3.0 AFFECTED ENVIRONMENT, POTENTIAL ENVIRONMENTAL IMPACTS, MITIGATION MEASURES, AND SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

3.1 Earth

This chapter describes the geology, soils, topography, hazardous areas, and potential impacts to or resulting from those resources from Alternatives 1 and 2 compared with the No Action Alternative.

This environmental review determined that there would be no significant unavoidable adverse impacts to earth during construction or operation of any of the alternatives.

3.1.1 Regulatory Context

Earth resources are regulated by a combination of state and local regulations. The regulations described below may be incorporated during design of the transfer station and the permitting and approval process.

3.1.1.1 State Regulations

The Washington State Growth Management Act requires that counties and local jurisdictions adopt development regulations that protect the functions and values of critical areas, including geologically hazardous areas. Geologically hazardous areas are defined as:

> "areas that because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns." *[Revised Code of Washington 36.70A.030(20)]*

3.1.1.2 Local Laws, Plans, and Policies

City and county critical areas codes regulate activities that may impact critical or environmentally sensitive resources, such as geologically hazardous areas. The local regulations may vary, but critical areas codes generally specify buffer widths for critical areas, identify those activities requiring permits, and mitigation measures.

The No Action Alternative and Alternative 1 are located in the City of Kirkland. Activities that may impact geologically hazardous areas are regulated by the Kirkland Municipal Code Chapter 85, Critical Areas: Geologically Hazardous Areas. Kirkland regulates geologically hazardous areas, including erosion, landslide, and seismic hazards. Per Chapter 85.12, a site-specific geologic hazard study is required to evaluate if a geologic hazard area actually exists on the site prior to development approval, land surface modification, or utility installation. If a geologic hazard is identified in the study, the study will assess appropriate options for hazard mitigation consistent with Chapter 85.15

Alternative 2 is located in the City of Woodinville. Activities that have the potential to impact geologically hazardous areas at the site would be regulated according to the Woodinville Municipal Code

Chapter 15.05, Site Development Regulations and Chapter 21.51 Critical Areas. Chapter 15.05 includes general site development regulations, with sections applicable to earth, including clearing, grading, slopes, fill, and earthwork construction. Chapter 21.51 addresses geologically sensitive areas including areas susceptible to erosion, sliding, earthquake, or other geological events. Per Chapter 21.51.100, the City of Woodinville will perform a critical area determination and assess whether a critical areas report is required. The critical areas report will include critical areas reports for seismic and other hazard areas.
Chapter 21.51.250 describes the designation for geologically sensitive areas. For areas designated as geologically sensitive due to erosion and landslide hazards, Chapter 21.51.260 required hazard mitigation requirements. Chapter 21.51.270 describes development standards, and report requirements for areas designated as geologically sensitive due to seismic hazard areas and/or other hazard areas. Report requirements include but are not limited to a hazard analysis to describe potential impacts of seismic activity on the site; a geological assessment to describe surface and subsurface geology, hydrology, soils, and vegetation; and a review of site history including landslides, erosion, prior grading, and a description of vulnerability of the site to geologic hazards.

3.1.2 Affected Environment

3.1.2.1 Study Area

The study area for each alternative includes the area within each alternative's site boundary and includes a 500-foot area around each site. The study areas include areas of potential site development and associated development areas as well as the areas immediately adjacent to the sites that may have the ability to impact the geologic landscape of the site in the future.

3.1.2.2 No Action Alternative and Alternative 1

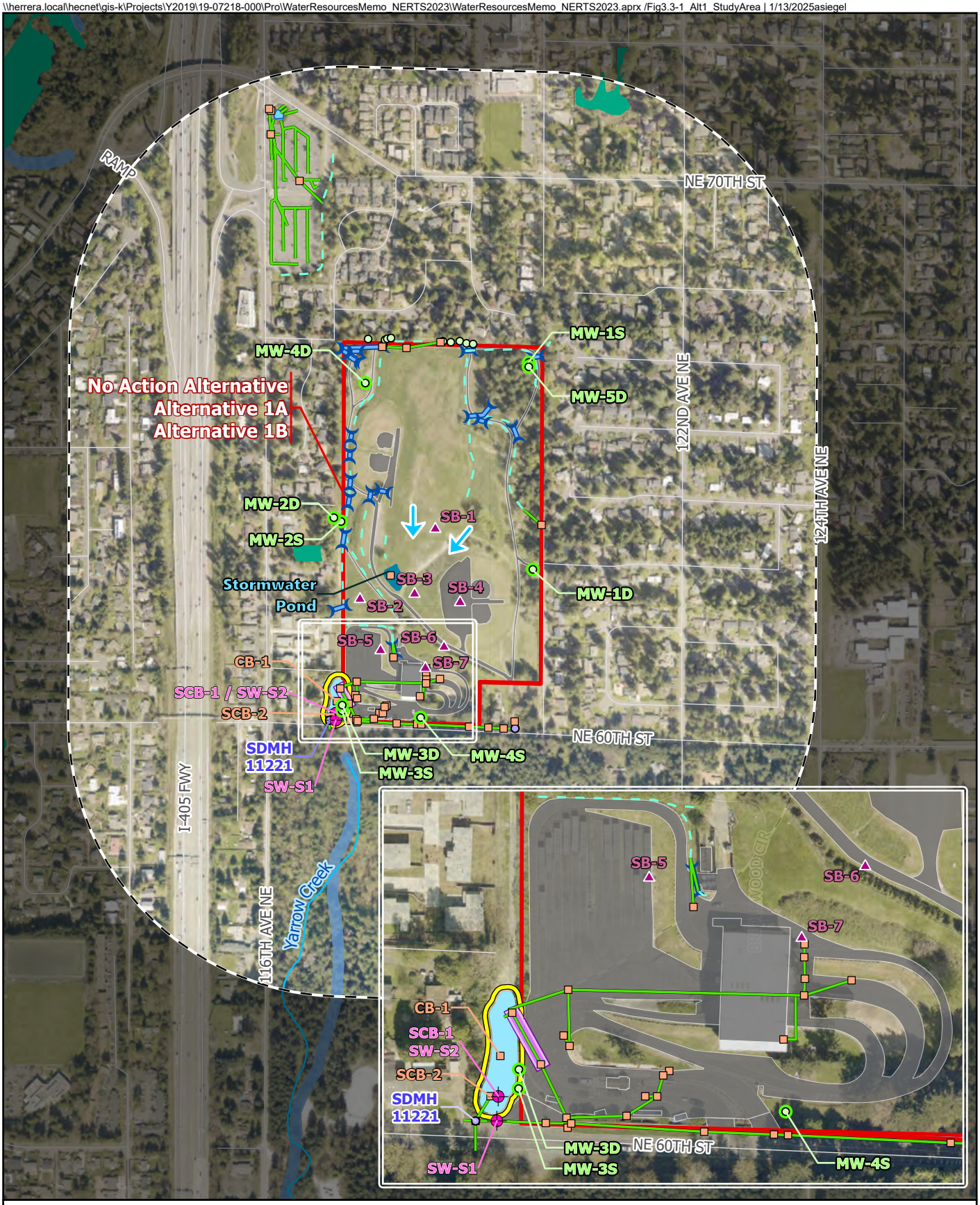
The site for the No Action Alternative and Alternative 1 includes the existing Houghton RTS and closed Houghton landfill property at 11724 NE 60th Street in Kirkland. The study area evaluated encompasses the No Action Alternative and Alternative 1 site plus a 500-foot border around the site, which includes surrounding single-family residences, and the northern portion of Bridle Trails State Park (Figure 3.1-1).

3.1.2.2.1 Geologic Setting and Topography

The study area for the No Action Alternative and Alternative 1 is situated within the Puget Sound Lowland, a wide low-lying area between the Cascade Mountains to the east and the Olympic Mountains to the west. The Puget Sound Lowland is comprised primarily of unconsolidated Quaternary sediments deposited during multiple glacial and interglacial sequences. The glaciation events in the Puget Sound Lowland resulted in multiple glacial drift sequences across the region which create an alternating pattern of coarse- and fine-grained deposits up to 3,000 feet deep. Drift sequences are typically separated by interglacial fluvial and lacustrine deposits or unconformities. Aquifer units in the region are generally comprised of alluvium and coarse-grained deposits whereas fine-grained deposits create semi-confining to confining units (Jones 1999).

3.1.2.2.1.1. Surficial Geology

The Quaternary fine- and coarse-grained unconsolidated deposits of continental glacial drift deposits generally consist of till and outwash clay, silt, sand, gravel, cobbles, and boulders (Qgd) (Figure 3.1-1).



Legend

- Houghton Transfer Station ISGP Sampling Locations
- Groundwater Well
- Houghton Landfill Groundwater Monitoring Locations
- 2024 Soil Boring and Soil Sampling Location
- Catch Basin
- Manhole
- Storm Pipe
- Ditch
- Streams
- Approximate groundwater flow direction*
- Detention Tank
- Stormwater Pond
- Bioretention Swale
- Riverine Wetland
- Wetland (City of Kirkland)
- Existing Impervious Surface
- Alternative Location
- 0.25-mile Study Area

*Groundwater flow directions vary: flow in the shallow perched water-bearing zone varies from north to south to northeast to southwest, and flow in the deeper regional aquifer has more consistent flow to the southwest.

Figure 3.3-1. No Action Alternative, Action Alternative 1A, and Action Alternative 1B Site Existing Conditions.

N

PLAN

SCALE: 1" = 950'-0"

0 475 950

Feet

King County

According to Washington Department of Natural Resources (WDNR) maps, within the Qgd formation, the surficial geology of the No Action Alternative and the Alternative Action 1 study areas is primarily Vashon drift till (Qvt) deposited during the Fraser Glaciation, 10,000 to 30,000 years ago (Figure 3.1-3) (WDNR 2023). Qvt is generally sandy and may include poorly sorted clay, silt, sand, pebbles, cobbles, and boulders in varying amounts. Qvt is frequently hard lodgment till ("hardpan") which retards internal drainage in the formation, causing water to move laterally along the hardpan surfaces (WDNR 2023). Site documents, however, indicate glacial till is not observed at the site. The observed absence of Qvt is reported as potentially due to suspected erosion or gravel mining at the closed Houghton landfill site occurring roughly during the 1960s prior to its use as a landfill (KCSWD 2020, King County 2002).

The observed surficial geology of the site consists of Vashon advance outwash deposits from the Fraser Glaciation (Qva) (Figures 3.1-2, 3.1-3, 3.1-4). Qva, which generally underlies Qvt, is typically a thick section of clean pebbly sand with an increasing gravel content higher in the section. Lower portions of the unit contain fine grained sand and some silt. In general, the sediments of the Qva unit coarsen upwards, corresponding to the withdrawal of the sediment source. Qva is a clean sand and gravel unit and is one of the thickest and most extensive aquifers in the Puget Sound region. It is well drained and provides a stable foundation (WDNR 2023). Historical site reports indicate Qva is the primary exposed geological surface unit across the study area and underlying the refuse associated with the closed Houghton landfill (King County 2002).

In response to comments on the DEIS, King County SWD conducted a Soil Boring Investigation (SBI) to characterize the nature, location, and depth of buried municipal solid waste (MSW) and soil at a portion of the Houghton Custodial Landfill (Site) where Alternative 1 redevelopment could occur. Specifically, the SBI helps characterize MSW and soil within the potential site development areas and at potential excavation depths of options A and B for Action Alternative 1. Detailed results are presented in the revised NERTS Hazardous Materials Assessment in Appendix C, and summarized in Section 3.4 of this Final EIS. A summary of soil and refuse descriptions is included below.

The SBI included completing seven soil borings (SB) with a hollow-stem auger drill rig, collecting samples of refuse and soil at five-foot intervals until native soils underlying the refuse were encountered, field screening refuse and soil for potential contamination, and submitting samples for laboratory analysis of contaminants of interest.

All seven borings contained silty, sandy soils, which were interpreted as clean fill cover material with no indications of refuse, to depths ranging from ground surface to 3.5-feet below ground surface (bgs) at SB-7 and 15-feet bgs at SB-1. Native soils, marking the bottom layer of refuse, were encountered between 13.5-feet bgs at SB-4 and 35-feet bgs at SB-1. Refuse thickness varied from 5-ft at SB-4 to 24-ft at SB-2. No refuse was encountered at SB-7, which was near the northeast corner of the existing transfer station building. In general, the thickness of refuse appears to decrease from the central portion of the landfill northward and westward. Cross-sections showing results of the soil borings are in Figures 3.1-2, 3.1-3, and 3.1-4 below.

Refuse was encountered in a matrix of brown to gray silty sand or sandy silt, which is consistent with the historical use of excavated material for daily cover (KCSWD 2020a). Refuse in all borings was similar to refuse encountered during previous soil boring investigations, and included wood debris, ash, newspaper, glass, porcelain, brick, aluminum and aluminum foil, tin, a copper necklace and copper wire, steel nails and wire, rubber, hard plastic and plastic film, cloth, cured adhesive/glue, and a cigarette filter. Several soil samples exhibited a slight petroleum-, solvent-, or creosote-like odor. In addition, field screening was conducted with a handheld photo-ionization detector (PID) that detects the presence of VOCs such as benzene in gasoline or solvents. For some samples, the field screening indicated low PID readings, which indicates potential contamination with VOCs.

3.1.2.2.1.2. Soils

According to the National Resources Conservation Service (NRCS), the central entirety of the No Action Alternative and Alternative 1 site, including the existing structures of the existing Houghton RTS, is directly underlain by the capped former landfill and designated as Pits (Figure 3.1-5) (NRCS 2023). The lateral edges of the study area are underlain by Alderwood soils (AgC and AmC).

Fill and topsoil cover the former landfill located at the site. The final topsoil cap was placed in 1970, with additional filling in 1972 and filling and grading intermittently between 1974 and 1997. Topsoil material included “clayey-swampy fill” imported from the construction of Highway 520 (Ecology 2022).

Alderwood soils contain gravel, sand, and loam and are found on slopes of 6 to 15 percent. This soil is moderately well drained and has a low capacity to retain water. The soil is classified as Hydrologic Soil Group B which indicates it is well drained with moderate rates of water transmission (NRCS 2023).

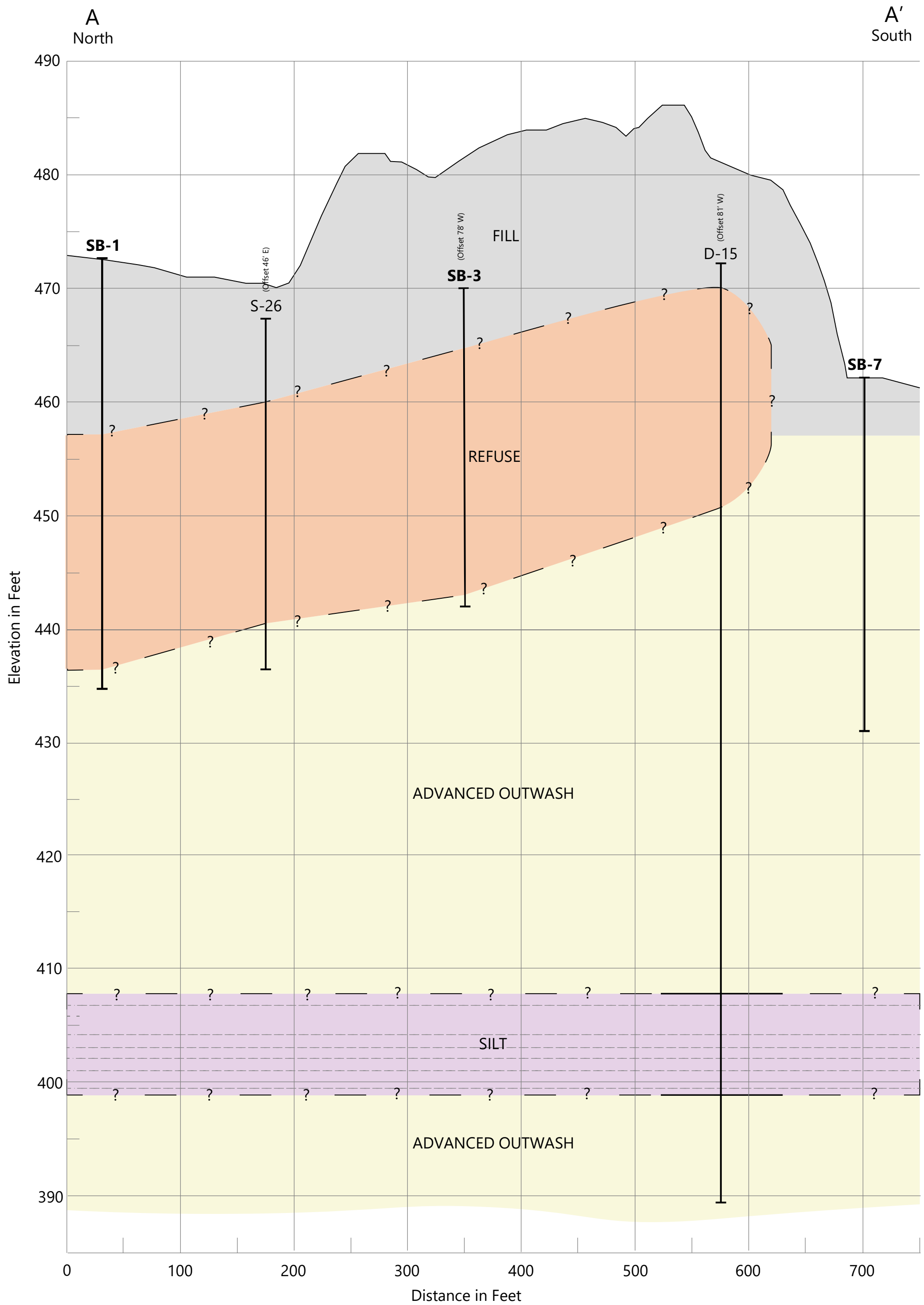
As discussed in the previous section, the results of the SBI indicate that where refuse is encountered, it is mixed with brown to gray silty sand or sandy silt; components of refuse are discussed in Section 3.1.2.2.1.1.

3.1.2.2.1.3. Topography

Based on a review of the U.S. Geological Survey (USGS) topographic maps, the study area is 400 to 500 feet above mean sea level (AMSL), and the No Action Alternative and Alternative 1 site is 420 to 500 feet AMSL. In general, the study area gently slopes downward to the west (USGS 2023) (Figure 3.1-6). In the south-southeastern portion of the project site area, there are localized areas of steeper slopes at approximately 35 to 75 percent.

3.1.2.2.1.4. Environmentally Sensitive Areas and Seismic Hazards

The study area is located within the seismically active Puget Sound region. Within the study area for the No Action Alternative and Alternative 1 site, there are no areas categorized as an environmentally sensitive area due to potential landslide hazards or 50-foot proximity to potential landslide hazards, potential erosion hazards, or seismic hazards (King County 2023g) (Figure 3.1-6).



Legend

- Fill
- Refuse
- Advanced Outwash (Qva): dense sand with gravel and silt
- Silt
- (Offset #' W) Offset Distance and Direction from Profile
- SB-# Soil Boring Identification
- Water Table

Notes and References

Elevation Datum: NAVD 88

Ground Surface Data Source:
Photogrammetry with 2' Contours by GeoTerra; October 29, 2019.

D-15 and S-26 Data Source:
Associated Earth Sciences Inc. (AESI),1996. "Basis of Design Memorandum: Landfill Gas Collection and Treatment System Expansion."

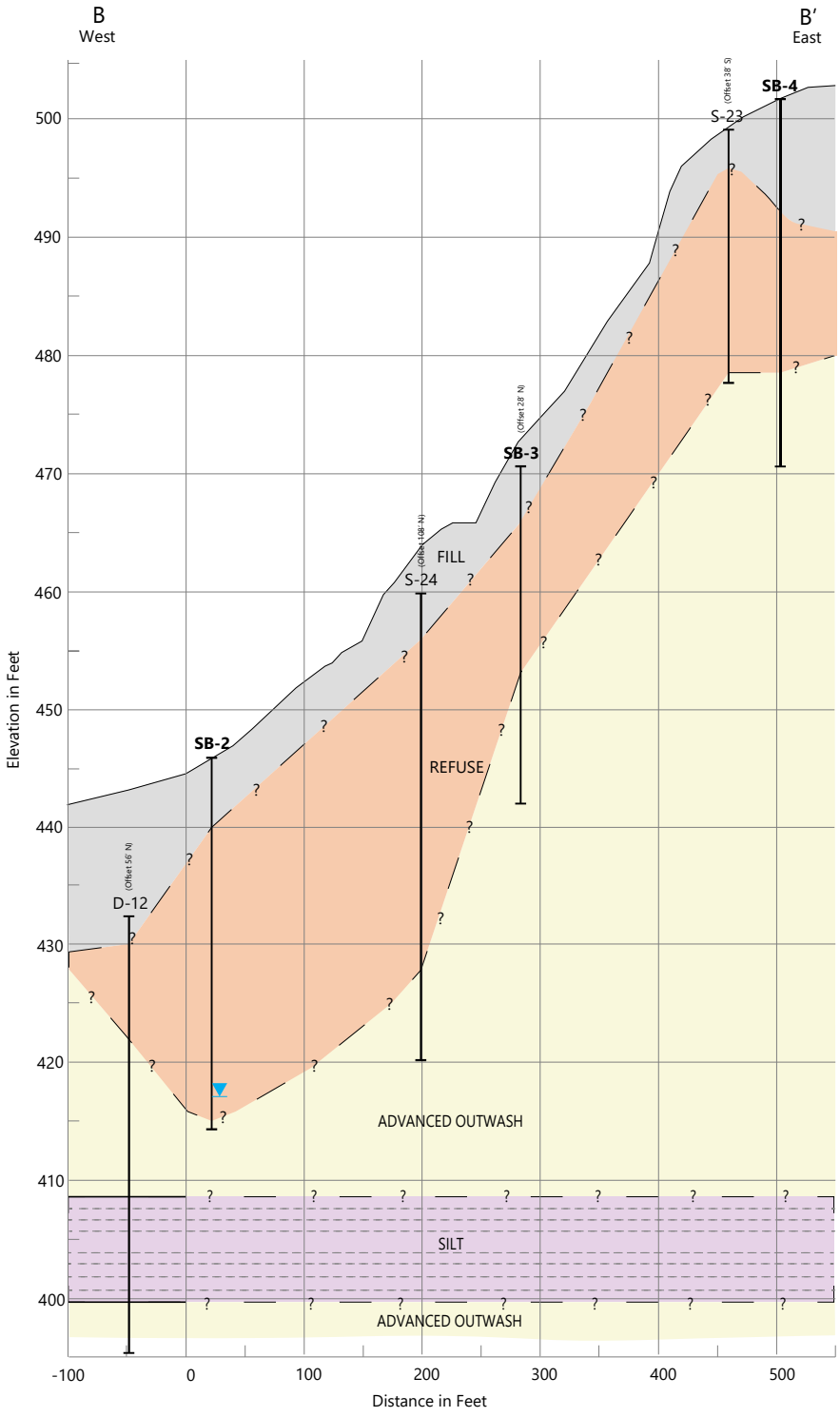
Some borings appear to be lower than the ground surface because they are offset from the cross section alignment.

Figure 3.1-2. Geologic Cross Section A-A', Alternative 1 Proposed Project Site.
Northeast Recycling and Transfer Station Project

HORIZONAL SCALE 1" = 100'
VERTICAL SCALE 1" = 10'
VERTICAL EXAGGERATION 10X

0 50 100 Feet

King County



Legend

- Fill
- Refuse
- Advanced Outwash (Qva): dense sand with gravel and silt
- Silt
- (Offset # W) — Offset Distance and Direction from Profile
- SB-# — Soil Boring Identification
- Water Table

Notes and References

Elevation Datum: NAVD 88

Ground Surface Data Source:
Photogrammetry with 2' Contours by GeoTerra; October 29, 2019.

D-12 Source:
Associated Earth Sciences Inc. (AESI),1996. "Basis of Design Memorandum: Landfill Gas Collection and Treatment System Expansion."

S-23 and S-24 Source:
Converse Consultants NW (Converse), 1995. "Technical Memorandum Gas Treatment Technology Evaluation Houghton Custodial Landfill Kirkland, WA."

Some borings appear to be lower than the ground surface because they are offset from the cross section alignment.

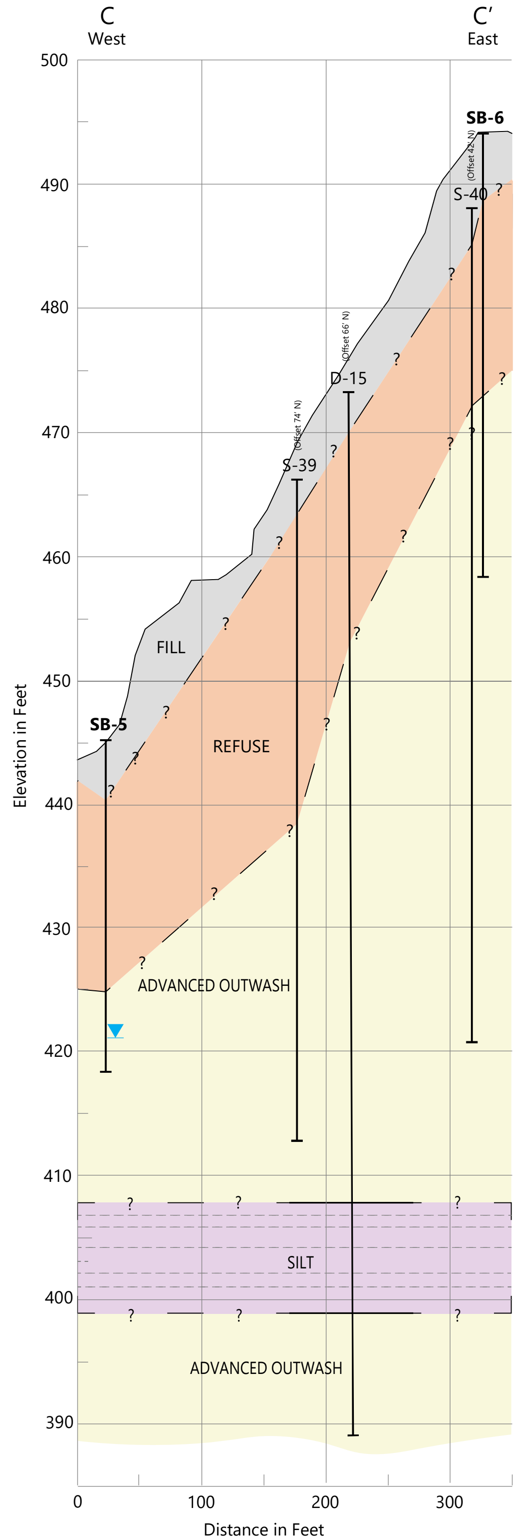
Figure 3.1-3. Geologic Cross Section B-B', Alternative 1 Proposed Project Site.
Northeast Recycling and Transfer Station Project

HORIZONAL SCALE 1" = 100'
VERTICAL SCALE 1" = 10'
VERTICAL EXAGGERATION 10X

0 50 100 Feet

King County

Author: lhicks Date: 12/9/24 File Path: Q:\proj\2019\19-07218-000\Draft Graphics\NERTS_ReportFigures



Legend

Fill

Refuse

Advanced Outwash (Qva): dense sand with gravel and silt

Silt

(Offset #′ W) Offset Distance and Direction from Profile

SB-# Soil Boring Identification

Water Table

Notes and References

Elevation Datum: NAVD 88

Ground Surface Data Source:
Photogrammetry with 2′ Contours by GeoTerra; October 29, 2019.

D-15, S-39, and S-40 Source:
Associated Earth Sciences Inc. (AESI),1996. "Basis of Design Memorandum: Landfill Gas Collection and Treatment System Expansion."

Some borings appear to be lower than the ground surface because they are offset from the cross section alignment.

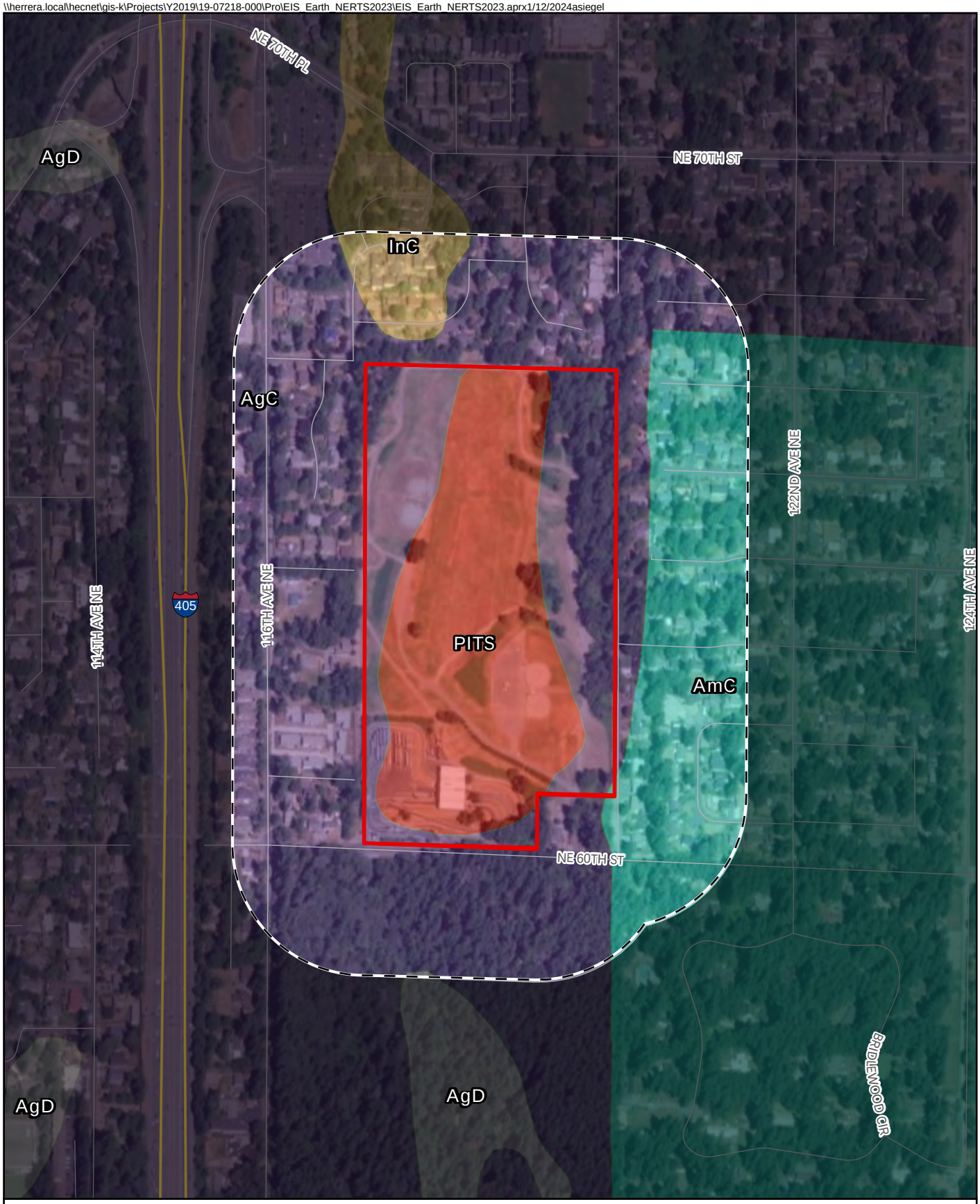
Figure 3.1-4. Geologic Cross Section C-C′, Alternative 1 Proposed Project Site.
Northeast Recycling and Transfer Station Project

HORIZONAL SCALE 1" = 100′
VERTICAL SCALE 1" = 10′
VERTICAL EXAGGERATION 10X

0 50 100
Feet

King County

Author: lholtz Date: 12/9/24 File Path: O:\proj\Y2019\19-07218-000\Draft_Graphics\NERTS_ReportFigures



Legend

- Alternative Location
- 500-ft Site Buffer
- Waterbody

Soil Type

- AgC - Alderwood gravelly sandy loam, 8 to 15 percent slopes
- AgD - Alderwood gravelly sandy loam, 15 to 30 percent slopes
- AmC - Arents, Alderwood material, 6 to 15 percent slopes
- InC - Indianola loamy sand, 5 to 15 percent slopes
- PITS - Pits

Figure 3.1-5. Surface Soils in the Vicinity of Action Alternative 1.

N
PLAN

SCALE: 1" = 750'-0"

0 375 750 Feet

King County

Legend

- Alternative Location
- 500-ft Study Area
- 50-ft Elevation Contour (AMSL)
- 10-ft Elevation Contour (AMSL)
- Waterbody
- Erosion Hazard

Figure 3.1-6. Site Topography in the Vicinity of Action Alternative 1.

N
PLAN

SCALE: 1" = 750'-0"

0 375 750 Feet

King County

In 1990, King County developed the Sensitive Area Ordinance (SAO) to protect environmentally sensitive features, such as wetlands, streams, and steep slopes in King County (King County 1990). There are no geologically related features in the study area that are classified as environmentally sensitive areas based on the 1990 SAO.

Landslides and Landslide Hazards

Landslides are a type of mass wasting event that occur when a slope destabilizes. Landslides include a variety of earth movements, including debris flows, slope failures, rockfalls, and mudflows. Landslides occur under a variety of circumstances, including slope failure following heavy rainfall or an earthquake or destabilization following reduced land vegetation. The study area for the No Action Alternative and Alternative 1 site is not located within a potential landslide hazard area or within a 50-foot buffer zone of a potential landslide hazard area (King County 2023g). The study area is not within a mapped river corridor and there are no recorded historical landslides, debris flows, fans, or debris flows. There are no potential steep slope hazards indicated for the study area, but some areas of sloped landscape features are indicated throughout the study area, particularly in the southern portion of the No Action Alternative and Alternative 1 site (Figure 3.1-6).

Erosion Hazards

Erosion is the geological process in which materials such as soil or rock on the earth's surface are naturally broken down and transported to a new location, often by wind or water. The study area is not in an area indicated to be prone to severe to very severe erosion hazards (King County 2023g).

Liquefaction Hazards

Liquefaction occurs when vibration or shaking of the ground increases pore pressure in saturated silty and sandy subsurface layers to result in a near total loss of shear strength in these layers. Liquefaction can result in the expulsion of sediment at the ground surface, extensive ground settlement or heaving, horizontal land displacement, and localized flooding. In general, materials susceptible to liquefaction include saturated, loose to medium-dense sands, particularly those below the water table. The liquefaction susceptibility within the study area is categorized as very low (WDNR 2023) (Figure 3.1-7).

Faults and Folds

The study area for the No Action Alternative and Alternative 1 site is situated between two fault zones within the Puget Lowland: the Southern Whidbey Island Fault Zone (SWIF) to the north, and the Seattle Fault Zone (SFZ) to the south. (Figure 3.1-7). The SWIF is a series of closely spaced northwest striking faults and the SFZ consists of a series of closely spaced east-west faults. There is no indication that any traces from the SWIF or SFZ underlie the study area, therefore the study area would not be subject to surface fault rupture hazards associated with either of the fault zones. Mapping by WDNR shows the closest location of the SWIF to the study area is about 3.6 miles to the northwest. The SFZ is approximately 5.1 miles to the south of the study area (WDNR 2023).

Legend

- Alternative Locations
- Waterbody
- Bedrock
- Peat

Seismogenic Faults
- Inferred Fault Trace
- Visible Fault Trace

Liquefaction Susceptibility
- High
- Moderate - High
- Moderate
- Low - Moderate
- Low
- Very Low - Low
- Very Low

Figure 3.1-7. Seismic Hazards in the Vicinity of Action Alternatives.

PLAN

SCALE: 1" = 12,500'-0"

0 6,250 12,500 Feet

King County

Seismic Hazards

The Puget Sound region is susceptible to substantial seismic hazard. The size and intensity of an earthquake and its effects are measured in several ways, including the moment magnitude scale (Mw), the Richter magnitude, and the Modified Mercalli Intensity Scale (MMI). The Mw scale, similar to the Richter magnitude but more commonly used, is used to provide an estimate of earthquake size. The largest recorded earthquakes on earth exceed a moment magnitude of M9.

The MMI describes the intensity, or measure of shaking, of an earthquake at a given location. The MMI varies from place to place and depends on several factors. The MMI at a location largely depends on the distance from the fault rupture area, the direction of the fault rupture, and the surface geology at a location. The MMI scale ranges from 1 (shaking not felt) to 10+ (extreme shaking felt). The MMI categorizes potential damage associated with an earthquake beginning with very light potential damage for a MMI 5, up to very heavy damage for a MMI 10+.

Within the Puget Sound Lowland, there are substantial seismic hazards associated with the regional Cascadia Subduction Zone (CSZ). According to seismic scenarios for the CSZ, the No Action Alternative and Alternative 1 study area are projected to experience an MMI of 7, which would correspond to very strong shaking. An MMI of 7 would create variable damage depending on design and construction. Damage would be negligible for buildings of good design and construction and considerable damage would occur in poorly built or badly designed structures. In addition to the CSZ, there are more localized fault zones throughout the region and King County, including, but not limited to the Seattle Seismic Zone (SSZ) and the Southern Whidbey Island Seismic Zone (SWIF), described above (WDNR 2023).

Based on the King County 1990 SAO, the study area for the No Action Alternative and Alternative 1 is not located in an environmentally sensitive seismic hazard area (King County 1990). A significant seismic hazard area would indicate the area is at severe risk of earthquake damage as a result of seismically induced settlement or soil liquefaction.

3.1.2.3 Alternative 2

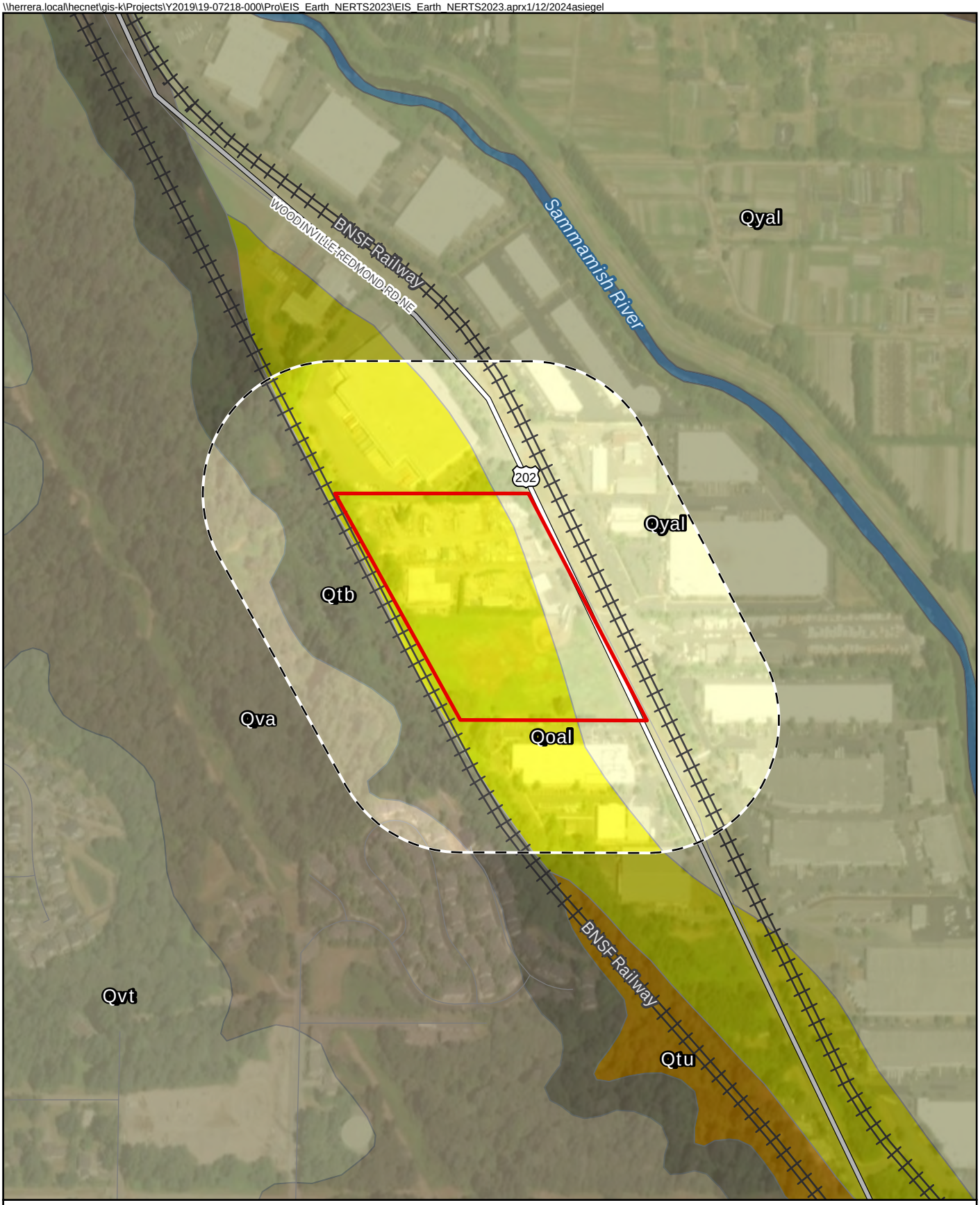
The site for Alternative 2 includes warehouses and commercial businesses in the northern half of the site, and a vegetated wetland in the southern half of six tax parcels in the 15000 block of Woodinville-Redmond Road NE in Woodinville. The study area evaluated encompasses the Alternative 2 site plus a 500-foot border around the site, which includes a portion of an industrial warehouse to the north, Highway 202 and a private school and warehouses to the east, warehouses to the south, and a vegetated sloping area to the west (Figure 3.1-8).

3.1.2.3.1 Geologic Setting and Topography

The study area for the Alternative 2 site is situated in a similar geologic setting in the Puget Sound Lowland as the No Action Alternative and the Alternative 1 study area, except where noted in the following sections.

3.1.2.3.1.1. Surficial Geology

Surficial geology at the Alternative 2 study area is comprised of sediments from the Quaternary alluvium (Qa) formation. Qa is largely unconsolidated or semi-consolidated clay, silt, sand, gravel, or cobble alluvium. Local deposits of Qa may include modified land and artificial fill. Younger alluvium (Qyal) occurs closer to the Sammamish River, in the eastern portion of the study area and older alluvium (Qoal) occurs in the western portion of the study area (Figure 3.1-8) (WDNR 2023).



Legend

- Alternative Location
- 500-ft Study Area
- Geologic Cross Section
- Waterbody

Quaternary Alluvium (Qa)

- Qyal - younger alluvium (Holocene)
- Qoal - older alluvium (Holocene)

Pleistocene Continental Glacial Drift (Qgd)

- Qva - advance outwash, Vashon Drift, Fraser Glaciation (Pleistocene)
- Qvt - till, Vashon Drift, Fraser Glaciation (Pleistocene)
- Qtb - transitional beds, Fraser Glaciation to pre-Fraser Glaciation (Pleistocene)
- Qtu - till, undivided, pre-Fraser Glaciation (Pleistocene)

Figure 3.1-8. Surficial Geology in the Vicinity of Action Alternative 2.

N

PLAN

SCALE: 1" = 750'-0"

0 375 750 Feet

King County

The Qyal that occurs in the surficial geology of the eastern approximate one-third of the site is poorly drained fluvial sediments of the Sammamish River floodplain. Qyal is predominantly sand with some mud and peat. Qyal deposits can be up to 12 meters thick.

The surficial geology of the western two-thirds of the site is older alluvium (Qoal). Qoal along the sides of the Sammamish River Valley is mostly sand and gravel with silt. Qoal is one to 10 meters thick and can form terraces along the valley sides.

Immediately adjacent to the west of the Alternative 2 site surficial geology is comprised of quaternary (Pleistocene) glacial drift (Qgd) formation sediments. Qgd includes glacial till and outwash of fine- to-coarse sediments. Peat, modified land, and artificial fill may be observed in the formation surficial geology. Qgd includes transitional beds (Qtb) of clay, silt, and fine sand which can grade upward or sharply transition into Vashon advance outwash (Qva). For the description of Qva, see Section 3.1.2.2.1.1.

3.1.2.3.1.2. Soils

Based on the United States Department of Agriculture (USDA) Natural Resources Conservations Service (NRCS) Web Soil Survey (WSS), he entire study area for Alternative 2 is underlain by Indianola loamy sand (InC) (Figure 3.1-9). InC contains loamy sand underlain by sand and is commonly found on slopes of 5 to 15 percent. This soil is somewhat excessively drained and has a very low capacity to retain water. The soil is classified as Hydrologic Soil Group A, indicating it has a high rate of water transmission, which results in a low runoff potential (NRCS 2023).

The western portion of the study area is underlain by Alderwood gravelly sandy loam, 15 to 30 percent slopes (AgD). AgD, which is primarily very gravelly sandy loam, is sourced from glacial deposits and typically forms hills and ridges at a slope of 15 to 30 percent. The soil is moderately well drained. The eastern portion of the study area is developed on Earlmont silt loam (Ea). The Ea unit, within the floodplain immediately adjacent to the west and east of the Sammamish River, is somewhat poorly drained.

Limited site-specific sub-surface investigations have previously been performed within the study area. Directly east of the study area at 15902 Woodinville Redmond Road Northeast (Tax Parcel 152605-9053), soil borings indicated subsurface soils were primarily silty sand. A water-bearing unit of silty sand and gravel produced groundwater between 5 and 12 feet bgs (ATC 2018). Also, to the east of the study area at 15800 Woodinville Redmond Road NE (Tax Parcel 152605-9063), records indicate that in general, three to four feet of fill material overlies two to three feet of silty-clay. The silty-clay overlies a medium-dense silty-sand that extends to ten feet bgs, which is the extent of the exploration (EAI 1993). The general transition of finer silt to coarser sand and gravel is a typical depositional transition for a river valley and consistent with the available surficial geology for the study area, shown in Figure 3.1-8.

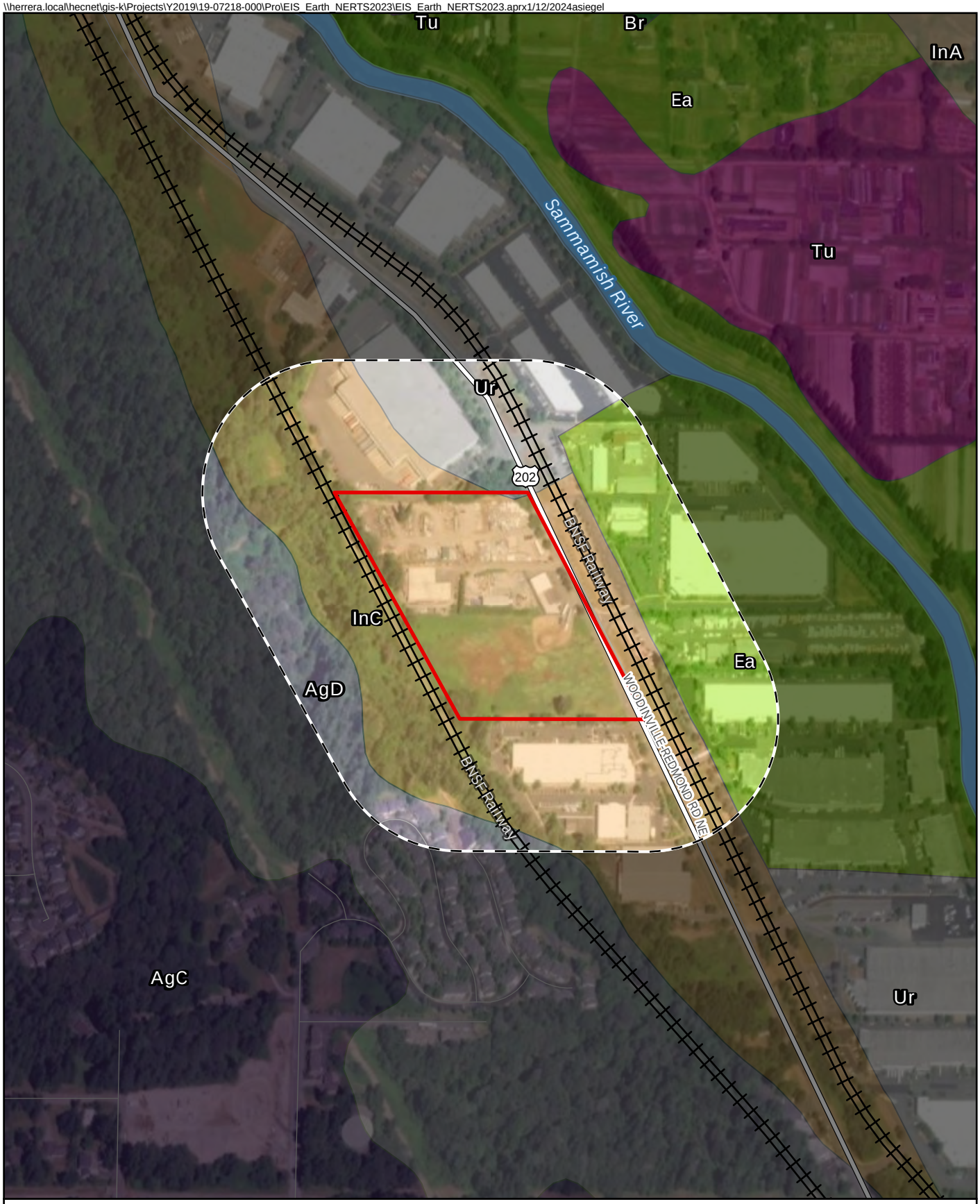
3.1.2.3.1.3. Topography

Based on a review of the USGS topographic maps, the elevation of the study area for Alternative 2 is approximately 40 to 160 feet above MSL. The Alternative 2 site, within the Sammamish River Valley, is relatively flat and gently slopes to the east towards the Sammamish River. To the west of the Alternative 2

site, there are steeper slopes at 15 to 30 percent, typical for river valley topography (Figure 3.1-10) (USGS 2023).

3.1.2.3.1.4. Environmentally Sensitive Areas and Seismic Hazards

The study area is located within the seismically active Puget Sound region. The study area for Alternative 2 is categorized as an environmentally sensitive area due to potential landslide hazards, potential erosion hazards, and significant seismic hazards (King County 2023g).



Legend

- Alternative Location
- 500-ft Site Buffer
- Waterbody

Soil Type

- AgC - Alderwood gravelly sandy loam, 8 to 15 percent slopes
- AgD - Alderwood gravelly sandy loam, 15 to 30 percent slopes
- Br - Briscot silt loam
- Ea - Earlmont silt loam
- InA - Indianola loamy sand, 0 to 5 percent slopes
- InC - Indianola loamy sand, 5 to 15 percent slopes
- Tu - Tukwila muck
- Ur - Urban land

Figure 3.1-9. Surface Soils in the Vicinity of Action Alternative 2.

N
PLAN

SCALE: 1" = 750'-0"

0 375 750 Feet

King County

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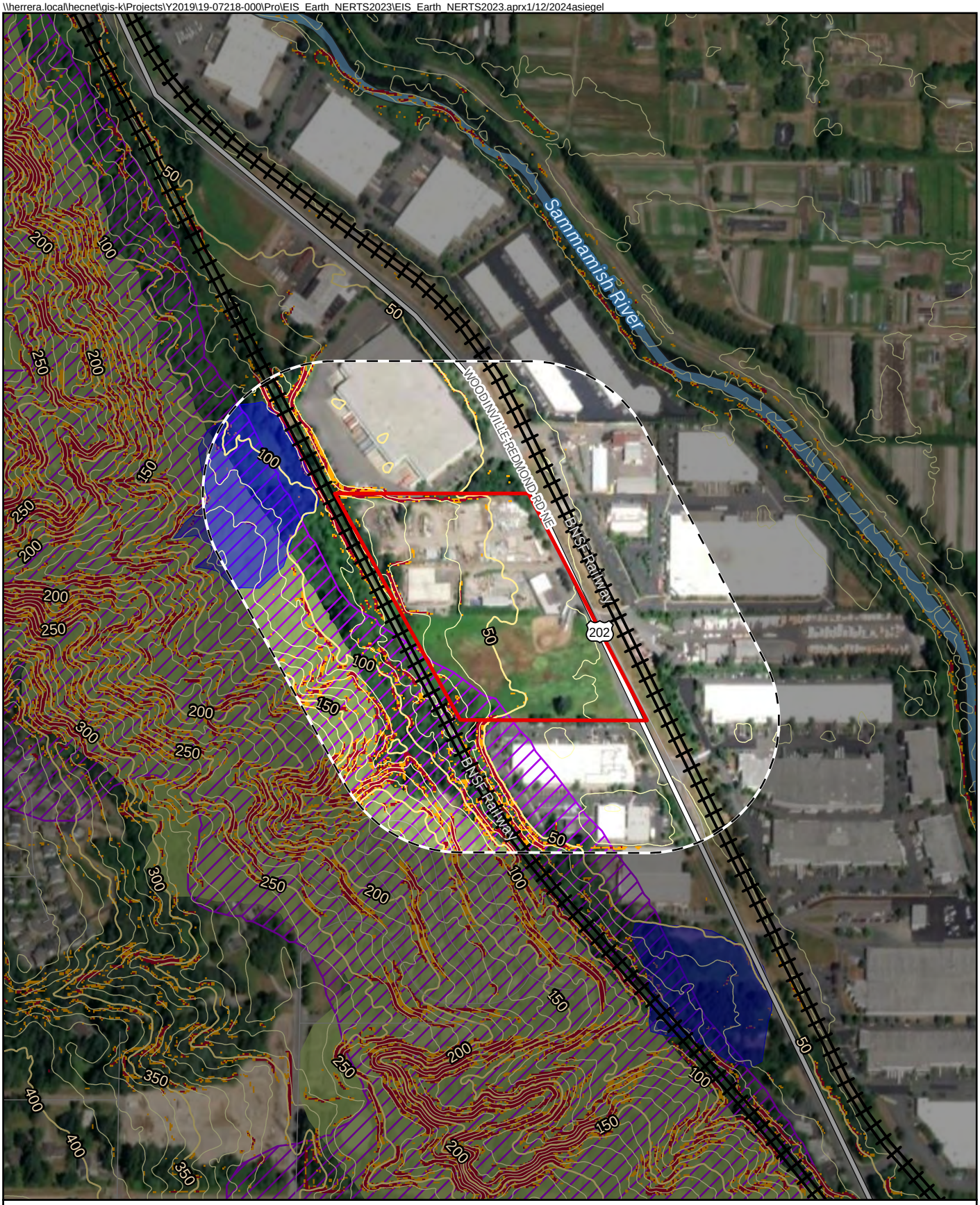

Legend

- Alternative Location
- 500-ft Study Area
- 50-ft Elevation Contour (AMSL)
- 10-ft Elevation Contour (AMSL)
- Waterbody
- Landslide Hazard
- Erosion Hazard
- Lowland Fan
- Shallow Debris Slide (Moderate Potential)
- Shallow Debris Slide (Severe Potential)

Figure 3.1-10. Site Topography and Landslide Hazards in the Vicinity of Action Alternative 2.

PLAN

SCALE: 1" = 750'-0"

0 375 750 Feet

King County

Landslides and Landslide Hazards

The southwest portion of the study area for Alternative 2 is located within a designated landslide hazard area along the Sammamish River corridor designated by the King County 1990 SAO (Figure 3.1-10) (King County 1990). Geologists in the King County Department of Natural Resources and Parks, Water and Lands Resource Division (DNRP) review LiDAR imagery to review and map debris flows or debris floods in the Puget Lowland area and have mapped evidence of a lowland fan to the east/northeast of the northernmost parcel of the study area (Parcel Number 1526059086). Fans are formed when sediment moving down a steep channel is deposited where the channel gradient abruptly decreases (King County 2023g).

Shallow debris slides are failures of shallow soil (three to six feet) sliding on a surface of more competent material, such as dense glacial sediments. Shallow debris slides are common and widespread in King County, especially during periods of high rainfall. Shallow debris slides can also occur as a result of discharging stormwater on a steep slope and can increase in potential due to anthropogenic activities, such as vegetation removal or inappropriate fill placement. The northern boundary and northwestern portion of the site for Alternative 2 as well as the western portion of the study area are indicated to have moderate to severe potential for debris slides to start. There are no other potential steep slope hazards indicated for the study area.

Erosion Hazards

The site for Alternative 2 is not identified as a significant erosion hazard area, however in the western portion of the study area, the slopes of AgC soil are identified by the King County 1990 SAO as a significant erosion hazard area (Figure 3.1-10) (King County 1990).

Liquefaction Hazards

The liquefaction susceptibility for the study area for Alternative 2 is categorized as low to moderate Figure 3.1-7) (WDNR 2023).

Faults and Folds

The study area for Alternative 2 is located within the SWIF. The study area is located between two SWIF traces- one approximately 3,100 feet to the northeast of the study area and the other approximately 4,300 feet to the southwest of the study area (Figure 3.1-7) (WDNR 2023).

Seismic Hazards

The study area for Alternative 2 is located in the seismically active Puget Sound region and lies within the CSZ. The seismic hazards associated with the CSZ are similar for all site alternatives, as discussed in section 3.1.2.2. According to seismic scenarios for the CSZ, the Alternative 2 study area is also projected to experience an MMI of 7, as described for the No Action Alternative and Alternative 1 study area.

Based on the King County 1990 SAO, the study area for Alternative 2 is located in an environmentally sensitive seismic hazard area (King County 1990). The SAO defines significant seismic hazard areas as "those areas in King County subject to severe risk of earthquake damage as a result of seismically induced

settlement or soil liquefaction." Areas within the seismic hazard area are generally underlain by unconsolidated soils with shallow groundwater.

DNR maps the site as NEHRP seismic site class of D/E. Site class reflects the relative stiffness of the subsurface soil conditions in the top 100 feet at the project site and provides some measure of the potential site amplification for strong ground shaking in a particular area during an earthquake. Site class B represents a soft rock condition, where earthquake shaking is neither amplified nor reduced by the near-surface geology. Site classes C, D, and E represent increasingly softer soil conditions which result in a progressively increasing amplification of ground shaking in longer periods. Site class F is delineated as areas of peat soil.

3.1.3 Environmental Impacts

This section describes the potential earth related environmental impacts associated with implementation of the No Action Alternative and any of the action alternatives.

In addition to impacts to the earth under each alternative, this section also describes potential impacts to each alternative from potential geologic hazards, including landslide hazards and seismic hazards, in turn including susceptibility to liquefaction.

3.1.3.1 No Action Alternative

Under the No Action Alternative, there would be no additional impacts on earth because there would be no excavation or ground disturbing activities, except as may be warranted by regular maintenance activities. Ongoing impacts related to the existing transfer station operations would continue as planned and permitted under the No Action Alternative.

The study area for the No Action Alternative does not have any areas indicated as an area of concern due to landslide hazards or seismic hazards. Overall, the study area is indicated to have very low liquefaction susceptibility.

Under the No Action Alternative, seven acres of the Houghton RTS site, which includes building roofs, parking areas, roads, and compacted soils, are considered impervious surfaces. Impervious surfaces, which are largely associated with developed land, reduce rain and surface water infiltration into the ground subsurface and subsequently reduce natural groundwater recharge. For further details regarding the environmental impacts of impervious surfaces on water resources, see Section 3.3, Water.

3.1.3.2 Impacts Common to All Action Alternatives

The following subsections describe potential impacts associated with earth under all action alternatives. Potential impact considerations assume all action alternatives would comply with the recommendations of a geotechnical study conducted prior to final design to minimize earth hazards, including best management practices (BMPs) described below.

3.1.3.2.1 Impacts from Construction

The evaluation of impacts to earth assumes that well-recognized and proven engineering methods and techniques would be used to design and construct each of the action alternatives following BMPs. A geotechnical study would be conducted during the design process to determine any special foundation or construction techniques that may be necessary to reasonably minimize potential impacts from geologic hazards. Recommendations included in the study would be incorporated into design of the facility and adhered to during project development. In particular, the design and construction for each action alternative would consider the following:

- Potential landslide hazards within and surrounding the study area associated with each action alternative design.
- BMPs to control erosion and sedimentation during both construction and operation would be used to minimize the impacts of each action alternative.
- Soil conditions and soil structure for structural seismic stability and the potential impacts of seismically induced liquefaction on the facility.
- Potential risks to facility stability due to seismic hazards.

BMPs to address some of these considerations, including construction and structural measures may include, but are not limited to:

- Constructing retaining walls to mitigate potential geological hazards including erosion, debris slides, or landslide hazards.
- Specifically engineered foundation or construction techniques to create structures that would be stable during potential seismic hazards and potential liquefaction associated with ground movement. These techniques could include structural anchoring through direct excavation to native soil or drilled piles to native soil.
- Implementing erosion control during construction compliant with the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit and a Temporary Erosion and Sedimentation Control (TESC) plan (see Section 3.3, Water).
- Retention of vegetation or immediate revegetation following construction activities to prevent erosion and provide hillslope stability.

At and adjacent to the action alternative sites, construction activities will be performed such that there will be no significant impact to slope stability and will not create serious erosion, sedimentation, or landslide hazards.

3.1.3.2.1.1. Direct Impacts

For any action alternative selected, a geotechnical study will be conducted to identify appropriate design measures to address any steep slope hazards associated with the development of the site and new construction. Design measures may include options such as setback and slope stabilization measures to minimize landslide or debris slide risk and reduce any potential adverse effects.

Under each action alternative, soil movement would occur within portions of each respective site boundary. Based on the construction designs for each action alternative, existing surface excavation, filling, and/or grading would be required within and surrounding the footprint of the future development areas as part of developing the NERTS facility. Based on the results of the SBI, any soils containing refuse and/or contamination would be excavated and disposed of, as discussed more fully in Section 3.4 Hazardous Materials and Appendix C, NERTS Hazardous Materials Assessment. Uncontaminated excavated soil may be stockpiled and reused at the site during grading and regrading activities or exported for use by other public or private entities needing soil. If additional soil or fill material is needed for operations, it would incrementally be imported to the sites.

The sites for each action alternative do not include any areas classified as having erosion hazards (Figures 3-1.6 and 3-1.10) (King County 2023g). However, under each action alternative, there would be an increased temporary risk of erosion during construction as a result of vegetation clearing and ground disturbance. Erosion during construction would be minimized by implementing BMPs. The BMPs for erosion control would include a Stormwater Pollution Prevention Plan (SWPP) developed to comply with the requirements of the NPDES Construction Stormwater General Permit and a TESC plan (See Section 3.3, Water). Ground disturbing activities would create temporary, minor, localized impacts to soils from erosion. Potential erosion from ground disturbance during construction related activities would be limited to the action alternative site and would not affect surrounding areas. To reduce potential erosion during construction, disturbance to existing vegetation would be minimized where possible and revegetation would occur as soon as construction related activities ended.

Depending on the depth of excavation required for site development activities, shoring, flattening of slopes, and/or dewatering may be needed. If construction activities require dewatering, the groundwater table at the site may be temporarily lowered. The resultant lowering of the groundwater would have the benefit of temporarily reducing the susceptibility to liquefaction in the study area during a seismic event. Conversely, if water accumulates at or closer to the surface of the site, susceptibility to liquefaction during a seismic event could increase. The presence of soft or liquefiable soils at the development site may result in the need for deep foundations. See Water, Section 3.3.3.2 – Impacts Common to All Action Alternatives, for additional details about the impacts of dewatering to water resources.

3.1.3.2.1.2. Indirect Impacts

The limited earth impacts from each action alternative are unlikely to lead to additional projects or actions that would result in indirect impacts to earth. Existing sources of fill that may be required for development for each action alternative are adequate without the need for development of new supplies (see Section 3.7, Energy and Natural Resources).

3.1.3.2.2 Impacts from Operation

3.1.3.2.2.1. Direct Impacts

Under each action alternative, there would be no direct impacts to earth associated with the operation of the new NERTS facility. The earth landscape for each study area would not be changed or impacted by any future NERTS facility operations. Also, operation of the new NERTS facility would not alter potential geologic hazards, including landslide hazards and seismic hazards, or susceptibility to liquefaction.

3.1.3.2.3 Indirect Impacts

Under each action alternative, there would be indirect, beneficial impacts to earth. Under the action alternatives, the new NERTS facility would provide areas for source-separated yard waste collection to be transported to regional compost processors. Yard waste is made up of grass clippings, leaves, stalks, twigs, branches, and general yard debris. When yard waste is composted and added to soil, it improves the amended soil health. Compost-amended soil has the increased ability to absorb excess rainwater, slow runoff, and release water to plants between rainfalls, which supports healthy roots to vegetation. As air and water percolate through the amended soil, healthy roots can trap pollutants such as heavy metals and pesticides (King County 2023h).

3.1.3.2.4 Cumulative Impacts

Activities associated with construction of the action alternatives would contribute incrementally to overall past, present, and likely future impacts on earth locally and in the surrounding region due to ongoing development but are not likely to be significant.

Past development and the corresponding increase in population density has increased the number of people within the study area that could be at risk of experiencing a seismic event (i.e., earthquake). However, a beneficial impact of site redevelopment under any of the action alternatives would be that new site buildings and associated infrastructure would add to the stock of buildings built to modern building codes to withstand seismic events. In addition, increased general awareness about emergency preparations and response actions for seismic events also provides mitigation to lessen potential impacts to workers and residents.

The impacts of erosion during construction would be limited to the portions of the study areas to be developed. Erosion associated with construction would be mitigated by the implementation of BMPs, including an NPDES Construction Stormwater General Permit and a TESC plan, and would be temporary until vegetation at the redeveloped site is re-established. Erosion would therefore be unlikely to contribute to overall increased sediment loading to nearby surface waters (see Section 3.3, Water).

Future actions in combination with the proposed actions are likely to transform the landscape in limited areas of the action alternative site but would likely impact only surface soils or shallow geology and would not significantly alter the landscape.

3.1.3.3 Alternative 1A

The earth impacts associated with Alternative 1A include the impacts listed below, as well as those that are common to all action alternatives as described in Section 3.1.3.2.

Under Alternative 1A, the new NERTS facility will be constructed after the existing transfer station is closed and deconstructed or demolished.

3.1.3.3.1 Impacts from Construction

Under Alternative 1A, minimal impacts to earth from construction are anticipated, and are described in the following sections.

3.1.3.3.1.1. Direct Impacts

As described in Section 3.1.3.2, a geotechnical study will be conducted prior to site development for the selected action alternative to identify appropriate design measures that would minimize risk and reduce any potential adverse impacts. At the Alternative 1 site, a geotechnical study would make recommendations for foundational support and hillslope stability where the site topography may necessitate engineering controls. Based on the specific site conditions and the results of a geotechnical study, the new NERTS facility structures would be designed and constructed to the most recent seismic standards in the Washington Uniform Building Code (UBC), and County and local codes. The new structures would provide enhanced ability to resist probable earthquake intensities to a much greater degree than existing structures under the No Action Alternative.

As described in Section 3.1.2, the study area for the No Action Alternative and Alternative 1 does not have any areas geologically classified as areas of concern. Excavation activities would take place within the footprint of the closed Houghton landfill, requiring slope stability and other mitigation measures to guard against runoff, odors, and exposure to contaminated soils. Site preparation work is expected to last approximately twelve months, assuming 12-hour workdays, six days per week. Under Alternative 1A, the construction of the new NERTS facility is anticipated to require approximately 162,460 cubic yards of cut/export and approximately 103,675 cubic yards of fill/import if utilizing the direct excavation to native soil method; construction utilizing the drilled piles to native soil is not anticipated under Alternative 1A. Table 3.1-1 summarizes the quantity of export and import material estimated for development of Alternative 1A, and the estimated duration of work. To provide a conservative estimate of construction activity, for example for the traffic analysis in Section 3.13, no reuse of on-site material is assumed, although KCSWD will attempt to maximize the reuse of on-site material.

Table 3.1-1. Estimated Site Preparation Quantities for Action Alternative 1A.

Construction Method	Export Material (cubic yards)	Import In-Place (cubic yards)	Site Preparation Duration
Direct excavation to native soil	162,460	103,675	12 months

As discussed above in Section 3.1.3.2.1.1, based on the results of the SBI, any soils containing refuse and/or contamination would be excavated and disposed of at an appropriately permitted disposal facility. Uncontaminated excavated soil may be stockpiled and reused at the site during grading and regrading activities or exported for use by other public or private entities needing soil. If additional soil or fill material is needed for operations, it would incrementally be imported to the sites. Where waste is excavated, clean fill and improved environmental control systems would be installed (see sections 3.3, 3.4, and 3.8).

Under Alternative 1A, there would be a potential site development area of approximately 10 acres, of which approximately 70 percent would be impervious, which is similar to the current seven acres of impervious surfaces associated with the No Action Alternative. The impacts of land surface permeability are discussed further in Section 3.3, Water. For further discussion of the effects of impervious surfaces to water resources associated with Alternative 1A, see Water, Section 3.3.3.3.

3.1.3.3.1.2. Indirect Impacts

As discussed in Section 3.1.3.2, indirect construction impacts under all action alternatives are temporary and limited to construction related activities.

Under Alternative 1A, the existing transfer station building at the site would be deconstructed or demolished, which could have an indirect, not significant, impact. Deconstruction or demolition and replacement of the transfer building would include disposal of some construction and demolition wastes, resulting in minor modifications to topography in other disposal locations. There are no additional indirect construction impacts to the earth associated with Alternative 1A.

3.1.3.3.2 Impacts from Operation

The direct and indirect impacts to earth from operation associated with all action alternatives would be similar. See Section 3.1.3.2 for impacts from operation common to all action alternatives.

3.1.3.3.3 Cumulative Impacts

Section 3.1.3.2 discusses the cumulative impacts common to all action alternatives including those that would contribute incrementally to overall past, present, and likely future impacts on earth locally and in the surrounding region. Prior to being developed as a landfill, past actions at the Alternative 1 site included mining of glacial drift deposits of sand and gravel to support construction and development of the surrounding region.

Establishing the landfill at its current site caused modifications to the landscape and created some unnatural landscape features, though the closed Houghton landfill does support actively used sports fields and trails for public use.

For site redevelopment under Alternative 1A, in addition to new buildings built to modern building codes to withstand seismic events, development would include excavating and removing waste to create more stable building foundations and installation of new or modified environmental controls systems, creating a reduction in cumulative impacts from past actions at the site.

3.1.3.4 Alternative 1B

The earth impacts associated with Alternative 1B include the impacts listed below, as well as those that are common to all action alternatives as described in Section 3.1.3.2.

Under Alternative 1B, the new NERTS facility will be constructed while the existing transfer station building is open and operating, and then the existing transfer station building would be closed and repurposed, or deconstructed or demolished and replaced after the new station is open.

3.1.3.4.1 Impacts from Construction

Under Alternative 1B, construction impacts are expected to be minimal and similar to the impacts for Alternative 1A. Construction impacts are described more below.

3.1.3.4.1.1. Direct Impacts

As described in Section 3.1.3.2, a geotechnical study will be conducted prior to site development for the selected action alternative to identify appropriate design measures, such as setbacks and slope stabilization measures, to minimize risk and reduce any potential adverse impacts. The direct impacts to earth associated with Alternative 1B would be similar to those associated with Alternative 1A. As described in Section 3.1.2, the study area for the No Action Alternative and Alternative 1 does not have any areas geologically classified as areas of concern. See Section 3.1.3.3 for direct impacts common to Alternatives 1A and 1B.

As with Alternative 1A, excavation activities under Alternative 1B also would take place within the footprint of the closed Houghton landfill, requiring slope stability and other mitigation measures to guard against runoff, odors, and exposure to contaminated soils. Site preparation work is expected to last approximately twelve months, assuming 12-hour workdays, six days per week. Under Alternative 1B, the construction of the new NERTS facility is anticipated to require approximately 219,277 cubic yards (CY) of cut/export and approximately 196,945 cubic yards of fill/import if utilizing the direct excavation to native soil method; construction is anticipated to require approximately 110,218 cubic yards (CY) of cut/export and approximately 76,674 cubic yards of fill/import if utilizing the drilled piles to native soil method. Table 3.1-2 summarizes the quantity of export and import material estimated for development of Alternative 1B for both construction methods, and the estimated durations of work. As with the other action alternatives, no reuse of on-site material is assumed, although reuse is possible.

Table 3.1-2. Estimated Site Preparation Quantities for Action Alternative 1B.

Construction Method	Export Material (cubic yards)	Import In-Place (cubic yards)	Site Preparation Duration
Direct excavation to native soil	219,277	196,945	12 months
Drilled piles to native soil	110,218	76,674	12 months

As discussed above in Section 3.1.3.2.1.1, based on the results of the SBI, any soils containing refuse and/or contamination would be excavated and disposed of at an appropriately permitted disposal facility.

Uncontaminated excavated soil may be stockpiled and reused at the site during grading and regrading activities or exported for use by other public or private entities needing soil. If additional soil or fill material is needed for operations, it would incrementally be imported to the sites. Where waste is excavated, clean fill and improved environmental control systems would be installed (see sections 3.3, 3.4, and 3.8).

Alternative 1B would have a potential site development area of approximately 12.8 acres, of which approximately 70 percent would be impervious, an increase from the current seven acres of impervious surfaces associated with the No Action Alternative. The changes in land surface permeability are discussed further in Section 3.3, Water. For further discussion of the effects of impervious surfaces to water resources associated with Alternative 1B, see Section 3.3.3.4.

Excavation activities under Alternative 1B would also take place within the footprint of the closed Houghton landfill but over a larger area than under Alternative 1A. Similar measures discussed for Alternative 1A would be used to mitigate the effects of waste removal (see sections 3.3, 3.4, and 3.8).

3.1.3.4.1.2. Indirect Impacts

Under Alternative 1B, indirect construction impacts are expected to be minimal and similar to those discussed for Alternative 1A and those common to all action alternatives.

Under Alternative 1B, the existing transfer station building at the site would remain during construction of the new NERTS. The existing facility would be closed and repurposed or replaced, which could also have an indirect, not significant, impact. Replacement of the facility would have indirect impacts similar to Alternative 1A. Impacts associated with adaptation or remodeling of the existing transfer building would be unlikely to result in the need for other activities with impacts on earth.

3.1.3.4.2 Impacts from Operation

The direct and indirect impacts to earth from operation associated with all action alternatives would be similar. See above for impacts from operation common to all action alternatives.

3.1.3.4.3 Cumulative Impacts

Impacts to the earth under Alternative 1B would be similar as described for Alternative 1A in section 3.1.3.3. Under Alternative 1B a new transfer station building would be built to modern building codes to withstand seismic events and waste beneath the building footprint would be removed to provide a stable building foundation. Impacts during construction would be mitigated to make erosion or other impacts less than significant.

3.1.3.5 Alternative 2

The geologic hazards associated with Alternative 2 include the impacts listed below, as well as those that are common to all action alternatives as described in Section 3.1.3.2.

Under Alternative 2, the new NERTS facility will be constructed at a site on six tax parcels in the 15000 block of Woodinville-Redmond Road NE in Woodinville. The study area for Alternative 2 currently includes

existing buildings, and paved asphalt or gravel parking lots and roads, vegetation, and a designated wetland in the southern half of the Alternative 2 site boundary. The site would be developed or redeveloped and existing businesses at the site would relocate.

3.1.3.5.1 Impacts from Construction

Under Alternative 2, minimal construction impacts to earth are anticipated. Construction impacts and geologic hazards are described more below.

3.1.3.5.1.1. Direct Impacts

The Alternative 2 study area includes portions indicated as environmentally sensitive areas due to earth hazards including debris slide hazards, landslide hazards, and seismic hazards. Earth hazards have the potential to become cumulative (i.e. earthquakes can trigger debris slides and/or landslides and liquefaction. Without mitigation, these types of earth hazards could create significant impacts. However, as described in Sections 3.1.1 and 3.1.3.2, a geotechnical study as part of the critical areas report will be conducted prior to site development for the selected action alternative to identify appropriate design measures, such as setbacks and slope stabilization measures, to minimize risk and reduce any potential adverse impacts. Compliance with the requirements of the geotechnical study is intended to prevent significant impacts to both the site and adjacent sites due to individual and/or cumulative geological hazards.

As with the other action alternatives, site preparation work is expected to last approximately twelve months, assuming 12-hour workdays, six days per week. Under Alternative 2, the construction of the new NERTS facility is anticipated to require approximately 89,196 cubic yards (CY) of cut/export and approximately 10,667 CY of fill/import utilizing the direct excavation to native soil method; construction utilizing the drilled piles to native soil is not anticipated under Alternative 2. Table 3.1-2 summarizes the quantity of export and import material estimated for development of Alternative 2, and the estimated duration of work. As with the other action alternatives, no reuse of on-site material is assumed, although reuse is possible.

Table 3.1-3. Estimated Site Preparation Quantities for Action Alternative 2.

Construction Method	Export Material (cubic yards)	Import In-Place (cubic yards)	Site Preparation Duration
Direct excavation to native soil	89,196	10,667	12 months

As discussed above in Section 3.1.3.2.1.1, any contaminated soils would be excavated and disposed of at an appropriately permitted disposal facility. Uncontaminated excavated soil may be stockpiled and reused at the site during grading and regrading activities or exported for use by other public or private entities needing soil. If additional soil or fill material is needed for operations, it would incrementally be imported to the sites.

Erosion Hazards

Temporary, not significant erosion hazards common to all action alternatives during construction are described in Section 3.1.3.2.

To the west of the site for Alternative 2, the eastward dipping hillslopes in the study area are indicated as an environmentally sensitive area. The area is indicated as a significant erosion hazard area that may experience severe to very severe erosion hazard (Figure 3.1-10). Construction of Alternative 2 would be unlikely to affect erosion hazards because the slope is separated from the site by an abandoned rail line easement and the project is likely to include a retaining wall on the western portion of the site to account for necessary site grading and to increase stability of the areas west of the site.

Debris Slide Hazards

Development of Alternative 2 may require grading and regrading of the site, particularly in the northwest portion of the site, where there is currently area designated with moderate to severe potential for shallow debris slides to start (Figure 3.1-10). BMPs based on the geotechnical evaluation would likely be required to stabilize or re-grade the northern boundary of the site where approximately 75 percent of that Alternative 2 site boundary is indicated to have a severe potential for a shallow debris slide to start. These structural BMPs could include a retaining wall on the northwest corner and northern side of the site, in addition to the western side of the site as described above.

Landslide Hazards

The southwest portion of the Alternative 2 site includes less than one acre of land classified within an environmentally sensitive area due to landslide hazards (Figure 3.1-10). The area immediately adjacent to the western boundary and up to 200 feet from the Alternative 2 site fall within the environmentally sensitive area due to landslide hazards. Structural BMPs similar to those described above would minimize impacts related to landslide hazards.

Seismic Hazards and Liquefaction Susceptibility

The study area for Alternative 2 is located within an area categorized as an environmentally sensitive area due to seismic hazards with low to moderate liquefaction susceptibility (Figure 3.1-7). However, the high seismicity of the region combined with the young alluvial deposits mapped at the site with potentially high groundwater table could result in high liquefaction potential at the site. During the design process for Alternative 2, the geotechnical study for the site would determine any special foundation or construction techniques that may be necessary to reasonably minimize the potential for damage during an earthquake. Based on Site Class D/E conditions and the regional seismicity DNR predicts the Seismic Design Category of D1 at the site which indicates heavy seismic detailing might be required for the structure. Like Alternative 1, based on the specific site conditions and the results of a geotechnical study, the new NERTS facility structures would be designed and constructed to the most recent seismic standards in the Washington Uniform Building Code (UBC), and County and local codes. The new structures would provide enhanced ability to resist probable earthquake intensities to a much greater degree than existing structures under the No Action Alternative.

Impervious Surfaces

At the Alternative 2 site, approximately six acres of the site are currently covered with impervious surface, which generally consists of building roofs, parking lots, driveways, and roadway. Under the proposed action, Alternative 2 would have a potential site development area of at least seven acres with additional area potentially available dependent on compliance with federal, state, and local environmental regulations, of which 70 percent would be impervious. The changes in land surface permeability are discussed further in Section 3.3, Water. For further discussion of the effects of the increase in potential impervious surfaces to water resources associated with Alternative 2, see Water, Section 3.3.3.5.

3.1.3.5.1.2. Indirect Impacts

As discussed in Section 3.1.3.2, indirect construction impacts under all action alternatives would be temporary and limited to construction related activities. There would be no additional indirect construction impacts to the earth associated with Alternative 2.

3.1.3.5.2 Impacts from Operation

3.1.3.5.2.1. Direct Impacts

The direct impacts to earth from operation associated with all action alternatives would be similar. See above for direct impacts from operation common to all action alternatives.

The steep slopes located in the western portion of the study area at Alternative 2 are susceptible to landslides from erosion and earthquakes, which could pose a potential long-term risk to operations at the site. The high seismicity of the region combined with the young alluvial deposits mapped at the site with potentially high groundwater table could result in high liquefaction potential at the site. These geologic hazards have the potential to result in an interruption of operations at the Alternative 2 site, which could have short-term, localized and regional impacts until operations are restored. These impacts would be minimized by the structural BMPs designed to reduce those risks, including retaining walls and drainage features designed to reduce soil saturation, and geotechnical and structural design features to reduce seismic risk.

3.1.3.5.2.2. Indirect Impacts

The indirect impacts from operation under Alternative 2 would be similar to those described in Section 3.1.3.2. Under Alternative 2, there would be indirect, beneficial impacts to earth resources from more yard waste being collected, recycled, and composted. This in turn would yield several benefits, including providing a soil resource for gardeners and landscapers.

3.1.3.5.3 Cumulative Impacts

Section 3.1.3.2.3 discusses the cumulative impacts common to all action alternatives, including those that would contribute incrementally to overall past, present, and likely future impacts on earth locally and in the surrounding region. The site for Alternative 2 is relatively flat and redevelopment would not increase the

instability of slopes adjacent to the east of the site. Development of Alternative 2 along with increasing development at other sites within the study area would increase the number of workers and residents exposed to risk of a seismic event, but mitigation would be similar to the other action alternatives. Erosion during construction would also be mitigated to make the risk of impacts minimal.

3.1.4 Mitigation Measures

As discussed in previous sections, adverse impacts on and from earth from implementing any of the action alternatives are mitigated by adhering to state and local design standards, adhering to the recommendations of the site geotechnical study, and implementing effective BMPs during construction and during post-construction operations and maintenance.

3.1.4.1 No Action Alternative

Under the No Action Alternative, the existing Houghton RTS would remain in operation and there would be no additional impacts on earth. No additional mitigation measures are known at this time.

3.1.4.2 Alternative 1

As discussed above, BMPs would be followed during the design and construction of each action alternative.

- BMPs and a geologic hazard study, as required by the City of Kirkland, would address potential erosion and sedimentation as a result of construction and subsequent operations.
- Erosion and sedimentation would be controlled during construction by the implementation of a Construction Stormwater General Permit according to NPDES and a TESC plan.
- Construction erosion would be mitigated by minimizing the disturbance of existing vegetation and performing revegetation immediately following construction related activities.
- The recommendations of a geotechnical study would be adhered to in order to mitigate potential future geological hazards.

Future geological hazards within the Alternative 1 study area may include hillslope stability, seismic events, and the associated impacts of shaking, and very low susceptibility to liquefaction.

- Hillslope stability would be mitigated with engineering controls during building design and construction and may include grading and regrading and building retaining walls.
- Potential seismic events and associated shaking and liquefaction hazards would be mitigated by adhering to state and local design standards as well as geotechnical study recommendations, which may include special foundation or construction techniques to minimize the potential for damage.

3.1.4.3 Alternative 2

As discussed above, the Alternative 2 site is within and adjacent to designated environmentally sensitive areas related to geologic hazards. Geologic hazards unique to the Alternative 2 study area include mass

wasting events, such as erosion, debris slides, and landslides. Impacts from these and other potential hazards are mitigated during both construction and operation by adhering to Washington State and City of Woodinville BMPs and regulations, including an applicable critical areas report as determined by the City of Woodinville and associated recommendations for geologically sensitive areas.

3.1.4.3.1 Erosion Hazards

As discussed in the above mitigation measures section for the Alternative 1 study area (Section 3.1.4.2), Alternative 2 would adhere to similar mitigation measures for erosion during construction.

Erosion risk on the slopes to the west of the site designated as an environmentally sensitive area s would be mitigated during construction and design. Site grading may be required, and the project is likely to include a retaining wall on the western portion of the site to increase hillslope stability. In addition, the slopes to the west of the site are separated from the site by an abandoned rail line easement that creates an additional buffer to the site from potential off-site erosion hazards.

3.1.4.3.2 Debris Slide Hazards

The northern boundary and northwestern portion of the Alternative 2 site are indicated to have moderate to severe potential for shallow (three to six feet) debris slides to start. Debris slide hazards are mitigated during construction activities with grading and regrading during excavation activities. Structural BMPs during construction may also include retaining walls and would be implemented following the recommendations of a geotechnical study.

3.1.4.3.3 Landslide Hazards

The area within the southwest portion of the Alternative 2 site and adjacent to the western boundary of the Alternative 2 site are classified as an environmentally sensitive area due to landslide hazards. As described in the sections for erosion hazards and debris slide hazards, potential mass wasting events, including landslide hazards, would be mitigated during design and construction of the site. Mitigation measures to address landslides may also include a retaining wall along the western edge of the Alternative 2 site. Design and construction recommendations from a geotechnical study would be adhered to in order to mitigate impacts from mass wasting hazards, including landslides.

3.1.4.3.4 Seismic Hazards and Liquefaction Susceptibility

The Alternative 2 study area is in an area designated with low to moderate liquefaction susceptibility. As described for the Alternative 1 site, potential seismic events and associated shaking and liquefaction hazards would be mitigated by adhering to state and local design standards as well as geotechnical study recommendations, which may include special foundation or construction techniques to minimize the potential for damage.

3.1.5 Significant Unavoidable Adverse Impacts

Based upon the analysis performed for this EIS, there would be no significant unavoidable adverse impacts to earth associated with the No Action Alternative, Alternative 1A, Alternative 1B, or Alternative 2 when the regulatory and mitigation measures described are implemented.