GIG HARBOR SPORTSMAN'S CLUB

CITY OF GIG HARBOR, WASHINGTON

NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA)

Prepared By:

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EnviroVector
OPTIMIZE USABLE LAND

17 December 2019

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Prepared For:

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1.0 INTRODUCTION

1.1 Purpose

At the request of Farallon Consulting LLC, EnviroVector prepared a Net Environmental Benefit Analysis (NEBA) covering areas on the Gig Harbor Sportsman's Club during 13 & 20 May 2019. Field methodology is based on a Terrestrial Ecological Evaluation (TEE) under the Model Toxics Control Act (MTCA) (WAC 173-340-7490 through 7494).

Net Environmental Benefit Analysis (NEBA) is a methodology for identifying and comparing net environmental benefits of alternative management options. Net environmental benefits are the gains in environmental services or other ecological properties attained by remediation or ecological restoration (*i.e.*, mitigation), minus the environmental injuries caused by those actions. In short, NEBA is the procedure of weighing the advantages of active cleanup (remediation) versus the impact that cleanup might have on potentially valuable ecological receptor habitat. Terrestrial ecological evaluation procedures should not create an incentive to cause harm through the destruction of habitat.

A NEBA for chemically contaminated sites typically involves the comparison of the following management alternatives:

(1) Leaving contamination in place;

(2) Removing the contaminants through traditional remediation;

(3) Improving ecological value through on-site or off-site restoration that does not involve removing contaminants; or

(4) A combination of those alternatives. Examples of combinations include remediation of localized soil contamination combined with natural attenuation and the planting of trees, and the dredging of sediment hotspots combined with local wetland restoration.

NEBA has the potential to help land managers avoid the possibility that the selected remedial or ecological restoration alternative will provide 'no net environmental benefit' over natural attenuation of contaminants and ecological recovery.

An alternative may provide no net environmental benefit because:

(1) The remedial or ecological restoration action is ineffective (the action does not substantially change the risk) or

(2) The remediation alternative causes environmental injuries greater than the damage associated with the contamination because

   a. The need for remediation has been driven by human health risk, not ecological risk;

   b. The ecological injury from contamination has been overestimated because of conservative assumptions; or

   c. Injuries associated with remediation were not properly addressed.

Similarly, NEBA has the potential to help land managers plan an ecological restoration alternative that provides a positive net environmental benefit over the hypothetical state that would prevail in the absence of contamination. NEBA is needed when the multiple alternatives are beneficial, but the one (1) with the greatest net benefits is not apparent without formal analysis.

2.0 SITE LOCATION

2.1 Property Location

The 30.38-acre subject property (Pierce County Parcel Numbers 0222313073 & 0222314016) is located at 9721 Burnham Drive Northwest in the City of Gig Harbor, WA in Section 31, Township 22, Range 02, Willamette Meridian (**Figure 1; Table 1**). The study focused on the areas of concern where NEBA is needed (**Figure 2**; **Table 2**).

Table 1. Parcels Comprising Subject Property

No#	Property Address	Parcel Number	Property Size (Acres)
1	9721 Burnham Drive NW	0222313073	25.66 Acres
2	9721 Burnham Drive NW	0222314016	4.72 Acres
2 Parcels	Total Size		30.38 acres

The permitting jurisdiction is the City of Gig Harbor.

2.2 Study Area

In discussions between Farallon Consulting LLC and the Washington State Department of Ecology (DOE), the subject property has been segregated into Areas of Concern labeled Areas A through G (**Figure 2; Table 2**). The Department of Ecology has determined a need for NEBA in Areas D and E. The other Areas of Concern have been excluded from NEBA.

The NEBA Study Area is defined as Areas D and E (**Figure 2**).

Table 2. Areas of Concern

Area	DOE Preliminary Results	Shooting Range/Forested	~Area (sf)	~Acres	NEBA Needed
Area A	Not Potential Valuable Habitat	Shooting Range	570,618	13.00	No
Area B	Potential Valuable Habitat	Forested	90,487	2.07	No
Area C	Potential Valuable Habitat	Forested	96,038	2.20	No
Area D	Potential Valuable Habitat	Forested	201,107	4.61	Yes
Area E	Potential Valuable Habitat	Forested	218,541	5.01	Yes
Area F	Potential Valuable Habitat	Forested	79,104	1.81	No
Area G	Not Potential Valuable Habitat	Shooting Range	73,181	1.68	No

3.0 SITE DESCRIPTION

The 30.38-acre subject property consists of an existing outdoor archery, live round shooting range, shooting berms, and an office building and storage building (**Appendix A, Photos 1 & 2**). There is a shotgun range on the central portion of the property, and rifle and pistol ranges in a bermed area on the northwestern portion of the property. Continued use as a shooting range since the 1940s has resulted in antimony, arsenic, lead, and/or carcinogenic polycyclic aromatic hydrocarbon (cPAH) contamination to soils.

The northern, eastern, and southern portions of the property are forested with dense understory vegetation. Soils on the eastern portion of the property, downrange of the southern shooting stations, contain remnants of lead shot deposited as a result of recreational shooting of fire arms for many years.

4.0 TERRESTRIAL ECOLOGICAL EVALUATION METHODOLOGY

4.1 Delineation of Potentially Valuable Habitat

Potentially Valuable Habitat was delineated by marking the habitat boundary using orange ribbon flags labeled A-1 through A-43 (**Figure 3**).

4.2 Terrestrial Ecological Evaluation (TEE)

A Terrestrial Ecological Evaluation (TEE) was performed to satisfy the requirements of the DOE and Washington Administrative Code (WAC) title WAC 173-340-7490---*Terrestrial ecological evaluation procedures*. A qualified field biologist documented types of flora and fauna and signs of excessive contaminant uptake on the subject property on 13 & 20 May 2019.

4.3 Wildlife Study

Four (4) remote motion sensor camera traps were mounted on trees and deployed for one (1) week to further document the local wildlife in Areas D & E (**Figure 6; Appendix A, Photos 10, 13, 32, 73, & 87**). Cameras were baited with dried corn scattered on the ground and corn suet cakes attached to trees within camera range located approximately fifteen (15) feet from the camera and set to record one (1)-minute videos upon detecting motion. Camera locations were GNSS-located with a Trimble Geo 7x with sub-foot accuracy.

Camera videos were analyzed for behaviors and characteristics attributed to contaminant uptake in wildlife including, but not limited to:

- Muscular incoordination
- Jerkiness
- Fluffed feathers
- Debility
- Falling
- Drooped eyelids
- Slowness
- Hyperactivity
- Seizures

Species and number of instances per camera were recorded. Priority species, State listed species, Federally-listed species, or species with other protection statuses were documented.

4.4 Vegetation Sampling

Vegetation was recorded at nineteen (19) sample locations of varying contamination within the Study Area for comparison. Several sample plots were taken outside of the Study Area and outside of the potentially valuable habitat also for comparison. Vegetation was analyzed for:

- Wilting
- Browning
- Excess mortality
- Chlorosis (pale, yellow or white plant tissue)
- Reduced growth, photosynthesis

4.5 Soil

4.5.1 Soil Sampling

A soil sampling and testing plan was performed to satisfy the requirements of the DOE and WAC 173-204-600 to determine if lead, antimony, or arsenic were present in the soils.

A qualified field biologist and a Farallon Field Scientist collected twelve (12) soil samples on 20 May 2019 in compliance with WAC 173-340-7490 (5) and the NEBA Preliminary Habitat Assessment. Soil samples were collected at predetermined points during the 20 May 2019 site evaluation in compliance with the NEBA Preliminary Habitat Assessment (**Figure 7**).

Prior to sampling, the field biologist completed the following:

1) Planned for sampling and decision units using land use history
2) Prepared the sampling points according to the property size, predicted levels of contamination, and discussion with DOE

The NEBA Preliminary Habitat Assessment requires collection of samples at the following depths:

- Zero (0) – six (6) inches,
- Six (6) – twelve (12) inches,
- Twelve (12) – twenty-four (24) inches, and
- Twenty-four (24) – thirty-six (36) inches.

Using the points plotted out prior to the site visit, four (4) soil samples were collected at each of the three (3) sampling locations.

Soil samples were collected from a hand-augured boring using a decontaminated hand auger. Samples were placed in laboratory-supplied sample jars for analysis. The soil sampling procedure at each sampling location is as follows:

1) Prior to sampling, the stainless-steel sampling equipment was washed and decontaminated.
2) The boring was advanced from zero (0) to six (6) inches below the soil surface using the decontaminated soil auger.
3) Soil samples were collected from the upper sampling interval (0 to 6 inches). Soil was placed directly from the auger using gloved hands and placed into a clean plastic bag.
4) The soil samples were homogenized until they were uniform in texture and color and placed into a laboratory-provided sample jar. The sample jar was labeled, and the necessary information was recorded on the sample collection log and chain-of-custody form.
5) The auger was decontaminated, and the hole was advanced to the next sample interval. The process was repeated until all samples were collected.
6) All sampling equipment was decontaminated between sample intervals and locations.

Each sample collected was properly labeled with the sample name/location, depth, date and time, and sampler's initials. All samples were stored in a cooler with ice and transported for analysis under chain-of-custody procedures. The locations of soil characterization sampling are shown on **Figure 7.**

4.5.2 Depth Weighted Receptor Adjustment

As determined in the Gig Harbor Sportsman's Club Preliminary Habitat Assessment, a Depth Weighted Receptor Adjustment was completed in Areas D and E. For each of the three (3) sampling points, a Depth Weighted Receptor Adjustment was performed.

Per Ecology guidance, the soil contamination was weighted as follows to determine exposure risk at each sample location:

- Adjustment of 0.3 for sample depth zero (0) to six (6) inches (including duff)
- Adjustment of 0.55 for sample depth six (6) to twelve (12) inches
- Adjustment of 0.1 for twelve (12) to twenty-four (24) inches
- Adjustment of 0.05 for twenty-four (24) to thirty-six (36) inches

4.6 Laboratory Testing of Soils

Farallon LLC completed lead testing of soils throughout Areas D and E in 2017 and 2018 (**Figure 7**). Results from the 2017 and 2018 soil tests informed the additional soil sampling conducted for the NEBA.

The soil sample testing headed by Farallon included twelve (12) soil samples (one [1] sample each from depths zero [0]-six [6], six [6]-twelve [12], twelve [12]-twenty-four [24], and twenty

[24]-thirty-six [36] inches below the surface). OnSite Environmental Inc. performed the soil testing using method EPA 6010D. Test results are present in **Appendix G.**

Laboratory analyses for soil sample characterization included a number of quality assurance/quality control provisions for evaluation of the quality of the reported results. The evaluation considered the following elements:

- Chain-of-custody records
- Holding times
- Blank results
- Laboratory matrix spikes and blank spikes
- Laboratory duplicates
- Quantitation limits
- Completeness

Upon receipt of the laboratory reports, data was reviewed for quality assurance purposes. The results of the quality assurance evaluation indicated that data was acceptable for monitoring purposes.

5.0 STUDY RESULTS

5.1 Field Results

The Study Area is designated as "Especially Valuable Habitat" through DOE Method 1 because the site is used by a pileated woodpecker (*Dryocopus pileatus*), a Priority Species designated under 77 RCW. Method 2 infers potential use by these species. However, wildlife cameras have captured video of the pileated woodpecker exhibiting normal behavior within Area D of the Study Area (**Appendix A, Photos 21-24**). Pileated woodpecker feeding stations, exhibiting rectangular scars on standing snags, were documented in both Areas D & E, indicating that habitat in both Areas D & E is used by a Priority Species designated under Title 77 RCW (**Appendix A, Photos 11, 12, 69, 70, 99, & 100**). Thereby, both Areas D & E are designated as "Especially Valuable Habitat" under Method 1 because a Priority Species designated under Title 77 RCW was documented using these areas.

The wildlife study found normal to high levels of wildlife activity and use in areas of contamination similar to that in less contaminated areas. Individual animals appeared healthy and exhibited normal behavior. No abnormal behaviors induced by contaminant uptake were identified. A mountain beaver (*Aplodontia rufa*), a burrowing marmot-like animal, was recorded by a wildlife camera trap in an area of high contamination (**Appendix A, Photos 91-94**). Mountain beaver burrows are located throughout the areas of contamination (**Appendix A, Photo 88**).

No effects of chemical uptake by vegetation were identified during the study. However, two (2) individual cascara (*Frangula purshiana*) plants exhibited shriveled leaves (**Figure 5**; **Appendix A, Photo 105**). Both of these plants were located within areas of contamination, but more than four hundred (400) feet apart. Other cascara (*Frangula purshiana*) found in areas with higher contamination did not exhibit these characteristics. However, these two (2) individual plants were surrounded by healthy vegetation. Thereby, whether contamination was directly responsible for this condition is not conclusive. Dry leaves have been identified on some individual salal (*Gaultheria shallon*) plants (**Appendix A, Photos 64, 57, & 58**). However, these individuals are located outside of the areas of contamination (**Figure 5**).

Invertebrate activity within areas of contamination appeared normal (**Appendix A, Photos 47-50 & 101-104**). Invertebrates identified in areas of contamination include thatch ants, millipedes, collembola, beetle, larva, Enchytraeidae worms, and other soil invertebrates. A thatch ant nest occurs within Area E (**Appendix A, Photos 101 & 102**). Dense root structure was identified in areas of contamination (**Appendix A, Photos 54 & 110**).

Lab results for lead, arsenic, or antimony at the sample locations can be found in **Appendix G** and are illustrated in **Figure 7**.

5.2 Designation of Especially Valuable Habitat

Prior to performing a NEBA, the proposed non-remediated area needs to be defined as "Especially Valuable Habitat" (DOE, 2012). A site can be designated "Especially Valuable Habitat" through several verifications:

- *The site is used by a Threatened or Endangered species protected under the Federal Endangered Species Act, or;*

  No Threatened or Endangered species protected under the Federal Endangered Species Act has been identified in the Study Areas by Agency databases or during the site evaluation or are expected to occur in the Study Areas (**Appendix D**).

- *The site is used by a "Priority Species" or "Species of Concern" designated under Title 77 RCW, or;*

  A "Priority Species" was identified in the Study Area. Pileated woodpecker (*Dryocopus pileatus*) is a Priority Species that was documented at Camera 1 in Area D of the Study Area through a cameras trap (**Appendix A, Photos 21-24**). The rectangular scars of pileated woodpecker feeding stations were identified at vegetation sample point V16 in Area D, at Camera 3 in Area E, and at Cameral 4 in Area E (**Appendix A, Photos 11, 12, 69, 70, 99, & 100**). Thereby, Areas D and E would be designated as "Especially Valuable Habitat" and a proposed non-remediated area.

- *The site is used by a plant species classified as "endangered," "threatened," or "sensitive" under Title 79 RCW, or;*

  No plant species classified as "endangered," "threatened," or "sensitive" under Title 79 RCW has been identified in the Study Area by the Department of Natural Resources (DNR) Natural Heritage Database or during the site evaluation or are expected to occur in the Study Areas (**Appendix F**).

- *Wetlands and Fish and Wildlife Habitat Conservation Areas designated as critical areas under Chapter 36. 70A.l70 RCW.*

RCW 36.70A.170---*Natural resource lands and critical areas—Designations.*

(1) On or before September 1, 1991, each county, and each city, shall designate where appropriate:

(a) Agricultural lands that are not already characterized by urban growth and that have long-term significance for the commercial production of food or other agricultural products;

(b) Forestlands that are not already characterized by urban growth and that have long-term significance for the commercial production of timber;

(c) Mineral resource lands that are not already characterized by urban growth and that have long-term significance for the extraction of minerals; and

(d) Critical Areas.

(2) In making the designations required by this section, counties and cities shall consider the guidelines established pursuant to RCW 36.70A.050.

A stream has been identified that extends through Areas A and B that would qualify as a Critical Area under RCW 36.70A.170.

5.3 Plants

The TEE occurred during spring, when new plant growth is abundant. Two (2) individuals of one (1) species, cascara buckthorn, exhibited wilting and shriveling of leaves (**Figure 5**). One (1) individual of cascara buckthorn exhibiting wilting was at V4 (**Appendix A, Photo 105; Appendix H**). New growth of cascara buckthorn elsewhere appeared healthy and did not exhibit wilting or shriveling of leaves (**Appendix A, Photos 106**). Dry leaves have been identified on some individual salal plants (**Appendix A, Photos 64, 57, & 58**). However, these individuals are located outside of the areas of contamination (**Figure 5**). All other plants within the Study Area appeared normal.

A summary of vegetation sampling at nineteen (19) sample plots and at Cameras 1-4 can be found in **Appendix H**. Vegetation sampling points outside of the habitat delineation, such as V1-V3, V5, V8, & V10, are dominated by non-native weed species (**Figure 5; Appendix H**).

Species observed on the subject property in areas of potential habitat include:

Dominant Native Vegetation in Forested Area:

Common Name	Scientific Name	Common Name	Scientific Name
Douglas fir	(*Pseudotsuga menziesii*)	Big-leaf maple	(*Acer macrophyllum*)
Cascara buckthorn	(*Rhamnus purshiana*)	Devil's club	(*Oplopanax horridus*)
Trailing blackberry	(*Rubus ursinus)*	Oregon grape	(*Mahonia nervosa*)
Red alder	(*Alnus rubra*)	Spreading woodfern	(*Dryopteris expansa*)
Oceanspray	(*Holodiscus discolor*)	Western hemlock	(*Tsuga heterophylla*)
Evergreen huckleberry	(*Rubus laciniatus*)	Red elderberry	(*Sambucus racemosa*)
Salal	(*Gaultheria shallon*)	Salmonberry	(*Rubus spectabilis*)
Sword fern	(*Polystichum munitum*)	Bitter cherry	(*Prunus emarginata*)
Raspberry	(*Rubus idaeus*)	Bedstraw	(*Galium spp*.)
Bracken fern	(*Pteridium aquilinum*)	Pacific madrone	(*Arbutus menziesii*)

Common Non-native Weeds on Property:

Common Name	Scientific Name	Common Name	Scientific Name
Himalayan blackberry	(*Rubus armeniacus*)	English holly	(*Ilex aquifolium*)
Scot's broom	(*Cytius scoparius*)	European mountain ash	(*Sorbus aucuparia*)
English laurel	(*Prunus laurocerasus*)	European grasses	

5.4 Wildlife

None of the wildlife identified during the study exhibited signs of excessive contaminant uptake. Species observed in the Study Area include:

Common Name	Scientific Name	Native	State Priority Species	State Listed	Federally-listed
Northwest crow	(*Corvus caurinus*)	Yes	---	---	---
Dark-eyed junco	(*Junco hyenalis*)	Yes	---	---	---
Pileated woodpecker	(*Dryocopus pileatus*)	Yes	Yes	Candidate	---
Spotted towhee	(*Pipilo maculatus*)	Yes	---	---	---
Song sparrow	(*Melospiza melodia)*	Yes	---	---	---
Mountain beaver	(*Aplodontia rufa*)	Yes	---	---	---
Douglas squirrel	(*Tamiasciurus douglasii*)	Yes	---	---	---
Eastern grey squirrel	(*Sciurus carolinensis*)	No	---	---	---
Norway rat	(*Rattus norvegicus*)	No	---	---	---
Mouse	(*Peromyscus spp.*)	Yes	---	---	---
Thrush spp.	(*Catharus spp.*)	Yes	---	---	---
Coyote	(*Canis latrans*)	Yes	---	---	---
Steller's jay	(*Cyanocitta stelleri*)	Yes	---	---	---
Lazuli bunting	(*Passerina amoena*)	Yes	---	---	---
Shrew	(*Sorex sp.*)	Yes	---	---	---
Long-toed salamander	(*Ambystoma macrodactylum)*	Yes	---	---	---

One (1) State Priority Species, the pileated woodpecker, was documented to occur at Camera 1 in Area D during the wildlife study (**Figures 5 & 6; Appendix A, Photos 21-24**). Pileated woodpecker feeding stations with large rectangular scars on standing snags were identified and documented at Vegetation Sample V16, at Camera 3, and at Camera 4 (**Appendix A, Photos 11, 12, 69, 70, 99, & 100**).

Individuals of both sexes were observed among the Oregon dark-eyed junco, spotted towhee, and song sparrow populations on the subject property. Direct observations of wildlife included feeding and reproductive behaviors. Feeding behaviors observed include ground foraging (spotted towhee, Oregon dark-eyed junco, song sparrow) and feeding on snags (pileated woodpecker). Reproductive behaviors observed include feeding of fledglings (Oregon dark-eyed junco). Indirect observations of wildlife include presence of scat (deer), fur (coyote), and burrows (mountain beaver).

Fifteen (15) bird and mammal species were captured by the wildlife camera traps. However, this may be an underestimate because some of the individual animals recorded by the cameras were difficult to identify because of lighting and distance issues. Shrews and small rodents appear very similar in the night vision camera at a distance. Fast moving birds in faint light are difficult to identify.

The greatest number of occurrences of species, counting seventy-four (74), was identified at Camera 2 (**Table 3**). Cameras 1 and 3 were very similar in number at sixty-two (62) and (61) respectively. Note that Camera 1 was located in an area of low contamination in contrast to Area 3, which was in the area of the highest contamination. Camera 4 had the least number of occurrences, counted at thirty-six (36). However, the number of occurrences was driven by squirrels defending the bait against various species of birds. The numbers of occurrences are much closer if squirrels were not counted.

Squirrels and birds vigorously competed and defended the food source. This vigorous behavior caught on video, including acrobatics, is contrary to the effects of contaminant uptake. Observed wildlife were energetic, alert, and always present. No individual wildlife species observed on videos exhibited muscular incoordination, debility, slowness, jerkiness, falling, hyper-activity, fluffed feathers, drooped eyelids, or seizures (**Table 4**).

A coyote was observed hunting at night by Camera 3 in Area E. The Study Area contains sufficient prey items to support higher trophic levels, demonstrating the complexity and health of the ecosystem as a whole.

Table 3. Wildlife Camera Results

Species	Scientific Name	Camera 1	Camera 2	Camera 3	Camera 4	Symptoms of Contamination?	Appendix A Photos
Northwestern Crow	*Corvus caurinus*	4	0	0	0	None	15, 19
Douglas Squirrel	*Tamiasciurus douglasii*	21	2	4	23	None	17, 26, 29, 30, 77, 85, 86, 89, 90
Eastern Grey Squirrel	*Sciurus carolinensis*	2	18	49	0	None	14, 33, 34, 43, 44, 46, 75, 76
Spotted Towhee	*Pipilo maculatus*	8	32	0	5	None	31, 38, 40, 41, 89, 90
Song Sparrow	*Melospiza melodia*	5	1	6	4	None	25, 98
Pileated Woodpecker	*Dryocopus pileatus*	2	0	0	0	None	21-24
Norway Rat	*Rattus norvegicus*	2	0	0	0	None	20, 27, 28
Mouse	*Peromyscus spp*.	13	3	0	1	None	45, 97
Dark-eyed Junco	*Junco hyenalis*	2	16	0	0	None	35, 36, 39, 41, 42
Thrush	*Catharus spp.*	0	1	0	0	None	
Coyote	*Canis latrans*	0	0	1	0	None	79-82
Steller's Jay	*Cyanocitta stelleri*	0	0	1	1	None	74, 83, 84, 95, 96
Mountain Beaver	*Aplodontia rufa*	0	0	0	1	None	91-94
Shrew	*Sorex sp.*	3	0	0	1	None	28
Lazuli Bunting	*Passerina amoena*	0	1	0	0	None	37
Total Sightings		62	74	61	36	No symptoms of contamination observed for any individual.	

Table 4. Wildlife camera sightings

Species	Scientific Name	Muscular incoor-dination	Debility	Slowness	Jerkiness	Falling	Hyper-activity	Fluffed feathers	Drooped eyelids	Seizures
American Crow	*Corvus brachyrhynchos*	No	No	No	No	No	No	No	No	No
Douglas Squirrel	*Tamiasciurus douglasii*	No	No	No	No	No	No	No	No	No
Eastern Grey Squirrel	*Sciurus carolinensis*	No	No	No	No	No	No	No	No	No
Spotted Towhee	*Pipilo maculatus*	No	No	No	No	No	No	No	No	No
Song Sparrow	*Melospiza melodia*	No	No	No	No	No	No	No	No	No
Pileated Woodpecker	*Dryocopus pileatus*	No	No	No	No	No	No	No	No	No
Norway Rat	*Rattus norvegicus*	No	No	No	No	No	No	No	No	No
Mouse	*Peromyscus spp*.	No	No	No	No	No	No	No	No	No
Dark-eyed Junco	*Junco hyenalis*	No	No	No	No	No	No	No	No	No
Thrush	*Catharus spp.*	No	No	No	No	No	No	No	No	No
Coyote	*Canis latrans*	No	No	No	No	No	No	No	No	No
Steller's Jay	*Cyanocitta stelleri*	No	No	No	No	No	No	No	No	No
Mountain Beaver	*Aplodontia rufa*	No	No	No	No	No	No	No	No	No
Shrew	*Sorex sp.*	No	No	No	No	No	No	No	No	No
lazuli bunting	*Passerina amoena*	No	No	No	No	No	No	No	No	No

5.5 Soils

5.5.1 Laboratory Testing

A summary of depth-weighted averages calculated from the laboratory results is provided in **Table 5**. Totals are the sum of the depth-weighted exposure adjustment concentrations for antimony, arsenic and lead (DOE, 2018). Concentration of lead shot in the soils can be found in **Figure 4** and soil sampling locations can be found in **Figure 7**.

Table 5. Sum of Depth Weighted Averages

Sampling Point	Total Antimony	Total Arsenic	Total Lead
FB-50	97	26	4,054.2
FB-51	2,094.1	309.3	25,230
FB-52	540	391.5	15,221.1

5.5.2 Area D Results

The lab testing results indicate that arsenic, lead, and antimony are present in soils greater than ecological indicator soil concentrations determined by the MTCA at boring location FB-52 in Area D (**Figure 7**).

Arsenic was measured at 391.5 mg/kg and exceeds the ecological indicator soil concentration of greater than seven (>7) mg/kg for wildlife. Lead was measured at 15,221.1 and exceeds the ecological indicator soil concentrations for plants, soil biota, and wildlife (50, 500, and 118 mg/kg, respectively). Antimony was measured at five hundred forty (540) mg/kg and exceeds the ecological indicator soil concentration of five (5) mg/kg for plants (**Figure 7**; **Appendix G**).

5.5.3 Area E Results

Two (2) boring locations, FB-50 and FB-51, were completed in Area E. The results indicate that arsenic, lead, and antimony are present in the soils at greater than ecological indicator soil concentrations determined by the MTCA at both locations.

Arsenic was measured at 26mg/kg at FB-50 and 309.3 mg/kg at FB-51 and exceeds the ecological indicator soil concentration (>7 mg/kg for wildlife) at both boring locations. Lead was measured at 4,054.2 mg/kg and 25,230 mg/kg and exceeds the ecological indicator soil concentrations for plants, soil biota, and wildlife (50, 500, and 118 mg/kg respectively) at both boring locations. Antimony was measured at 97 mg/kg and 2,094.1 mg/kg and exceeds the ecological indicator soil concentration (5 mg/kg for plants) at both boring locations (**Appendix G; Insert 1**).

Insert 1. Ecological Indicator Soil Concentrations of Arsenic, Lead, and Antimony

Table 749-3

Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals[a]. For chemicals 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). Where these values are exceeded, 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 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	10		
Cadmium	4	20	14
Chromium (total)	42[g]	42[g]	67
Cobalt	20		
Copper	100	50	217
Fluorine	200		
Iodine	4		
Lead	50	500	118

5.3.4 Soil Biota and Root Structure

Soil biota and root density were quantified to document any differences between areas of contamination and less impacted areas (**Table 6**).

Root mass depths and soil biota numbers in Area D were comparable between samples in areas of contamination and paired locations. No obvious color change was observed in roots in areas of high contamination and soil biota was present and appeared healthy.

Root mass depths in Area E were highly variable between all sampling locations. Locations resulting in shallow root depth were taken in areas with dense canopy cover and therefore, shallow ground vegetation cover. Roots and vegetation present in these areas appeared healthy (**Appendix A, Photo 54, 60**). Soil biota numbers were comparable between all test locations in Area E (**Table 6**).

Table 6. Summary of soil biota and root mass results

Test plot	Common Name	Number of Individuals	Root Depth	Effects of Contamination	Appendix A Photos
Area D					
Camera 1	Staphylinid	>2	11"	No effects observed. Appeared healthy.	--
TA-2	Thatch ants	>5	12"	No effects observed. Appeared healthy.	20, 21
	Fungus	>2			
Camera 2	Millipede	1	11"	No effects observed. Appeared healthy.	19
	Collembola	1			
	Thatch Ants	3			
	Arachnid	1			
TB-2	Collembola	1	11"	No effects observed. Appeared healthy.	22
	Staphylinid	6			
	Millipede	1			
	Enticrid	1			
	Arachnid	1			
Area E					
Camera 3	Millipede	1	3"	No effects observed. Appeared healthy.	--
	Arachnid	3			
	Staphylinid	4			
TC-2	Arachnid	3	9"	No effects observed. Appeared healthy.	--
	Thatch ants	>5			
	Staphylinid	4			
Camera 4	Millipede	1	7"	No effects observed. Appeared healthy.	40
	Staphylinid	1			
TD-2	Staphylinid	1	2"	No effects observed. Appeared healthy.	--

5.6 NEBA Factors by Area

Factors that should be considered by the Ecology Site Manager (or designee) in granting a non-remediation include:

- The rarity of the habitat for the geographic area in which the site is located
- 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 the cleanup would significantly disturb the ecological functions of the habitat
- The level of human activity in the area
- The length of time for recovery of the habitat after cleanup

5.6.1 Area D

Area D has a natural, structurally diverse, habitat forested by Douglas fir (*Pseudotsuga menziesii*) and native understory species including salal (*Gaultheria shallon*), and western sword fern (*Polystichum munitum*) (**Table 7**). A stream flows through Area D. The canopy, sub-canopy, and undergrowth consist of native species. Area D currently has a fence on the eastern portion of the property and is subject to limited human activity. Area D is bordered on the western side by a shooting range and maintained grounds and is bordered by forest on the northern and southern edge. This area acts as a wildlife corridor, connecting vegetated forested habitats for birds and mammals, and can potentially be used as a refuge and/or feeding area by migratory passerines.

Any removal of large trees in the Study Areas could result in a temporal loss of habitat lasting fifty (50) years or more as young trees grow to the size and habitat value of existing trees. The clean-up decision must weigh temporal loss of habitat, but also the quality of habitat. The forested areas are dominated by intact native vegetation, containing few non-native weed species.

Another consideration for cleanup is the vibrant wildlife community that currently utilizes the Study Area as habitat. This wildlife community would be displaced with minimal to no opportunity of relocating to surrounding areas. Habitat for a priority species may be jeopardized in the clean-up efforts.

Table 7. Summary of the NEBA factors in Area D

NEBA Factor	Area D
Rarity of habitat for geographic area	Not rare in geographic area, but relatively rare in vicinity because surrounded by high intensity development.
Size of habitat	~201,107 sf (4.62 acers).
Wildlife corridor function?	Yes: wildlife corridors occur that connect the site to off-site habitat. Also, corridor for bird species that cross roads and development.
Refuge or feeding area for a migratory species?	Yes: The site is a feeding area for migratory birds, which were identified on the site during the study.
Structural diversity of the habitat	Moderate: Structural diversity in the study area consists of a multilayered canopy, topographic relief, and fish and wildlife habitat area.
Surrounding habitat and land uses	Habitat patches and McCormick Forest Park surrounded by roads, highways and high intensity land use.
Whether the habitat is manmade or natural	Natural
Would cleanup disturb the ecological functions?	Yes: Cleanup would disturb ecological functions through vegetation and soil removal.
Level of human activity in the area	Human activity on the subject property is consistent with a sportsman's club. Human activity within the vicinity consists of roads, highways, parks, residential high intensity residential, and commercial development.
Length of recovery time after cleanup	~50 years for vegetation, soils, and ecosystem to recover.

5.6.2 Area E

Area E is a similar forested habitat to and contiguous with Area D (**Table 8**). As with Area D, cleanup would be expected to disturb the ecological functions this habitat provides, as the Douglas firs, western hemlocks, western red cedar, and red alder present would likely be damaged or removed. The same clean-up considerations for Area D, apply to Area E.

Table 8. Summary of the NEBA factors in Area E

NEBA Factor	Area E
Rarity of habitat for geographic area	Not rare in geographic area, but relatively rare in vicinity because surrounded by high intensity development.
Size of habitat	~218,541 sf (5.02 ac)
Wildlife corridor function?	Yes: wildlife corridors occur that connect the site to off-site habitat. Also, corridor for bird species that cross roads and development.
Refuge or feeding area for a migratory species?	Yes: The site is a feeding area for migratory birds, which were identified on the site during the study.
Structural diversity	Moderate
Surrounding habitat and land uses	Habitat patches and McCormick Forest Park surrounded by roads, highways and high intensity land use.
Manmade or natural	Natural
Would cleanup disturb the ecological functions?	Yes: Cleanup would disturb ecological functions through vegetation and soil removal.
Level of human activity in the area	Human activity on the subject property is consistent with a sportsman's club. Human activity within the vicinity consists of roads, highways, parks, residential high intensity residential, and commercial development.
Length of recovery time after cleanup	~50 years for vegetation, soils, and ecosystem to recover.

5.7 Assessment of Effects of Contamination

No effects of contaminant uptake by most plants or wildlife were observed. Only two (2) individual plants of one (1) species within the area of contamination showed wilting and shriveling of leaves. All new plant growth appeared to be healthy. Wildlife appeared to be healthy with no apparent effects caused by lead, antimony, or arsenic uptake. Signs of wildlife that are in close contact with the soils on the subject property (mountain beaver, ants, mice, rats, squirrels, and ground-foraging birds) were observed (**Appendix A**). Thatching ant colonies were found in Areas D & E and appeared to be healthy (**Appendix A, Photo 101 & 102**).

Multiple bird species were observed directly and indirectly in the areas of concern and all appeared to be healthy and did not exhibit signs of excessive contaminant uptake (**Appendix A**).

6.0 PROPOSED LAND USE

Continued existing land use is proposed.

7.0 ALTERNATIVES

Alternative Actions are provided below for discussion purposes.

7.1 Alternative 1. No Action (Preferred Alternative)

No action is the preferred alternative in order to preserve Especially Valuable Habitat in the Study Area. The pileated woodpecker, a Priority Species, utilizes Especially Valuable Habitat within the Study Area. The pileated woodpecker was documented in the Study Area by wildlife camera traps, recording video of normal behavior. Pileated woodpecker feeding stations were identified in the Study Area, indicating use of habitat within the Study Area.

In addition, no signs of excessive contaminant uptake by local plants, wildlife, or soil biota have been identified in this study. Two (2) individual cascara plants exhibited withered and shriveled leaves within areas of contamination. However, the surrounding vegetation was healthy and showed no effects of contaminant uptake.

No indication of diminished health or affected behavior associated with contaminant uptake was observed in numerous wildlife species in the Study Area by wildlife camera traps that recorded hundreds of one (1) minute videos.

Wildlife species documented in the Study Area utilize this area as habitat. The Study Area is forested by a variety of large native tree species over a dense understory of native shrubs and herbs. A stream extends through the study are providing habitat diversity.

Clean-up action would jeopardize Especially Valuable Habitat utilized by a Property Species and numerous other wildlife species. Removal of vegetation as part of the clean-up efforts would displace wildlife species. If large trees were removed as a part of the clean-up process, a temporal loss of habitat would occur and jeopardize established wildlife species, including the pileated woodpecker, a Priority Species. The pileated woodpecker depends on large diameter trees as currently found in the Study Area. The recovery and replacement of the existing mature forest would take at least fifty (50) years. The loss of the pileated woodpecker would be likely during this temporal loss of their essential habitat. In addition, the disturbance of vegetation would stimulate invasive weed invasion and hamper recovery efforts.

This alternative would include limiting access to areas of high contaminant concentrations through fencing and informational signs. Human access would be restricted from areas of highest concentration other than on existing roads and trails while allowing the existing wildlife to flourish.

7.2 Alternative 2. Limited Remediation

Limited remediation would remove contaminated soils from selected areas of high concentration, while preserving habitat used by Priority Species and other established wildlife. No trees would be removed as part of this alternative. However, established shrubs and herbaceous vegetation

would be removed in selected areas and then replanted following the removal of contamination. Temporal loss of habitat would displace many wildlife species. Because these species are isolated within an island of forested habitat surrounded by high-intensity land use, many of these species, such as the mountain beaver and Douglas squirrel, may not recover. The recovery and replacement of the existing understory vegetation would take at least ten (10) years. In addition, the disturbance of vegetation would stimulate invasive weed invasion and hamper recovery efforts.

Recommendations would include avoiding pileated woodpecker feeding stations and cavity nests while preserving the largest area of forest practicable. Tress and snags would be preserved in the Study Area. Any incidental tree mortality would be preserved as snags. Clean-up activities would occur outside of the breeding and nesting periods of the pileated woodpecker, which occurs from late March to early July. Clean-up activities would occur in the uppermost layers of the soils where contaminants are concentrated and to minimize disturbance to mountain beaver burrows.

The WDFW (2003) Management Recommendations for the pileated woodpecker states that in urbanizing areas, the greatest negative influence on pileated woodpeckers is the clearing of remnant forest patches. The WDFW recommends the retain of forests in the largest patches available. Where large patches are unavailable, smaller patches should be retained; where the average size of smaller patches should be no less than approximately seven (7) acres. The Study Area is approximately 9.6 acres in size.

7.3 Alternative 3. Remediation in Study Area

Remedial or ecological restoration alternative would provide 'no net environmental benefit' over the "No Action" alternative. The remediation alternative would cause environmental injuries that may be greater than the damage associated with the contamination. Removal of vegetation jeopardizes the displacement of wildlife species that depend on this island of forested vegetation surrounded by high intensity residential and commercial development.

Removal of mature Douglas fir, western red cedar, and western hemlock trees would cause significant ecological disturbance. The temporal loss of forested habitat would jeopardize the pileated woodpecker, a priority species, as well as other species that depend on this island of forested habitat surrounded by high intensity residential and commercial development. Species, such as the Douglas squirrel and mountain beaver, are not expected to recover with the temporal loss of coniferous forested habitat.

Mitigation would result in a temporal loss in habitat, wildlife corridors, and refuges for resident and migratory wildlife. Recovery to the current conditions in the areas of concern could take over fifty (50) years or longer, based on the size of the trees, in the areas of concern. Remediation in the Study Area is not recommended for these reasons. The lack of observable signs of contaminant uptake does not justify the level of ecological disturbance that would occur as a result of remediation. Human health risk would be minimal because there is currently minimal human activity within the areas of concern and future human activity in these areas is not anticipated.

The installation of a fence around undisturbed habitat would allow for the preservation of habitat while discouraging human intrusion.

8.0 CONCLUSION & RECOMMENDATIONS

A Net Environmental Benefit Analysis (NEBA) was performed on the subject property to determine if the Study Area contains Especially Valuable Habitat and to document any signs of excessive contaminant uptake by local plants and wildlife. This information will be used to determine a clean-up strategy, or if cleanup is warranted.

A "Priority Species" was identified in the Study Area. The pileated woodpecker (*Dryocopus pileatus*) is a Priority Species that was documented at Camera 1 in Area D of the Study Area through a cameras trap (**Appendix A, Photos 21-24**). Pileated woodpecker feeding stations were identified at vegetation sample point V16 in Area D, Camera 3 in Area E, and at Camera 4 in Area E (**Appendix A, Photos 11, 12, 69, 70, 99, & 100**). Thereby, Areas D and E are designated as "Especially Valuable Habitat".

The pileated woodpecker utilizes Especially Valuable Habitat within the Study Area. The pileated woodpecker was documented in the Study Area by wildlife camera traps, recording video of normal behavior. Pileated woodpecker feeding stations were identified in the Study Area, indicating use of this habitat.

Plants appeared healthy with no sign of contaminant uptake. However, two (2) individual cascara buckhorn plants exhibited withered and shriveled leaves. The two individuals were not found together. All the surrounding vegetation was healthy with no similar conditions observed. Because only two (2) individual plants exhibited withered leaves and because a number of other factors, including insects or pathogens, could cause withered leaves, contaminant uptake as a cause of this condition was inconclusive.

Root density and depth appeared normal and similar to that outside of the contaminated areas. Soil invertebrates appeared normal in areas of contamination. A busy thatch ant nest is located in Area E where lead shot is visible on the ground (**Appendix A, Photos 101 & 102**). Ants were observed traversing lead shot. Other invertebrates were observed on the lead shot. A wasp was photographed utilizing this habitat (**Appendix A, Photo 104**). Leaf miners were observed in Area E (**Appendix A, Photo 104**).

Hundreds of one (1) minute long videos were analyzed from the camera traps for effects of contaminant uptake. Some video scenes were converted to photographs included in **Appendix A**. No effects of contaminant uptake were observed as a part of this analysis. Wildlife appeared vigorous and healthy. For example, Douglas squirrels and eastern gray squirrels vigorously defended the camera bait from various song birds during the day and rats vigorously defended the traps from mice and shrews at night. Rodents and shrews attracted a coyote to one of the cameras at night. These are all signs of a vigorous and healthy wildlife community.

The Study Area consists of a mature forest with dense understory vegetation. Because a priority species uses the Study Area for habitat, the Study Area is designated as Especially Valuable Habitat. A stream is located within the Study Area, increasing habitat diversity and providing resources for wildlife species. The temporal loss of this habitat as a result of clean-up activities would displace wildlife species. Because the Study Area is an island of habitat surrounded by high intensity residential and commercial development, some displaced wildlife species may not recover. The pileated woodpecker requires large trees and snags in at least seven (7) acres of intact forested habitat to survive according the WDFW (2003) Management Recommendations

for the pileated woodpecker. Mountain beaver and the Douglas squirrel have specific habitat requirements that may be jeopardized upon vegetation removal associated with clean-up activities. The overall ecological integrity of this intact and functioning habitat may be jeopardized with any level of vegetation removal.

The 'no action' alternative is preferred for the following reasons:

- Pileated woodpecker, a "species of concern", has been documented using the Study Area as habitat, thereby the Study Area is designated as "Especially Valuable Habitat".
- Large native trees and a dense understory of native plant species provide significant habitat value within the Study Area. Any removal of vegetation may jeopardize habitat for wildlife species and the overall ecological integrity of the habitat.
- Vegetation and wildlife appear healthy with no apparent effects caused by lead, arsenic, or antimony uptake.
- Remedial or ecological restoration alternative would provide 'no net environmental benefit' over natural attenuation of contaminants.
- The remediation alternative may cause environmental injuries greater than the damage associated with the contamination.
- Remediation would cause significant ecological disturbances that would require long-term recovery.

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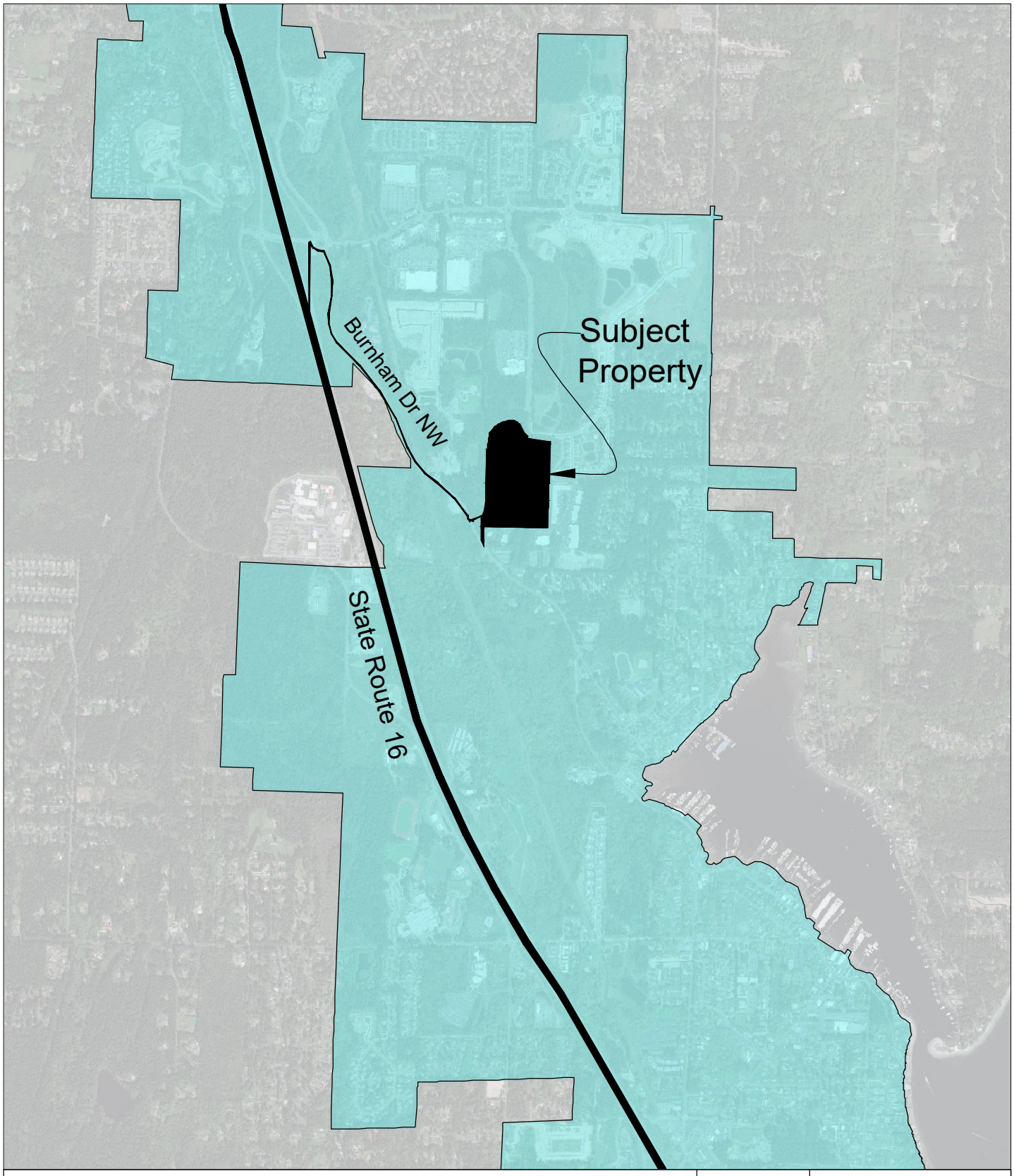
FIGURES



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City of Gig Harbor

Figure 1

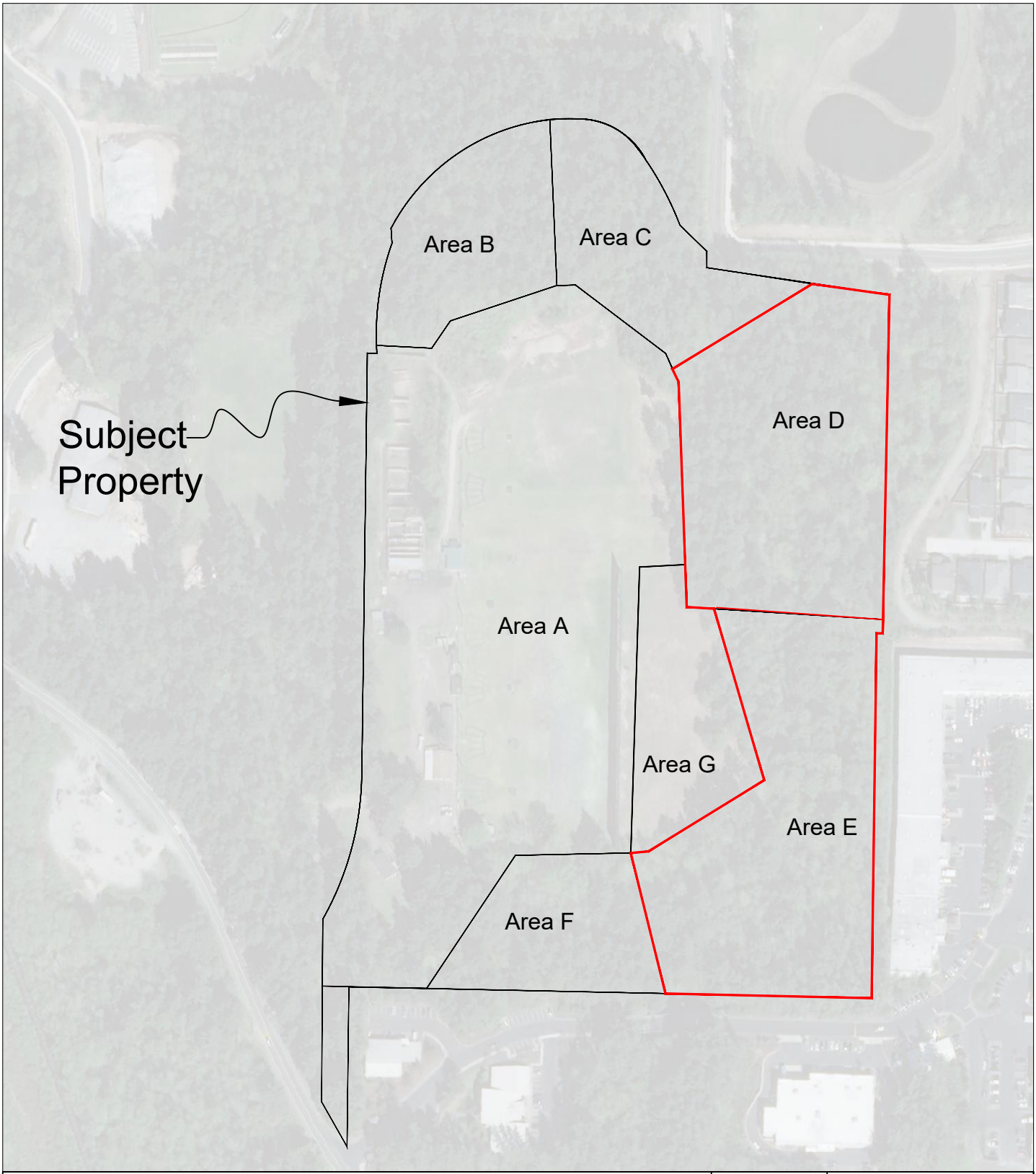
Gig Harbor Sportsman's Club

Vicinity Map

Scale: 1" = 2000'

0 2000'

17 December 2019



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Study Area

Figure 2

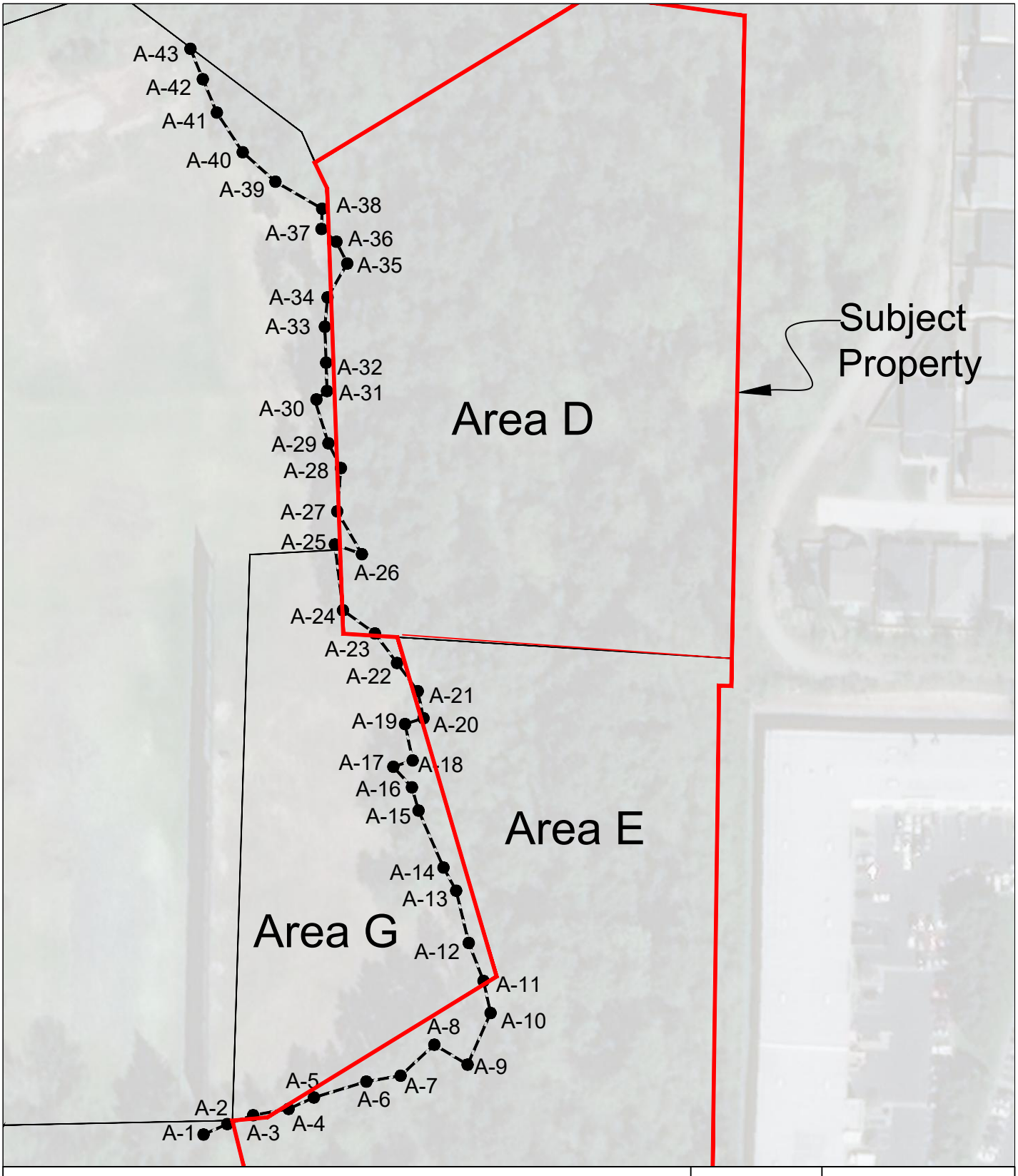
Gig Harbor Sportsman's Club

Study Area

Scale: 1" = 250'

0 250'

17 December 2019



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A-1 — A-2 Quality Habitat Boundary

Study Area

Figure 3

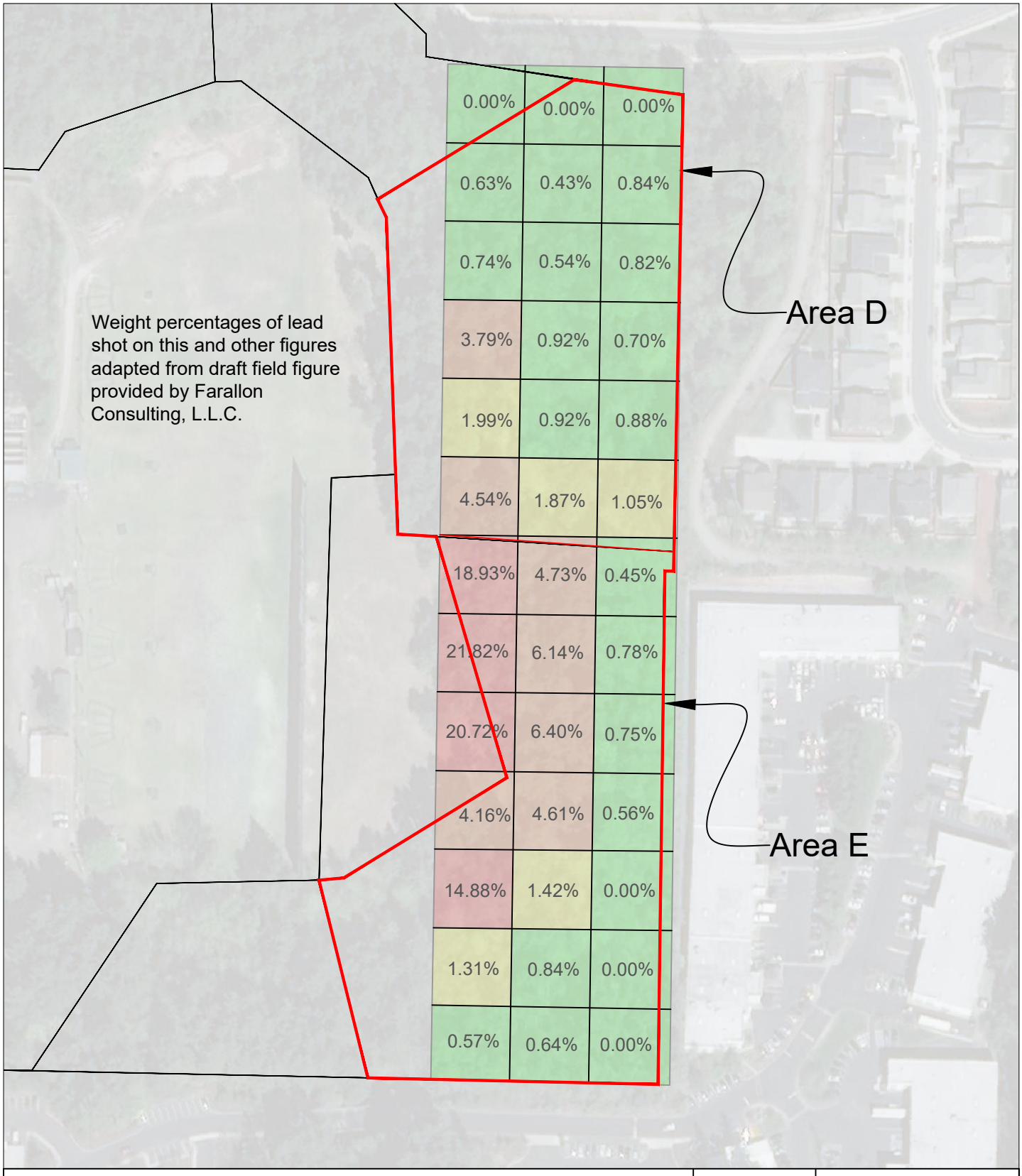
Gig Harbor Sportsman's Club

Habitat Delineation

Scale: 1" = 125'

0 125'

17 December 2019



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15.02% Percent of Bulk Soil Sample Comprising Lead Shot

Field Screening Grid (100' x 100')

Lead Weight Percent >10%

Lead Weight Percent 3-10%

Lead Weight Percent 1-3%

Lead Weight Percent <1%

Study Area

Figure 4

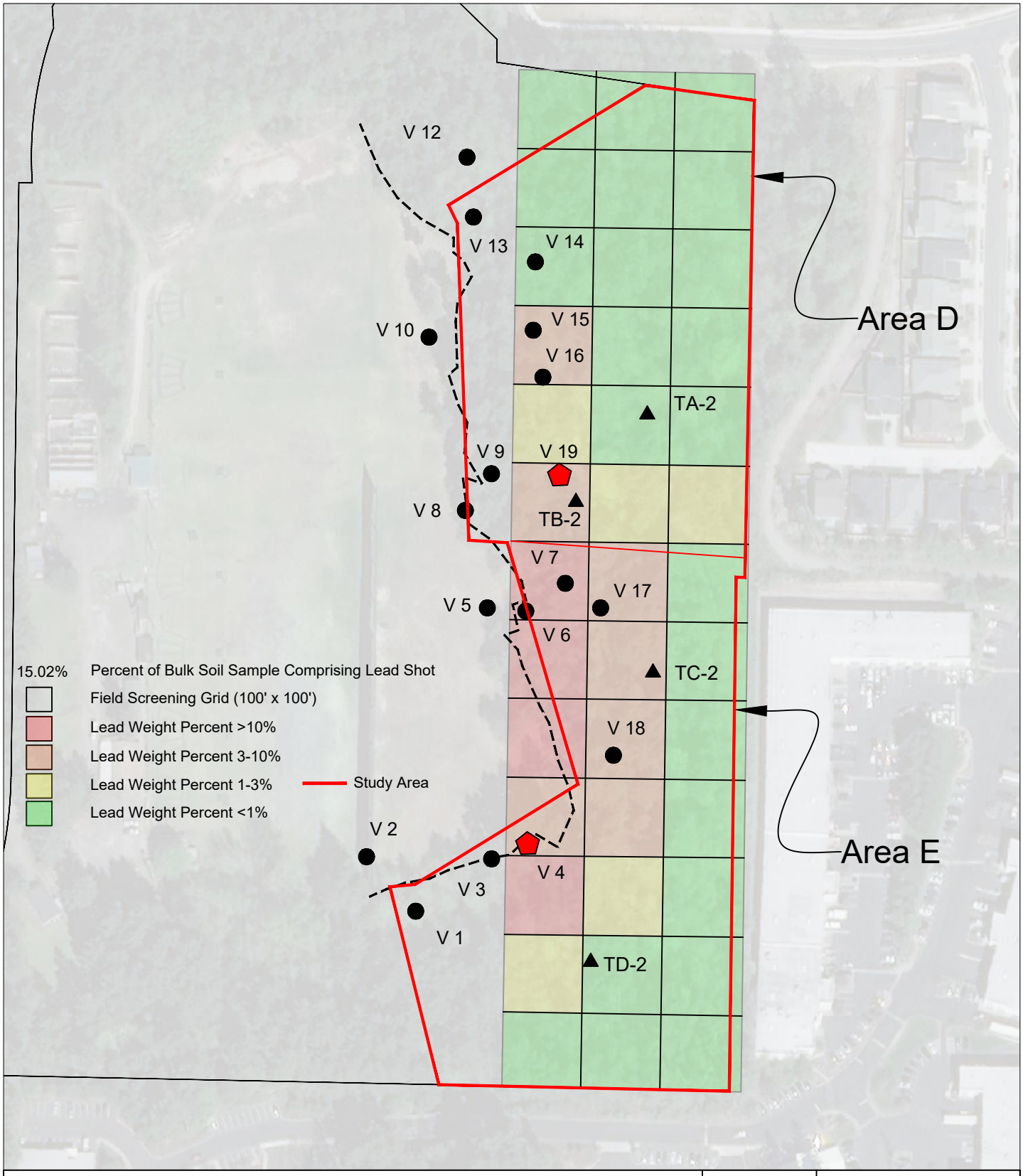
Gig Harbor Sportsman's Club

Lead Shot in Soil

Scale: 1"=175'

0 175'

17 December 2019



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Habitat Boundary Delineation
Study Area
Soil Invertebrate & Root Structure Sample Points
Vegetation Sample Points
Wilted Cascara Buckthorn

Figure 5

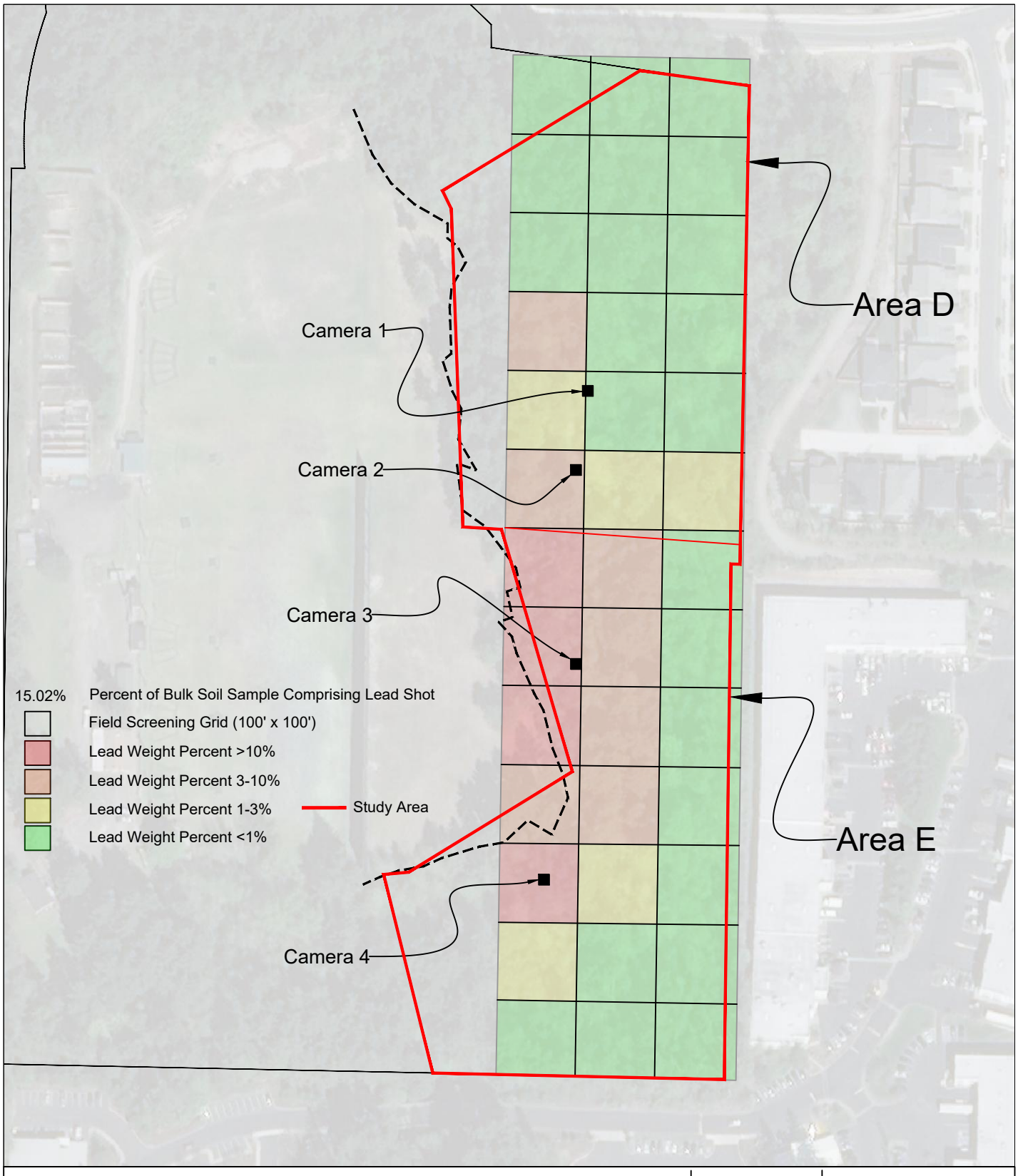
Gig Harbor Sportsman's Club

Vegetation Sample Plots

Scale: 1"=175'

0 175'

17 December 2019



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Quality Habitat Boundary

Study Area

Camera Location

Figure 6

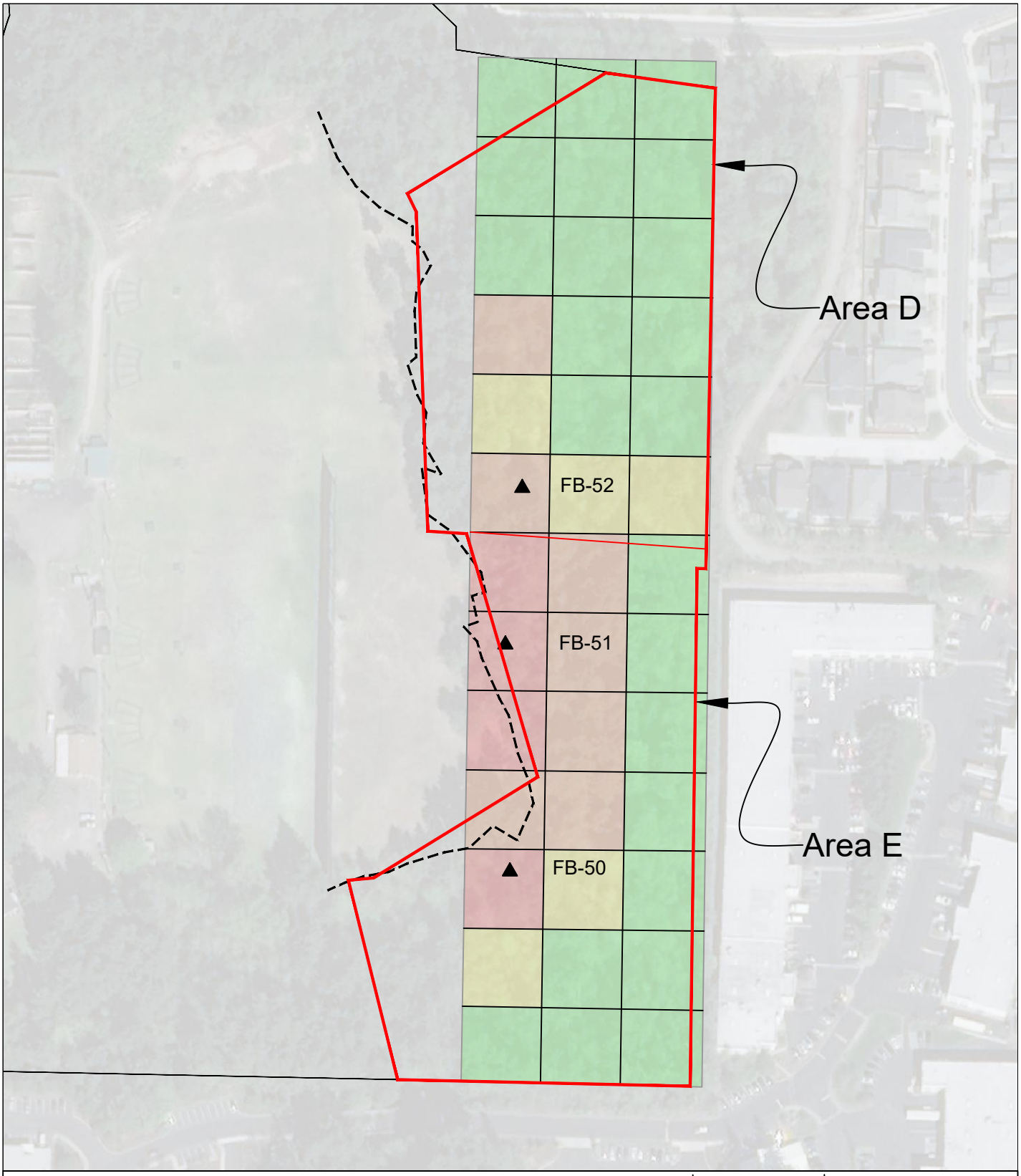
Gig Harbor Sportsman's Club

Wildlife Camera Traps

Scale: 1" = 175'

0 175'

17 December 2019



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Quality Habitat Boundary

Study Area

Soil Sampling Location for Lab Testing

Figure 7

Gig Harbor Sportsman's Club

Soil Sample Locations

Scale: 1" = 175'

0 175'

17 December 2019

APPENDIX A

Photographs

SUBJECT PROPERTY

Photo 1. Shooting range area, clay pigeons visible on ground.

Photo 2. Scot's broom located ease of shot screen in Area A

Photo 3. Long-toed salamander located on-site

Photo 4. Open area north of shot screen

Photo 5. Edge of habitat boundary delineated

Photo 6. Habitat boundary, shot screen in background

AREA D

Photo 7. Healthy Douglas fir trees and sword fern within Area D

Photo 8. Deer scat approximate 50 feet north of Area D

Photo 9. Fur tufts from coyote at western edge of Area D

Photo 10. Locating Cam 1, Trimble Geo 7x (Sub-foot accuracy)

Photo 11. Pileated woodpecker feeding station at Sample V16


Photo 12. Pileated woodpecker feeding station at Sample V16

Area D Camera 1 Wildlife

Photo 13. Baited camera trap at Camera 1 (Cam 1)


Photo 14. Eastern gray squirrel at Cam 1 in Area D


Photo 15. Northwestern crow


Photo 16. Spotted towhee at Camera 1


Photo 17. Douglas squirrel at Camera 1


Photo 18. Song sparrow at Camera 1

Photo 19. Northwest Crow at Camera 1

Photo 20. Norway rat at Camera 1

Photo 21. Pileated woodpecker at Camera 1

Photo 22. Pileated woodpecker at Camera 1

Photo 23. Pileated woodpecker at Camera 1

Photo 24. Pileated woodpecker at Camera 1

Photo 25. Unidentified bird at Camera 1

Photo 26. Douglas squirrel at Camera 1

Photo 27. Norway Rat at Camera 1

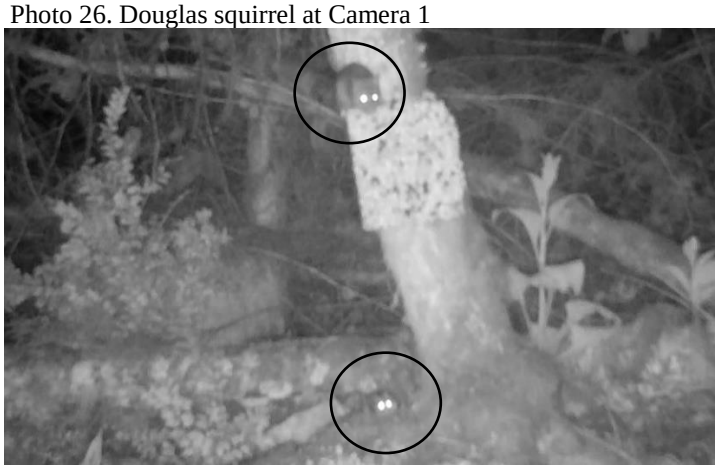


Photo 28. Norway Rat & small rodent, likely shrew, on the ground

Photo 29. Douglas squirrel at Camera 1

Photo 30. Douglas squirrel at Camera 1

Area D Camera 2 Wildlife

Photo 31. Spotted towhee at Camera 2

Photo 32. Baited Camera 2 surrounded by dense vegetation

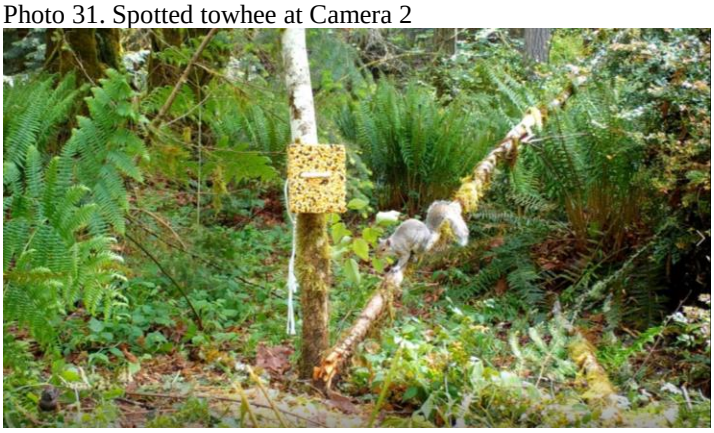


Photo 33. Eastern gray squirrel at Camera 2

Photo 34. Eastern gray squirrel at Camera 2

Photo 35. Dark-eyed junco at Camera 2

Photo 36. Dark-eyed junco females at Camera 2

Photo 37. Female lazuli bunting in flight at Camera 2

Photo 38. Spotted towhee at Camera 2

Photo 39. Female dark-eyed junco at Camera 2

Photo 40. Spotted towhee at Camera 2

Photo 41. Spotted towhee & male dark-eyed junco at Cam 2

Photo 42. Male and female dark-eyed juncos at Camera 2

Photo 43. Eastern gray squirrel at Camera 2

Photo 44. Eastern gray squirrel at Camera 2

Photo 45. Small rodent at Camera 2

Photo 46. Eastern gray squirrel at Camera 2

Area D Soil Invertebrates

Photo 47. Millipede (Polydesmida) in soils at TA-2

Photo 48. Enchytraeidae worm in soils at TB-2

Photo 49. Millipede (Polydesmida) in soils at TA-2

Photo 50. Beetle larva in soils at TB-2

Area D Vegetation

Photo 51. Healthy vegetation at Camera 2

Photo 52. Healthy Cascara at Camera 2

Photo 53. Small mushrooms located at TA-2

Photo 54. Healthy root structure located at TA-2

Photo 55. Healthy vegetation at A-27 in Area D

Photo 56. Healthy black cottonwood at edge of Area D habitat

Photo 57. Some dried out salal leaves at Camera 1


Photo 58. Some dried out salal leaves at Camera 1

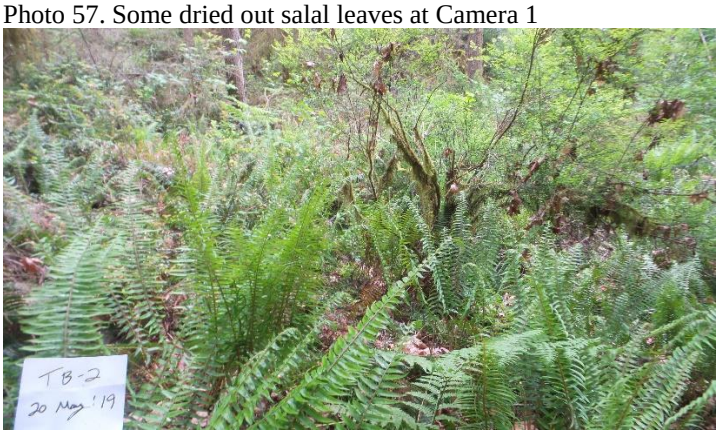


Photo 59. Healthy sword fern at TB-2


Photo 60. Healthy root structure at TP-2

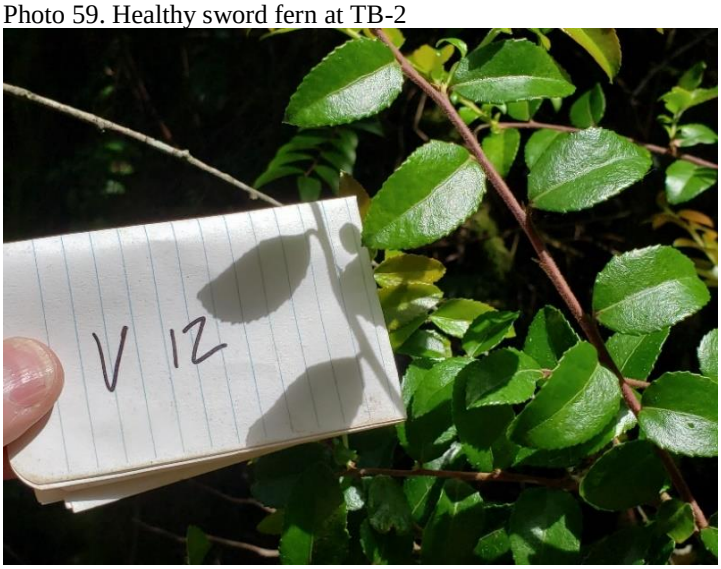


Photo 61. Healthy vegetation at V12

Photo 62. Healthy vegetation at V16

Photo 63. Healthy salal at V13

Photo 64. Some dried out salal leaves at V13

Photo 65. Healthy Vegetation at V15

Photo 66. Healthy devil's club at V16

AREA E

Photo 67. Dense healthy forest and understory at Flag A-4

Photo 68. Dense vegetation in Area E

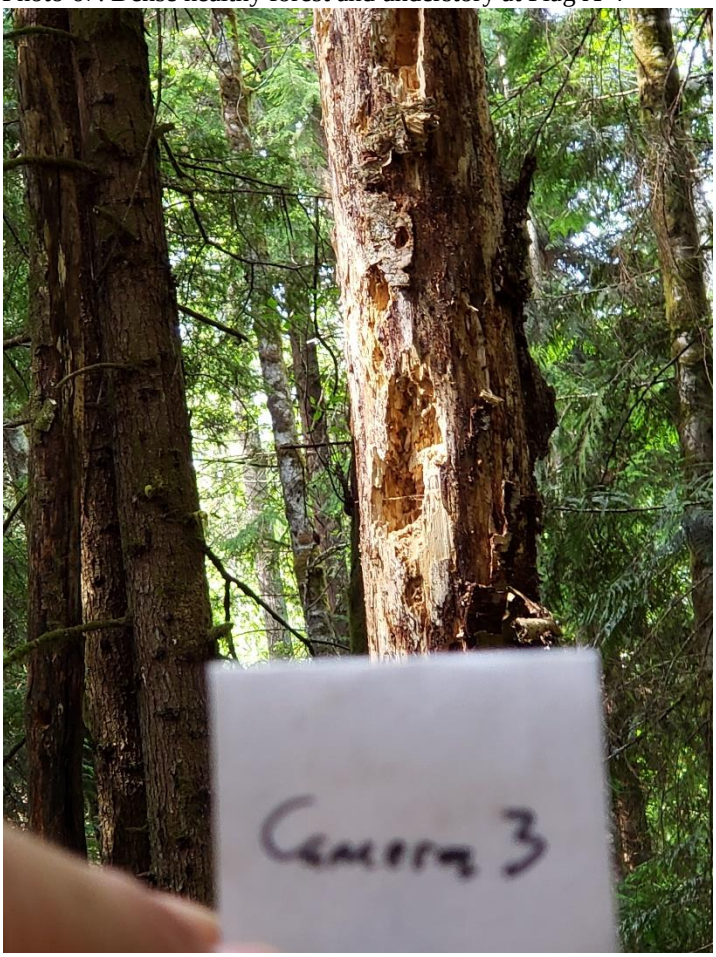


Photo 69. Pileated woodpecker feeding stations at Camera 3

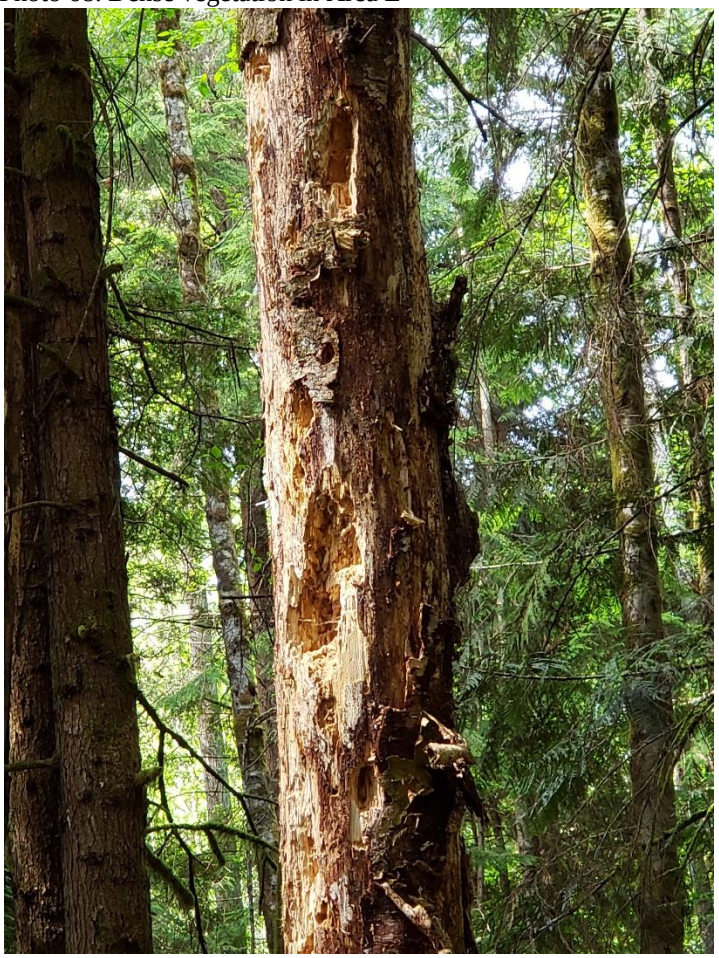


Photo 70. Pileated woodpecker feeding stations at Camera 3

Photo 71. Artificial deer on pedestrian path in Area E

Photo 72. Lead shot present in soils at Camera 3

Area E Camera 3 Wildlife

Photo 73. Camera 3 in Area E


Photo 74. Steller's Jay at Camera 3


Photo 75. Eastern gray squirrel at Cameral 3 in Area E


Photo 76. Eastern gray squirrel at Cameral 3 in Area E

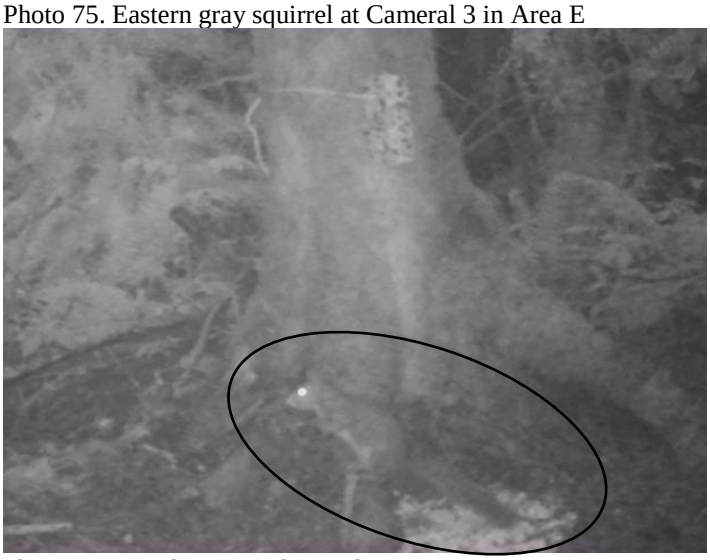


Photo 77. Douglas squirrel at night at Camera 3 in Area E


Photo 78. Unidentified bird at Camera 3 in Area E


Photo 79. Coyote at Camera 3 in Area E


Photo 80. Coyote at Camera 3 in Area E


Photo 81. Coyote at Camera 3 in Area E


Photo 82. Coyote at Camera 3 in Area E


Photo 83. Steller's jay at Camera 3 in Area E


Photo 84. Steller's Jay at Camera 3 in Area E

Photo 85. Douglas squirrel at Camera 3 in Area E

Photo 86. Douglas squirrel at Camera 3 in Area E

Area E Camera 4 Wildlife

Photo 87. Camera 4 in Area E


Photo 88. Mountain beaver burrow in Area E


Photo 89. Douglas squirrel and spotted towhee at Camera 4


Photo 90. Douglas squirrel and spotted towhee at Camera 4


Photo 91. Mountain beaver face in picture at Camera 4


Photo 92. Mountain beaver face in picture at Camera 4

Photo 93. Mountain beaver face in picture at Camera 4

Photo 94. Mountain beaver in picture at Camera 4

Photo 95. Steller's jay at Camera 4

Photo 96. Steller's jay at Camera 4

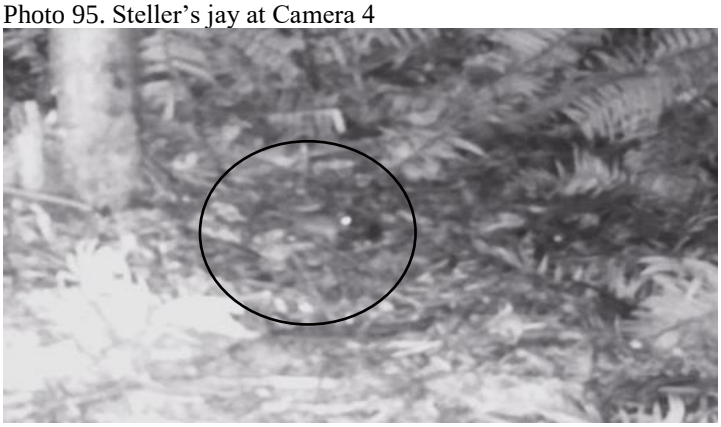


Photo 97. Small rodent at Camera 4, likely mouse

Photo 98. Song sparrow at Camera 4

Photo 99. Pileated Woodpecker feeding station at Camera 4


Photo 100. Pileated Woodpecker feeding station at Camera 4

Area E Invertebrates

Photo 101. Thatch ant mound in Area E

Photo 102. Thatch ants with lead shot present in Area E

Photo 103. Leaf miners infecting holly in Area E

Photo 104. Wasp near lead shot in Area E

Area E Vegetation

Photo 105. Some shriveled cascara leaves at Camera 4

Photo 106. Healthy cascara leaves at Camera 4

Photo 107. Health vegetation near Camera 4

Photo 108. New plant growth in Area E

Photo 109. Moss growing on soils at TC-2

Photo 110. Root depth at Camera 4

Photo 111. New plant growth present at TD-2

Photo. 112. Healthy Vegetation present at Flag A-4

Photo 113. Forest understory in Area E with dense vegetation

Photo 114. Dense vegetation at V17

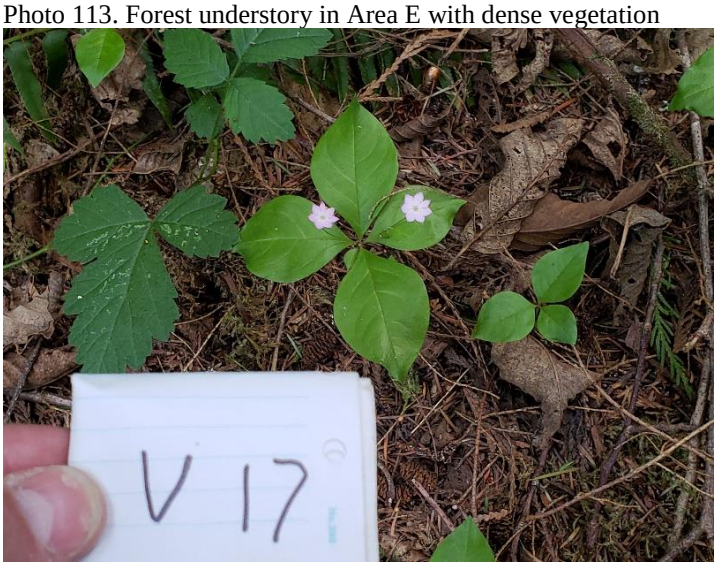


Photo 115. Forest understory in Area E with dense vegetation

Photo 116. Dense vegetation in Area E At V17

Photo 117. Forest understory in Area E with dense vegetation

Photo 118. Dense vegetation in Area E

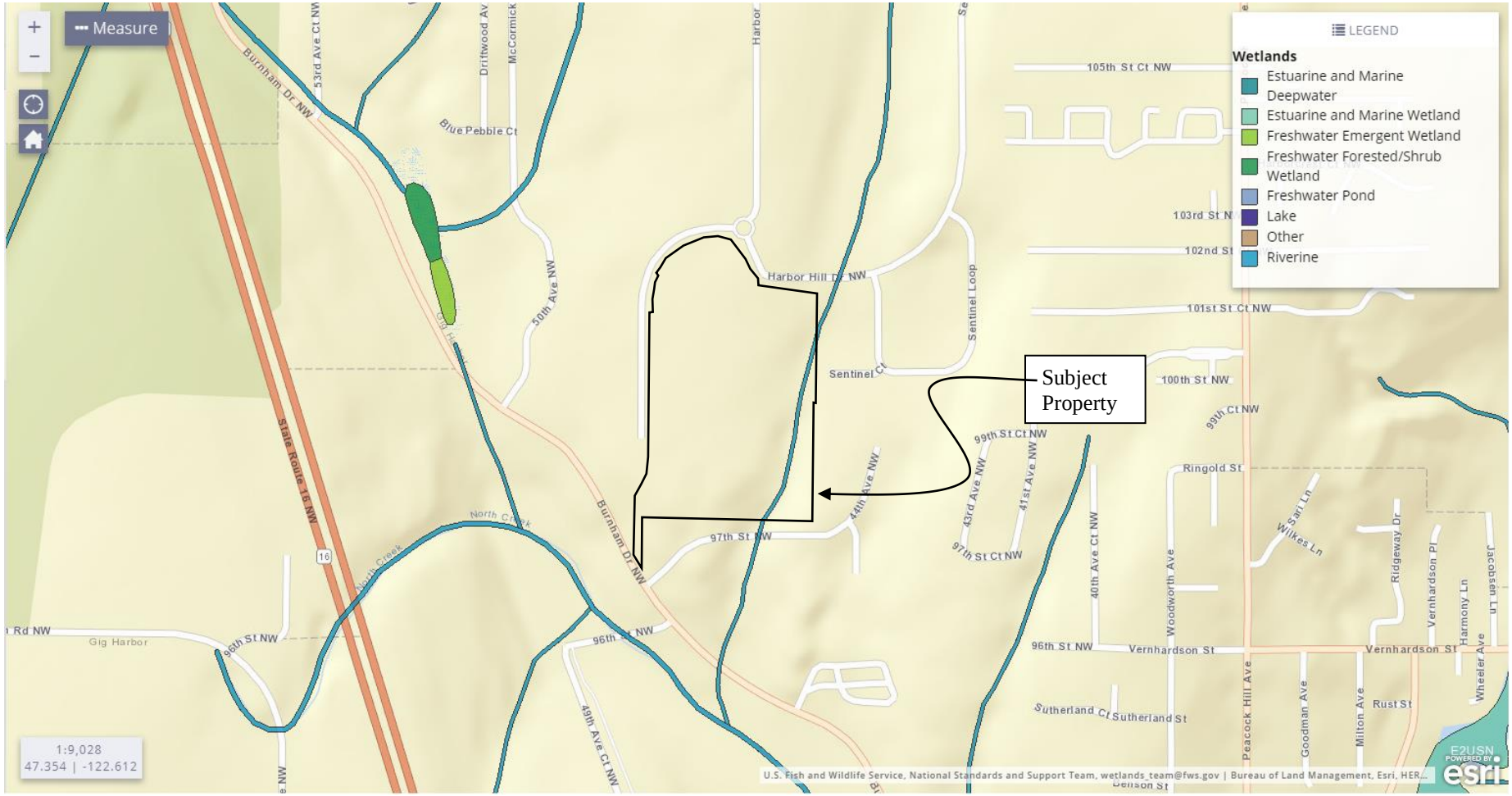
APPENDIX B

NRCS Soil Survey


Harstine gravelly ashy sandy loam, 6 to 15% slopes
Subject Property
102nd Street Ct Nw
101st Street Ct Nw
100th Street Ct Nw
44th Ave Nw
43rd Ave Nw
41st Ave Nw
87th St Nw
Burnham
18C
0
400 ft

APPENDIX C

USFWS National Wetlands Inventory (NWI) Database

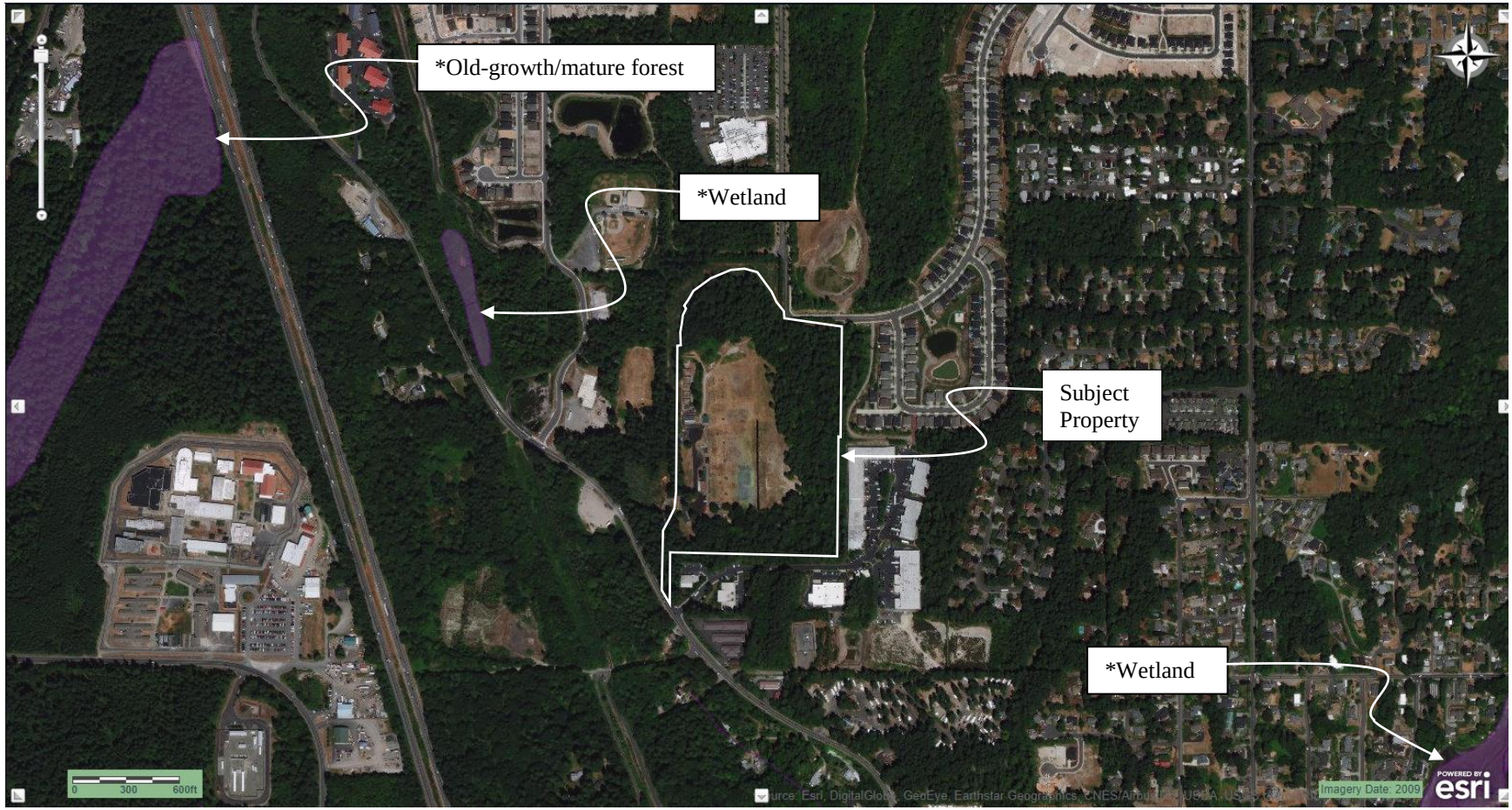

Measure
LEGEND
Wetlands
Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Other
Riverine
Subject Property
Burnham Dr NW
Harbor Hill Dr NW
Sentinel Loop
Sentinel Ct
105th St Ct NW
103rd St N
102nd St
101st St Ct NW
100th St NW
99th St Ct NW
97th St NW
97th St Ct NW
96th St NW
Vernhardson St
Ringold St
Gig Harbor
State Route 16 NW
1:9,028
47.354 | -122.612
U.S. Fish and Wildlife Service, National Standards and Support Team, wetlands_team@fws.gov | Bureau of Land Management, Esri, HER...

APPENDIX D

Washington Department of Fish and Wildlife (WDFW)

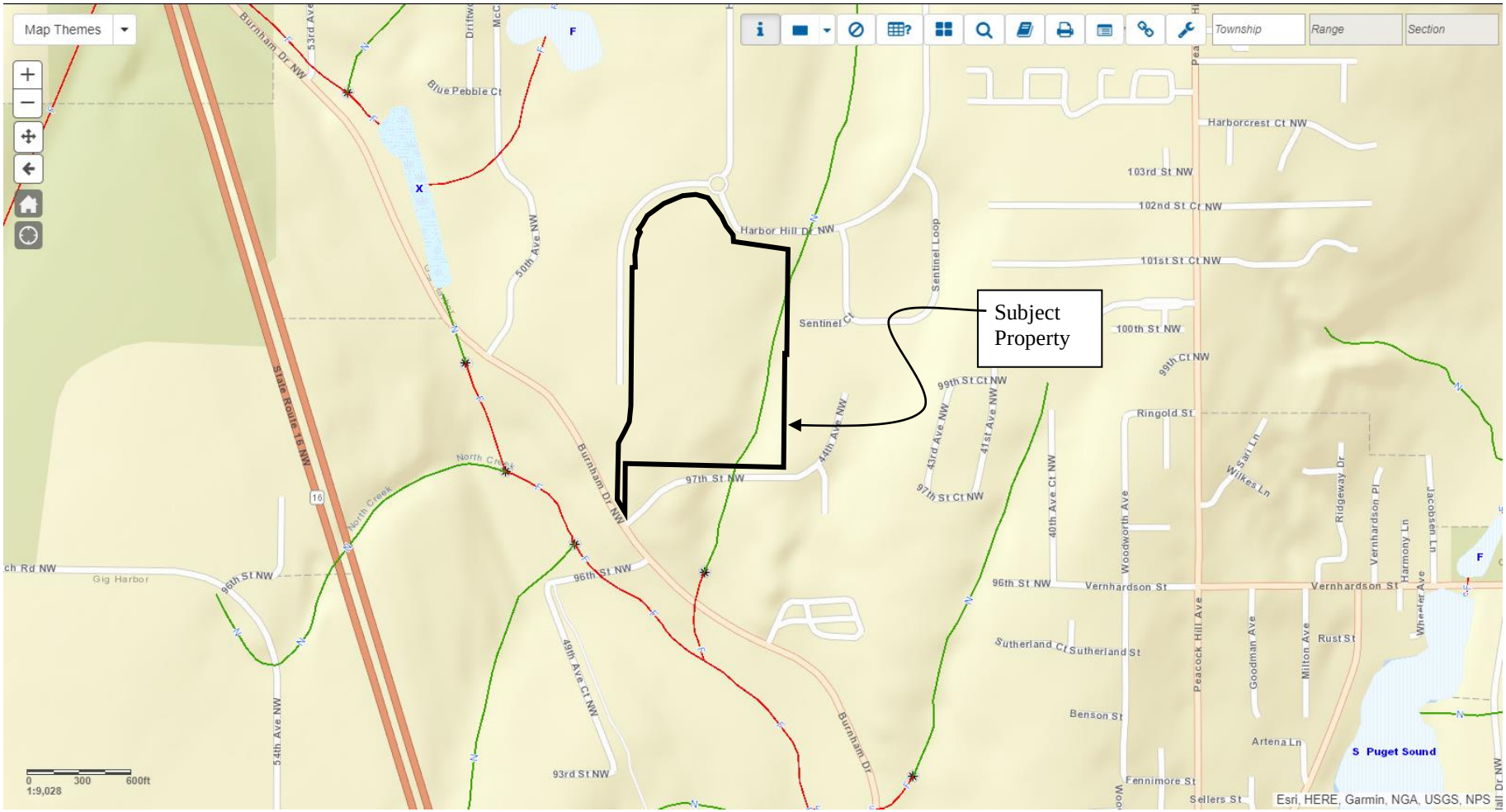
Priority Habitats and Species (PHS)

Database


*Old-growth/mature forest
*Wetland
Subject Property
*Wetland
0 300 600ft
Imagery Date: 2009
esri

APPENDIX E

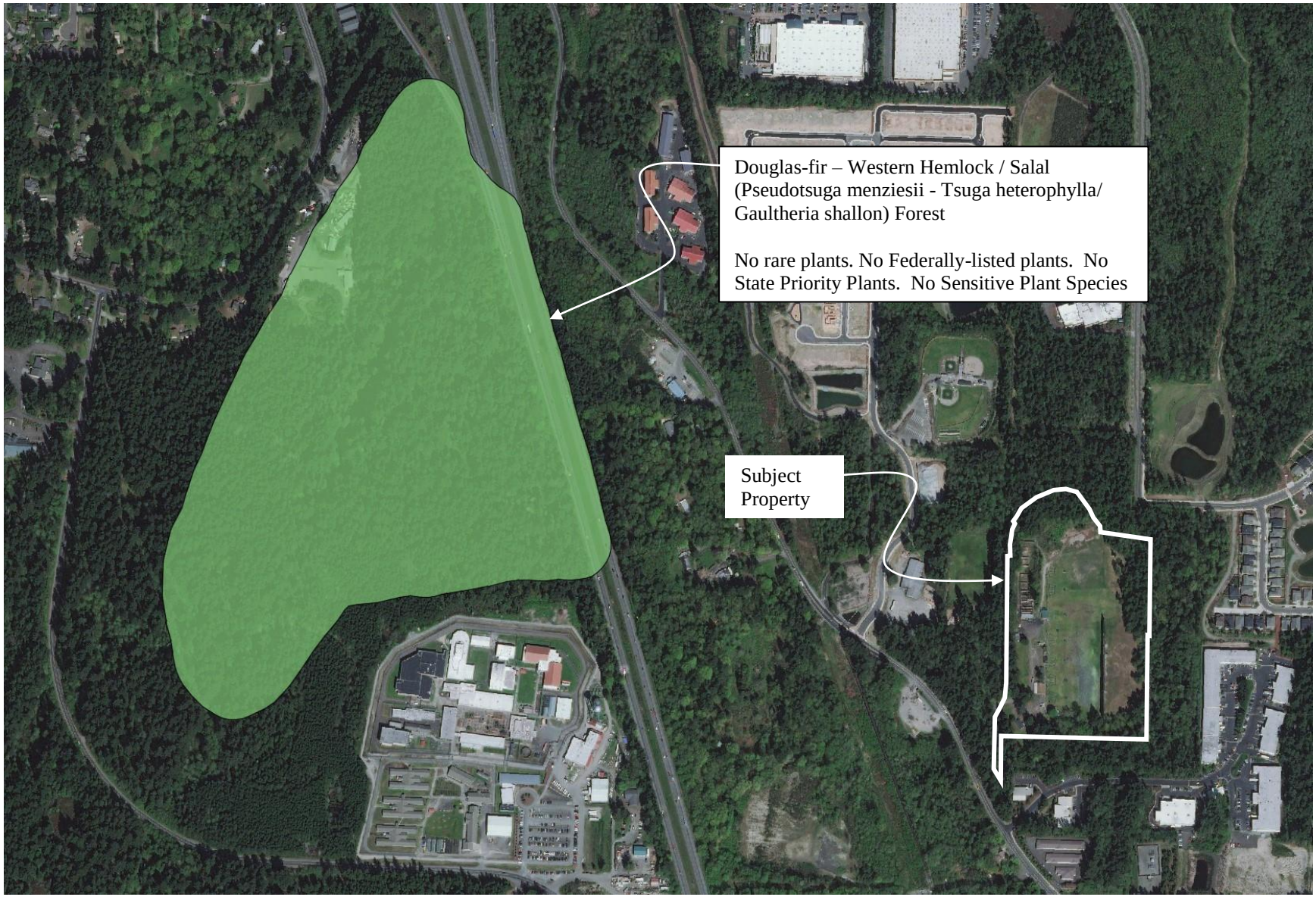
Washington DNR
Stream Typing Database


Map Themes
Township
Range
Section
Subject Property
Harborcrest Ct NW
103rd St NW
102nd St Ct NW
101st St Ct NW
100th St NW
99th Ct NW
99th St Ct NW
Harbor Hill Dr NW
Sentinel Loop
Sentinel Ct
Blue Pebble Ct
50th Ave NW
Burnham Dr NW
State Route 16 NW
97th St NW
97th St Ct NW
44th Ave NW
43rd Ave NW
41st Ave NW
40th Ave Ct NW
Ringold St
Sari Ln
Wilkes Ln
Ridgeway Dr
Vernhardson Pl
Harmony Ln
Jacobsen Ln
Woodworth Ave
North Creek
96th St NW
Gig Harbor
Vernhardson St
Sutherland Ct
Sutherland St
Peacock Hill Ave
Goodman Ave
Milton Ave
Rust St
Wheeler Ave
Benson St
Artena Ln
S Puget Sound
49th Ave Ct NW
54th Ave NW
93rd St NW
Fennimore St
Sellers St
0 300 600ft
1:9,028
Esri, HERE, Garmin, NGA, USGS, NPS

APPENDIX F

State Department of Natural Resources (DNR)

Natural Heritage Database


Douglas-fir – Western Hemlock / Salal (Pseudotsuga menziesii - Tsuga heterophylla/ Gaultheria shallon) Forest
No rare plants. No Federally-listed plants. No State Priority Plants. No Sensitive Plant Species
Subject Property

APPENDIX G

Soil Sample Lab Results

OnSite Environmental Inc. ID	Sample ID	Matrix	Antimony (ppm)	Adjusted Level (ppm)[1]	Arsenic (ppm)	Adjusted Level (ppm)[1]	Lead (ppm)	Adjusted Level (ppm)[1]
05-269-01	FB-52-0.5-052019	Soil	1,600	480	300	90	47,000	14,100
05-269-02	FB-520-0.5-05209	Soil	3,900	1,170	940	282	58,000	8,700
05-269-03	FB-52-1.0-052019	Soil	ND	ND	ND	ND	37	20.4
05-269-04	FB-520-1.0-052019	Soil	6.8	3.7	ND	ND	320	176
05-269-05	FB-52-2.0-052019	Soil	ND	ND	ND	ND	7.0	0.7
05-269-06	FB-520-2.0-052019	Soil	ND	ND	ND	ND	54	5.4
05-269-07	FB-52-3.0-052019	Soil	1,200	60	250	12.5	22,000	1,100
05-269-08	FB-520-3.0-052019	Soil	1,000	50	140	7	29,000	1,450
05-269-09	FB-51-0.5-052019	Soil	5,500	1,650	740	222	61,000	18,300
05-269-10	FB-51-1.0-052019	Soil	71	39.1	25	13.8	3,600	1,980
05-269-11	FB-51-2.0-052019	Soil	2,900	290	580	58	35,000	3,500
05-269-12	FB-51-3.0-052019	Soil	2,300	115	310	15.5	29,000	1,450
05-269-13	FB-50-0.5-052019	Soil	140	42	55	16.5	9,500	2,850
05-269-14	FB-50-1.0-052019	Soil	ND	ND	ND	ND	97	53.4
05-269-15	FB-50-2.0-052019	Soil	ND	ND	ND	ND	8.1	0.8
05-269-16	FB-50-3.0-052019	Soil	1,100	55	190	9.5	23,000	1,150

Sampling Point	Total Antimony[2]	Total Arsenic[2]	Total Lead[2]	
FB-50	97	26	4,054.2	
FB-51	2,094.1	309.3	25,230	
FB-52	540	391.5	15,221.1	

APPENDIX H

Vegetation Test Plot Data

Species		Invasive Weed	Contaminant Uptake	Comments
V1				
Scot's Broom	*Cytisus scoparius*	X		
Red fescue	*Alnus rubra*	X		
Himalayan blackberry	*Rubus armeniacus*	X		
Evergreen huckleberry	*Vaccinium ovatum*	X		
Trailing blackberry	*Rubus ursinus*			
Big-leaf maple	*Acer Macrophyllum*			
Douglas fir	*Pseudotsuga menziesii*			
V2				
Scot's broom	*Cytisus scoparius*	X		Dominated by Himalayan blackberry
Hairy cat's ear	*Hypochaeris radicata*	X		
Red fescue	*Festuca rubra*	X		
Sweet vernalgrass	*Anthoxanthum odoratum*	X		
Himalayan blackberry	*Rubus armeniacus*	X		
V3				
Western red cedar	*Thuja plicata*			
Evergreen huckleberry	*Vaccinium ovatum*			
Sword fern	*Polystichum munitum*			
Red alder	*Alnus rubra*			
European mountain ash	*Sorbus aucuparia*	X		
V4				
Trailing blackberry	*Rubus ursinus*			
Red alder	*Alnus rubra*			
Big-leaf maple	*Acer macrophyllum*			
Cascara	*Frangula purshiana*		Possible	Some leaves shriveled
Douglas fir	*Pseudotsuga menzeisii*			
Western red cedar	*Thuja plicata*			
English holly	*Ilex aquifolium*	X		
Himalayan blackberry	*Rubus armeniacus*	X		
Bracken fern	*Pteridium aquilinum*			

Species		Invasive Weed	Contaminant Uptake	Comments
V5				
Scot's Broom	*Cytisus scoparius*	X		
Red fescue	*Alnus rubra*	X		
Cat's Ear	*Hypochaeris radicata*	X		
Trailing blackberry	*Rubus ursinus*			
V6				
Trailing blackberry	*Rubus ursinus*			Dominated by Himalayan blackberry
Red alder	*Alnus rubra*			
Ocean spray	*Holodiscus discolor*			
Bedstraw	*Galium sp.*			
Nodding brome	*Bromus carinatus*			
Western red cedar	*Thuja plicata*			
English holly	*Ilex aquifolium*	X		
Himalayan blackberry	*Rubus armeniacus*	X		
Evergreen blackberry	*Rubus laciniatus*	X		
Bracken fern	*Pteridium aquilinum*			
V7				
Western red cedar	*Thuja plicata*			
Evergreen huckleberry	*Vaccinium ovatum*			
Sword fern	*Polystichum munitum*			
Red alder	*Alnus rubra*			
European mountain ash	*Sorbus aucuparia*	X		
V8				
Scot's broom	*Cytisus scoparius*	X		
Hairy cat's ear	*Hypochaeris radicata*	X		
Red fescue	*Festuca rubra*	X		
Sweet vernalgrass	*Anthoxanthum odoratum*	X		
V9				
Evergreen huckleberry	*Vaccinium ovatum*			
Douglas fir	*Pseudotsuga menziesii*			
Salal	*Gaultheria shallon*			
Bitter cherry	*Prunus emarginata*			
Western red cedar	*Thuja plicata*			
V10				
Red fescue	*Festuca rubra*	X		
Trailing blackberry	*Rubus ursinus*			
Himalayan blackberry	*Rubus armeniacus*	X		
Hairy Cat's ear	*Hypochaeris radicata*	X		
Scot's broom	*Cytisus scoparius*	X		
Evergreen blackberry	*Rubus laciniatus*	X		
Common bentgrass	*Agrostis stolonifera*	X		
Sweet vernalgrass	*Anthoxanthum odoratum*	X		

Species		Invasive Weed	Contaminant Uptake	Comments
V11				
Salal	*Gaultheria shallon*			Spotted towhee, downy woodpecker, black-capped chickadee
Western red cedar	*Thuja plicata*			
Evergreen huckleberry	*Vaccinium ovatum*			
Douglas fir	*Pseudotsuga menziesii*			
Bracken fern	*Pteridium aquilinum*			
Big-leaf maple	*Acer macrophyllum*			
12				
Bracken fern	*Pteridium aquilinum*			Deer scats & Thatch ants
Sword fern	*Polystichum munitum*			
Salal	Gaultheria shallon			
Evergreen huckleberry	*Vaccinium ovatum*			
Western red cedar	*Thuja plicata*			
Red alder	*Alnus rubra*			
Bitter cherry	*Prunus emarginata*			
European mountain ash	Sorbus aucuparia	X		
Red huckleberry	*Vaccinium parvifolium*			
Pacific madrone	*Arbutus menziesii*			
V13				
Salal	*Gaultheria shallon*			Some dried leaves
Sword fern	*Polystichum munitum*			
English holly	*Ilex aquifolium*	X		
Red alder	*Alnus rubra*			
Big-leaf maple	*Acer macrophyllum*			
Western red cedar	*Thuja plicata*			
Trailing blackberry	*Rubus ursinus*			
Salmonberry	*Rubus spectabilis*			
V14				
Sword fern	*Polystichum munitum*			
Western red cedar	*Thuja plicata*			
Evergreen huckleberry	*Vaccinium ovatum*			
Salal	Gaultheria shallon			
Himalayan blackberry	*Rubus armeniacus*	X		
Red alder	*Alnus rubra*			
Bitter cherry	*Prunus emarginata*			
Douglas fir	*Pseudotsuga menziesii*			
V15				
Western red cedar	*Thuja plicata*			Two (2) spotted towhee, house sparrow, robin, dark-eyed junco
Douglas fir	*Pseudotsuga menziesii*			
Red huckleberry	*Vaccinium parvifolium*			
Evergreen huckleberry	*Vaccinium ovatum*			

Species		Invasive weed	Contaminant Uptake	Comments
V16				
Western hemlock	*Tsuga heterophylla*			Pileated woodpecker feeding station at snag (**Appendix A, Photos 11-12**)
Devil's club	*Oplopanax horridus*			
Sword fern	*Polystichum munitum*			
Trailing blackberry	*Rubus ursinus*			
Red huckleberry	*Vaccinium parvifolium*			
Raspberry	*Rubus idaeus*			
Evergreen huckleberry	*Vaccinium ovatum*			
Big-leaf maple	*Acer macrophyllum*			
Western red cedar	*Thuja plicata*			
V17				
Evergreen huckleberry	*Vaccinium ovatum*			Near stream
Bracken fern	*Pteridium aquilinum*			
Western hemlock	*Tsuga heterophylla*			
Spreading wood fern	*Dryopteris expansa*			
Sword fern	*Polystichum munitum*			
Red alder	*Alnus rubra*			
Western red cedar	*Thuja plicata*			
Salmonberry	*Rubus spectabilis*			
Red elderberry	*Sambucus racemosa*			
V18				
Evergreen huckleberry	*Vaccinium ovatum*			Near stream
Bracken fern	*Pteridium aquilinum*			
Sword fern	*Polystichum munitum*			
Big-leaf maple	*Acer macrophyllum*			
Cascara	*Frangula purshiana*			
Red alder	*Alnus rubra*			
Western red cedar	*Thuja plicata*			
Salmonberry	*Rubus spectabilis*			
Red elderberry	*Sambucus racemosa*			
Western hemlock	*Tsuga heterophylla*			
V19				
Trailing blackberry	*Rubus ursinus*			
Red alder	*Alnus rubra*			
Big-leaf maple	*Acer macrophyllum*			
Cascara	*Frangula purshiana*		Possible	Some leaves shriveled
Western red cedar	*Thuja plicata*			
English holly	*Ilex aquifolium*	X		
Himalayan blackberry	*Rubus armeniacus*	X		
Bracken fern	*Pteridium aquilinum*			

Species		Invasive weed	Contaminant Uptake	Comments
Camera 1				
Red alder	*Alnus rubra*			Pileated woodpecker documented by Camera 1 (**Appendix A, Photos 12-24**)
Western hemlock	*Tsuga heterophylla*			
Evergreen huckleberry	*Vaccinium ovatum*			
Salal	*Gaultheria shallon*			
Trailing blackberry	*Rubus ursinus*			
Big-leaf maple	*Acer macrophyllum*			
Red elderberry	*Sambucus racemosa*			
Camera 2				
Sword fern	*Polystichum munitum*			
Bracken fern	*Pteridium aquilinum*			
Evergreen huckleberry	*Vaccinium ovatum*			
Salal	*Gaultheria shallon*			
Red alder	*Alnus rubra*			
Western hemlock	*Tsuga heterophylla*			
Cascara	*Frangula purshiana*			
Big-leaf maple	*Acer macrophyllum*			
Beaked hazelnut	*Corylus cornuta*			
Ocean spray	*Holodiscus discolor*			
Camera 3				
Red alder	*Alnus rubra*			Pileated woodpecker feeding station at snag (**Appendix A, Photos 69 & 70**)
Western hemlock	*Tsuga heterophylla*			
Douglas fir	*Pseudotsuga menziesii*			
Sword fern	*Polystichum munitum*			
Red huckleberry	*Vaccinium parvifolium*			
English holly	*Ilex aquifolium*	X		
Evergreen huckleberry	*Vaccinium ovatum*			
Oregon grape	*Mahonia nervosa*			
Camera 4				
Evergreen huckleberry	*Vaccinium ovatum*			Pileated woodpecker feeding station at snag (**Appendix A, Photos 99 & 100**)
Sword fern	*Polystichum munitum*			
Red alder	*Alnus rubra*			
Bitter cherry	*Prunus emarginata*			
Douglas fir	*Pseudotsuga menziesii*			
Big-leaf maple	Acer macrophyllum			
Bracken fern	*Pteridium aquilinum*			
English holly	*Ilex aquifolium*	X		
Himalayan blackberry	*Rubus armeniacus*	X		