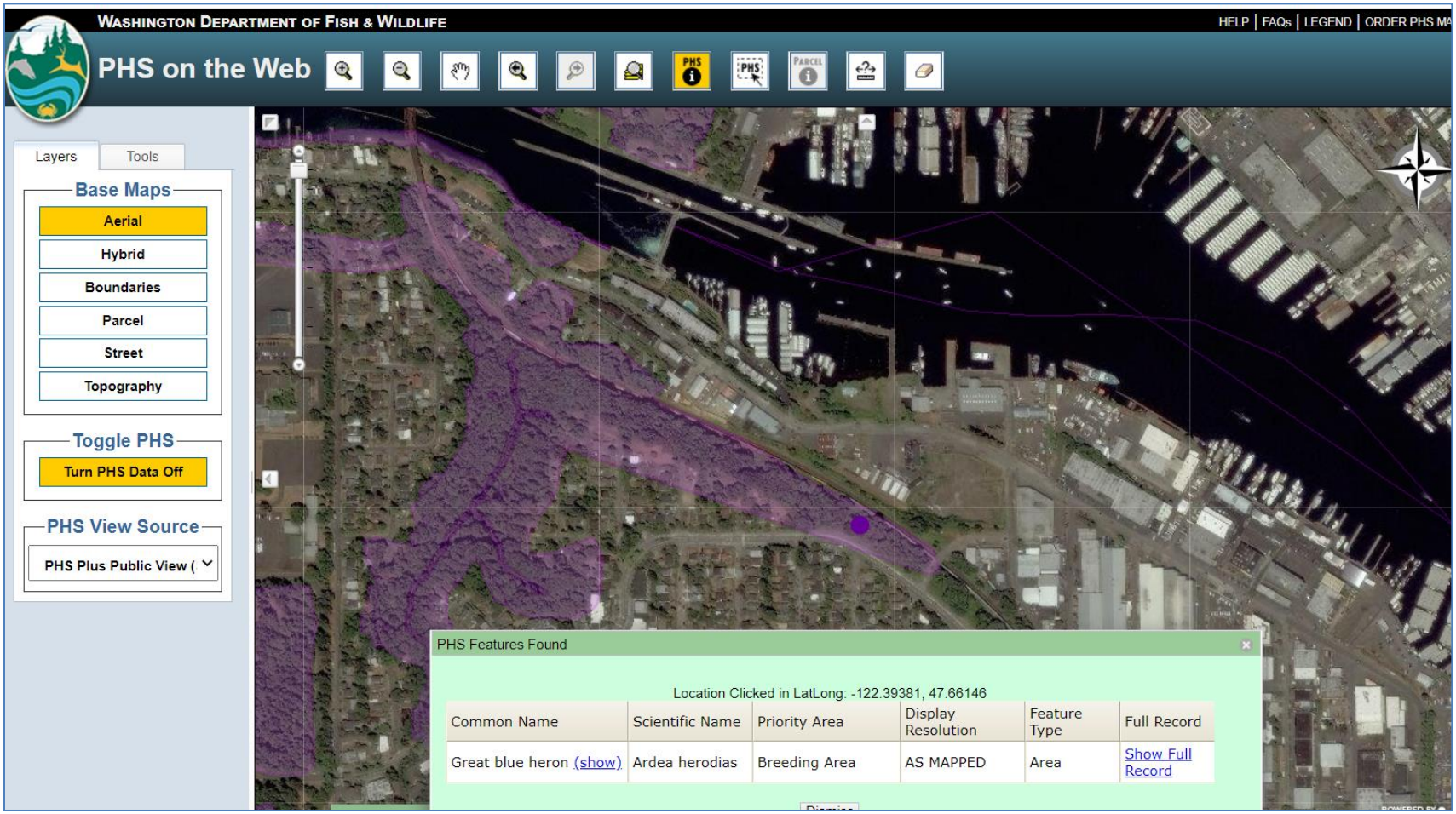
WDFW. (2004). *Management Recommendations for Washington's Priority Species – Volume IV: Birds.* Great Blue Heron Updated 2012. Retrieved from: https://wdfw.wa.gov/sites/default/files/publications/00026/wdfw00026.pdf

WDFW. (2020). *Priority Habitats and Species.* Interactive Web Mapping Tool. Retrieved from: http://apps.wdfw.wa.gov/phsontheweb/

Appendix A: Location of site (Floyd Snider 2020).



Appendix B: Location of locally designated environmentally sensitive area (Found at: http://apps.wdfw.wa.gov/phsontheweb/**).**



Appendix C: Upland ecological protective values. Contaminant list based on detected observations.

Contaminant	CAS #	Plants (mg/Kg)	Reference	Soil Biota (mg/Kg)	Reference	Wildlife (mg/Kg)	Reference	Benchmark (mg/Kg)	Reference	Final Protection (mg/Kg)
Arsenic	7440-38-2	1.00E+01	749-3	6.00E+01	749-3	1.32E+02	749-3	x	x	1.00E+01
Barium	7440-39-3	5.00E+02	749-3	3.30E+02	US EPA SSL	1.02E+02	749-3	x	x	1.02E+02
Cadmium	7440-43-9	4.00E+00	749-3	2.00E+01	749-3	1.40E+01	749-3	x	x	4.00E+00
Chromium	16065-83-1	4.80E+01	Background (PSB)	4.80E+01	Background (PSB)	6.70E+01	749-3	x	x	4.80E+01
Lead	7439-92-1	5.00E+01	749-3	5.00E+02	749-3	1.18E+02	749-3	x	x	5.00E+01
Selenium	7782-49-2	1.00E+00	749-3	7.00E+01	749-3	3.00E-01	749-3	x	x	3.00E-01
Silver	7440-22-4	2.00E+00	749-3	x	x	4.20E+00	US EPA SSL	x	x	2.00E+00
GRO	x	1.20E+02	IM #19	1.20E+02	IM #19	1.00E+03	Residual Saturation	x	x	1.20E+02
DRO + HO	x	1.60E+03	IM #19	2.60E+02	IM #19	2.00E+03	Residual Saturation	x	x	2.60E+02
Benzene	71-43-2	x	x	x	x	5.23E+02	WEM	x	x	5.23E+02
Ethylbenzene	100-41-4	x	x	x	x	x	x	5.00E+00	US EPA R5	5.00E+00
Toluene	108-88-3	2.00E+02	749-3	x	x	7.36E+02	WEM	x	x	2.00E+02
Xylenes	1330-20-7	x	x	x	x	9.58E+00	WEM	x	x	9.58E+00
1,2-Dichloroethane	107-06-2	x	x	x	x	5.82E+01	WEM	x	x	5.82E+01
1,2,4-Trimethylbenzene	95-63-6	x	x	2.00E+01	US EPA R6	x	x	1.10E+01	US EPA R5	1.10E+01
1,3,5-Trimethylbenzene	108-67-8	x	x	x	x	x	x	x	x	x
Acetone	67-64-1	x	x	x	x	4.72E+01	WEM	x	x	4.72E+01
Isopropylbenzene	98-82-8	x	x	x	x	x	x	x	x	x
n-butylbenzene	104-51-8	x	x	x	x	x	x	x	x	x
n-propylbenzene	103-65-1	x	x	x	x	x	x	x	x	x
p-isopropyltoluene	99-87-6	x	x	x	x	x	x	x	x	x
sec-butylbenzene	135-98-8	x	x	x	x	x	x	x	x	x
tert-butylbenzene	98-06-6	x	x	x	x	x	x	x	x	x
2-butanone (MEK)	78-93-3		x	x	x	5.87E+03	WEM	x	x	5.87E+03
Tetrachloroethene (PCE)	127-18-4	x	x	x	x	x	x	9.90E+00	US EPA R5	9.90E+00
Tricloroethene (TCE)	79-01-6	x	x	x	x	7.82E+00	WEM	x	x	7.82E+00
cis-1,2-dichloroethene	156-59-2	x	x	x	x	4.26E+01	WEM	x	x	4.26E+01
Vinyl Chloride	75-01-4	1.00E+04	EcoTox	x	x	3.52E+00	WEM	x	x	3.52E+00
Benzo(a)anthracene	56-55-3	x	x	1.80E+01	US EPA H.M.W.	1.10E+00	US EPA H.M.W.	x	x	1.10E+00
Chrysene	218-01-9	x	x	1.80E+01	US EPA H.M.W.	1.10E+00	US EPA H.M.W.	x	x	1.10E+00
Benzo(a)pyrene	50-32-8	x	x	1.80E+01	US EPA H.M.W.	1.20E+01	749-3	x	x	1.20E+01
Benzo(b)fluoranthene	205-99-2	x	x	1.80E+01	US EPA H.M.W.	1.10E+00	US EPA H.M.W.	x	x	1.10E+00
Benzo(k)fluoranthene	207-08-9	x	x	1.80E+01	US EPA H.M.W.	1.10E+00	US EPA H.M.W.	x	x	1.10E+00
Indeno(1,2,3-cd)pyrene	193-39-5	x	x	1.80E+01	US EPA H.M.W.	1.10E+00	US EPA H.M.W.	x	x	1.10E+00
Dibenz(a,h)anthracene	53-70-3	x	x	1.80E+01	US EPA H.M.W.	1.10E+00	US EPA H.M.W.	x	x	1.10E+00
Napthalene	91-20-3	x	x	2.90E+01	US EPA L.M.W.	1.00E+02	US EPA L.M.W.	x	x	2.90E+01
1-methylnaphthalene	90-12-0	x	x	2.90E+01	US EPA L.M.W.	1.00E+02	US EPA L.M.W.	x	x	2.90E+01
2-methylnaphthalene	91-57-6	x	x	2.90E+01	US EPA L.M.W.	1.00E+02	US EPA L.M.W.	x	x	2.90E+01
Acenaphthene	83-32-9	2.00E+01	749-3	2.90E+01	US EPA L.M.W.	1.00E+02	US EPA L.M.W.	x	x	2.00E+01
Acenaphthylene	208-96-8	x	x	2.90E+01	US EPA L.M.W.	1.00E+02	US EPA L.M.W.	x	x	2.90E+01
Fluorene	86-73-7	x	x	3.00E+01	749-3	1.00E+02	US EPA L.M.W.	x	x	3.00E+01
Phenanthrene	85-01-8	x	x	2.90E+01	US EPA L.M.W.	1.00E+02	US EPA L.M.W.	x	x	2.90E+01
Anthracene	120-12-7	x	x	2.90E+01	US EPA L.M.W.	1.00E+02	US EPA L.M.W.	x	x	2.90E+01
Fluoranthene	206-44-0	x	x	1.80E+01	US EPA H.M.W.	1.10E+00	US EPA H.M.W.	x	x	1.10E+00
Pyrene	129-00-0	x	x	1.80E+01	US EPA H.M.W.	1.10E+00	US EPA H.M.W.	x	x	1.10E+00
Pentachlorophenol (PCP)	87-86-5	3.00E+00	749-3	6.00E+00	749-3	4.50E+00	749-3	x	x	3.00E+00
Dioxins/Furans	x	x	x	x	x	0.000006 (TEF)	Background (State)	x	x	0.000006 (TEF)

Appendix D: Proposed upward adjustment of Diesel + Heavy Oil concentrations based on WAC 173-340-7493(3) (f) – Weight of Evidence Methodology.

Note: This weight of evidence methodology was investigated and performed by the consultant working on the site (Floyd-Snider). The information included was delivered to Ecology via email. Only minor corrections/notations/citations were made to the correspondence, which were completed to aid in readability.

Screening Level Background

The DRO and ORO contamination present on the Property is known to be a mixture of diesel and heavy oil, as the former owner and operator stored, handled, and sold both products. Therefore, based on the varying toxicity of these products for plants vs soil biota, it is more appropriate to compare the concentrations of each product separately to the most protective screening level described below to determine protectiveness of ecological receptors.

Screening levels for Total DRO and ORO for the TEE that were considered include:

- The current PCUL of 2,000 mg/kg which is protective of the combined contribution of DRO and ORO in groundwater. This is equivalent to the TEE indicator concentration for wildlife based on residual saturation at the ground surface (Ecology 2001).
- The TEE indicator concentration for plants of 1,600 mg/kg, which is based on a lowest apparent effects concentration (LOAEL) finding for ORO in Table 10 of Ecology's 2016 Toxicity Testing of Soils Contaminated with Gasoline, Diesel, and Heavy Oil report. This concentration, and ORO concentrations more than 100-fold higher, had no apparent effect on soil biota (Ecology 2016, 2017).
- The TEE indicator concentration for soil biota of 260 mg/kg, which is based on a LOAEL for DRO in Ecology's report. This concentration had no apparent effect on plants. It should also be noted that DRO concentrations between 500 and 1,400 mg/kg had no apparent effects on soil biota (earthworm) survival in samples tested for as part of the Ecology study (refer to Table 10 of Ecology's 2016 *Toxicity Testing of Soils Contaminated with Gasoline, Diesel, and Heavy Oil* report) (Ecology 2017).

The final CUL(s) for DRO and ORO must be protective of all the likely receptors at the Property. Importantly, a portion of the Property (the Uplands AOC, comprised of two parcels) is anticipated to have institutional controls, including a requirement to maintain industrial use and maintenance of a cap. In addition, a site-specific remediation level for DRO and ORO has been selected for the Upland AOC. However, the East Waterfront parcel located on the shoreline is not anticipated to require any institutional controls post-cleanup and will not require a cap as the proposed cleanup action is excavation of remaining contamination to meet CULs. Therefore further assessment of DRO and ORO for protection of Ecological receptors was limited to the East Waterfront.

Current Property Conditions

The current condition of observed ecological receptors at the Property, and their relationship to residual DRO and ORO in soil, are described below:

Soil Biota: the formation of organic soil has been observed in former operational areas throughout the Property. Soil borings and hand auger borings advanced along the shoreline found layers of organic soil ranging from 0.1 feet to 1 foot in thickness. The development of topsoil indicates active plant and soil biota communities in shallow soils at the Property. Soil biota such as earthworms have also been observed during hand auger borings on the East Waterfront.

Plants: robust plant populations that are largely non-native pioneering species are present at this former facility. Areas of thick vegetation are present along the shoreline and between former operational areas, and some vegetation has additionally begun to grow through the gravel surfacing of former parking areas. Grass ground cover has also been established in shoreline areas where recent TPH excavations were performed in 2013 (aside from areas where rock armor was placed for erosion prevention).

Wildlife: the southern portion of the Uplands AOC of the Property is within WDFW's designated year-round buffer for blue heron nesting colony (WDFW 2020). The nesting colony is defined as the line between the outer nesting trees, and does not extend onto the Property where tall nesting trees are not present and the ground surface consists of pavement and grass. Herons do not use the Property for foraging. Other wildlife observed at the Property include waterfowl (primarily Canada geese) and birds that use structures for nests; small rodents such as mice, rats and squirrels are also likely to be present given the Property location in an urban industrial area.

Significant excavation was completed on the East Waterfront in 2013 to remediate petroleum in soil and groundwater. At the time of excavation, the buildings on the parcel were still in use and excavation was limited to accessible areas outside of building footprints. Residual total DRO and ORO exceeding the PCUL of 2,000 mg/kg are located beneath the existing garage structure on the eastern portion of the East Waterfront Property and in the rock armored area north of the structure. The garage and adjacent area to the north have been designated as a cleanup action area (CAA) where total DRO and ORO exceeding the PCUL of 2,000 mg/kg are planned to be fully removed. Residual DRO and ORO at concentrations less than the PCUL would remain outside of the planned CAA. Adjustments to the final excavation extents would be made as part of engineering design as warranted based on the final CULs in the Cleanup Action Plan to ensure that the dual goals of groundwater and ecological receptor protection are achieved on the East Waterfront.

<u>DRO and ORO Evaluation</u>

Localized areas with combined DRO and ORO concentrations greater than 260 mg/kg (the lowest screening level described above) are present outside the current proposed excavation limits. DRO concentrations on the East Waterfront are compared to the soil biota indicator concentration for DRO of 260 mg/kg and ORO concentrations are compared to the plant indicator concentration for ORO of 1,600 mg/kg (note that the PCUL for total DRO and ORO is

sufficiently protective of wildlife, so wildlife protection is not evaluated further here) (Ecology 2017).

A weight of evidence approach (WAC 173-340-7493(3)(f)) using site-specific field observations, data, and literature evidence was used to evaluate if these localized areas with DRO and ORO contamination greater than 260 mg/kg are protective of ecological receptors at the Property as described below (Ecology 2001):

C03-EX01-SSW01

- Confirmation sample collected at 3.5 feet bgs from the northwest corner of the 2013 excavation
- DRO 200 mg/kg, ORO 1,300 mg/kg
- DRO and ORO are both less than indicator concentrations and therefore protective of ecological receptors

D02-EX01-NSW01

- Confirmation sample collected from 3 feet bgs from the northwest corner of the 2013 excavation
- DRO 570 mg/kg, ORO 1500 mg/kg
- DRO exceeds indicator concentration of 260 mg/kg and warrants further evaluation for protectiveness of soil biota, ORO is less than the indicator concentration of 1600 mg/kg and is considered protective of plants
- This soil sample was collected from the shoreline area with a vegetated ground surface; soil borings advanced in 2019 (02MW17, 02MW21) adjacent to this location had 0.75 feet of topsoil at the surface underlain by sand and gravel
- Topsoil and plants are supported at a DRO concentration of 570 mg/kg, which is consistent with Ecology's study (refer to Table 10) (Ecology 2016) which showed variable survival rates for soil biota including samples with DRO concentrations up to 1,400 mg/kg that had no apparent effect on earthworms
- The presence of DRO at a depth of 3 feet bgs does not appear to adversely affect receptors closer to the surface. This would be expected given the low density of receptors in the affected interval; studies have shown that soil biota are likely to be present in the top 0.5 to 1 foot of soil where organic matter is more plentiful and unlikely to be present below 2 feet bgs where much lower fractions of organic carbon are typically observed (Hendrix et al., 1992, Curry 1998). This is further reinforced by the lithology of property soils underlying topsoils, which are typically firm silty sand, silty sand and gravel not easily accessible to biota.

02SB01

- Samples collected from 3.5 feet bgs and 6 feet bgs from a soil boring near the southwest corner of the 2013 excavation at the edge of a gravel-surfaced driveway area
- 3.5 feet bgs: DRO 540 mg/kg, ORO 1300

- 6 feet bgs: DRO 290 mg/kg, ORO 710
- Both samples exceed the DRO indicator concentration of 260 mg/kg and warrant further evaluation for protectiveness of soil biota; ORO in both samples is less than the indicator concentration of 1,600 mg/kg and is considered protective of plants
- Samples were collected from an area that was historically maintained as a driveway and it is difficult to assess the current effects of DRO at depth because surfacing was intentionally placed to limit plant growth and organic soil development. Residual soils underlying the gravel surfacing are typically firm silty sand, silty sand and gravel which are also not easily accessible to biota
- The presence of DRO at a depth of 3 feet bgs would not be expected to adversely affect future receptors closer to the surface given the likely low density of receptors in the affected interval; studies have shown that soil biota are likely to be present in the top 0.5 to 1 foot of soil where organic matter would be more plentiful and unlikely to be present below 2 feet bgs where much lower fractions of organic carbon are typically observed (Hendrix et al., 1992, Curry 1998).

Conclusion

Based on the current conditions at D02-EX01-NSW01 DRO is present at 570 mg/kg and topsoil and plants are supported based on field observations, data, and literature; it appears that a DRO concentration of 570 mg/kg would be protective of ecological receptors at the Property, specifically in portions of the Property where institutional controls aren't necessary.

It is important to note that this evaluation was not completed by a plant or wildlife biologist and therefore does not constitute a professional ecological assessment. It does however provide field observations and information relevant to the weight of evidence necessary to make a determination for a site-specific cleanup level. Based on our summary above, we believe that a DRO CUL of 570 mg/kg and an ORO CUL of 1,600 mg/kg would be protective of ecological receptors at the Property where institutional controls are not anticipated. Ultimately, Ecology will select the most appropriate cleanup level for DRO and ORO as part of the Cleanup Action Plan.

Ecology Determination:

Based on the information provided by the consultant, Ecology is considering this submission a professional ecological assessment. With that understanding, it is recommended that the information provided by Floyd-Snider meets the requirements of the Weight of Evidence Method under the Terrestrial Ecological Evaluation – WAC 173-340-7493(3)(f). As a result, the protective values at this site (site-specific only) should be upward adjusted from 260 mg/kg (total diesel + heavy oil) to:

DRO = 570 mg/kg

ORO = 1600 mg/kg

References for Appendix D:

Curry, J.P. (1998). *Factors Affecting Earthworm Abundance in Soil.* In: Earthworm Ecology. St Lucie Press. Pgs. 37 – 64.

Ecology (2001). *Model Toxics Control Act. Washington State Department of Ecology, Toxics Cleanup Program.* Revised 2013. Publication No. 94-06.

Ecology (2016). *Toxicity Testing of Soils Contaminated with Gasoline, Diesel, and Heavy Oil: Toxicity Testing of Washington Soils.* Washington State Department of Ecology, Environmental Assessment Program. Publication No. 16-03-038.

Ecology (2017). *Implementation Memorandum #19. Gasoline and Diesel Soil Concentrations Determined to be Protective of Upland Ecological Receptors.* Washington State Department of Ecology, Toxics Cleanup Program. Publication No. 17-09-051.

Hendrix, P.E., B.R. Miller, R.R. Bruce, G.W. Langdale, R.W. Parmelee (1992). *Abundance and Distribution of Earthworms in Relation to Landscape Factors on the Georgia Peidmont, U.S.A.* Soil Biology and Biochemistry. December, 1992. Pgs. 1357 – 1361.

WDFW (2020). Washington State Department of Fish and Wildlife Priority Habitat and Mapping. Can be found at: http://apps.wdfw.wa.gov/phsontheweb/