Gunshy Manor
Redmond, Washington

PRELIMINARY ASSESSMENT

Task Order, Subtask:
TO-0525-003

March 2020

Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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List of Abbreviations and Acronyms

µg/kg	micrograms per kilogram
AMSL	above mean sea level
bgs	below ground surface
CRQL	Contract Required Quantitation Limit
DOH	Washington State Department of Health
E & E	Ecology and Environment, Inc., member of WSP
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
GWMA	Groundwater Management Area
I-90	Interstate 90
IDW	investigation-derived waste
MTCA	Model Toxics Control Act Method
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QA	quality assurance
QC	quality control
Qob	Olympia Gravels
Qtb	Transitional Beds
Qva	Vashon Advance Outwash
Qvr	Vashon Recessional Outwash
Qvt	Vashon Till

List of Abbreviations and Acronyms (cont.)

Qyal	Alluvium
RSL	Regional Screening Level
SQAP	Sampling and Quality Assurance Plan
SQL	Sample Quantitation Limit
START	Superfund Technical Assessment and Response Team
SVOC	semivolatile organic compound
TAL	Target Analyte List
TDL	target distance limit
TEQ	Toxicity Equivalent Quotient
TMEQ	Toxicity Mobility Equivalent Quotient
TPH	total petroleum hydrocarbons
TPH-Dx	total petroleum hydrocarbons as diesel
TPH-Gx	total petroleum hydrocarbons as gasoline
USACE	United States Army Corps of Engineers
VOC	volatile organic compound
WAC	Washington Administrative Code

1 Introduction

Ecology and Environment, Inc., member of WSP (hereafter referred to as E & E), was tasked by the United States Environmental Protection Agency (EPA) to provide technical support for completion of a Preliminary Assessment (PA) at the Gunshy Manor, located in Redmond, Washington (Figure 1-1). E & E completed PA activities under Task Order, Subtask Number TO-0525-003, issued under EPA, Region 10, Superfund Technical Assessment and Response Team (START)-IV Contract Number EP-S7-13-07.

The specific goals identified by the EPA for the Gunshy Manor PA are:

- Determine the potential threat to public health or the environment posed by the site;
- Determine the potential for a release of hazardous constituents into the environment; and
- Determine the potential for placement of the site on the National Priorities List.

Completion of the PA included reviewing existing site information, collecting receptor information within the range of site influence, determining regional characteristics, conducting a site visit, and collecting subsurface soil and groundwater samples.

This document includes a discussion of background site information (Section 2); a discussion of potential sources, sample locations, and sample results (Section 3); a discussion of migration/exposure pathways, potential targets (Section 4); a summary of site conditions and a discussion of conclusions (Section 5); and a list of pertinent references (Section 6).

2 Site Background

2.1 Site Location

Site Name:	Gunshy Manor
SEMS ID Number	WAN001010129
Site Address:	20005 NE Union Hill Road Redmond, Washington 98053
Latitude:	47.6699278° North
Longitude:	-122.0751028° West
Legal Description:	Township 25 North, Range 6 East, Section 8
County:	King
Congressional District:	8
Site Owner/Contact:	William C. Nelson Jr,. Trustee Estate of Barbara Nelson 16508 Northeast 79th Street Redmond, Washington 98052

2.2 Site Description

Gunshy Manor is the name given to a proposed new residential subdivison on a historic farm in unincorporated King County, Washington, approximately 4 miles east of the Redmond, Washington. The site is accessed via 196th Avenue Northeast. The property consists of seven parcels (082506-9012, -9067, -9013, -9102, -9103, -9104, and -9105), which total approximately 126 acres (Figure 2-1) that currently contain several large fields, a single-family home, a guest house, a log cabin, and several outbuildings related to former farming operations, including barns, sheds, etc. (King County 2019a; ESM 2018). The fields make up the western and central portions of the site, while the northern and southern portions and eastern edge of the site are forested. Topography on the western portion of the site is relatively flat, with elevations increasing near the center of the site and rising steeply on the eastern boundary. Residential properties and developments surround the site to the north, east, and west. Evans Creek runs along a portion of the site's western border and the Evans Creek Natural Area, a large wetland complex, is located south of the western portion of the site (Figure 2-2).

Community members residing near the site have expressed a concern that imported fill material applied to a portion of parcel 082506-9012 known as "Thompson Field" may contain hazardous substances (Figure 2-2) and that, if present, these substances may have impacted local groundwater and may represent a cause for concern regarding proposed residential redevelopment plans (Members of Community 2018).

2.3 Ownership History

In 1890, James Stryker filed a 160-acre land patent claiming the land that includes the subject property and retained ownership of the property until January 1915, when he deeded it to the Dexter Horton Trust and Savings Bank. In June 1926, Dexter Horton National Bank deeded the subject property to Ames Ogden. Mr. Ogden later conveyed the property to W.F. Coleman by deed, recorded August 8, 1940. The guardian of Mr. Coleman's estate conveyed the property to William F. Niemi by deed, recorded December 1, 1952. William and Barbara Nelson purchased the property from William and Louise Niemi on February 4, 1957, and this was the first of the parcels the Nelson family acquired that now make up Gunshy Manor site (ESA 2018). Additional parcels were later purchased, including the parcel known as the Thompson Field in 1975; Double Wide Pasture in 2001; a parcel located south of the Thompson Field in 2011; and, more recently, in 2018, the Evans parcel located at the north end of the site (Foster Pepper 2018). The property is currently under the ownership of the Estate of Barbra J. Nelson.

2.4 Historic and Current Site Operations

The Nelsons operated the Gunshy Manor Farm, where they raised and bred horses and, for some time, cattle. The farm had approximately 40 to 50 acres devoted to horses; however, much of the breeding was conducted off-site at other farms. In addition to horse breeding, Gunshy Manor Farm grew hay and pasture grass (ESA 2018).

In order to illuminate the history of the site features' development, historic aerial photographs and topographic maps were reviewed. The following sections discuss these reviews.

2.4.1 Historic Aerial Photographs

Historic aerial photographs that cover all parcels included in the Gunshy Manor site were reviewed for the years 1943, 1965, 1969, 1977, 1980, 1990, 2006, 2009, 2013, and 2017 (Appendix A). Features at the site over these years are described below:

- **1943** – A house and outbuildings are in view in the northwest corner of the western portion of the site along 196th Avenue Southeast, as are fields. What appears to be a second home is in view in the northern portion of the site.
- **1965** – Trees have been cleared from a large portion of the east-central part of the site.
- **1969** – No new changes to the site are evident.
- **1977** – Additional land has been cleared on the western portion of the site near 196th Avenue Southeast, including land in the Thompson Field area. Two new structures are in view near the center of the site.

- **1980** – Surface conditions appear to be much the same as in 1977.
- **1990** – Additional land has been cleared in the Thompson Field area of the site.
- **2006, 2009, 2013, and 2017** – Surface conditions appear to be much the same as in 1990.

2.4.2 Historic Topographic Maps

Historic topographic maps that cover the site were reviewed for the years 1895, 1897, 1950, 1968, 1973, and 2014 (Appendix B). Features at the site over these years are described below:

- **1895 and 1897** – The outline of the site boundaries on these maps has shifted somewhat to the northeast. Elevation lines at the site are in view, as are two structures, one in the northwest portion of the western side of the site along 196th Avenue Southeast and one in the north-central portion of the site.
- **1950, 1968, and 1973** – A clearing in the northwest corner of the western portion of the site and a smaller clearing near the house in the north-central portion of the site are indicated. The remainder of the site is forested. The map from 1968 shows an access road leading from the northern structure and heading south. The map from 1973 shows two new structures on either side of this road near the center of the site.
- **2014** – Most of the western portion of the site has been cleared, as has a large portion of the center of the site.

2.5 Previous Investigations

The Seattle District United States Army Corps of Engineers (USACE) performed an inspection of the Gunshy Manor property on March 20, 1984. The inspection report, dated April 3, 1984, indicates that approximately 5,500 cubic yards of earthen fill material was placed in wetlands adjacent to Evans Creek in an effort to create pastureland, and that the work was being completed without a USACE permit (USACE 1984). A letter from the USACE dated April 27, 1984, indicates that an inspection of activities along Evans Creek revealed fill material, approximately 4 feet in depth, placed on wetlands adjacent to waters of the United States, and this work was considered a violation of federal law. On March 26, 1986, the USACE notified the property owners that removal of a portion of the unauthorized fill material was in the public interest (USACE 1986a). A portion of the fill material was removed by the property owners, who were notified on November 5, 1986, by the USACE and November 7, 1986, by King County that their fill removal efforts were satisfactory and no further action was anticipated (USACE 1986b; King County 1986).

On February 18, 2015, staff from the EPA, USACE, the National Oceanic and Atmospheric Administration (NOAA), and the Washington State Department of

Ecology (Ecology) conducted a site visit and collected soil samples at the site; however, details regarding the soil samples collected could not be located. This site visit was conducted in response to heavy earth-moving equipment being used to place fill material into wetlands adjacent to the southern portion of the Thompson Field. This work was conducted on or before January 2010, was not authorized by permit, and was in violation of the Clean Water Act. As a result of the violation, the property owner entered an Administrative Order on Consent, which outlined restoration and mitigation requirements (EPA 2016).

2.6 START Site Visit

On April 11, 2019, a site visit of the Gunshy Manor site was conducted. Site visit attendees included:

- Clifford Schmitt (Farallon Consulting);
- Eric LaBrie (ESM Consulting Engineers LLC);
- Monica Tonel (EPA); and
- Jeff Fetters, (E & E).

Upon arriving at site the, EPA and E & E met with Mr. Schmitt and Mr. La Brie, consultants for the property owner to discuss the purpose of the PA and view the site. The primary focus of the site visit was to view the area currently known as the Thompson Field (Figure 2-2), the subject area of the PA petition submitted to the EPA.

Mr. La Brie indicated that the property in which the Gunshy Manor is located was purchased by Bill and Barbara Nelson in 1957, at which time operations began, raising both cattle and horses. Cattle operations cased sometime in the 1980s. The land comprising the Thompson Field was not purchased until sometime in 1975 and, at that time, the property was primarily forested; trees were cleared sometime after 1975. Mr. Schmitt and Mr. La Brie indicated that material from the Interstate 90 (I-90) tunnel project was brought to the Gunshy Manor property for use as fill in leveling the Thompson Field. This project began in late 1982/early 1983, to complete a large diameter tunnel through the Mount Baker Ridge area, north of the original Mount Baker Tunnel which was completed in 1940. Enough fill material was placed in Thompson Field to raise its elevation by approximately 4 feet; however, the total volume of fill material brought to the site was not known.

After viewing the Thompson Field area, the group viewed the western portion of the property where an irrigation well (Ecology identification number BCB399) is located approximately 1,300 feet east of Thompson Field. Based on this well’s construction log, it was drilled to a depth of 210 feet below ground surface (bgs) and has a static water level of approximately 8 feet bgs. This well is not in use and has had a cap welded to the casing. Mr. La Brie indicated that no other wells were located on the property and that water is supplied to the site (primary residence, guest house, and log cabin) via a spring box located on the northeast portion of the property. This spring also provides water to a pond, which has been used for fire suppression, located near the primary residence.

Before concluding the site visit, the proposed development of the property was briefly discussed. Mr. La Brie and Mr. Schmitt noted that water would be supplied to the development from the Union Hill Water Association. It was also noted that no development was planned for the Thompson Field area.

3 START Preliminary Assessment Sampling Event

The PA field sampling event was conducted at the Gunshy Manor site on two separate days, October 23, 2019, and November 6, 2019. A total of 17 subsurface soil samples and 18 water samples (including quality assurance/quality control [QA/QC] samples) were collected for the PA. Sample were collected in accordance with an approved Sampling and Quality Assurance Plan (SQAP) developed prior to field sampling (E & E 2019). Any deviations to the SQAP are discussed below and presented in a sample plan alteration form included as Appendix C. A list of all samples collected for laboratory analysis under this PA and their associated sample location coordinates are provided in Table 3-1. All samples collected as part of this PA were submitted for off-site fixed laboratory analysis of total petroleum hydrocarbons (TPH) as diesel (TPH-Dx); TPH as gasoline (TPH-Gx); semivolatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs); Target Analyte List (TAL) metals, including mercury; polychlorinated biphenyls (PCBs); and volatile organic compounds (VOCs). Groundwater samples were also were analyzed for dissolved TAL metals based on achievable groundwater quality measurements (specifically turbidity) (E & E 2019). Groundwater samples analyzed for dissolved TAL metals are distinguished by a "-D" at the end of the sample location identification number. Copies of QA/QC and data validation memoranda are provided in Appendix D. Photographic documentation of PA field activities is included as Appendix E.

3.1 Analytical Results Evaluation Criteria

Analytical results presented in the summary tables show all analytes detected above laboratory detection limits in bold type. Analytical results indicating significant concentrations (sources samples) or elevated concentrations (target samples) of contaminants in project samples with respect to background concentrations are shown underlined and in bold type. For the purposes of this investigation, significant/elevated concentrations include those concentrations that are:

- Equal to or greater than the sample's Contract Required Quantitation Limit (CRQL) or the Sample Quantitation Limit (SQL) when a non-Contract Laboratory Program laboratory was used; and

- Equal to or greater than the background sample's CRQL or SQL when the background concentration was below detection limits; or

- At least three times greater than the background concentration when the background concentration equals or exceeds the detection limits.

The analytical summary tables present all detected compounds, but only those detected analytes meeting the significant/elevated concentration criteria are discussed in the report text. All detected concentrations are discussed for the background samples. When samples were diluted for re-analysis at a laboratory, the dilution results were considered for evaluation and are provided in the tables.

In addition to site-specific background samples, samples collected at the Gunshy Manor site were also compared to risk-based screening levels presented in Table 3-2. These levels include the most current Washington State Model Toxics Control Act Method (MTCA) A and Method B cleanup levels, as well as the May 2019 EPA Regional Screening Levels (RSLs) in a residential setting. Groundwater was compared to the most current RSL tap water value. Soil samples were also compared to Washington State background metals concentrations (Ecology 1994). Additionally, as per MTCA, PAHs were compared to cleanup values for benzo(a)pyrene using calculated Toxicity Equivalent Concentration (TEQ) and Toxicity Mobility Equivalent Concentration (TMEQ) values. Calculation were performed using one-half the method detection limit for non-detect analytes (Ecology 2015). Analytes detected at elevated concentrations, as outlined above and that exceeded the most restrictive regulatory standard and, for metals, the 90^{th} percentile background concentration, have been shaded in the analytical summary tables.

The analytes aluminum, calcium, iron, magnesium, potassium, and sodium are common earth crust elements. Based on EPA Region 10 policy, these common earth crust elements will not be discussed in this report.

3.2 Background Samples

Background samples were collected for each of the naturally occurring media from which samples were collected. These media were subsurface soil and groundwater. Results for the appropriate background samples are shown in the analytical results summary tables for comparison against remaining sample results.

3.2.1 Background Samples

3.2.1.1 Sample Location

Background samples were collected from one boring (BK01) placed in an area southeast of the Thompson Field in an effort to compare potential fill material to native soils (Figure 3-1). Samples were collected from intervals similar to those in which source samples were collected. A total of three background subsurface soil samples and two background groundwater samples (one total and one dissolved metals sample) were collected from boring BK01.

Sample BK01SB01 was collected from 2 to 3.5 feet bgs, and consisted of gray to tan, silt to silty sand. Sample BK01SB02 was collected from 4.5 to 6 feet bgs and consisted of light brown to tan-colored silty sand. Lastly, sample BK01SB03 was collected from 8 to 10 feet bgs and consisted of light brown to tan-colored silty sand.

Groundwater samples BK01GW and BK01GW-D were collected from a temporary well screen placed at approximately 12 to 16 feet bgs. Water quality parameters generally stabilized in the boring, with the exception of turbidity. The lowest achievable turbidity in borehole BK01 was 43.9 nephelometric turbidity units (NTUs). Due to the high turbidity, a sample for dissolved metals analysis was collected (BK01GW-D) using a 0.45 micron filter, in addition to the sample collected for total metals analysis (BK01GW).

3.2.1.2 Background Subsurface Soil Sample Results

Background subsurface soil sample results are presented in Table 3-3. Analytical results indicate the following:

- **BK01SB01 (2 to 3.5 feet bgs):** A total of 10 TAL metals (arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc) and one SVOC (dimethylphthalate) were detected above CRQLs. PAH TEQ and TMEQ values of 0.34 micrograms per kilogram (µg/kg) and 0.72 µg/kg, respectively, were calculated for BK01SB01.

- **BK01SB02 (4.5 to 6 feet bgs):** A total of 10 TAL metals (arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc) were detected above CRQLs.

- **BK01SB03 (8 to 10 feet bgs):** A total of 10 TAL metals (arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc) and one SVOC (dimethylphthalate) were detected above CRQLs. PAH TEQ and TMEQ values of 0.36 µg/kg and 0.75 µg/kg, respectively, were calculated for BK01SB03.

3.2.1.3 Background Groundwater Sample Results

Background groundwater sample results are presented in Tables 3-4. Analytical results indicate the following:

- **BK01GW:** Aside from common earth crust metals, manganese was the only analyte detected above CRQLs.

- **BK01GW-D:** Aside from common earth crust metals, no other analytes were detected above CRQLs.

3.3 Source Characteristics

It is believed that one source of fill material placed in the Thompson Field in the 1980s was from the I-90 expansion project that began in late 1982/early 1983, to complete a large diameter tunnel through the Mount Baker Ridge area, north of the original Mount Baker Tunnel completed in 1940. However, no documents linking the fill material from the I-90 expansion project to the site were located. Some, but not all, of the fill material was later removed; however, the amount removed is not known. Additional fill, discussed in the EPA Administrative Order on Consent for the wetlands mitigation, was placed in the Thompson Field sometime before 2010. The amount and source of this additional fill is not known. Anecdotal information also suggests that demolition debris from apartment buildings and gas stations was used as fill material at the site at various times from approximately 1957 through the 1980s. However, as noted in Section 2.3, the Thompson Field was not acquired by the Nelson Family until 1975 and historic aerial photographs indicate that this area was forested until at least 1969 (Foster Pepper 2018; King County 2018). The net volume of fill placed on site is not known.

The potential contaminants of concern at the site associated with the fill material are TPH-Dx; TPH-Gx; SVOCs, including PAHs; TAL metals, including mercury; PCBs; and VOCs.

3.3.1 Source Sample Locations

Subsurface soil samples were collected from a total of six borings (BH01 through BH06) located within the Thompson Field to assist in determining whether subsurface soil contamination was present, and if present, to what extent. To accomplish this, a total of 14 subsurface soil samples were collected from the six borings. Borings were advanced utilizing a direct-push Geoprobe™ sampling rig (borings BH01, BH02, and BH03) or using hand augers when the ground surface was too soft, due to surface soils saturated with water, to allow Geoprobe™ access (borings BH04, BH05, and BH06). Borehole locations are presented on Figure 3-1. Borehole logs are presented in Appendix F.

Borehole BH01 was drilled to a depth of 12 feet bgs on the western edge of the Thompson Field. Soils encountered in borings BH01 varied, consisting of silty sand to well-graded gravel. Notable materials observed in this boring included red brick-like material from 1.6 to 3 feet bgs, and a woody debris present from 4 to 4.7 feet bgs. A light diesel-like odor was noted between 5.3 and 6 feet bgs. Groundwater was encountered while drilling at a depth of 9.64 feet bgs. Following drilling activities, a temporary 4-foot well screen was placed in the boring from 8 to 12 feet bgs. A static water level measurement of 4.53 feet bgs was later measured, several hours after the temporarily well screen had been installed in the borehole.

BH02 was drilled on the southern edge of the Thompson Field to a depth of 16 feet bgs. Soils ranged from well-graded sands with silt to well-graded gravel above 4.7 feet bgs. Peat was observed from 4.7 to 9.9 feet bgs where it transitioned to clay to a depth of 11 feet bgs. Well-graded sand with silt and well-graded gravel with silt were observed below 11 beet bgs, to the bottom of the boring at 16 feet bgs. Following drilling activities, a temporary 4-foot well screen was placed in the boring from 12 to 16 feet bgs, as no signs of groundwater were observed during drilling within 12 feet of the ground surface. A static water level measurement of 3.21 feet bgs was later measured, several hours after the temporarily well screen had been installed in the borehole.

BH03 was also located at the southern edge of the Thompson Field and was drilled to a depth of 12 feet bgs. Silt was observed from the ground surface to 0.6 feet bgs, followed by well-graded gravel with silt to 3 feet bgs. Peat was observed beginning at 4.5 feet bgs, similar to the depth in which it was observed in BH02, and continued to 6.7 feet bgs. Silt was encountered from 8 feet bgs to 12 feet bgs. Following drilling activities, a temporary 4-foot well screen was placed in the boring from 12 to 16 feet bgs, as no signs of groundwater were observed during drilling within 12 feet of the ground surface. A static water level of 15.06 feet bgs was later measured in this boring.

Borings BH04 and BH06 were advanced in the northern portion of the Thompson Field, and BH05 near the center. BH04 and BH05 were both advanced to 2.5 feet bgs and BH06 was advanced to 3 feet bgs using hand augers. The soils encountered in each of these borings consisted of silty loam atop silty gravel. Brick-like material was observed in both BH05 and BH06 from 1.5 to 2.5 feet bgs and 0.6 to 1.5 feet bgs, respectively. Pieces of white plastic were also noted in BH05 from 0.6 to 1.5 feet bgs. Multiple attempts to advance borings to greater depths were made at each location, generally within 1 to 2 feet of each other. These attempts were all met with refusal.

3.3.2 Source Sample Results

3.3.2.1 BH01

- **BH01SB01 (1.5 to 3 feet bgs):** Thirteen SVOCs (acenaphthene, anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; phenanthrene; and pyrene) were detected at significant concentrations with respect to background concentrations. A PAH TEQ of 13.36 µg/kg and PAH TMEQ of 29.83 µg/kg were calculated for this sample, both of which are significant when compared to the calculated background values.

- **BH01SB02 (4.5 to 6 feet bgs):** One TAL metal (lead) and 17 SVOCs (2-methylnaphthalene; acenaphthene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; dibenzo(a,h)anthracene; dimethylphthalate; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; naphthalene; phenanthrene; and pyrene), and three VOCs (2-butanone; acetone; and m,p-xylene) were detected at significant concentrations with respect to background concentrations. A PAH TEQ of 225.8 µg/kg and PAH TMEQ of 489.4 µg/kg were calculated for this sample, both of which are significant when compared to the calculated background values. In addition to being significant with respect to background concentrations, the detected concentrations of benzo(a)pyrene also exceeded its most restrictive risk-based value. The calculated PAH TEQ and TMEQ values also exceeded their most restrictive risk-based values.

- **BH01SB03 (8 to 10 feet bgs):** Acetone was the only analyte to be detected at significant concentrations with respect to background concentrations in this sample.

3.3.2.2 BH02

- **BH02SB01 (0.5 to 2 feet bgs):** Fifteen SVOCs (2-methylnaphthalene; acenaphthene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; naphthalene; phenanthrene; and pyrene), and one VOC (acetone), and motor oil-range organics were detected at significant concentrations with respect to background concentrations. A PAH TEQ of 14.25 µg/kg and PAH TMEQ of 30.23 µg/kg were calculated for this sample, both of which are significant when compared to the calculated background values.

- **BH02SB02 (4 to 5 feet bgs):** One TAL metal (lead) and one VOC (acetone) were detected at significant concentrations with respect to background concentrations.

- **BH02SB03 (8 to 10 feet bgs):** Two TAL metals (arsenic and selenium) were detected at significant concentrations with respect to background concentrations. In addition to being significant with respect to background concentrations, the detected concentrations of both arsenic and selenium also exceeded their most restrictive risk-based value.

3.3.2.3 BH03

- **BH03SB01 (1.5 to 3 feet bgs):** Eleven SVOCs (2-methylnaphthalene; acenaphthene; anthracene; benzo(a)anthracene; benzo(b)fluoranthene; chrysene; fluoranthene; fluorene; naphthalene; phenanthrene; and pyrene), and one VOC (acetone) were detected at significant concentrations with respect to background concentrations. A PAH TEQ of 1.56 µg/kg and PAH TMEQ of 1.87 µg/kg were calculated for this sample, both of which are significant when compared to the calculated background values.

- **BH03SB02 (4.5 to 6 feet bgs):** One TAL metal (lead), one SVOC (dimethylphalate), and three VOCs (2-butanone, acetone, and methylene chloride) were detected at significant concentrations with respect to background concentrations. In addition to being significant with respect to background concentrations, the detected concentrations of methylene chloride also exceeded its most restrictive risk-based value.

3.3.2.4 BH04

- **BH04SB01 (0.5 to 1 feet bgs):** No analytes were detected at elevated concentrations with respect to background concentrations.

- **BH04SB02 (2 to 2.5 feet bgs):** Lead was the only analyte detected at significant concentrations with respect to background concentrations.

3.3.2.5 BH05

- **BH05SB01 (1.5 to 2 feet bgs):** Two TAL metals (lead and mercury) and 16 SVOCs (2-methylnaphthalene; acenaphthene; acenaphthylene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; dibenzo(a,h)anthracene; fluoranthene; indeno(1,2,3-cd)pyrene; naphthalene; phenanthrene; and pyrene) were detected at significant concentrations with respect to background concentrations. A PAH TEQ of 75.82 µg/kg and PAH TMEQ of 164.38 µg/kg were calculated for this sample, both of which are significant when compared to the calculated background values.

  In addition to being significant with respect to background concentrations, the detected concentration of mercury also exceeded its most restrictive risk-based value.

- **BH05SB02 (1.5 to 2 feet bgs):** Due to an abundance of brick material at this location and depth, a second sample was collected from 1.5 to 2 feet bgs. One TAL metal (lead), 11 SVOCs (anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; fluoranthene; indeno(1,2,3-cd)pyrene; phenanthrene; and pyrene), and motor oil range organics were detected at significant concentrations with respect to background concentrations. A PAH TEQ of 25.26 µg/kg and PAH TMEQ of 56.67 µg/kg were calculated for this sample, both of which are significant when compared to the calculated background values.

3.3.2.6 BH06

- **BH06SB01 (1 to 1.75 feet bgs):** One TAL metal (lead) and six SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene, and pyrene) were detected at significant concentrations with respect to background concentrations. A PAH TEQ of 5.82 µg/kg and PAH TMEQ of 13.78 µg/kg were calculated for this sample, both of which are significant when compared to the calculated background values.

- **BH06SB02 (2.5 to 3 feet bgs):** Pyrene was the only analyte detected at significant concentrations with respect to background concentrations.

3.4 Target Samples

The primary source of drinking water near the site is from Group A and B community water systems, as well as domestic wells. Contamination present at the site may have impacted local groundwater.

3.4.1 Target Sample Locations

Groundwater was sampled from two of the six borings (BH01 and BH02) advanced within Thompson Field. Groundwater was not present in sufficient quantities to collect a groundwater sample from BH03. Two groundwater samples (one for total metals and one for dissolved metals) were collected from each of these borings. Groundwater samples BH01GW and BH01GW-D were collected from boring BH01, and samples BH02GW and BH02GW-D were collected from BH02. In general, water quality parameters stabilized with the exception of turbidity. The lowest achievable turbidity in BH01 was 37.0 NTUs after approximately 2.5 hours of purging. As per the SQAP, a dissolved metals aliquot would not be required if a turbidity of less than 50 NTUs could be achieved; however, because this was the first sample collected, the field team was not certain if a turbidity of less than 50 NTUs could be achieved in the remaining on-site borings. For this reason, a dissolved metals aliquot was collected from all sampled borings. The lowest achievable turbidity in BH02 was 77.1 NTUs.

Three groundwater samples were collected from a privately owned parcel located approximately 1,800 feet northwest of Thompson Field. Sample MW01GW was collected from an approximate 1-inch diameter polyvinyl chloride monitoring well screened from 10 to 20 feet bgs after nearly 2 hours of purging. In general, water quality parameters stabilized over this time period; however, the final turbidity reading at this location was 38.2 NTUs. Samples MW02GW and MW02GW-D were collected on the same parcel, from an unused domestic drinking water well. Details regarding the construction of this well and its dates of service could not be located; however, the well was constructed with an approximate 6-inch diameter iron casing. MW02 was purged for approximately 1 hour, during which time, water quality parameters general stabilized; however, the final turbidity achieved was 90.8 NTUs. The water from this location was orange in color.

Two additional groundwater samples (MW355 and MW356) were collected from pre-existing, permanent 2-inch-diameter groundwater monitoring wells located northwest of the site at Author Johnson Park (owned by the City of Redmond). Sample MW355 was collected from monitoring well MW355, located on the east side of Evans Creek. This well is screened from 8 to 18 feet bgs. Sample MW356 was collected from monitoring well MW356, located on the west side of Evans Creek. This well is screened from 9.8 to 19.8 feet bgs. At both locations, water quality parameters stabilized within 30 minutes of purging, with a final turbidity of 0 NTUs being achieved.

3.4.2 Target Sample Results

3.4.2.1 On-site Groundwater Sample Results

- **BH01GW:** Arsenic and manganese were the only analytes detected at elevated concentrations with respect to background concentrations in the groundwater sample collected from boring BH01.

  In addition to being significant with respect to background concentrations, the detected concentration of arsenic also exceeded its most restrictive risk-based value.

- **BH01GW-D:** Manganese was the only analyte detected at elevated concentrations with respect to background concentrations in the dissolved metals aliquot collected from boring BH01.

- **BH02GW:** Arsenic and manganese were the only analytes detected at elevated concentrations with respect to background concentrations in the groundwater sample collected from boring BH02.

  In addition to being significant with respect to background concentrations, the detected concentration of arsenic also exceeded its most restrictive risk-based value.

- **BH02GW-D:** Arsenic and manganese were the only analytes detected at elevated concentrations with respect to background concentrations in the dissolved metals aliquot collected from boring BH02.

  In addition to being elevated with respect to background concentrations, the detected concentration of arsenic also exceeded its most restrictive risk-based value.

3.4.2.2 Off-site Groundwater Sample Results

- **MW01GW:** No analytes were detected at elevated concentrations with respect to background concentrations.

- **MW02GW:** Manganese was the only analyte detected at an elevated concentration with respect to background concentrations.

- **MW02GW-D:** Manganese was the only analyte detected at an elevated concentration with respect to background concentrations.

- **MW355:** Manganese was the only analyte detected at an elevated concentration with respect to background concentrations. Manganese also exceeded the EPA RSL in this sample.

- **MW356:** Arsenic and manganese were the only analytes detected at elevated concentrations with respect to background concentrations. In addition to being elevated with respect to background concentrations, the detected concentration of both arsenic and manganese also exceeded their most restrictive risk-based values. However, as mentioned in Section 3.4.1, this sample was collected on the west side of Evans Creek, which may represent a hydrological divide in the shallow groundwater between this sample location and the site.

3.5 Investigation-Derived Waste

Wastewater from decontamination operations and temporary boring purge water were contained in a single 55-gallon drum stored at an off-site location. This drum was picked up by Chemical Waste Management Inc. on December 23, 2019, and delivered to their facility in Arlington Oregon on January 1, 2020, for disposal as non-hazardous material. Documentation related to investigation-derived waste (IDW) disposal is provided in Appendix G.

4 Groundwater Migration Pathway

The following sections describe the migration/exposure pathways and potential targets within the site's range of influence (Figure 4-1).

4.1 Environmental Setting

The Gunshy Manor site is situated within the Puget Lowland physiographic province, a broad, low-lying region bounded by the Olympic Mountains on the west and the Cascade Range on the east. The region's proximity to the Puget Sound and, more so, the Pacific Ocean, supports a maritime climate regime, characterized by moderate temperatures and long-duration precipitation events. Approximately 75% of the annual precipitation occurs from October through March, during which time prevailing winds are from the southwest. Less than 5% of the annual precipitation falls between July and September, and prevailing winds are generally from the northwest. The average annual precipitation for the surrounding area is 42 inches (Redmond 1999).

The topography of the western portion of the property is generally flat, while the central portion gently slopes to the west. Moving east, the property is marked by moderate to steep slopes. Surface water generally flows west across the site to the Evans Creek Natural Area, a large wetland complex that is part of the larger Bear Creek Basin, through which the main stem of Evans Creek flows. Martin Creek, a tributary to Evans Creek, flows west across the northern tip of the site prior to joining Evans Creek. Five other unnamed creeks are located on the property and drain into Evans Creek, which is known to support runs of anadromous fish (Talasaea 2018). These fish include Puget Sound Chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), sockeye (*Oncorhynchus nerka*), steelhead (*Oncorhynchus mykiss*), and coastal cutthroat trout (*Oncorhynchus clarki*) (Talasaea 2018). The *Evans Creek Natural Area Site Management Guidelines*, published in April 2005 by King County, identifies Evans Creek as the home to substantial populations of Chinook, coho, and sockeye salmon (King County 2005).

The southwest portion of the Thompson Field adjacent to the Evans Creek Natural Area is also classified as wetland and is located within a 100-year floodplain (Talasaea 2018; King County 2005).

Soils in the western portion of the site, in the area of the Thompson Field, consist of Norma sandy loam and Seattle Muck. These soils form in depressions and originate from alluvium and the decomposition of organic material (e.g., sedges, rushes, and grasses), respectively, and are very poorly drained. Near the center and northern portions of the property, Everett very gravelly sandy loam and Indianola loamy sand are present. Both these soils form in convex areas from sandy, and sandy and gravelly, glacial outwash and are somewhat excessively drained. Alderwood and Kitsap soils, whose parent material consists of Vashon glacial till and silty lacustrine sediments, respectively, make up the eastern slope of the site and are moderately well-drained (USDA 1973, 2019).

4.2 Groundwater Migration Pathway

The target distance limit (TDL) for the groundwater migration pathway is a 4-mile radius that extends from the source(s) at the site. Figure 4-1 depicts the groundwater 4-mile TDL.

4.2.1 Geologic Setting

The Puget Lowland was formed by a series of glacial advances and retreats during the Pleistocene epoch. The Puget Lobe of the Cordilleran Ice Sheet advanced into the Puget Lowland at least twice, perhaps four times, during the Pleistocene Epoch depositing. The most recent and final of these glaciations, referred to as the Vashon Stade of the Fraser Glaciation (Vashon), began about 15,000 years ago, when the climate cooled. By 12,500 years ago, the ice had retreated from the Puget Lowland. The ice reached a maximum thickness of 3,000 feet and an elevation of approximately 5,000 feet above mean sea level in King County. This most recent glaciation, however, left behind a characteristic sequence of glacial drift approximately 1,000 feet thick and was the most significant in terms of geologic influence on the development of groundwater in the region. (Redmond 1997, 1999; USGS 1999)

4.2.2 Near Site Geology

The Gunshy Manor site lies within the Redmond-Bear Creek Valley Groundwater Management Area (GWMA), which covers an area of approximately 50 square miles, bounded by the Snohomish County line on the north, the Bear Creek basin divide on the east, Lake Sammamish on the south, and the Sammamish River on the west. Three basic rock types—tertiary or older sedimentary and crystalline bedrock; semi-consolidated to unconsolidated fluvial, glacial, and marine Pleistocene sediments; and recent alluvium—are found the GWMA, with bedrock being found beneath 400 to 1,200 feet of Pleistocene sediments and recent alluvium. (Redmond 1997, 1999)

Seven individual geologic units have been identified in the GWMA. The units, from youngest to oldest, are as follows:

- Alluvium;
- Vashon Recessional Outwash;
- Vashon Glacial Till;
- Vashon Advance Outwash;

- Transitional Beds;
- Olympia Gravel; and
- Older Undifferentiated Deposits.

A description of the six youngest units is provided below:

Alluvium (Qyal) – Post-glacial depositional and erosional processes have modified the glacial landforms and former stream and river valleys. Today, alluvial sediments are found primarily in the Evans Creek and Bear Creek valleys and in the downtown portion of the city of Redmond, north of Lake Sammamish. The alluvial deposits are composed of organic-rich fine sand, silt, and clay. Their maximum thickness is approximately 40 feet. (Redmond 1997, 1999)

Vashon Recessional Outwash (Qvr) – The Vashon Recessional Outwash consists primarily of permeable, well-drained, stratified sand and gravel with some silt and clay deposited from meltwater emanating from the receding glacier. The Qvr, together with the alluvium described above, make up the unconfined water table aquifer. Locally, the Qvr contains silt, or sand and gravel in a matrix of silt. In areas where the sand and gravel has relatively low silt content, the Qvr facilitates the movement of water, and where a significant amount of silt occurs, the Qvr retards the movement of water. In the GWMA, Qvr deposits range up to 90 feet in thickness and are generally discontinuous, occurring as isolated surface deposits in the Evans Creek Valley. (Redmond 1997, 1999; USGS 1999)

Vashon Till (Qvt) – Commonly known as "hardpan" due to its compacted nature, the Qvt consists of non-sorted clay, silt, sand, gravel, and boulders deposited directly by glacial ice and compacted by the overburden pressure of the overriding Vashon glacier. The Qvt is present at the surface over much of the higher elevations of the GWMA. Due to its dense matrix of silt and clay, the Qvt does not transmit water readily and acts as an aquitard, forming a perched water table and swampy areas lying above it. Thicknesses range up to 100 feet and appear to be thickest in the northern portion of the GWMA. (Redmond 1997, 1999; USGS 1999)

Vashon Advance Outwash (Qva) – The Qva outwash deposits occur below the Qvt and consist of stratified clean sand and gravel with some thin clay beds deposited from melt waters along the perimeter of the Vashon ice sheet as the glacier advanced south into the Puget Sound region. The thickness of this unit ranges up to 90 feet in depth and comprises one of the thickest and most extensive aquifers in the area. Deposits of Qva are exposed on the upper portions of the steep slopes bordering Evans Creek. In the study area, Qva generally underlies the Vashon Till, except where it has been eroded away by creeks. (Redmond 1997, 1999; USGS 1999)

Transitional Beds (Qtb) – The Transitional Beds are made up of glacial and non-glacial lacustrine deposits that consist mainly of laminated or thin-bedded to thick-bedded blocky jointed clay, silt, and fine sand, with minor lenses of sand, gravel, peat, and wood. This unit was formed from sediments deposited in shallow lakes and wetlands created by the advancing Vashon Glacier, which covered much of the Puget Lowland between the Olympia Interglacial period and the early Fraser Glaciation. This unit constitutes a major regional aquitard between the Qva aquifer and the underlying deep sand and gravel aquifer of the Olympia Gravel. Where the Qtb consists of a substantial thickness of clay and silt, it serves as a protective layer, retarding the vertical movement of groundwater. The Qtb range up to 180 feet thick and are visible at the surface on the slopes along Evans Creek. (Redmond 1997, 1999; USGS 1999)

Olympia Gravels (Qob) – The Olympia Gravels consist of stratified fine to very coarse sand and gravel with minor thin silt and clay beds deposited by streams. This unit ranges up to 135 feet in thickness and is visible in the GWMA on the lower slopes bordering Lake Sammamish and the Evans Creek Valley. Elsewhere, the Olympia Gravels underlie the transitional beds at elevations ranging from 200 feet above mean sea level to 200 feet below mean sea level. (Redmond 1997, 1999; USGS 1999)

4.2.3 Aquifer System

At least four major water-bearing zones are present in the GWMA: the Alluvial Aquifer, Sea Level Aquifer, Local Upland Aquifer, and Regional Aquifer. The Alluvial Aquifer includes recent and older alluvium deposited in and along stream channels. The Sea Level Aquifer consists of the Qob and some older undifferentiated deposits found at elevations near mean sea level. The Local Upland Aquifers are made up of discontinuous Qva deposits and permeable zones within the Qvt. The Regional Aquifers are composed of the older undifferentiated glacial and interglacial deposits. (Redmond 1997, 1999)

The aquifers described above can be divided into shallow, intermediate, and deep groundwater systems. The Alluvial Aquifer and portions of the shallow Local Upland Aquifer make up the shallow groundwater system. The intermediate groundwater system occurs in the Sea Level Aquifer and deeper portions of the Local Upland Aquifer. Lastly, the deep groundwater system includes the Regional Aquifers. For the purposes of this SI, only the shallow Alluvial Aquifer will be further discussed. (Redmond 1997, 1999)

The Alluvial Aquifer appear restricted to alluvial deposits along creeks, including Evans Creek, in the GWMA. These deposits consist of sand, gravel, and silt deposited in and along stream channels as alluvium, alluvial fan deposits, and older alluvium. The Alluvial Aquifer is proximate to the Local Upland Aquifer and the Sea Level Aquifer to either side and underneath, respectively. However, aquitards generally separate the three aquifers. The aquitards Qvt and Qtb separate the Local Upland Aquifer from the Alluvial Aquifer; nevertheless, spring, interflow, and upward discharge from the Local Upland Aquifer may be responsible for considerable, but indirect, recharge to the Alluvial Aquifer. Generally, the Qtb separates the Sea Level Aquifer from the overlying Alluvial Aquifer, except possibly in lower Evans Creek and near Lake Sammamish. The overall thickness of the entire Qyal/Qvr deposit is typically about 70 feet, but only an average of 30 to 40 feet is highly transmissive. (Redmond 1997, 1999)

Within the GWMA, groundwater recharge occurs through precipitation, overland flow, and infiltration from surface water bodies. It is estimated that the Alluvial Aquifer receives 26 inches of recharge per year, with an average precipitation of 42 inches per year reported; recharge also occurs via discharge from the Local Uplands Aquifer. The Alluvial Aquifer is typically under unconfined or semi-confined conditions. In general, groundwater in the Alluvial Aquifer flows toward local discharge points along valley streams, in the Sammamish River, and in Lake Sammamish. Groundwater elevations in the Alluvial Aquifer near Evans Creek fall from approximately 120 feet above mean sea level in the eastern portion of the GWMA to 60 feet above mean sea level near the city of Redmond. Horizontal gradients in the GWMA range from 0.004 feet/foot from north to south and 0.01 feet/foot from east to west. (Redmond 1997, 1999)

4.2.4 Drinking Water Targets

Groundwater within the 4-mile TDL is used for municipal and domestic drinking water purposes. The Washington State Department of Health (DOH) maintains records of all active public water systems. Public water systems, regardless of group designation, indicate the total number of wells in the system, number of connections, and total population served. A search of the DOH Sentry Internet database and the King County Source Water Assessment Program database revealed the presence of 13 Group A community water systems and 79 Group B community water systems within the 4-mile TDL (DOH 2019; King County 2019b). Table 4-1 present the groundwater populations by distance ring.

The Washington Administrative Code (WAC) defines the Group A and B designations for community water systems as follows:

- **Group A:** (WAC 246-290) Group A water systems are those with 15 or more service connections, regardless of the number of people on the system; or systems serving an average of 25 or more people per day for 60 or more days within a calendar year, regardless of the number of service connections. Group A water systems do not include systems serving fewer than 15 single-family residences, regardless of the number of people on the system.

- **Group B:** (WAC 246-291) Group B water systems serve less than 15 residential connections and serve less than 25 people per day; or serve 25 or more people per day fewer than 60 days per year. Group B water systems are public water systems that do not meet the definition of a Group A water system.

The City of Redmond utilizes both surface water and groundwater sources for drinking water purposes. Residences located on the west side of Lake

Sammamish and the Sammamish River, as well as those who live in Redmond Ridge and Trilogy developments, are supplied drinking water from the Tolt River Watershed, located outside the TDL in the Cascade Mountains. Residences located east of Lake Sammamish and the Sammamish River are supplied groundwater from five wells located within the TDL. Four of these wells are located between 1 to 2 miles from the site and the other is located between 2 to 3 miles from the site. All City of Redmond supply wells produce from the Alluvial Aquifer, with well depths ranging from 41 to 86 feet bgs (DOH 2019). Groundwater from these wells is blended prior to distribution, and no one well provides more than 40 percent of the total water supply to the system. The total population of 68,675 people are served from these wells. Based on this information, it is estimated that each source serves a population of 13,735 people (68,675 people/5 sources = 13,735 people per source). A total of 54,940 (13,735 people x 3 wells) people are served by the four well located between 1 to 2 miles from the site and a total of 13,735 people are served by the well located between 2 to 3 miles from the site. Well head protections zones are in place for these wells.

The Union Hill Water Association provides drinking water to residences from three groundwater wells with depths ranging from 134 to 251 feet in depth, located between 2 to 3 miles from the site (DOH 2019). A total of population of 4,958 people are served from these wells. The Northeast Sammamish Sewer and Water District supplies drinking water to a total population of 8,161 residences from seven groundwater sources, three of which are located between 2 to 3 miles of the site. Groundwater from these wells is blended prior to distribution, and no one well provides more than 40 percent of the total water supply to the system. Based on this information, it is estimated that each source serves a population of 1,166 people (8,161 people/7 sources = 1,165.86 people per source). The groundwater sources in this system are, therefore, estimated to serve a population of 3,498 people (1,166 people x 3 groundwater sources = 3,498). Well head protections zones are in place for these wells. Lastly, the Dawn Breaker Water Association provides drinking water to a total population of 168 residences from two groundwater sources located between 3 to 4 miles from the site.

A total of 79 Group B water systems are located within the TDL, serving a total population of 821 people.

Domestic well logs are maintained by Ecology. A search of the internet database revealed the presence of 483 domestic wells (Ecology 2019). The number of people served by these wells is not known; therefore, the average number of persons per household (2.45) for King County, Washington, was used to determine well populations (USCB 2019). Based on this information, it is estimated that approximately 1,183 people are served by domestic groundwater wells (i.e., 483 wells x 2.45 people per well). The number of persons served by groundwater wells by distance ring is presented in Table 4-1.

Arsenic and manganese were the only analytes detected at elevated concentrations with respect to background concentrations in any of the groundwater samples collected for this PA. Elevated arsenic concentrations were limited to the two on-site borings (BH01 and BH02) and the sample collected from monitoring well MW356, which, as mentioned in Section 3.2.1, is located on the west side of Evans Creek, a possible hydrological divide in the shallow groundwater between this monitoring well and the site. Subsurface soil sample results discussed in Section 3.3.2 show that arsenic was detected in only one subsurface soil sample (BH02SB03) at a significant concentration. While it is possible that the elevated concentrations of arsenic observed in the groundwater samples are a result of on-site sources, it is more likely that the observed arsenic concentration are a result of naturally occurring conditions.

Manganese was detected at elevated concentrations with respect to background concentrations in all but one groundwater sample; however, manganese was not detected at significant concentrations in any of the on-site subsurface soil samples; thus it is not considered to be attributable to sources at the site.

5 Summary and Conclusions

Gunshy Manor is located in unincorporated King County, Washington, approximately 4 miles east of the Redmond, Washington. The property is comprised of seven parcels, which total approximately 126 acres, and is mostly undeveloped. Historically, the site was operated as the Gunshy Manor Farm where horses and, for some time, cattle, were raised and bred. Hay and pasture grass were also grown at the site. Several outbuildings still exist on the property related to former farm operations. Residential properties and developments surround the site to the north, east, and west. Evans Creek flows to the west of the site and the Evans Creek Natural Area, a large wetland complex, is located south and southwest of the site.

The site has been the subject to two previous investigations. The first of these investigations was conducted by the USACE in 1984 in relation to approximately 5,500 cubic yards of earthen fill material being placed in wetlands adjacent to Evans Creek in an effort to create pastureland in the Thompson Field. It is believed that this fill material originated from the I-90 expansion project that began in late 1982/early 1983. In 1986, at the direction of the USACE, a portion of the fill was removed, resulting in an no further action determination given to the property owner by both the USACE and King County. Later in 2015, the EPA, USACE, NOAA, and Ecology conducted a site visit in response to heavy earth-moving equipment being used to place fill material into wetlands adjacent to the southern portion of Thompson Field. The amount and source of this additional fill is not known. This work was conducted on or before January 2010, was not authorized by permit, and was in violation of the Clean Water Act. As a result of the violation, the property owner entered an Administrative Order on Consent, which outlined restoration and mitigation requirements. Anecdotal information also suggests that demolition debris from apartment buildings and gas stations was used as fill material at the site at various times from approximately 1957 through the 1980s; though this information has not been confirmed.

Groundwater within the 4-mile TDL is used for municipal and domestic drinking water purposes. Approximately 79,302 residents within the 4-mile TDL utilize groundwater for drinking water from a combination of Group A and B wells, and domestic wells.

The PA sampling event was conducted at the Gunshy Manor site on October 23, 2019 and November 6, 2019. A total of 17 subsurface soil samples were collected from six borings advanced in Thompson Field using a combination of direct-push drilling and hand augering. Eleven groundwater samples were also collected, six from three of the on-site borings (inclusive of the background boring), three from two off-site monitoring wells, and two from an unused drinking water well. All samples collected as part of this PA were submitted for off-site fixed laboratory analysis of TPH-Dx; TPH-Gx; SVOCs, including PAHs; TAL metals, including mercury; PCBs; and VOCs.

Subsurface soil sample results show that four TAL metals (arsenic, lead, mercury, and selenium), 18 SVOCs (2-methylnaphthalene; acenaphthene; acenaphthylene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene; benzo(k)fluoranthene; chrysene; dibenzo(a,h)anthracene; dimethylphthalate; fluoranthene; fluorene; indeno(1,2,3-cd)pyrene; naphthalene; phenanthrene; and pyrene), motor oil range organics, and four VOCs (2-butanone; acetone; methylene chloride; and m,p-xylene) were detected at significant concentrations with respect to background concentrations in one or more subsurface soil samples collected from Thompson Field. Three of four TAL metals listed above (arsenic, mercury, and selenium) each exceeded their lowest risk-based screening levels and/or 90^{th} percentile background concentration in three separate samples. Benzo(a)pyrene and the calculated PAH TEQ and TMEQ exceeded their lowest risk-based screening levels in one sample, as did methylene chloride.

Groundwater sample results show that arsenic and manganese were the only two analytes detected at elevated concentrations with respect to background concentrations. Although arsenic was detected in one subsurface soil sample, the detected concentrations observed in the groundwater samples likely are a result of naturally occurring conditions, rather than from sources at site. Likewise, as manganese was not detected in any of the subsurface soil samples, the concentrations observed in the groundwater samples are also likely a result of naturally occurring condition, rather than the site. When compared to risk-based screening levels, arsenic and manganese were the only analytes to exceed a risk-based screening level, with arsenic exceeding in three groundwater samples analyzed for total TAL metals and one groundwater sample analyzed for dissolved TAL metals, and manganese exceeding in two samples analyzed for total TAL metals.

6 References

Ecology and Environment, Inc., member of WSP (E & E). 2019. *Gunshy Manor Sampling and Quality Assurance Plan, Redmond, Washington*. T27-009. October 2019.

ESA. 2018. *Gunshy Manor Cabin Demolition Project, King County, Washington, Cultural Resources Assessment*. February 2018.

ESM Consulting Engineers LLC. (ESM). 2018. *Gunshy Manor Preliminary Technical Information Report*. April 26, 2018.

Foster Pepper PLLC (Foster Pepper). 2018. Letter to Kim Claussen RE: Preliminary Plat Application No. PLAT18-0007 (Gunshy Manor). October 12, 2018.

King County. 1986. Letter from Randy Sandin to William Nelson RE: Grading Permit #2767-17. November 7, 1986.

_____. 2005. *Evans Creek Natural Area Site Management Guidelines*. April 2005.

_____. 2018. Letter to Kim Claussen RE: Comments on Permit Application #: PLATI 8-0007; Project Name: Gunshy Manor; Parcel No.:082506-9012, all (082506) 9013, 9067, 9102, 9103, 9104, 9105; Project Location: on the east side of 196th Ave. NE (aka Red Brick Road); Applicant: The Estate of Barbara .1. Nelson. July 17, 2017.

_____. 2019a. Parcel Viewer web site. https://gismaps.kingcounty.gov/parcelviewer2/. Accessed April 2019.

_____. 2019b. Source Water Assessment Program web site. https://fortress.wa.gov/doh/swap/index.html. Accessed April 2019.

Redmond - Bear Creek Valley Ground Water Management Committee (Redmond). 1997. Wellhead Protection Report. Prepared by: Parametrix, INC., Pacific Groundwater Group, Carolyn Browne Associates. October 30, 1997.

_____. 1999. *Supplement to the Redmond - Bear Creek Valley Ground Water Management Plan: Area Characterization.* February 1999.

Talasaea Consultants, Inc. (Talasaea). 2018. *Critical Areas Report and Conceptual Mitigation Plan Gushy Manor Preliminary Plat King County, Washington*. February 28, 2018.

United States Army Corps of Engineers (USACE). 1984. Field Investigation report, Reference No. 071-0YB-4-00379. March 20, 1984.

_____. 1986a. Letter from Roger F. Yankoupe to William Nelson. Reference Number 071-0YB-4-009379. March 28, 1986.

_____. 1986b. Letter to William Nelson. Reference Number 071-0YB-4-009379. November 5, 1986.

United States Census Bureau (USCB). 2019. Quick Facts, King County, Washington web site. https://www.census.gov/quickfacts/fact/table/kingcountywashington,WA/PST045218. Accessed May 2019.

United States Department of Agriculture (USDA). 1973. *Soil Survey, King County Area, Washington.* November 1973.

_____. 2019. Web Soil Survey. https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Accessed April 2019.

United States Environmental Protection Agency (EPA). 2016. Administrative Order on Consent. Docket Number CWA-10-2016-0087. June 1, 2016.

United States Geological Survey (USGS). 1999. *Conceptual Model and Numerical Simulation of the Ground-Water-Flow System in the Unconsolidated Sediments of Thurston County, Washington*. Water-Resources Investigations Report 99-4165.

Washington State Department of Ecology (Ecology). 1994. Natural Background Soil Metals Concentrations in Washington State. 94-115. October 1994. https://fortress.wa.gov/ecy/publications/SummaryPages/94115.html. Accessed February 2020.

_____. 2015. *Evaluating the Human Health Toxicity of Carcinogenic PAHs (cPAHs) Using Toxicity Equivalency Factors (TEFs)*. Publication No. 15-09-049. April 20, 2015.

_____. 2019. Well log internet search. https://fortress.wa.gov/ecy/wellconstruction/map/wclswebMap/textsearch.aspx?newsearch=true. Accessed May 2019.

Washington State Department of Health (DOH). 2019. Office of Drinking Water, water system internet search. https://fortress.wa.gov/doh/eh/portal/odw/si/FindWaterSystem.aspx. Accessed May 2019.

Tables

Table 3-1 Sample Analysis Summary

Station Location	EPA Regional Tracking Number	CLP Sample Number	Sample Date	Sample Time	Sample Matrix	Collection Method	Sample Depth (feet bgs)	Sampler	Analyses: VOCs	Analyses: SVOCs + PAHs SIM/ PCBs	Analyses: TAL Metals (including Hg)	Analyses: TPH-Dx	Analyses: TPH-Gx	Analyses: PCBs	Analyses: VOCs	Analyses: SVOCs + PAHs SIM	Latitude	Longitude	Description
Subsurface Soil Samples																			
BH01SB01	19434000	JLNA0	10/23/2019	10:35	Soil	Grab	1.5 to 3	J. Fetters	X	X	X	X	X	--	--	--			Collected from BH01, See boring log for description
BH01SB02	19434001	JLNA1	10/23/2019	10:59	Soil	Grab	4.5 to 6	J. Fetters	X	X	X	X	X	--	--	--	47.6696055	-122.076284	Collected from BH01, See boring log for description
BH01SB03	19434002	JLNA2	10/23/2019	11:14	Soil	Grab	8 to 10	J. Fetters	X	X	X	X	X	--	--	--			Collected from BH01, See boring log for description
BH02SB01	19434003	JLNA3	10/23/2019	12:16	Soil	Grab	0.5 to 2	J. Fetters	X	X	X	X	X	--	--	--			Collected from BH02, See boring log for description
BH02SB02	19434004	JLNA4	10/23/2019	12:40	Soil	Grab	4 to 5	J. Fetters	X	X	X	X	X	--	--	--	47.66901868	-122.075225	Collected from BH02, See boring log for description
BH02SB03	19434005	JLNA5	10/23/2019	13:00	Soil	Grab	8 to 10	J. Fetters	X	X	X	X	X	--	--	--			Collected from BH02, See boring log for description
BH03SB01	19434006	JLNA6	10/23/2019	13:58	Soil	Grab	1.5 to 3	J. Fetters	X	X	X	X	X	--	--	--	47.66911005	-122.074388	Collected from BH03, See boring log for description
BH03SB02	19434007	JLNA7	10/23/2019	14:17	Soil	Grab	4.5 to 6	J. Fetters	X	X	X	X	X	--	--	--			Collected from BH03, See boring log for description
BH04SB01	19454000	JLNA8	11/6/2019	10:04	Soil	Grab	0.5 to 1	J. Fetters	X	X	X	X	X	--	--	--	47.67051424	-122.075592	Collected from BH04, See boring log for description
BH04SB02	19454001	JLNA9	11/6/2019	10:22	Soil	Grab	2 to 2.5	J. Fetters	X	X	X	X	X	--	--	--			Collected from BH04, See boring log for description
BH05SB01	19454002	JLNB0	11/6/2019	11:10	Soil	Grab	1.5 to 2	J. Fetters	X	X	X	X	X	--	--	--	47.66987622	-122.074872	Collected from BH05, See boring log for description
BH05SB02	19454003	JLNB1	11/6/2019	11:55	Soil	Grab	1.5 to 2	J. Fetters	X	X	X	X	X	--	--	--			Collected from BH05, See boring log for description
BH06SB01	19454004	JLNB2	11/6/2019	13:02	Soil	Grab	1 to 1.75	J. Fetters	X	X	X	X	X	--	--	--	47.67067064	-122.074195	Collected from BH06, See boring log for description
BH06SB02	19454005	JLNB3	11/6/2019	13:38	Soil	Grab	2.5 to 3	J. Fetters	X	X	X	X	X	--	--	--			Collected from BH06, See boring log for description, **MS/MSD/Duplicate**
BK01SB01	19434015	JLNB5	10/23/2019	16:01	Soil	Grab	2 to 3.5	J. Fetters	X	X	X	X	X	--	--	--			Collected from BK01, See boring log for description, **MS/MSD/Duplicate**
BK01SB02	19434016	JLNB6	10/23/2019	16:20	Soil	Grab	4.5 to 6	J. Fetters	X	X	X	X	X	--	--	--	47.66865187	-122.073377	Collected from BK01, See boring log for description
BK01SB03	19434017	JLNB7	10/23/2019	16:42	Soil	Grab	8 to 10	J. Fetters	X	X	X	X	X	--	--	--			Collected from BK01, See boring log for description
Groundwater Samples																			
BH01GW	19434018	JLNB8	10/23/2019	15:45	Groundwater	Grab	NA	D. Pulvino	--	--	X	X	X	X	X	X	47.6696055	-122.076284	Groundwater from temporary boring BH01, final turbidity = 37.0 NTUs
BH01GW-D	19434032	MJLND2	10/23/2019	15:45	Ground Water (Dissolved)	Grab	NA	D. Pulvino	--	--	X	--	--	--	--	--			Groundwater from temporary boring BH01, filtered with 0.45 micron filter
BH02GW	19434019	JLNB9	10/23/2019	16:12	Groundwater	Grab	NA	D. Pulvino	--	--	X	X	X	X	X	X	47.66901868	-122.075225	Groundwater from temporary boring BH02, final turbidity = 77.1 NTUs
BH02GW-D	19434033	MJLND3	10/23/2019	16:12	Ground Water (Dissolved)	Grab	NA	D. Pulvino	--	--	X	--	--	--	--	--			Groundwater from temporary boring BH02, filtered with 0.45 micron filter
MW01GW	19434023	JLNC3	10/22/2019	12:50	Groundwater	Grab	NA	J. Fetters	--	--	X	X	X	X	X	X	47.67463511	-122.077937	Groundwater from 1" monitoring well MW01 , final turbidity = 38.2 NTUs
MW02GW	19434037	JLND7	10/22/2019	15:40	Groundwater	Grab	NA	J. Fetters	--	--	X	X	X	X	X	X	47.67440379	-122.078058	Groundwater from former domestic well, final turbidity = 90.8 NTUs, water had orangish coloring
MW02GW-D	19434038	MJLND8	10/22/2019	15:40	Ground Water (Dissolved)	Grab	NA		--	--	X	--	--	--	--	--			Groundwater from former domestic well, filtered with 0.45 micron filter
MW355	19434024	JLNC4	10/22/2019	13:20	Groundwater	Grab	NA	A. Jensen	--	--	X	X	X	X	X	X	47.67486025	-122.080449	Groundwater from permanent monitoring well, final turbidity = 0 NTUs, **MS/MSD/Duplicate**
MW356	19434025	JLNC5	10/22/2019	14:50	Groundwater	Grab	NA	J. Fetters	--	--	X	X	X	X	X	X	47.67470497	-122.082275	Groundwater from permanent monitoring well, final turbidity = 0 NTUs
BK01GW	19434040	JLNE0	10/23/2019	17:55	Groundwater	Grab	NA	D. Pulvino	--	--	X	X	X	X	X	X	47.66865187	-122.073377	Groundwater from temporary boring, final turbidity = 43.9 NTUs
BK01GW-D	19434041	MJLNE1	10/23/2019	17:55	Ground Water (Dissolved)	Grab	NA	D. Pulvino	--	--	X	--	--	--	--	--			Groundwater, filtered with 0.45 micron filter
QA/QC Water Samples																			
RI01WT	19434026	JLNC6	10/24/2019	11:00	Water	Grab	NA	J. Fetters	--	--	X	X	X	X	X	X	NA	NA	Rinsate sample from temporary well screen.
RI02WT	19434027	JLNC7	10/24/2019	11:30	Water	Grab	NA	J. Fetters	--	--	X	X	X	X	X	X	NA	NA	Rinsate sample from cutting shoe.
RI03WT	19454006	JLNB4	11/6/2019	16:30	Water	Grab	NA	J. Fetters	--	--	X	X	X	X	X	X	NA	NA	Rinsate sample from hand auger.
TB01WT	19434028	JLNC8	10/23/2019	6:30	Water	Grab	NA	J. Fetters	--	--	--	--	X	--	X	--	NA	NA	Trip blank.
TB02WT	19454007	JLNC0	11/6/2019	7:30	Water	Grab	NA	J. Fetters	--	--	--	--	X	--	X	--	NA	NA	Trip blank.
FL01WT	19434042	MJLNE2	10/24/2019	12:00	Water	Grab	NA	J. Fetters	--	--	X	--	--	--	--	--	NA	NA	Filter Blank
ID0WT	19434030	JLND0	10/23/2019	16:00	Water	Grab	NA	J. Fetters	--	--	X	X	X	X	X	X	NA	NA	IDW water sample.

Key:

-- = Analysis not applied to sample
bgs= below ground surface
CLP = Contract Laboratory Program
EPA = United States Environmental Protection Agency
Hg = Mercury
IDW = Investigation-derived waste
MS/MSD = Matrix spike/matrix spike duplicate
NA = Not applicable
NTU = Nephelometric Turbidity Units
PAH = Polycyclic Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
QA/QC = Quality assurance/Quality control
SIM = Selective ion monitoring
SVOC = Semivolatile organic compounds
TAL = Target Analyte List
TPH Dx = Diesel-range total petroleum hydrocarbons
TPH Gx = Gasoline-range total petroleum hydrocarbons
VOC = Volatile organic compounds

Table 3-2 Regulatory Criteria and Screening Levels

Analyte	CAS #	Soil						Groundwater				
		MTCA A	MTCA B			EPA Residential Soil RSL	Puget Sound Background Concentrations (90th Percentile)	MTCA A	MTCA B		EPA MCL	EPA Groundwater RSL
			Non-cancer	Cancer	Protective of GW (Saturated)				Non-cancer	Cancer		
Target Analyte List Metals		(mg/kg)						(µg/L)				
Aluminum	7429-90-5	--	80,000	--	--	77,000	32,581	--	16000	--	50 to 200[d]	--
Antimony	7440-36-0	--	32	--	0.27	31	--	--	6.4	--	6	7.8
Arsenic	7440-38-2	20	24	0.67	0.15	0.68	7.3	5	4.8	0.058	10	0.052
Barium	7440-39-3	--	16,000	--	83	15,000	--	--	3,200	--	2,000	3,800
Beryllium	7440-41-7	--	160	--	3.2	160	0.61	--	32	--	4	25
Cadmium	7440-43-9	2	80	--	--	71	0.77	5	8	--	5	--
Chromium	7440-47-3	2,000 [a]	120,000 [a]	--	24,000 [a]	120,000	48.15	50	24,000 [a]	--	100	--
Cobalt	7440-48-4	--	--	--	--	23	--	--	--	--	--	6
Copper	7440-50-8	--	3200	--	14	3,100	36.35	--	11,000	--	1,300	800
Iron	7439-89-6	--	56,000	--	--	55,000	36,128	--	640	--	300[d]	--
Lead	7439-92-1	250	--	--	150	400	16.83	15	--	--	15	15
Manganese	7439-96-5	--	3,700	--	--	1,800	1,146	--	2,200	--	50[d]	430
Mercury	7439-97-6	2	--	--	0.1	11	0.07	2	--	--	2	0.63
Nickel	7440-02-0	--	1,600	--	6.5	1,500	--	--	320	--	--	390
Selenium	7782-49-2	--	400	--	0.26	390	38.19	--	80	--	50	100
Silver	7440-22-4	--	400	--	0.69	390	--	--	80	--	--	94
Thallium	7440-28-0	--	0.8	--	0.011	0.78	--	--	0.16	--	2	0.2
Vanadium	7440-62-2	--	400	--	80	390	--	--	80	--	--	86
Zinc	7440-66-6	--	24,000	--	300	23,000	85.06	--	4,800	--	--	6,000
Polychlorinated Biphenyls		(µg/kg)						(µg/L)				
Aroclor 1016	12674-11-2	--	5,600	14,000	--	4,100	--	--	1.1	1.3	0.5	0.22
Aroclor 1242	53469-21-9	--	--	--	--	230	--	--	--	--	0.5	0.0078
Aroclor 1248	12672-29-6	--	--	--	--	230	--	--	--	--	0.5	0.0078
Aroclor 1254	11097-69-1	--	1,600	500	--	240	--	--	0.32	0.044	0.5	0.0078
Aroclor 1260	11096-82-5	--	--	500	--	240	--	--	--	0.044	0.5	0.0078
Total PCBs	1336-36-3	1,000	--	500	--	230	--	0.10	--	0.044	0.5	0.5
Semivolatile Organic Compounds		(µg/kg)						(µg/L)				
1,1'-Biphenyl	92-52-4	--	40,000,000	130,000	--	47,000	--	--	4,000	5.5	--	0.83
2,2'-Oxybis(1-chloropropane)	108-60-1	--	3,200,000	14,000	--	3,100,000	--	--	320	0.63	--	710
2,3,4,6-Tetrachlorophenol	58-90-2	--	2,400,000	--	--	1,900,000	--	--	480	--	--	240
2,4,5-Trichlorophenol	95-95-4	--	8,000,000	--	1,500	6,300,000	--	--	800	--	--	1,200
2,4,6-Trichlorophenol	88-06-2	--	80,000	91,000	2.7	49,000	--	--	8	4	--	4.1
2,4-Dichlorophenol	120-83-2	--	240,000	--	10	190,000	--	--	24	--	--	46
2,4-Dimethylphenol	105-67-9	--	1,600,000	--	79	1,300,000	--	--	160	--	--	360
2,4-Dinitrophenol	51-28-5	--	160,000	--	9.2	130,000	--	--	32	--	--	39
2,4-Dinitrotoluene	121-14-2	--	160,000	3,200	0.11	1,700	--	--	32	0.28	--	0.24
2,6-Dinitrotoluene	606-20-2	--	24,000	670	0.021	360	--	--	4.8	0.058	--	0.049

Table 3-2 Regulatory Criteria and Screening Levels

Analyte	CAS #	Soil						Groundwater				
		MTCA A	MTCA B			EPA Residential Soil RSL	Puget Sound Background Concentrations (90th Percentile)	MTCA A	MTCA B		EPA MCL	EPA Groundwater RSL
			Non-cancer	Cancer	Protective of GW (Saturated)				Non-cancer	Cancer		
2-Chloronaphthalene	91-58-7	--	6,400,000	--	--	4,800,000	--	--	640	--	--	750
2-Chlorophenol	95-57-8	--	40,000	--	27	390,000	--	--	40	--	--	91
2-Methylnaphthalene	91-57-6	--	320,000	--	--	240,000	--	--	32	--	--	36
2-Methylphenol	95-48-7	--	4,000,000	--	150	3,200,000	--	--	400	--	--	930
2-Nitroaniline	88-74-4	--	800,000	--	--	630,000	--	--	160	--	--	190
3,3'-Dichlorobenzidine	91-94-1	--	--	2,200	0.2	1,200	--	--	--	0.19	--	0.13
4-Chloroaniline	106-47-8	--	320,000	5,000	0.077	2,700	--	--	32	0.22	--	0.37
4-Methylphenol	106-44-5	--	8,000,000	--	--	6,300,000	--	--	800	--	--	1,900
Acenaphthene	83-32-9	--	4,800,000	--	5,000	3,600,000	--	--	960	--	--	530
Acetophenone	98-86-2	--	8,000,000	--	--	7,800,000	--	--	800	--	--	1,900
Anthracene	120-12-7	--	24,000,000	--	110000	18,000,000	--	--	4,800	--	--	1,800
Atrazine	1912-24-9	--	2,800,000	4,300	--	2,400	--	--	560	0.38	--	0.3
Benzaldehyde	100-52-7	--	8,000,000	250,000	--	170,000	--	--	800	11	--	19
Benzo(a)anthracene	56-55-3	--	--	--	--	1,100	--	--	--	0.12	--	0.03
Benzo(a)pyrene	50-32-8	100*	24,000*	190*	190*	110	--	0.1	4.8	0.023	0.2	0.025
Benzo(b)fluoranthene	205-99-2	--	--	--	--	1,100	--	--	--	0.12	--	0.25
Benzo(k)fluoranthene	207-08-9	--	--	--	--	1,100	--	--	--	1.20	--	2.5
Bis(2-Chloroethyl)ether	111-44-4	--	--	910	0.014	230	--	--	--	0.040	--	0.014
Bis(2-ethylhexyl)phthalate	117-81-7	--	1,600,000	71,000	670	39,000	--	--	320	6.3	6	5.6
Butylbenzylphthalate	85-68-7	--	16,000,000	530,000	650	290,000	--	--	3,200	46	--	16
Caprolactam	105-60-2	--	40,000,000	--	--	31,000,000	--	--	8,000	--	--	9,900
Chrysene	218-01-9	--	--		--	110,000	--	--	--	11.99	--	25
Dibenzo(a,h)anthracene	53-70-3	--	--		--	110	--	--	--	0.012	--	0.025
Dibenzofuran	132-64-9	--	80,000	--	--	73,000	--	--	16	--	--	7.90
Diethylphthalate	84-66-2	--	64,000,000	--	4,700	51,000,000	--	--	13,000	--	--	15,000
Di-n-butylphthalate	84-74-2	--	8,000,000	--	3,000	6,300,000	--	--	1,600	--	--	900
Di-n-octylphthalate	117-84-0	--	800,000	--	13,000,000	630,000	--	--	160	--	--	200
Dioxane, 1,4-	123-91-1	--	2,400,000	10,000	--	5,300	--	--	240	0.44	--	0.46
Fluoranthene	206-44-0	--	3,200,000	--	32,000	2,400,000	--	--	640	--	--	800
Fluorene	86-73-7	--	3,200,000	--	5,100	2,400,000	--	--	640	--	--	290
Hexachlorobenzene	118-74-1	--	64,000	630	44	210	--	--	13	0.055	1	0.0098
Hexachlorocyclopentadiene	77-47-4	--	480,000	--	9,600	1,800	--	--	48	--	50	0.41
Hexachloroethane	67-72-1	--	56,000	25,000	2.3	1,800	--	--	5.6	1.1	--	0.33
Indeno(1,2,3-cd)pyrene	193-39-5	--	--	--	--	1,100	--	--	--	0.12	--	0.25
Isophorone	78-59-1	--	16,000,000	1100000	15	570,000	--	--	1,600	46	--	78
Naphthalene	91-20-3	5,000	1,600,000	--	240	3,800	--	160	160	--	--	0.17
Nitrobenzene	98-95-3	--	160,000	--	6.5	5,100	--	--	16	--	--	0.14
N-Nitroso-di-n-propylamine	621-64-7	--	--	140	0.0039	78	--	--	--	0.013	--	0.011
N-Nitrosodiphenylamine	86-30-6	--	--	200,000	28	110,000	--	--	--	18	--	12
Pentachlorophenol	87-86-5	--	400,000	2,500	0.88	1,000	--	--	80	0.22	1	0.041

Table 3-2 Regulatory Criteria and Screening Levels

Analyte	CAS #	Soil						Groundwater				
		MTCA A	MTCA B			EPA Residential Soil RSL	Puget Sound Background Concentrations (90th Percentile)	MTCA A	MTCA B		EPA MCL	EPA Groundwater RSL
			Non-cancer	Cancer	Protective of GW (Saturated)				Non-cancer	Cancer		
Phenol	108-95-2	--	24,000,000	--	760	19,000,000	--	--	2,400	--	--	5,800
Pyrene	129-00-0	--	2,400,000	--	33,000	1,800,000	--	--	480	--	--	120
Volatile Organic Compounds		(µg/kg)						(µg/L)				
1,1,1-Trichloroethane	71-55-6	2,000	160,000,000	--	84	8,100,000	--	200	16,000	--	200	8,000
1,1,2,2-Tetrachloroethane	79-34-5	--	1,600,000	5,000	0.08	600	--	--	160	0.22	--	0.076
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	--	2,400,000,000	--	--	6,700,000	--	--	240,000	--	--	10,000
1,1,2-Trichloroethane	79-00-5	--	320,000	18,000	1.8	1,100	--	--	32	0.77	5	0.28
1,1-Dichloroethane	75-34-3	--	16,000,000	180,000	2.6	3,600	--	--	1,600	7.7	--	2.8
1,1-Dichloroethene	75-35-4	--	4,000,000	--	2.5	230,000	--	--	400	--	7	280
1,2,4-Trichlorobenzene	120-82-1	--	800,000	34,000	29	24,000	--	--	80	1.5	70	1.2
1,2-Dibromo-3-chloropropane	96-12-8	--	16,000	1,300	--	5.3	--	--	1.6	0.055	0.2	0.00033
1,2-Dibromoethane	106-93-4	5	720,000	500	--	36	--	0.01	72	0.022	0.05	0.0075
1,2-Dichlorobenzene	95-50-1	--	7,200,000	--	400	1,800,000	--	--	720	--	600	300
1,2-Dichloroethane	107-06-2	--	480,000	11,000	1.6	460	--	5	48	0.48	5	0.17
1,2-Dichloropropane	78-87-5	--	3,200,000	27,000	1.7	2,500	--	--	320	1.2	5	0.85
1,4-Dichlorobenzene	106-46-7	--	5,600,000	190,000	68	2,600	--	--	560	8.1	75	0.48
2-Butanone	78-93-3	--	48,000,000	--	--	27,000,000	--	--	4,800	--	--	5,600
4-Methyl-2-pentanone	108-10-1	--	6,400,000	--	--	33,000,000	--	--	640	--	--	6,300
Acetone	67-64-1	--	72,000,000	--	2,100	61,000,000	--	--	7,200	--	--	14,000
Benzene	71-43-2	30	320,000	18,000	1.7	1,200	--	5	32	0.80	5	0.46
Bromodichloromethane	75-27-4	--	1,600,000	16,000	2.6	290	--	--	160	0.71	80	0.13
Bromoform	75-25-2	--	1,600,000	130,000	23	19,000	--	--	160	5.5	80	3.3
Bromomethane	74-83-9	--	--	--	--	6,800	--	--	11	--	--	7.5
Carbon disulfide	75-15-0	--	8,000,000	--	270	770,000	--	--	800	--	--	810
Carbon tetrachloride	56-23-5	--	320,000	14,000	2.2	650	--	--	32	0.63	5	0.46
Chlorobenzene	108-90-7	--	1,600,000	--	51	280,000	--	--	160	--	100	78
Chloroform	67-66-3	--	800,000	32,000	4.8	320	--	--	80	1.4	80	0.22
Chloromethane	74-87-3	--	--	--	--	110,000	--	--	--	--	--	190
cis-1,2-Dichloroethene	156-59-2	--	1,600,000	--	5.2	160,000	--	--	16	--	70	36
Dibromochloromethane	124-48-1	--	1,600,000	12,000	1.8	8,300	--	--	160	0.52	80	0.87
Dichlorodifluoromethane	75-71-8	--	16,000,000	--	--	87,000	--	--	1,600	--	--	200
Ethylbenzene	100-41-4	6,000	8,000,000	--	340	5,800	--	700	800	--	700	1.5
Isopropylbenzene	98-82-8	--	8,000,000	--	--	1,900,000	--	--	800	--	--	450
Methyl acetate	79-20-9	--	80,000,000	--	--	78,000,000	--	--	8,000	--	--	20,000
Methyl tert-butyl ether	1634-04-4	100	--	560,000	7.2	47,000	--	20	--	24	--	14
Methylene chloride	75-09-2	20	480,000	500,000	1.5	57,000	--	5	48	22	5	11
Styrene	100-42-5	--	16,000,000	--	120	6,000,000	--	--	1,600	--	100	1,200
Tetrachloroethene	127-18-4	50	480,000	480,000	2.8	24,000	--	5	48	21	5	11
Toluene	108-88-3	7,000	6,400,000	--	270	4,900,000	--	1,000	640	--	1,000	1,100

Table 3-2 Regulatory Criteria and Screening Levels

Analyte	CAS #	Soil						Groundwater				
		MTCA A	MTCA B			EPA Residential Soil RSL	Puget Sound Background Concentrations (90th Percentile)	MTCA A	MTCA B		EPA MCL	EPA Groundwater RSL
			Non-cancer	Cancer	Protective of GW (Saturated)				Non-cancer	Cancer		
trans-1,2-Dichloroethene	156-60-5	--	1,600,000	--	32	1,600,000	--	--	160	--	100	360
Trichloroethylene	79-01-6	30	40,000		1.5	940	--	5	4		5	0.49
Trichlorofluoromethane	75-69-4	--	24,000,000	--	--	23,000,000	--	--	2,400	--	--	5,200
Vinyl chloride	75-01-4	--	240,000	--	0.08	59	--	0.2	24	--	2	0.019
Xylene, m-	108-38-3	--	16,000,000	--	770	550,000	--	--	1,600	--	--	190
Xylene, mixture	1330-20-7	9,000	16,000,000	--	830	580,000	--	1,000	1,600	--	10,000	190
Xylene, o-	95-47-6	--	16,000,000	--	840	650,000	--	--	1,600	--	--	190
Xylene, p-	106-42-3	--	16,000,000	--	960	560,000	--	--	1,600	--	--	190
Total Petroleum Hydrocarbons		**(mg/kg)**						**(µg/L)**				
Gasoline	None	30[b]/100[c]	--	--	--	--	--	800[c]/1,000[d]	--	--	--	--
Diesel	None	2,000	--	--	--	--	--	500	--	--	--	--
Heavy oil	64742-65-0	2,000	--	--	--	--	--	500	--	--	--	--

Notes:

Background metals concentrations gathered from https://fortress.wa.gov/ecy/publications/summarypages/94115.html.

* Values used for comparison of calculated TEQ and TMEQ values

a = Value is for chromium III

b = If benzene is present

c = If benzene is not present

d = Secondary MCL

Key:

-- = No associated cleanup level or value.

µg/kg = micrograms per kilogram

µg/L = micrograms per liter

CAS = Chemical Abstracts Service

CLP = Contract Laboratory Program

EPA = Environmental Protection Agency

GW = Groundwater

MCL = Maximum Contaminant Level

mg/kg = milligrams per kilogram

mg/L = milligrams per liter

MTCA = Model Toxics Control Act

RSL = Residential Screening Level

TEQ = Toxicity Equivalent Quotient

TMEQ = Toxicity Mobility Equivalent Quotient

Table 3-3 - Subsurface Soil Analytical Summary

EPA Sample Number:	Soil Regulatory Standards					Puget Sound Background Concentrations (90th Percentile)	19434015	19434000	19434003	19434006	19454000	19454001	19454002	19454003	19454004	19454005	19434016	19434001	19434004	19434007	19434017	19434002	19434005
CLP Sample Number:	MTCA A	MTCA B			EPA Residential Soil RSL		JLNB5	JLNA0	JLNA3	JLNA6	JLNA8	JLNA9	JLNB0	JLNB1	JLNB2	JLNB3	JLNB6	JLNA1	JLNA4	JLNA7	JLNB7	JLNA2	JLNA5
Sample Location ID:		Non-cancer	Cancer	Protective of GW (Saturated)			BK01SB01	BH01SB01	BH02SB01	BH03SB01	BH04SB01	BH04SB02	BH05SB01	BH05SB02	BH06SB01	BH06SB02	BK01SB02	BH01SB02	BH02SB02	BH03SB02	BK01SB03	BH01SB03	BH02SB03
Sample Depth (feet bgs):							2 to 3.5	1.5 to 3	0.5 to 2	1.5 to 3	0.5 to 1	2 to 2.5	1.5 to 2	1.5 to 2	1 to 1.75	2.5 to 3	4.5 to 6	4.5 to 6	4 to 5	4.5 to 6	8 to 10	8 to 10	8 to 10
Sample Location Description:							Background	Thompson Field									Background	Thompson Field			Background	Thompson Field	
Target Analyte Metals (mg/kg)																							
Aluminum	--	80,000	--	--	77,000	32,581	20,700	16,700	10,900	14,800	14,900	18,800	15,100	14,800	17,300	22,200	10,500	15,300	12,900	17,200	13,100	18,600	11,900
Arsenic	20	24	0.67	0.15	0.68	7.3	11.5 JH	5.5 JH	6.7 JH	4.8 JH	3.2	5.3	3.4	3.9	3.4	5.2	1.9 JH	5.6 JH	4.9 JH	4.0 JH	5.7 JH	5.4 JH	47.1 JH
Barium	--	16,000	--	83	15,000	--	89.4	98.4	63.3	84.7	68.6	125	104	96.3	89.3	106	52.7	87.6	69.5	118.0	62.1	89	88
Calcium	--	--	--	--	--	--	3,970	5,930	4,400	6,440	4,870	4,140	7,150	7,990	4,660	4,010	3,850	5,710	6,700	5,660	4,070	6,300	13,600
Chromium	2,000 [a]	120,000 [a]	--	24,000 [a]	120,000	48.2	50.6	40.6	30.8	48.2	31.3	43.8	36.9	43.7	43.8	47	24.4	44.7	29.3	27.5	34.5	36.8	45.4
Cobalt	--	--	--	--	23	--	9.6	9.8	8.2	11.4	9.3	10.0	8.8	8.9	9.7	12.5	8.0	8.8	8.3	7.8 JQ	8.5	10.8	8.3
Copper	--	3,200	--	14	3,100	36.4	21	17.2	13.2	19.5	22.8	21.1	15.9	19.5	18.4	35.4	12.7	18.1	15.4	15.0	19.4	14.5	35.9
Iron	--	56,000	--	--	55,000	36,128	19,600	18,800	12,700	18,700	17,800	17,400	15,500	15,200	17,100	21,400	12,900	15,500	13,500	13,500	14,700	20,800	17,900
Lead	250	--	--	150	400	16.8	4.3	11.6	11.7	8.0	12.1	22	34.5	41.3	17.8	7.2	2.4	24.7	11.4	20.8	3.1	3.6	3.7
Magnesium	--	--	--	--	--	--	4,650	5,040	3,990	6,130	6,110	4,720	4,550	4,620	4,920	6,100	2,940	4,540	4,020	3,020	4,370	6,980	4,460
Manganese	--	3,700	--	--	1,800	1,146	205	326	216	303	275 JH	424 JH	269 JH	271 JH	287 JH	345 JH	225	238	247	350	166	260	159
Mercury	2	--	--	0.1	11	0.07	0.029 JQ (SQL = 0.123)	0.046 JQ	0.042 JQ	0.036 JQ	0.028 JQ	0.034 JQ	0.15	0.094 JQ	0.045 JQ	0.037 JQ	0.019 JQ (SQL = 0.108)	0.045 JQ	0.075 JQ	0.120 JQ	0.031 JQ (SQL = 0.130)	0.14 U	0.07 JQ
Nickel	--	1,600	--	6.5	1,500	38.2	29.6	43.4	31.1	50.3	30.9	38.3	39.1	40	39.2	40.4	19.5	35	27.8	25.1	27.2	27.5	46.5
Potassium	--	--	--	--	--	--	485 JQ (SQL = 618)	881	596	993	882	697	844	965	866	892	569	693	629 JQ	642 JQ	966	1,130	559
Selenium	--	400	--	0.26	390	--	3.0 U	2.9 U	2.6 U	2.7 U	0.2 JQ	0.4 JQ	2.8 U	0.2 JQ	2.8 U	0.2 JQ	2.4 U	3.2 U	4.4 U	4 U	2.7 U	3.3 U	3.2
Vanadium	--	400	--	80	390	--	50.7	49	34.1	50.2	45	50.7	44.9	44.9	47.2	59.8	41.2	45.1	44.7	40	44.5	60.4	75.8
Zinc	--	24,000	--	300	23,000	85.1	32.4	50.2	39.9	48.6	56	65.6	62.6	73.7	43.6	50.0	23.3	53.1	35.3	39.2	38.1	55.5	30.3
Semivolatile Organic Compounds (ug/kg)																							
2-Methylnaphthalene	--	320,000	--	--	240,000	--	4 U	1.1 JQ	6	6.4	3.9 U	1.0 JQ	4.9	1.8 JQ	4.0 U	3.7 U	4.1 U	33	5.1 U	2.0 JQ	4.2 U	4 U	14 UJL
Acenaphthene	--	4,800,000	--	5,000	3,600,000	--	4 U	4.2	4.6	9.5	3.9 U	3.8 U	4.2	3.2 JQ	4.0 U	3.7 U	4.1 U	77	1.3 JQ	6.5 U	4.2 U	4 U	14 UJL
Acenaphthylene	--	--	--	--	--	--	4 U	3.9 U	3.8 JQ	3.7 U	3.9 U	3.8 U	5.6	1.7 JQ	4.0 U	3.7 U	4.1 U	3.5 JQ	5.1 U	6.5 U	4.2 U	4 U	14 UJL
Anthracene	--	24,000,000	--	110,000	18,000,000	--	4 U	6.2	9	13	3.9 U	1.2 JQ	12	6.6	4.0 U	3.7 U	4.1 U	120	5.1 U	6.5 U	4.2 U	4 U	14 UJL
Benzo(a)anthracene*	--	--	--	--	1,100	--	4 U	9.9	19	7	1.6 JQ	2.2 JQ	68	20	4.4	1.9 JQ	4.1 U	230	5.1 U	6.5 U	4.2 U	4 U	14 UJL
Benzo(a)pyrene*	100	24,000	190	190	110	--	4 U	10	9.6	3.6 JQ	1.2 JQ	2.1 JQ	54	19	4.7	1.8 JQ	4.1 U	160	5.1 U	6.5 U	4.2 U	4 U	14 UJL
Benzo(b)fluoranthene*	--	--	--	--	1,100	--	4 U	13	16	5.4	1.7 JQ	3.0 JQ	78	21	5.7	2.4 JQ	4.1 U	230	1.7 JQ	6.5 U	4.2 U	4 U	14 UJL
Benzo(g,h,i)perylene	--	--	--	--	--	--	4 U	6.4	6.7	1.8 JQ	1.0 JQ	2.5 JQ	39	14	3.5 JQ	1.2 JQ	4.1 U	89	5.1 U	6.5 U	4.2 U	4 U	14 UJL
Benzo(k)fluoranthene*	--	--	--	--	1,100	--	4 U	4.1	4.1	1.9 JQ	1.1 JQ	2.1 JQ	25	8.1	2.2 JQ	1.1 JQ	4.1 U	61	5.1 U	6.5 U	4.2 U	4 U	14 UJL
Chrysene*	--	--	--	--	110,000	--	4 U	9.3	24	4.8	1.7 JQ	3.1 JQ	72	23	4.9	2.1 JQ	4.1 U	240	1.3 JQ	6.5 U	4.2 U	4 U	14 UJL
Dibenzo(a,h)anthracene*	--	--	--	--	110	--	4 U	1.4 JQ	1.9 JQ	3.7 U	3.9 U	1.4 JQ	9	3.1 JQ	0.9 JQ	3.7 U	4.1 U	31	5.1 U	6.5 U	4.2 U	4 U	14 UJL
Dimethylphthalate	--	--	--	--	--	--	310	360	220	240	120.0 JQ	200	170 JQ	180 JQ	140 JQ	120 JQ	110 JQ	360	160 JQ	390	430	330	990 JK
Fluoranthene	--	3,200,000	--	32,000	2,400,000	--	4 U	25	43	26	2.5 JQ	2.8 JQ	110	38	6.2	2.4 JQ	4.1 U	580 JH	1.6 JQ	6.5 U	4.2 U	4 U	14 UJL
Fluorene	--	3,200,000	--	5,100	2,400,000	--	4 U	5	8.1	11	3.9 U	0.9 JQ	3.2 JQ	2.2 JQ	4.0 U	3.7 U	4.1 U	120	1.2 JQ	6.5 U	4.2 U	4 U	14 UJL
Indeno(1,2,3-cd)pyrene*	--	--	--	--	1,100	--	4 U	5.5	4.8	1.8 JQ	0.8 JQ	2.0 JQ	31	11	2.7 JQ	1.0 JQ	4.1 U	82	5.1 U	6.5 U	4.2 U	4 U	14 UJL
Naphthalene	5,000	1,600,000	--	240	3,800	--	4 U	2.6 JQ	5.5	5.4	3.9 U	1.0 JQ	8.5	2.0 JQ	4.0 U	3.7 U	4.1 U	140	1.1 JQ	2.3 JQ	4.2 U	4 U	14 UJL
Phenanthrene	--	--	--	--	--	--	4 U	26	53	32	2.1 JQ	2.7 JQ	51	32	3.6 JQ	1.4 JQ	4.1 U	610	2.6 JQ	6.5 U	4.2 U	4 U	14 UJL
Pyrene	--	2,400,000	--	33,000	1,800,000	--	4 U	22	31.0	21	3.2 JQ	3.8	140	54	9.4	4.2	4.1 U	550	1.5 JQ	6.5 U	4.2 U	4 U	14 UJL
cPAH TEQ	100	24,000	190	--	--	--	0.34	13.36	14.25	1.56	0.33	0.32	75.82	25.26	5.82	0.32	0.34	225.8	0.43	0.55	0.36	0.34	1.14
cPAH TMEQ	--	--	--	190	--	--	0.72	29.83	30.23	1.87	0.69	0.68	164.38	56.67	13.78	0.66	0.72	489.4	0.91	1.16	0.75	0.71	2.41
Total Petroleum Hydrocarbons (mg/kg)						--																	
Motor Oil-Range Organics	2,000	--	--	--	--	--	110 U	97 U	500	99 U	100 U	100 U	96 U	140	97 U	96 U	99 U	110 U	160 U	150 U	98 U	89 U	360 U
Volatile Organic Compounds (ug/kg)																							
2-Butanone	--	48,000,000	--	--	27,000,000	--	13 U	11 U	9.1 U	7.9 JQ	8.9 U	5.5 JQ	10 U	12.0 U	9.9 U	6 JQ	10 UJK	17	13 U	260	11 U	20 U	250 JK
Acetone	--	72,000,000	--	2,100	61,000,000	--	10 JQ (SQL = 13)	7.7 JQ	19	41	8.9 U	31 U	25 U	12 U	11 U	70 U	10 UJK	55	26	780	7.7 JQ (SQL = 11)	25	660 JK
Methylene chloride	20	480,000	500,000	1.5	57,000	--	4.5 JQ (SQL = 6.3)	3.6 JQ	4.5 U	4.9 U	4.5 U	5.7 U	5.1 U	6.0 U	4.9 U	6.5 U	5.1 UJK	5.5 U	6.5 U	23	5.7 U	10 U	62 JQ
m,p-Xylene	9,000[b]	16,000,000[b]	--	830[b]	580,000[b]	--	6 U	5.5 U	4.5 U	4.9 U	4.5 U	5.7 U	5.1 U	6.0 U	4.9 U	6.5 U	5.1 U	5.7	6.5 U	17 U	5.7 U	10 U	71 UJL

Notes:

Bold type indicates the sample result is above the method reporting limit/adjusted Contract Required Quantitation Limit.

Underline type indicates the result is significant as defined in Section 3 (greater than three times background concentrations).

Background metals concentrations gathered from https://fortress.wa.gov/ecy/publications/summarypages/94115.html.

Yellow shading indicates the result is significant as defined in Section 3 (greater than three times background concentrations), exceeds the most restrictive soil regulatory standard or screening level, and for metals exceeds the 90th percentile background concentration.

a = Value is for chromium III

b = Value for xylene mixture used

* = As per MTCA, these compounds are compared to cleanup values for benzo(a)pyrene using calculated TEQ and TMEQ values. Calculation performed using one-half the method detection limit for non-detect analytes.

Key:

bgs = below ground surface

CLP = Contract Laboratory Program

cPAH = Carcinogenic Polycyclic Aromatic Hydrocarbon

EPA = United States Environmental Protection Agency

H = High bias

ID = Identification

J = The associated numerical value is an estimated quantity because the reported concentration is less than the sample quantitation limit or because quality control criteria limits were not met.

K = Unknown bias

L = Low bias

mg/kg = milligrams per kilogram

MTCA = Model Toxics Control Act

Q = Detected concentration is below the method reporting limit/Contract Required Quantitation Limit.

RSL = Regional screening level

TEQ = Toxicity Equivalent Quotient

TMEQ = Toxicity Mobility Equivalent Quotient

U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation or reporting limit.

ug/kg = micrograms per kilogram

Table 3-4 - Groundwater Sample Analytical Summary

EPA Sample Number:	Groundwater Regulatory Standards					19434040	19434041	19434018	19434032	19434019	19434033
CLP Sample Number:	MTCA A	MTCA B		EPA MCL	EPA RSL (Tapwater)	JLNE0	MJLNE1	JLNB8	MJLND2	JLNB9	MJLND3
Sample Location ID:		Non-cancer	Cancer			BK01GW	BK01GW-D	BH01GW	BH01GW-D	BH02GW	BH02GW-D
Sample Location Description:						Thompson Field					
Screened Interval (feet bgs):						12 to 16		8 to 12		12 to 16	
Total Target Analyte Metals (ug/L)											
Aluminum	--	--	--	50 to 200*	--	**429**	--	**1,520**	--	**618**	--
Arsenic	5	4.8	0.058	10	0.052	0.46 JQ (SQL = 1)	--	**<u>1.1</u>**	--	**<u>3.2</u>**	--
Calcium	--	--	--	--	--	**10,600**	--	**22,100**	--	**24,200**	--
Iron	--	--	--	300*	--	**377 JH**	--	**5170 JH**	--	**910 JH**	--
Magnesium	--	--	--	--	--	2,830 JQ (SQL = 5,000)	--	**9,970**	--	**10,700**	--
Manganese	--	2,200	--	50*	430	**18.4 JH**	--	**<u>218</u> JH**	--	**<u>140</u> JH**	--
Sodium	--	--	--	--	--	**8,740**	--	**11,700**	--	**13,600**	--
Dissolved Target Analyte Metals (ug/L)											
Arsenic	5	4.8	0.058	10	0.052	--	0.46 JQ (SQL = 1)	--	0.71 JQ	--	**<u>2.5</u>**
Calcium	--	--	--	--	--	--	**10,800**	--	**22,200**	--	**23,300**
Iron	--	--	--	300*	--	--	100 U	--	**4,330**	--	**241**
Magnesium	--	--	--	--	--	--	2,830 JQ (SQL = 5,000)	--	**10,300**	--	**10,700**
Manganese	--	2,200	--	50*	430	--	15 U	--	**<u>226</u>**	--	**<u>134</u>**
Sodium	--	--	--	--	--	--	**8,070**	--	**11,100**	--	**12,000**

Notes: Bold type indicates the sample result is above the method reporting limit/adjusted Contract Required Quantitation Limit.

Underline type indicates the result is elevated as defined in Section 3 (greater than three times background concentrations).

* Secondary Drinking Water Maximum Contaminant Level (for aesthetic considerations, such as taste, color, and odor).

Yellow shading indicates an elevated concentration defined in Section 3 (greater than three times background concentrations) and an exceedance of the lowest groundwater regulatory standard or screening level.

Key:

CLP = Contract Laboratory Program
EPA = United States Environmental Protection Agency
H = High bias
ID = Identification
J = The associated numerical value is an estimated quantity because the reported concentration is less than the sample quantitation limit or because quality control criteria limits were not met.
MCL = Maximum Contaminant Level
MTCA = Model Toxics Control Act
Q = Detected concentration is below the Contract Required Quantitation Limit.
RSL = Regional Screening Level
U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
ug/L = micrograms per liter

Table XXX - Groundwater Sample analytical Summary

EPA Sample Number:	Groundwater Regulatory Standards					19434023	19434037	19434038	19434024	19434025
CLP Sample Number:	MTCA A	MTCA B		EPA MCL	EPA RSL (Tapwater)	JLNC3	JLND7	MJLND8	JLNC4	JLNC5
Sample Location ID:		Non-cancer	Cancer			MW01GW	MW02GW	MW02GW-D	MW355	MW356
Sample Location Description:						Private Residence			Arthur Johnson Park	
Screened Interval (feet bgs):						10 to 20	Unknown		8 to 18	9.8 to 19.8
Total Target Analyte Metals (ug/L)										
Aluminum	--	--	--	50 to 200*	--	**1,270**	200 U	--	200 U	200 U
Arsenic	5	4.8	0.058	10	0.052	0.75 JQ	0.26 JQ	--	0.67 JQ	**4**
Calcium	--	--	--	--	--	**18,500**	**9,260**	--	**23,900**	**15,600**
Iron	--	--	--	300*	--	**1,340 JH**	**8,700 JH**	--	**758 JH**	**3,600 JH**
Magnesium	--	--	--	--	--	**9,640**	4800 JQ	--	**10,600**	**7,360**
Manganese	--	2200	--	50*	430	**21 JH**	**199 JH**	--	**460 JH**	**431 JH**
Sodium	--	--	--	--	--	**9,150**	**10,000**	--	**11,400**	**7,400**
Dissolved Target Analyte Metals (ug/L)										
Arsenic	5	4.8	0.058	10	0.052	--	--	0.21 JQ	--	--
Calcium	--	--	--	--	--	--	--	**9,530**	--	--
Iron	--	--	--	300*	--	--	--	**253**	--	--
Magnesium	--	--	--	--	--	--	--	**5,100**	--	--
Manganese	--	2200	--	50*	430	--	--	**165**	--	--
Sodium	--	--	--	--	--	--	--	**9,500**	--	--

Notes: Bold type indicates the sample result is above the method reporting limit/adjusted Contract Required Quantitation Limit.

Underline type indicates the result is elevated as defined in Section 3 (greater than three times background concentrations).

* Secondary Drinking Water Maximum Contaminant Level (for aesthetic considerations, such as taste, color, and odor).

Yellow shading indicates an elevated concentration defined in Section 3 (greater than three times background concentrations) and an exceedance of the lowest groundwater regulatory standard or screening level.

Key:

CLP = Contract Laboratory Program

EPA = United States Environmental Protection Agency

H = High bias

ID = Identification

J = The associated numerical value is an estimated quantity because the reported concentration is less than the sample quantitation limit or because quality control criteria limits were not met.

MCL = Maximum Contaminant Level

MTCA = Model Toxics Control Act

Q = Detected concentration is below the Contract Required Quantitation Limit.

RSL = Regional Screening Level

U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

ug/L = micrograms per liter

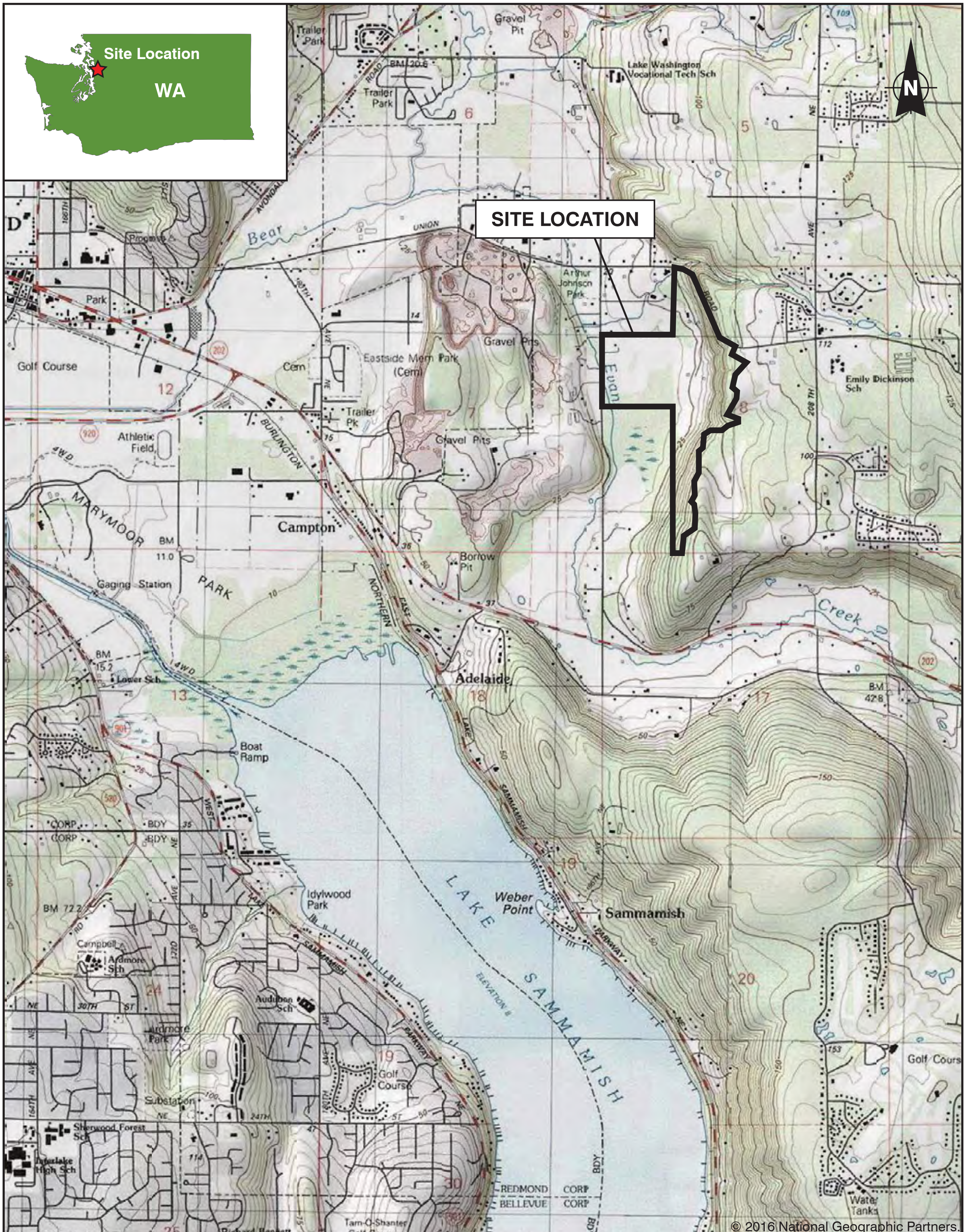
Table 4-1 Groundwater Drinking Water Populations by Distance Ring

Distance Ring (miles)	Number of Wells	Population Served	Total Population Served
0 – ¼	1 Domestic Wells	2	2
¼ – ½	3 Domestic Wells	7	7
½ – 1	18 Domestic Wells	44	52
	2 Group B Community Wells	8	
1 – 2	104 Domestic Wells	255	55,288
	4 City of Redmond Group A Wells	54,940	
	13 Group B Community Wells	93	
2 – 3	132 Domestic Wells	323	22,772
	1 City of Redmond Group A Well	13,735	
	3 Union Hill Water Association Group A Wells	4,958	
	3 Northeast Sammamish Sewer and Water District Group A Wells	3,498	
	29 Group B Community Wells	258	
3 – 4	225 Domestic Wells	551	1,181
	2 Dawn Breaker Water Association Group A Wells	168	
	35 Group B Community Wells	462	
Total			**79,302**

Note: The average number of persons per household for King County, Washington is 2.45. The population served for each domestic well calculated by multiplying the number of wells by 2.45.

Population values were rounded to the nearest whole number.

Figures



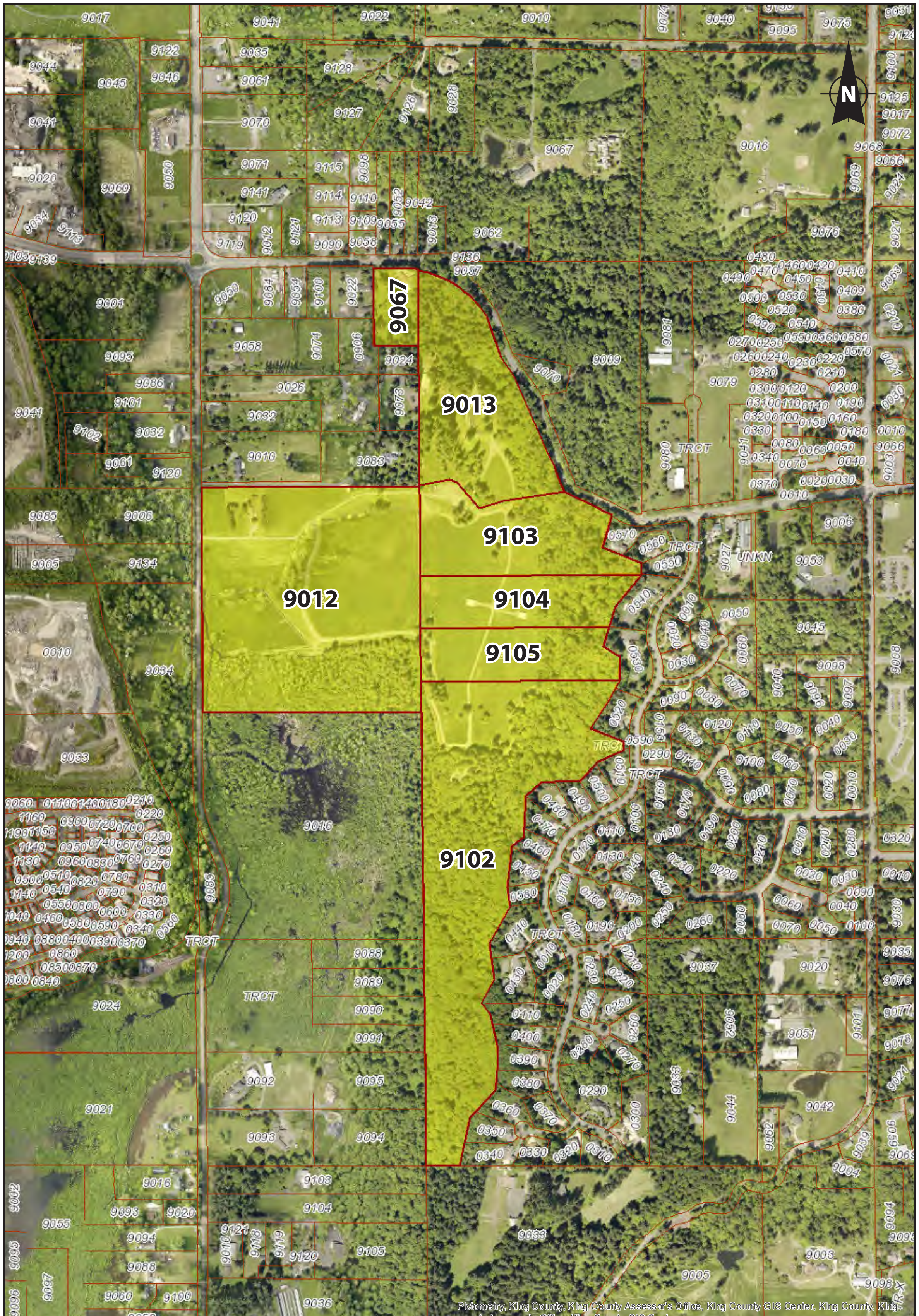
ecology and environment, inc.
Global Environmental Specialists
Seattle, Washington

GUNSHY MANOR
Redmond, Washington

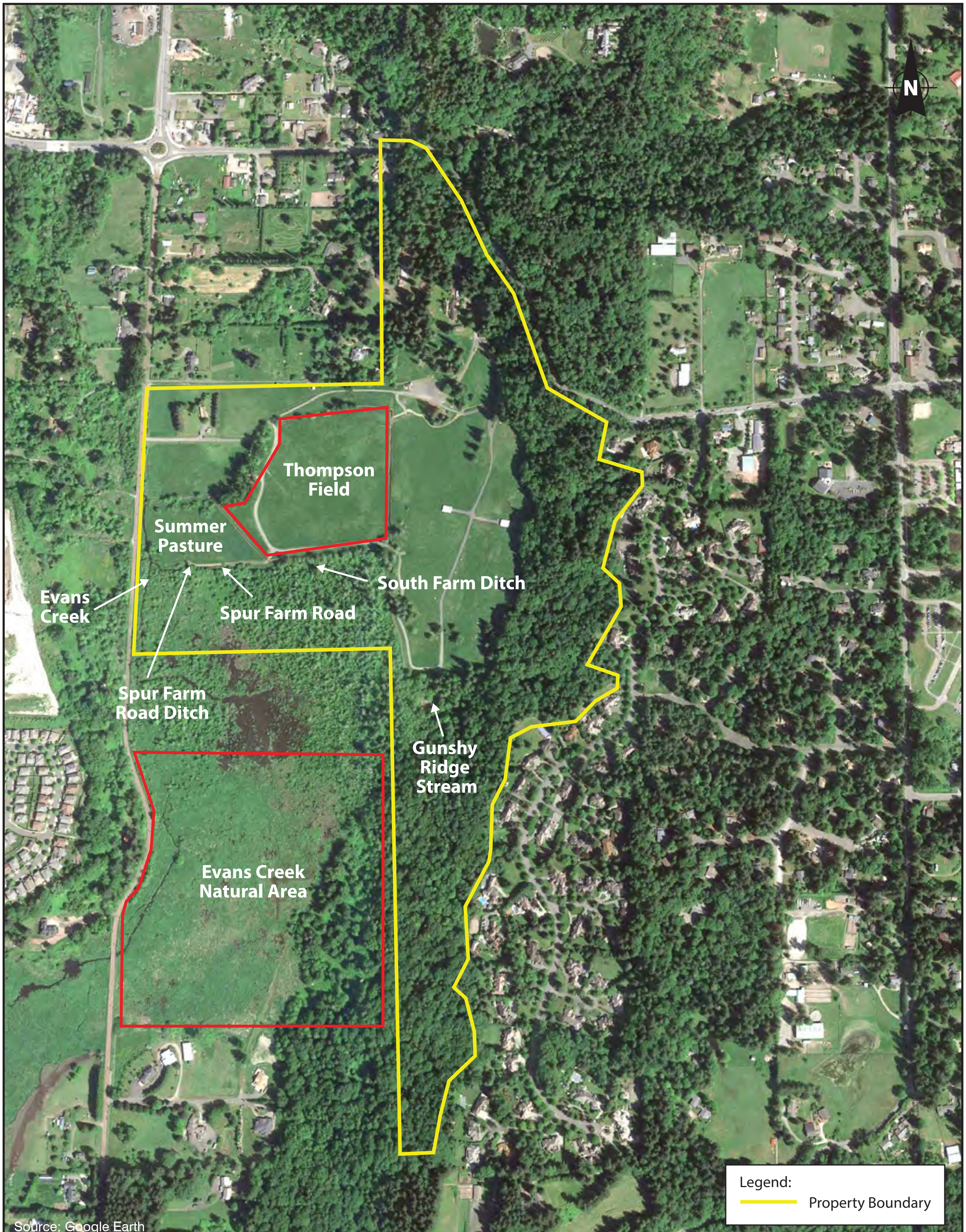
Figure 1-1
Site Vicinity Map

0 .5 1
Approximate Scale in Miles

Date:	Drawn by:	
9-27-19	AGM	02:1004530.0027.009.01



ecology and environment, inc. Global Environmental Specialists Seattle, Washington	GUNSHY MANOR Redmond, Washington	Figure 2-1 Site Parcel Map		
	0 400 800 Approximate Scale in Feet	Date: 9-27-19	Drawn by: AGM	02:1004530.0027.009.01



ecology and environment, inc.
Global Environmental Specialists
Seattle, Washington

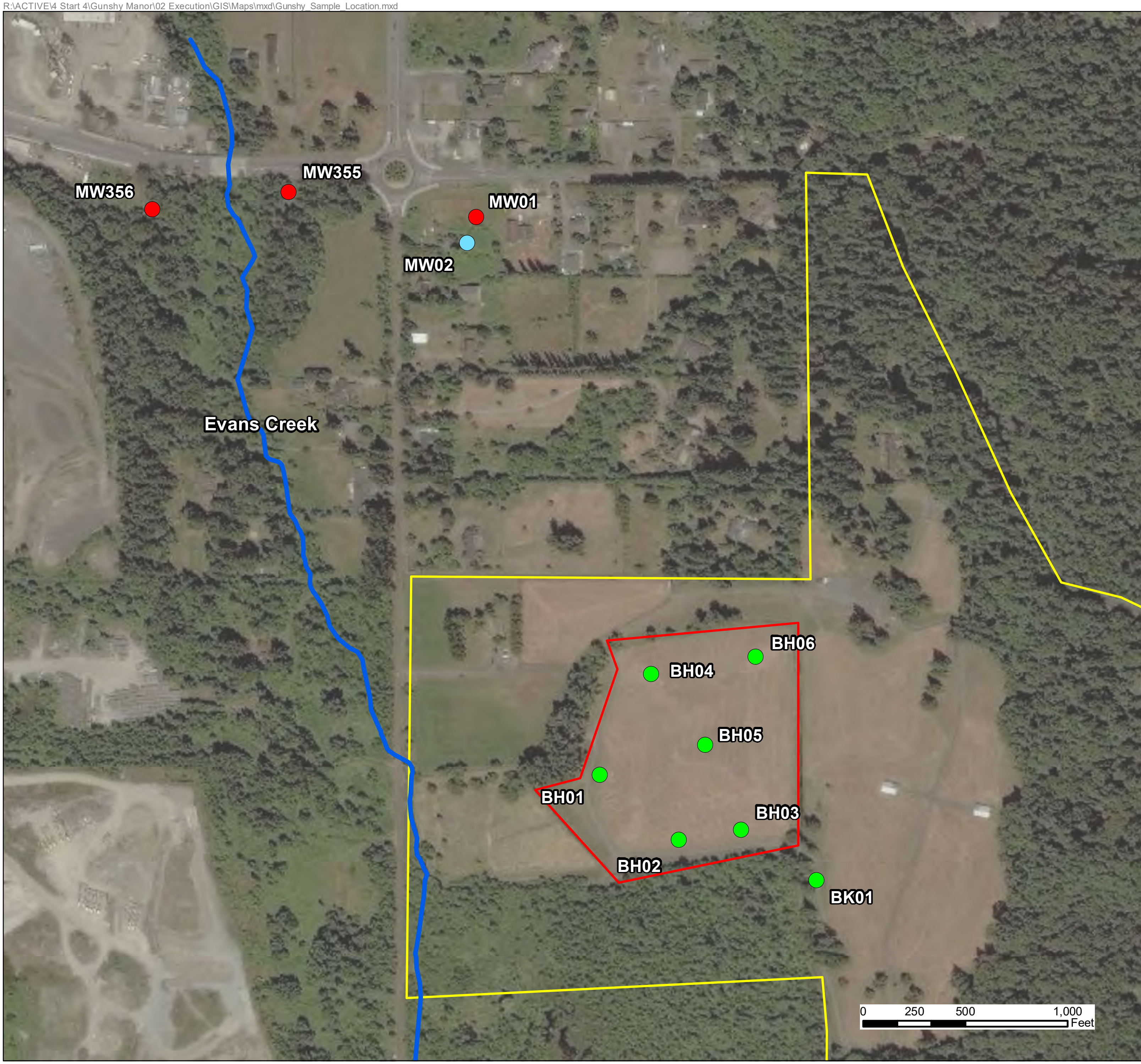
GUNSHY MANOR
Redmond, Washington

0 400 800
Approximate Scale in Feet

Figure 2-2
Site Map

Date:	Drawn by:	
9-27-19	AGM	02:1004530.0027.009.01

R:\ACTIVE\4 Start 4\Gunshy Manor\02 Execution\GIS\Maps\mxd\Gunshy_Sample_Location.mxd 2/27/2020 12:33:07 PM

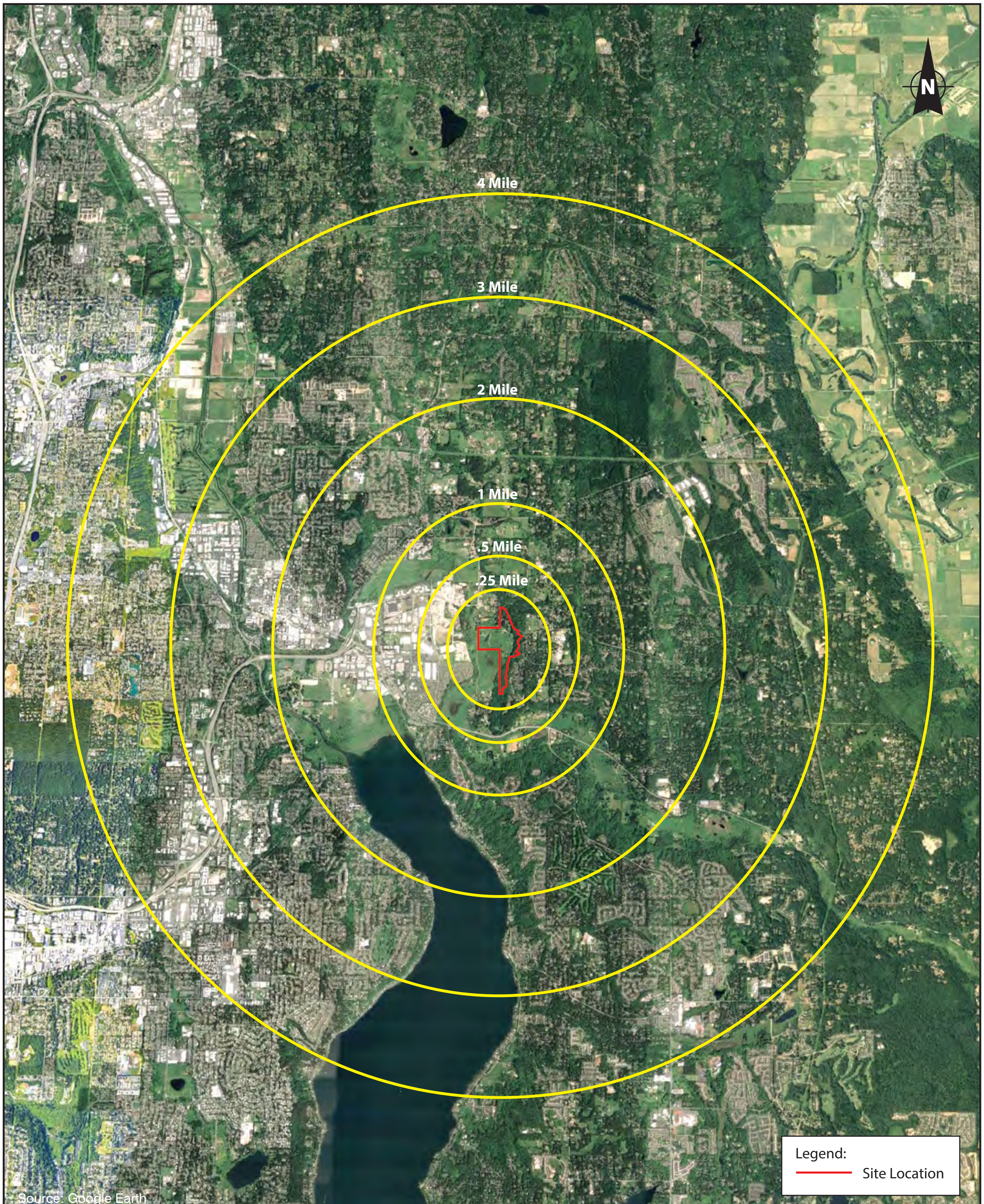


N

FIGURE 3-1
SAMPLE LOCATION MAP
GUNSHY MANOR
Redmond, Washington

Legend

- Domestic Well
- Monitoring Well
- Soil Boring
- Creek
- Property Boundary
- Thompson Field



ecology and environment, inc.
Global Environmental Specialists
Seattle, Washington

GUNSHY MANOR
Redmond, Washington

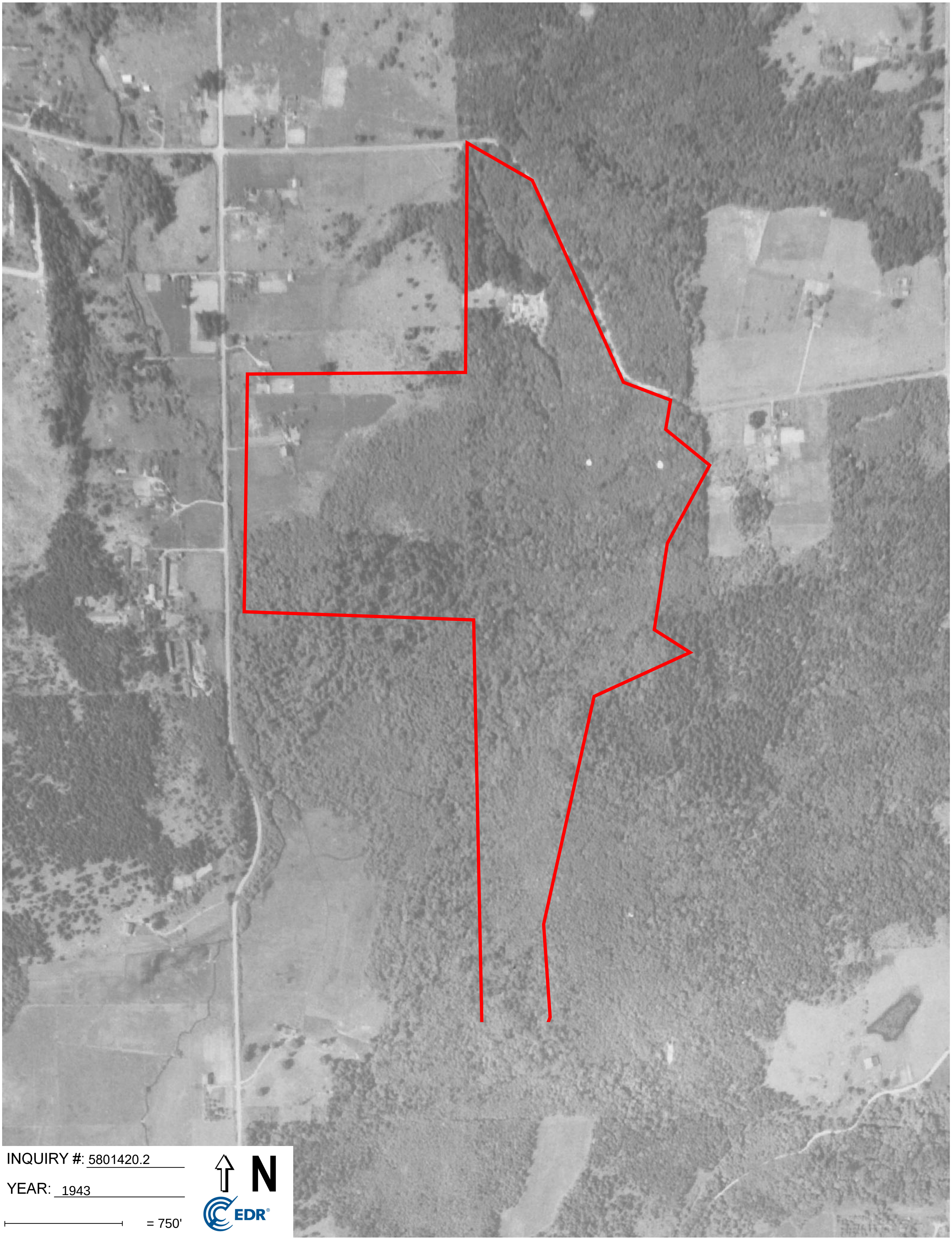
0 .5 1
Approximate Scale in Miles

Figure 4-1
4-Mile Map

Date:	Drawn by:	
9-27-19	AGM	02:1004530.0027.009.01

A

Aerial Photos



INQUIRY #: 5801420.2

YEAR: 1943

= 750'

N

EDR

INQUIRY #: 5801420.2

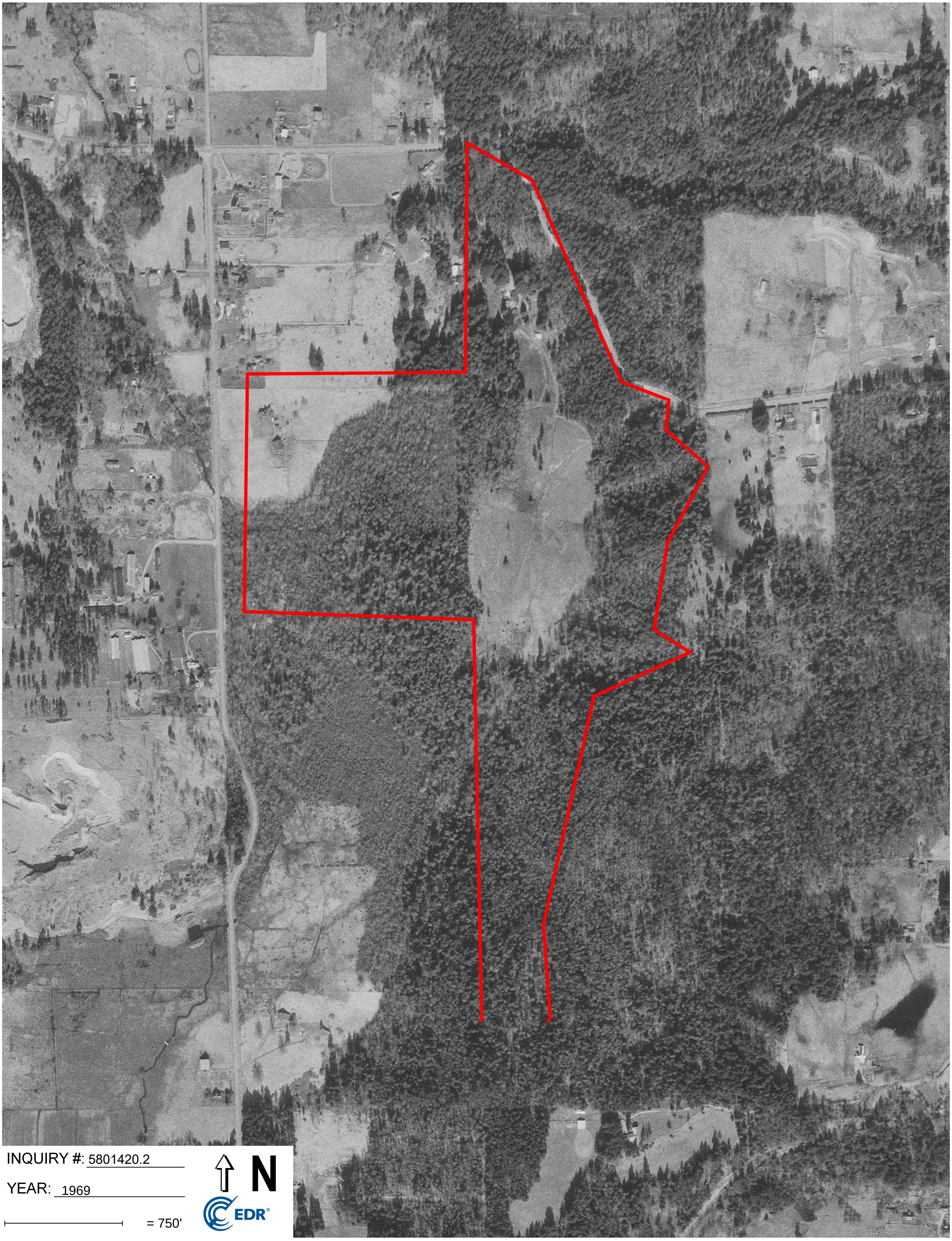
YEAR: 1965

= 750'

N

EDR

Subject boundary not shown because it exceeds image extent or image is not georeferenced.



INQUIRY #: 5801420.2

YEAR: 1969

= 750'

N

EDR

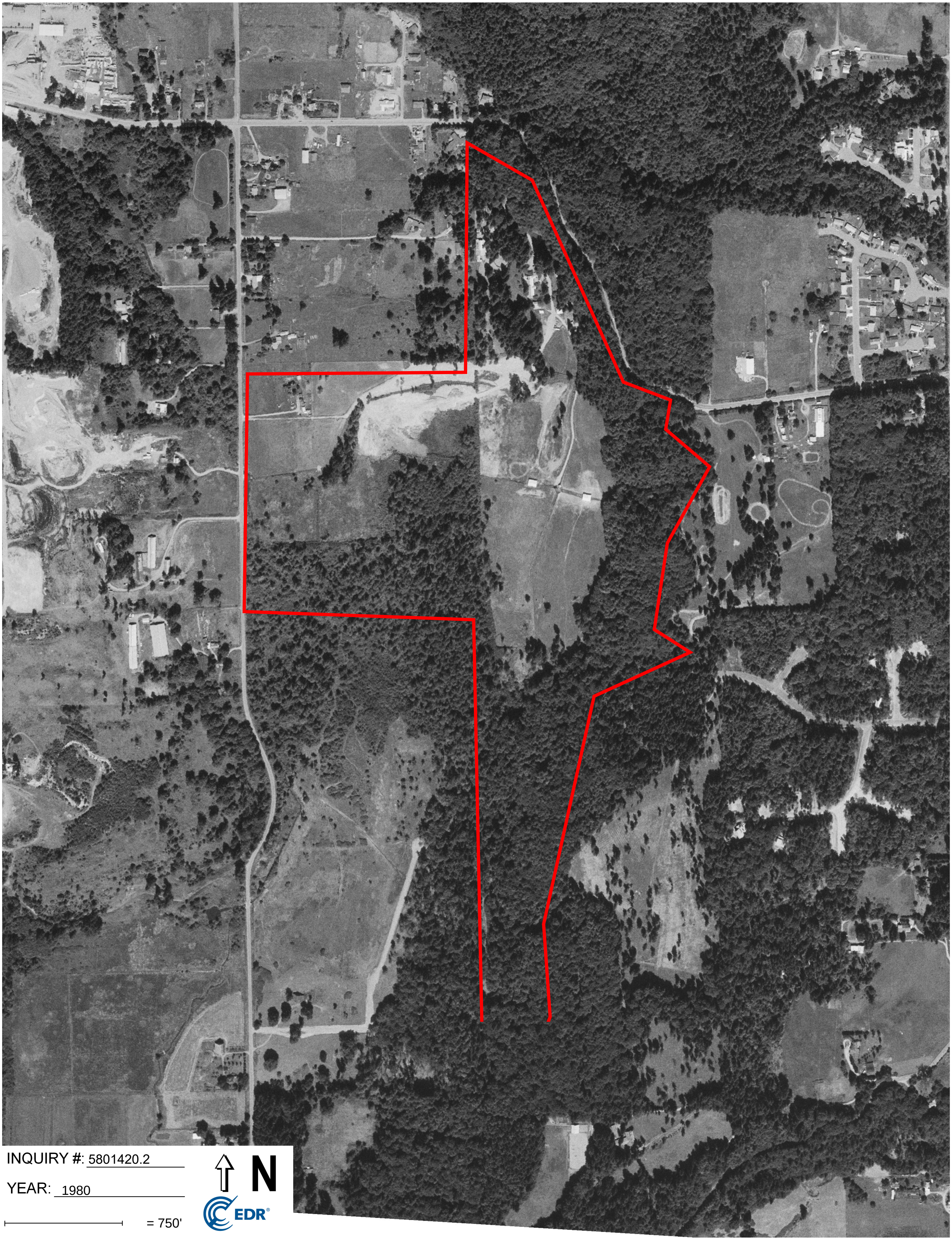
INQUIRY #: 5801420.2

YEAR: 1977

= 750'

N

EDR



INQUIRY #: 5801420.2

YEAR: 1980

= 750'

N

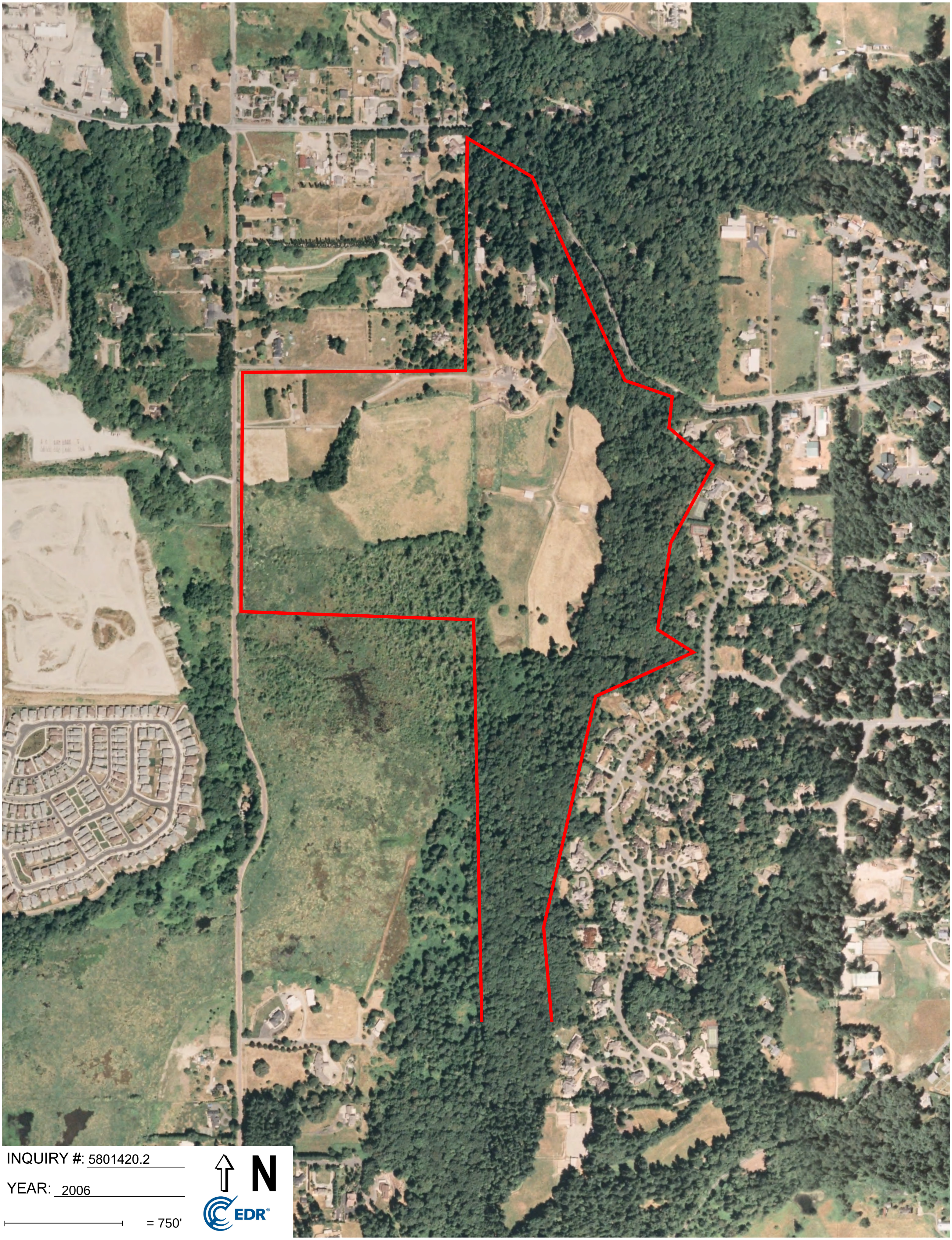
EDR

INQUIRY #: 5801420.2

YEAR: 1990

= 750'

N



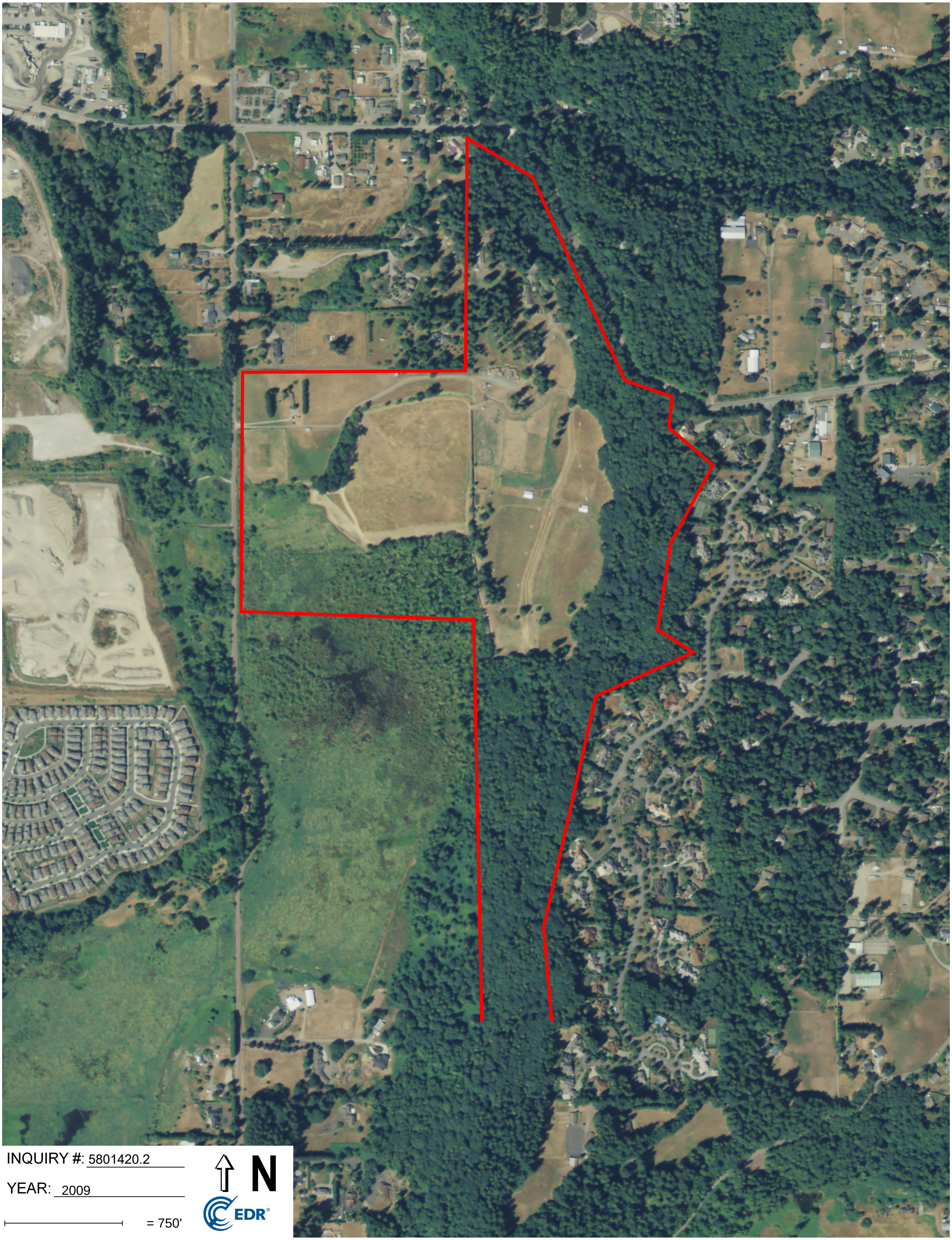
INQUIRY #: 5801420.2

YEAR: 2006

= 750'

N

EDR®



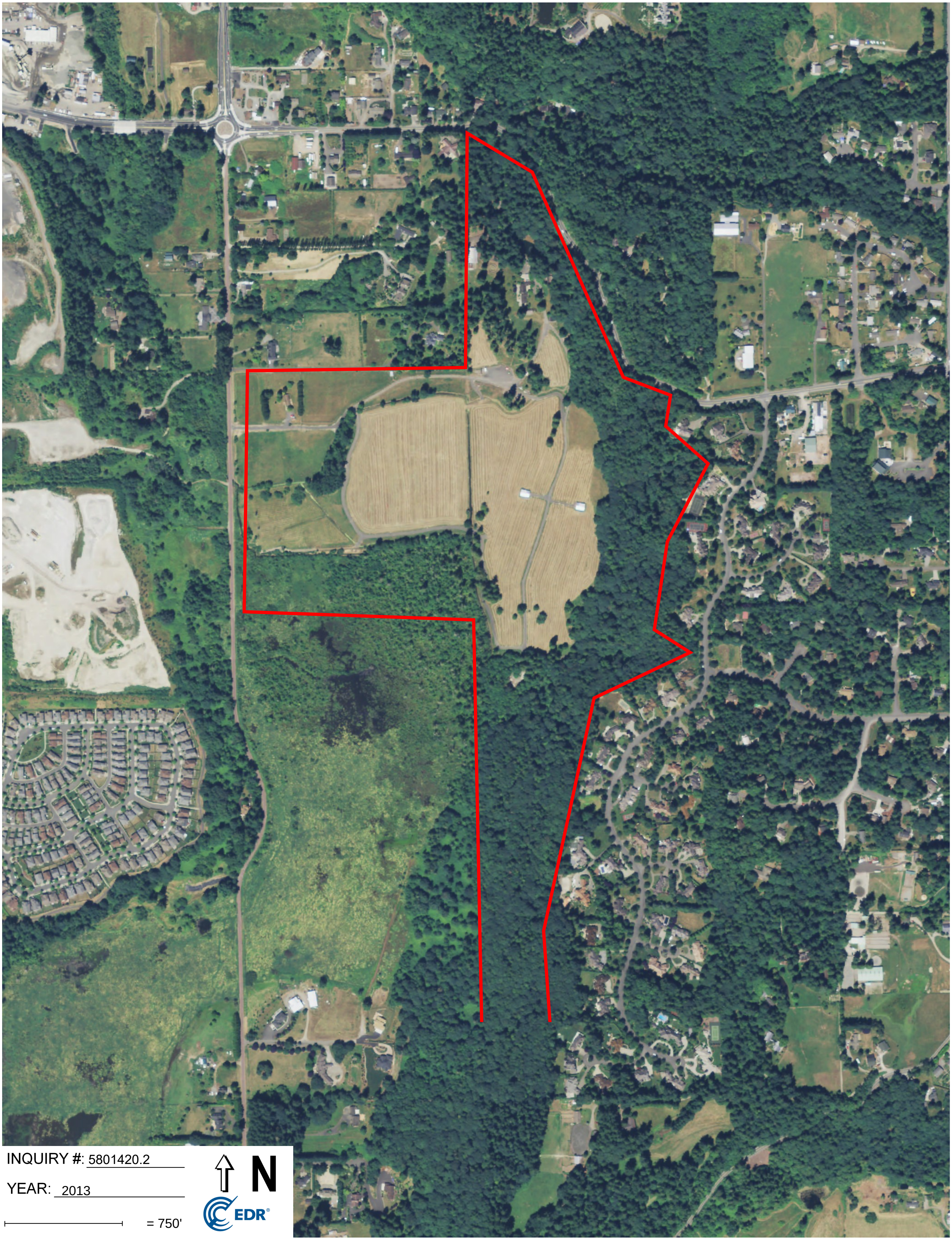
INQUIRY #: 5801420.2

YEAR: 2009

= 750'

N

EDR



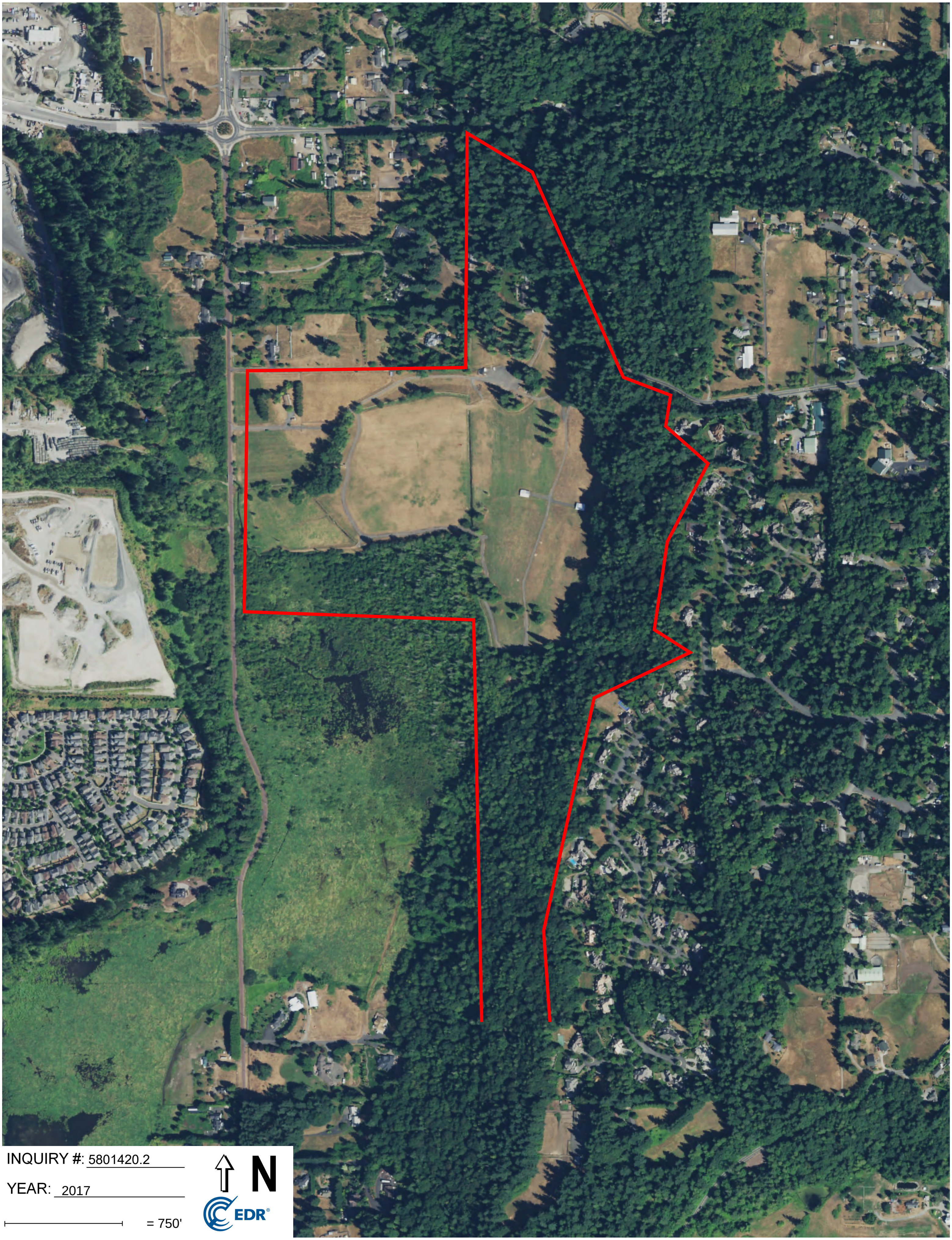
INQUIRY #: 5801420.2

YEAR: 2013

= 750'

N

EDR



INQUIRY #: 5801420.2

YEAR: 2017

= 750'

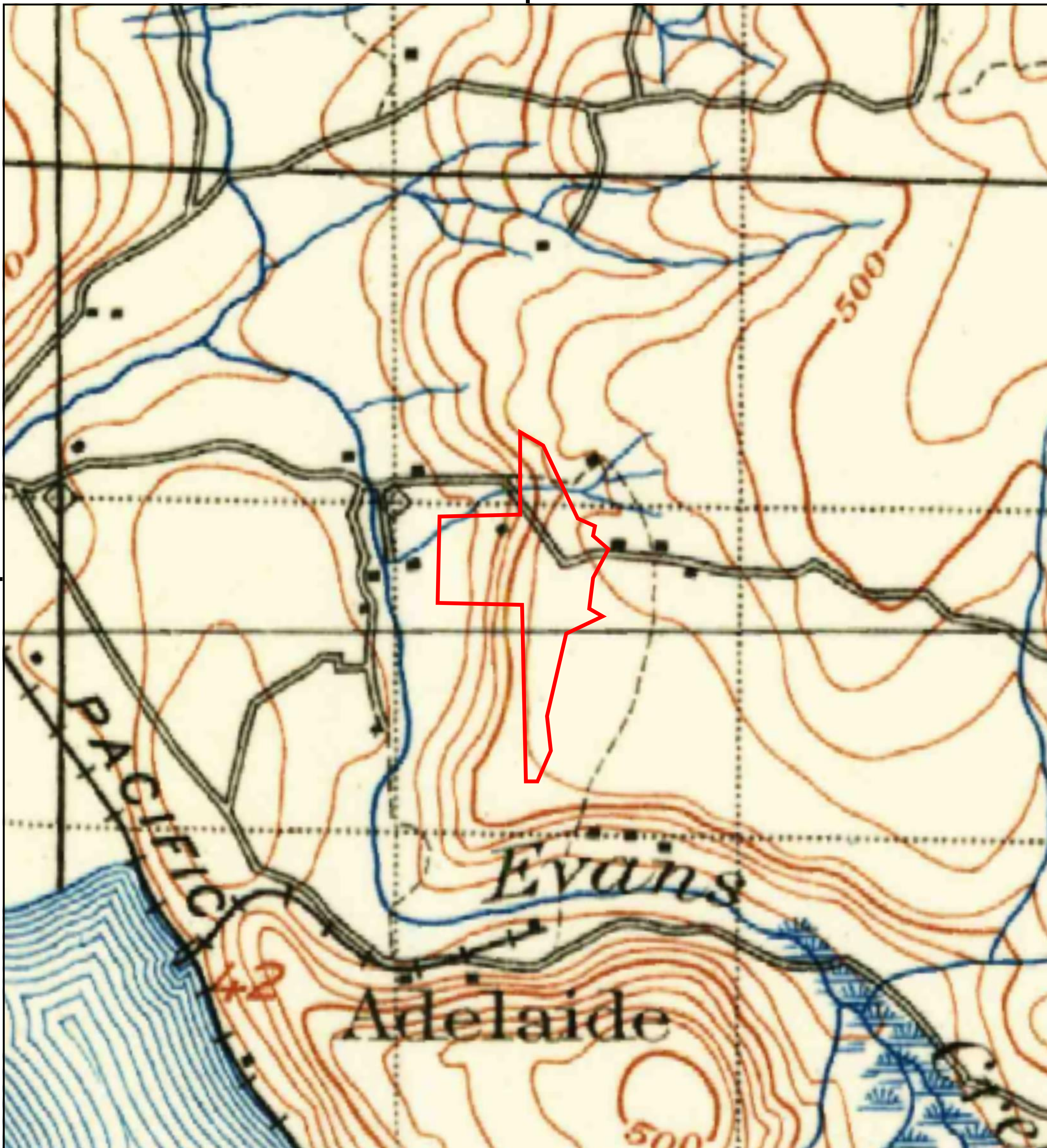
N

B

Topographic Maps

Historical Topo Map

1895



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

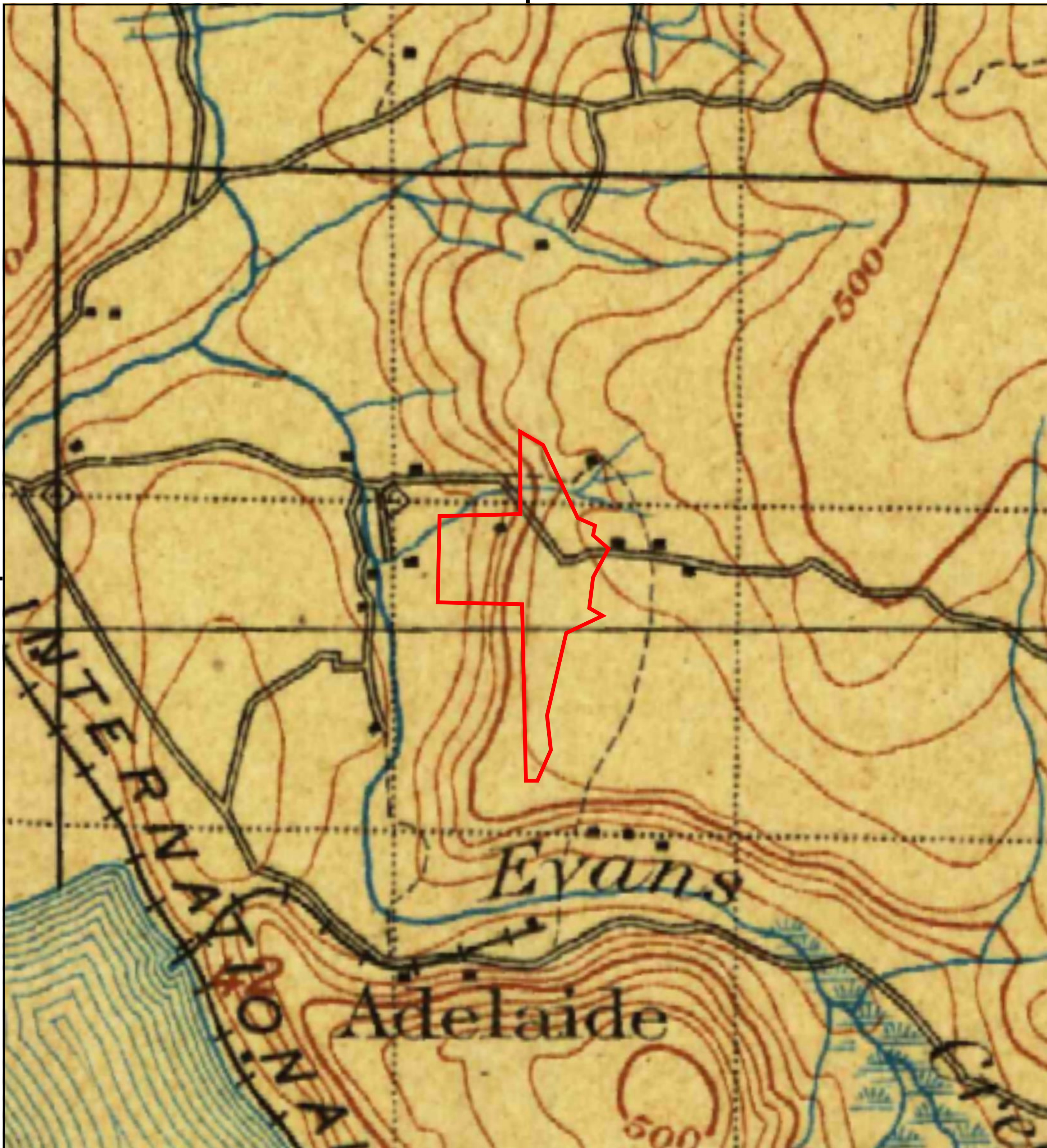
TP, Snohomish, 1895, 30-minute

SITE NAME: Gunshy Manor
ADDRESS: 7240 196th Ave NE
Redmond, WA 98053
CLIENT: Ecology and Environment

N

Historical Topo Map

1897



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

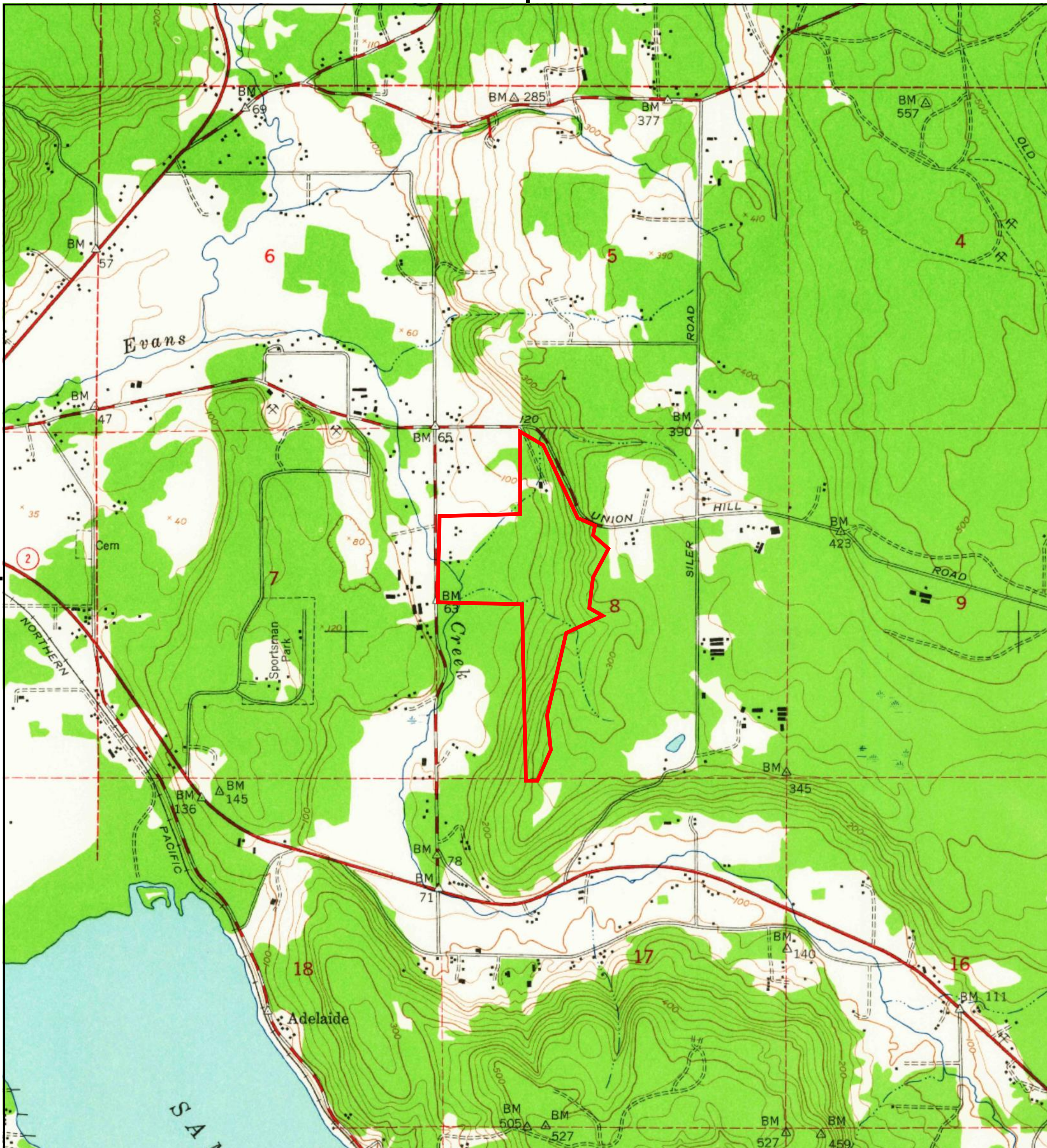
TP, Seattle, 1897, 30-minute
TP, Snohomish, 1897, 30-minute

SITE NAME: Gunshy Manor
ADDRESS: 7240 196th Ave NE
Redmond, WA 98053
CLIENT: Ecology and Environment

N

Historical Topo Map

1950



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0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

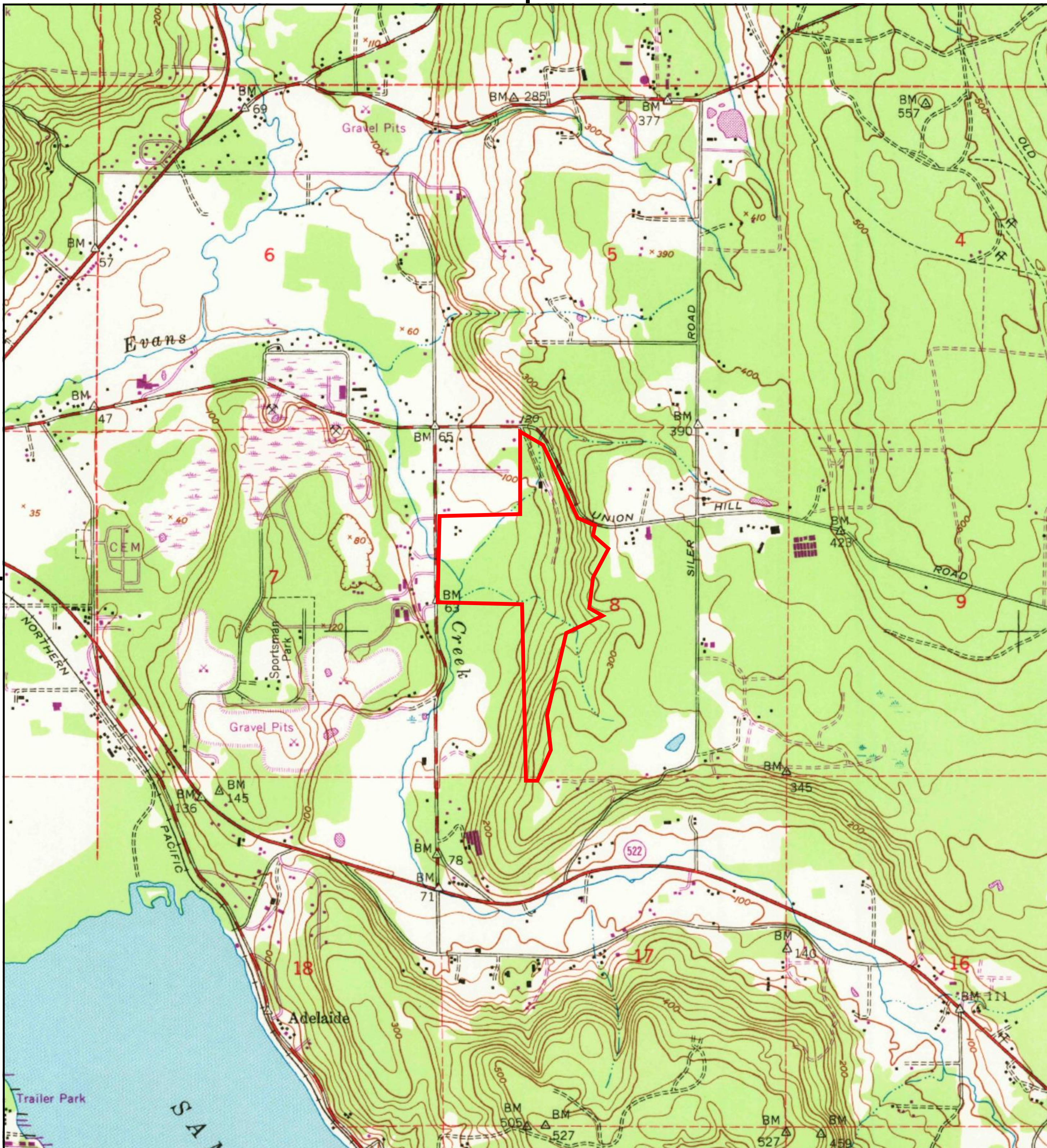
TP, Redmond, 1950, 7.5-minute

SITE NAME: Gunshy Manor
ADDRESS: 7240 196th Ave NE
Redmond, WA 98053
CLIENT: Ecology and Environment

N

Historical Topo Map

1968



0 Miles	0.25	0.5	1	1.5

This report includes information from the following map sheet(s).

NW N NE

W E

SW S SE

TP, Redmond, 1968, 7.5-minute

SITE NAME: Gunshy Manor

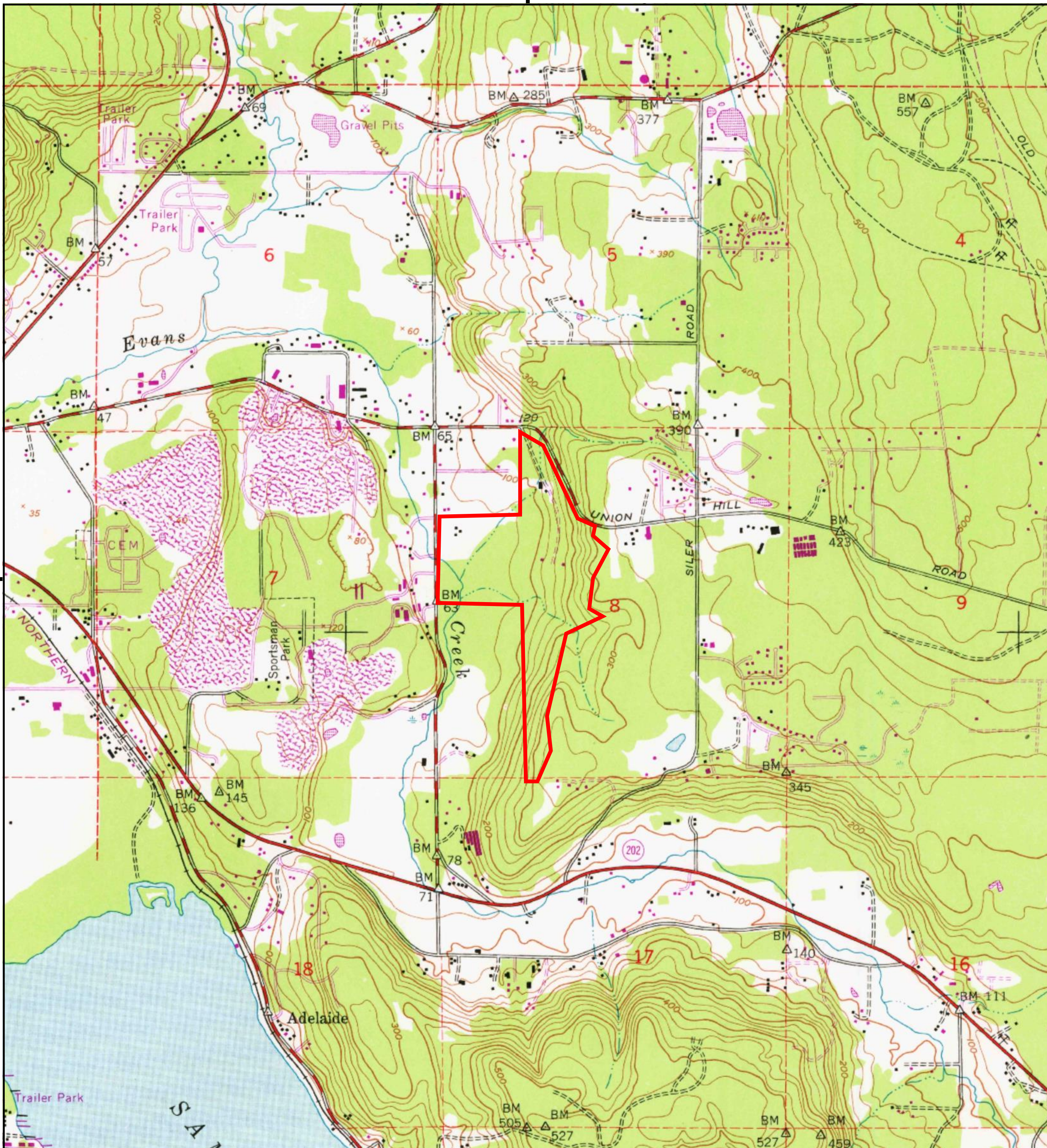
ADDRESS: 7240 196th Ave NE
Redmond, WA 98053

CLIENT: Ecology and Environment

N

Historical Topo Map

1973



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

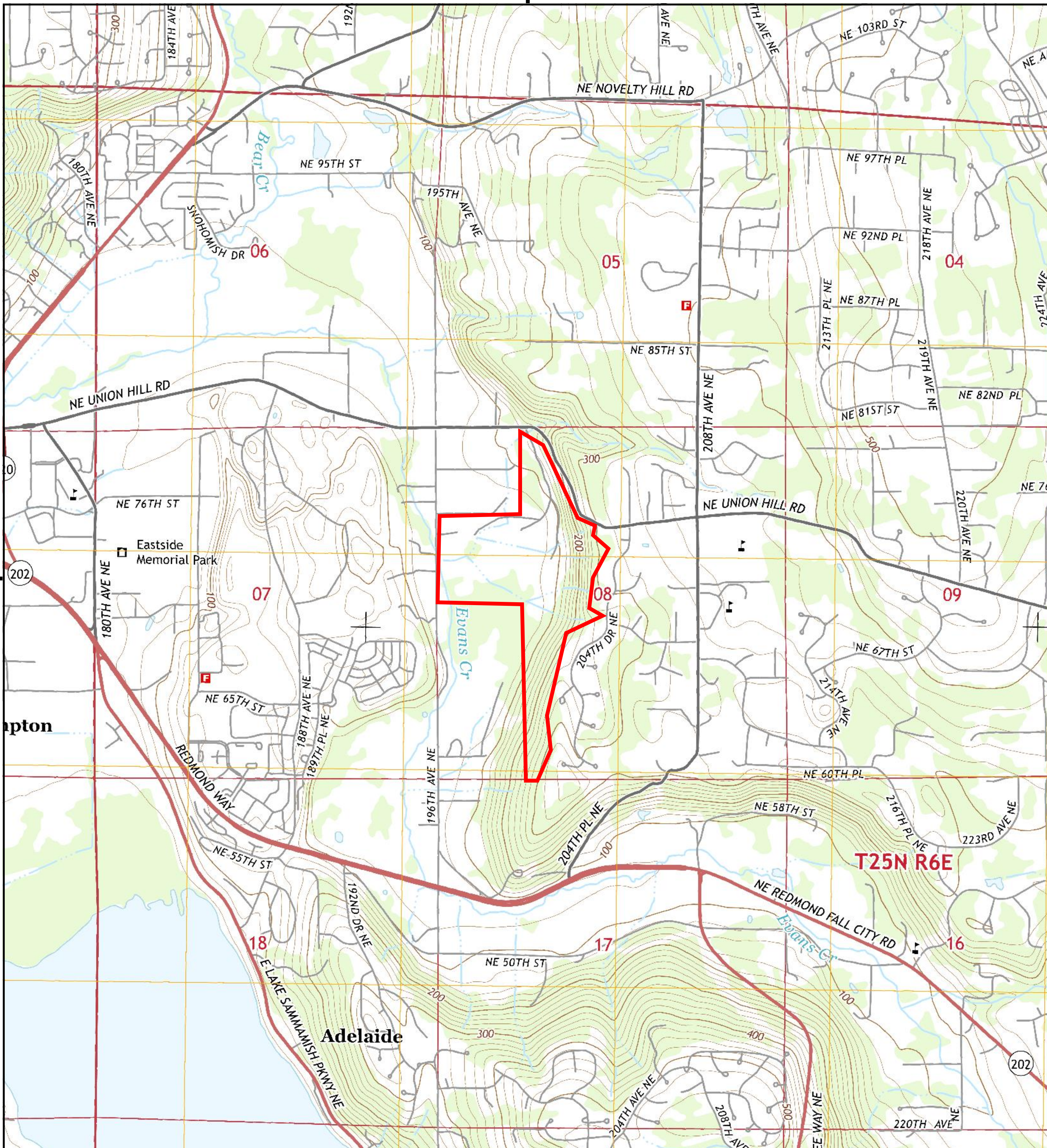
TP, Redmond, 1973, 7.5-minute

SITE NAME: Gunshy Manor
ADDRESS: 7240 196th Ave NE
Redmond, WA 98053
CLIENT: Ecology and Environment

N

Historical Topo Map

2014



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE W E SW S SE

TP, Redmond, 2014, 7.5-minute

SITE NAME: Gunshy Manor
ADDRESS: 7240 196th Ave NE
Redmond, WA 98053
CLIENT: Ecology and Environment

N

C

Sample Plan Alteration Form

SAMPLE PLAN ALTERATION FORM

Project Name and Number: Gunshy Manor, TO-027-009

Materials to be Sampled:

Subsurface soil and groundwater from Thompson Field at the Gunshy Manor site, and groundwater from downgradient off-site monitoring wells located on private property and property owned by the City of Redmond.

Measurement Parameters:

Field sampling for offsite fixed laboratory analysis for the following analytical suites:
Target Analyte List (TAL) metals (including mercury), semivolatile organic compounds (SVOCs) (including polycyclic aromatic hydrocarbons [PAHs]), polychlorinated biphenyls (PCBs), diesel range organics, residual range organics, gasoline range organics, and volatile organic compounds (VOCs).

Standard Procedure for Field Collection and Laboratory Analysis (cite references):

- Borehole Installation and Subsurface Soil Sampling Methods (E & E SOP – Geo 4.7);
- Groundwater Well Sampling (E & E SOP – Env 3.07);
- Surface and Shallow Subsurface Soil Sampling (E & E SOP – ENV 3.13);
- Evaluation of Existing Monitoring Wells (E & E SOP – GEO 4.19);
- Collecting Soil and Sediment Samples for VOC Analysis (E & E SOP – ENV 3.25);

- Diesel Range Petroleum Hydrocarbons in soil and water (NWTPH-Dx)
- Gasoline Range Hydrocarbons in soil and water (NWTPH-Gx)
- PCBs in soil and water (EPA CLP SOW SOM02.4)
- SVOCs/PAHs in soil and water (EPA CLP SOW SOM02.4)
- TAL Metals including Mercury in soil and water (EPA CLP SOW ISM02.4)
- VOCs in soil and water (EPA CLP SOW SOM02.4)

Reason for Change in Field Procedure or Analytical Variation:

Groundwater Sampling:

The sampling and quality assurance plan (SQAP) specified that one groundwater monitoring well would be sampled at a private residence and two groundwater monitoring wells would be sampled at Arthur Johnson Park, owned by the City of Redmond. Additionally, groundwater would be collected from six temporary borings located in Thompson Field at the Gunshy Manor site. For both monitoring wells and temporary borings, groundwater would be purged prior to sample collection to allow for water quality parameters to stabilize. A filtered groundwater aliquot would be collected for TAL metals analysis only if turbidity did not reduce below 50 nephelometric turbidity units (NTUs).

Subsurface Soil Sampling:

Temporary borings were to be advanced up to 15 feet below ground surface (bgs) utilizing a truck-mounted direct push drilling technique. Up to three subsurface soil samples would be collected from each boring.

Variation from Field or Analytical Procedure:

Groundwater Sampling:

While sampling the groundwater monitoring well located at the private residence, the property owner indicated that there was a second well on the property. This well was a drinking water well that had not been in service since the property had been connected to the Union Hill Water Association. The property owner did not know the length of time the well had been out of service. After confirming with the EPA TM, the well was sampled.

SAMPLE PLAN ALTERATION FORM

For the temporary borings located in Thompson Field, filtered groundwater aliquots were collected for TAL metals analysis even though turbidity reduced to below 50 NTUs.

Subsurface Soil Sampling:

Due to the wet and soft field conditions that prevented accessing some proposed borehole locations with the truck-mounted direct push drill rig, non-dedicated hand auger was utilized to collect subsurface soil samples from two boreholes in the northern and one borehole in the center portion of Thompson Field. The hand auger was decontaminated between each borehole. These boreholes could only be advanced up to three feet bgs and did not encounter groundwater. No groundwater samples were collected from the two northern and one center borehole. A single rinsate sample was collected from the hand auger.

Special Equipment, Materials, or Personnel Required:

Hand auger.

CONTACT	APPROVED SIGNATURE	DATE
Initiator: Jeff Fetters	Jeff Fetters	11/20/2019
START SA TL: Linda Ader	Linda E Ader	11/20/2019
EPA TM: Brandon Perkins	BRANDON PERKINS Digitally signed by BRANDON PERKINS Date: 2019.11.21 11:15:43 -08'00'	
EPA QA Manager: Donald M. Brown	DONALD MATHENY Digitally signed by DONALD MATHENY Date: 2019.11.21 11:36:57 -08'00'	