4.1 Earth Resources

This section provides an analysis of potential impacts on geology and soils.

4.1.1 Study Area

The study area for geology and soils includes the 188-acre Knutson Farm Project site.

4.1.2 Relevant Plans, Policies, and Regulations

Relevant policies and regulations related to geology and soils are summarized in Table 4-1.

Table 4-1. Applicable Regulations and Policies for Geology and Soils

Law and Regulation	Description
State	
Growth Management Act (GMA)	Requires all cities and counties in Washington to adopt development regulations that protect critical areas, including geologically hazardous areas.
Clean Water Act (CWA) Section 402, National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit	The United States Environmental Protection Agency (USEPA) has delegated authority to the Washington State Department of Ecology (Ecology) to regulate construction by issuing coverage under the CWA Section 402 NPDES Construction Stormwater General Permit.
Local – Pierce County	
Pierce County Comprehensive Plan	As required by the GMA, each county and city in the state of Washington must develop a Comprehensive Plan and periodic updates that address policies related to growth, including land use, housing, capital facilities, utilities, rural development, and transportation. Select goals and policies from Pierce County's Comprehensive Plan related to earth resource hazards are listed below. These are incorporated in the mitigation measures in Section 4.1.4. **Environmental Element** *Hazardous Areas* • Goal ENV-10: Avoid endangerment of lives, property, and resources in hazardous areas. – Policy ENV-10.2. Develop standards so that future development minimizes threats to lives, property, and resources. – Policy ENV-10.2.1. Require appropriate standards for site development and structural design in areas where the effects of the hazards can be mitigated. • Policy ENV-10.7.1. Maintain an evacuation plan and lahar warning system for volcanic hazard areas. – Design and Character Element • Sustainable Design

	• Policy D-18.6: The preferred approach to on-site water quality treatment is by using low-impact development techniques and practices.
Title 18E PCC, Development Regulations – Critical Areas	This ordinance was developed under the directives of the GMA to designate and protect critical areas and to assist in conserving the value of property, safeguarding the public welfare, and providing protection for these areas. Geologic critical areas defined in PCC Title 18E include volcanic, landslide, seismic, mine, and flood hazard, and erosion hazard areas. Pierce County has identified the Puyallup River as a CMZ with a severe risk of migration to avoid the effects of potential river migration on hazards in river valleys. Under Policy D-18.6, the preferred approach to on-site water quality treatment is by using low-impact development techniques and practices.
Title 17A PCC, Construction and Infrastructure Regulations – Site Development and Stormwater Drainage	A Site Development Permit allows for the performance of work (e.g., storm drainage system construction, road construction, driveway construction, clearing, grading, filling, excavating, ditching, and creation of impervious surfaces) on a piece of land.
Title 17C PCC, Construction and Infrastructure Regulations – Building and Fire Codes	Pierce County has adopted the International Building Code, which is a model code that provides the minimum requirements to safeguard the public health and general welfare of the occupants of new and existing buildings.
Local – City of Puyallup	
Chapter 21.06 PMC, Critical Areas	The City's critical area ordinance designates and classifies environmentally critical areas to protect these areas and their functions and values, while also allowing for economically beneficial or productive use of land on private property. The City seeks to protect members of the public and public resources and facilities from injury, loss of life, or property damage due to landslides, steep slope failures, erosion, seismic events, volcanic eruptions, or flooding. Geologically hazardous areas defined in Chapter 21.06 PMC include landslide and erosion hazard areas, seismic hazard areas, and volcanic hazard areas.

4.1.3 Affected Environment

This section summarizes the environmental setting related to geology and soils within the study area.

Geography and Topography

The proposed Project is located in the Puget Lowland Geologic Province, which lies between the Cascade Mountain Range on the east and the Olympic Mountains on the west. Geologic units in the Project site consist of unconsolidated deposits of Quaternary sediment and Quaternary glacial deposits (Washington State Department of Natural Resources [WDNR] 2021a).

The overall topography of the Project site is relatively flat with slight undulation, with approximately 10 feet of total elevation change. A lower bench feature is located in the northeastern portion of the

Project site that is approximately 8 to 10 feet lower than the rest of the Project site (Earth Solutions NW, LLC 2015).

Soils

Per the U.S. Department of Agriculture Natural Resources Conservation Service soil survey map, soils in the Project site consist mainly of Briscot loam, with areas of Pilchuck fine sand and Puyallup fine sandy loam (USDA 2021). Figure 4-1 illustrates the soils mapped in the Project site. Briscot loam and Pilchuck fine sand soils are prime farmland if drained and either protected from flooding or not frequently flooded during the growing season. Puyallup fine sandy loam is considered prime farmland. In the preliminary geotechnical report prepared for the Project site, these soils typically present a slight erosion hazard (Earth Solutions NW, LLC 2015). Topsoil was observed to a depth of approximately 12 inches, with native soils underlying the topsoil. Fill was not observed during the preliminary geotechnical site investigation (Earth Solutions NW, LLC 2015).

Geological Hazards

Pierce County defines geological hazards as hazards caused by natural or artificial causes that may damage persons or property and that include but are not limited to slides, slippage, or instability of earth, rock, and soil. Pierce County regulates the following geologic hazards as part of its Critical Areas development regulations (Title 18E PCC): volcanic, landslide, seismic (earthquake), mine, and erosion hazard areas. The following sections describe the potential geologic hazard areas found within the proposed study area and highlights applicable county standards.

Volcanic Hazards

Mount Rainier is located approximately 27 miles southeast of the study area and has erupted at least 10 times in the last 4,000 years. Mount Rainier poses a threat to adjacent communities from lahars and volcanic ash (USGS 2008). The largest eruption was 2,200 years ago. The Pierce County Hazard Identification and Risk Assessment (Pierce County 2019c) estimates that the recurrence rate for damaging volcanic activity, be it a damaging tephra eruption or a lahar coming down a valley, to be between 500 and 1,000 years. In other words, there is between 0.1 and 0.2 percent annual probability that a damaging eruption would occur.

A **lahar** is a hot or cold mixture of water and rock fragments that flows down the slopes of a volcano and typically enters a river valley.

Ash may also be a concern during a volcanic event. However, ash deposits based on prevailing winds would likely be distributed downwind of Mount Rainier towards the east and away from the Project site (Pierce County 2019c). In general, the annual probability of 1 centimeter (0.4 inch) or more of ash fall occurring on the Project site is between 0.2 and 0.1 percent (USGS 1998). In other words, the recurrence rate for 1 centimeter of ash fall would be between 500 and 1,000 years.

The study area is in an inundation zone for Case I and Case II lahars and Travel Time Zone C (Figure 4-2, Pierce County 2017). Pierce County critical area development regulations for Volcanic Hazard Areas (Title 18E.60 PCC) includes standards and review procedures intended to minimize the loss of life that may occur as a result of volcanic events emanating from Mount Rainer. Per Title 18E.60.020 PCC, inundation zones for Case I lahars could be affected by cohesive lahars that originate as enormous avalanches of weak chemically altered rock from the volcano. Case I lahars can occur with or without eruptive activity. The average reoccurrence rate for Case I lahars on Mount Rainier is about 500 to 1,000 years. Most Case I flows have reached some part of the Puget Sound lowland. The Electron Mudflow reached the lowland about 600 years ago along the Puyallup River, and its deposits at Orting are as much as 18 feet (Pierce County 2020).

Travel Time Zone: The ability to evacuate people from within a volcanic hazard area correlates to the distance from the source of an event (i.e., those areas closest to the event will have less time to evacuate than those areas farther away from the source of an event) and the amount of time for evacuation from the public notification (via a warning alarm system) that a lahar event has occurred. The amount of time that is anticipated for a debris flow, lahar, flood, or avalanche (estimated at 100,000,000 cubic feet of volume) to travel from either the source of the event or the point where the acoustic flow monitor alarm is sounded is classified into four travel time zones in Title 18E.60.020.C PCC.

Case II lahars are relatively large and non-cohesive, and most are caused by melting of snow and glacier ice by hot rock fragments during eruption. A few Case II lahars have reached the Puget Sound lowlands. One lahar occurred approximately 2,000 years ago and inundated the Nisqually River valley to depths of 30 to 120 feet. About 1,200 years ago, another lahar filled valleys of both forks of the White River to depths of 60 to 90 feet and flowed 60 miles to Auburn. The average time interval between Case II lahars from Mount Rainier is approximately 100 to 500 years (Pierce County 2019c). In other words, there is between 0.2 and 1.0 percent annual probability that a Case II lahar would occur.

The Project site is within Travel Time Zone C. Travel Time Zone C is the area that is an estimated 1.5- to 2-hour travel distance from the point where an acoustic flow monitor is sounded (Title 18E.60.020.C.3.b. PCC). Restrictions on occupancy in buildings within Travel Time Zone C are outlined in Table 4-2.

Pursuant to PCC Critical Areas regulations for development within a Volcanic Hazard Area, Hazardous Facilities and Essential Facilities are not allowed on the Project site. Special Occupancies and Covered Assemblies are limited to a 1,000-person occupant load. Standards on types of land uses and building occupancy limits allowed within the Project site for Inundation Zones for Case I and II lahars are provided in Title 18E. 60.040 PCC and summarized in Table 4-2.

Table 4-2. Project Site Volcanic Hazard Area Standards

Facility/Occupancy List	Case I Lahar Inundation Zone	Case II Lahar Inundation Zone
Bonus Densities[a]	Not Allowed	Not Allowed
Essential Facilities[b]	Not Allowed	Not Allowed
Hazardous Facilities[c]	Not Allowed	Not Allowed
Special Occupancies[d]	In Travel Time Zone C – Limited to 1,000-person occupant load	In Travel Time Zone C – Limited to 1,000-person occupant load
Covered Assemblies[e]	In Travel Time Zone C – Limited to 1,000-person occupant load	In Travel Time Zone C – Limited to 1,000-person occupant load
Other Occupancies	No Limitation	No Limitation

Source: Title 18E.60.040 PCC

[a] Bonus Density as set forth in Chapter 18A.35 PCC, Development Regulations – Zoning.

[b] Essential Facility as defined in PCC 18.25.030.

[c] Hazardous Facility as defined in PCC 18.25.030.

[d] Special Occupancy structures as defined in PCC 18.25.030.

[e] Covered Assemblies as defined in PCC 18.25.030.

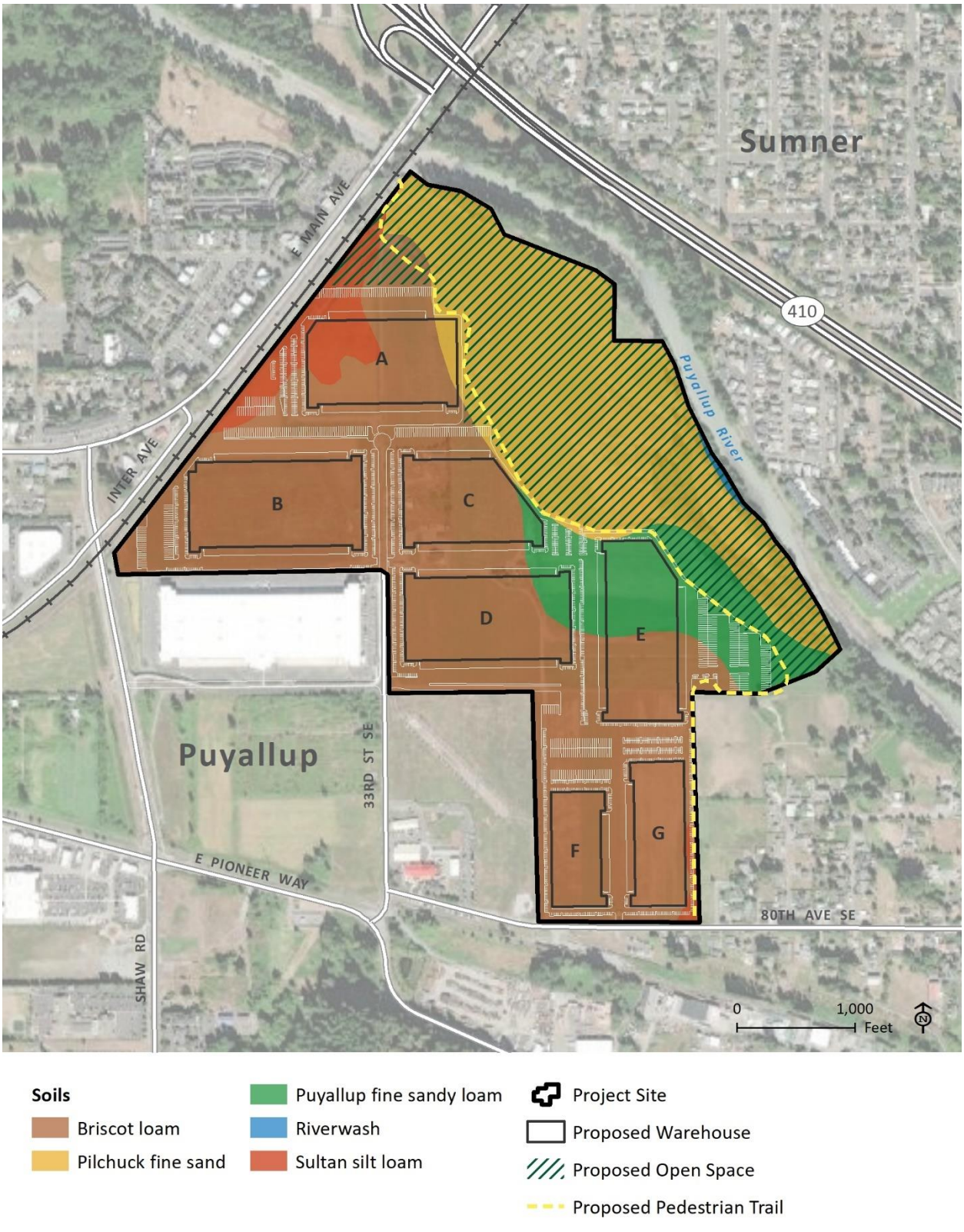

Figure 4-1. Soils Mapped in the Project Site

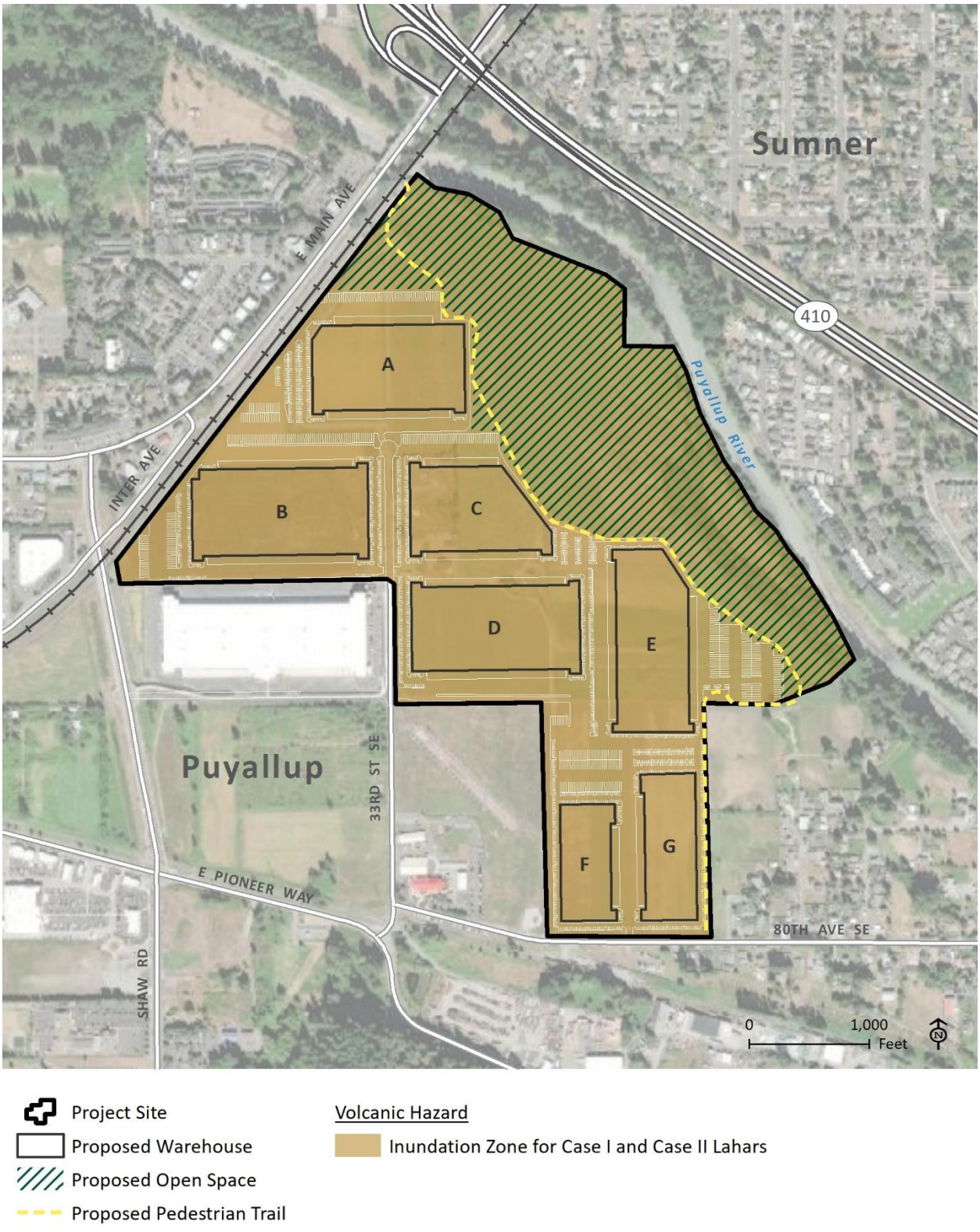

Figure 4-2. Volcanic Hazards in the Project Site

Landslides

When slopes are not stable, disturbances can cause mass movements of soil, rock, or debris known as landslides. The occurrence of a landslide depends on multiple factors, including but not limited to slope steepness, soil profile, slope shape, frequency of extreme weather events or earthquakes, and the density of vegetation in a given area.

Pierce County Landslide Hazard Areas regulations use multiple criteria to define landslide hazard areas (Title 18E.80.020 PCC). Some of these criteria include areas with slopes of greater than 20 percent or areas that have experienced a "historic failure" in the past, including areas of unstable, old, and recent landslides or landslide debris within a head scarp (the upslope portion of a landslide).

No historic landslides have been mapped on the Project site (WA DNR 2023); however, portions of the Project site near the Puyallup River and near the proposed locations of Warehouses A and E are mapped as landslide hazard areas having shallow susceptibility to landslides in accordance with Title 18E.80.020 PCC (Figure 4-3; Pierce County 2022).

Development in areas mapped as being within a landslide hazard area requires preparation of geological assessment as outlined in mitigation measure ER-3 (see Section 4.1.4). The assessment will categorize the landslide hazard area as being either active or stable (Title 18E.80.020 PCC). If the assessment determines that the area is stable, development of the site is permitted. If the assessment determines that the area is active, development within that site is prohibited per the requirements of Title 18E.80.040 PCC with some exceptions. There are some exceptions for stormwater conveyance lines, utility lines, and trails in active landslide areas. For development near active landslide areas, a buffer shall be required that is the larger of either 50 feet from the edge of the landslide hazard area limits, a distance of one-third the height of the slope if the regulated activity is at the top of the active landslide hazard area and a distance of one-half the height of the slope if the regulated activity is at the bottom of an active landslide hazard area, or the distance recommended by the geotechnical professional (Title 18E.80.050 PCC).

Seismic Earthquake Hazards

As outlined in Title 18E.90.020 PCC, seismic hazard areas are areas subject to severe risk of damage as a result of fault rupture, seismic ground shaking, soil liquefaction, flooding caused by tsunamis and seiches, or earthquake-induced landslides. As applicable, the design standards required per PCC 18E.90.040 are discussed further under each risk area below.

The level of seismic hazards in the Pacific Northwest vary from low to high depending on the location within the region, as indicated by historical seismicity; regional geological, geophysical, and tectonic data; and aerial imagery. Earthquake hazards in the Pacific Northwest are related primarily to the convergence of the North American and Juan de Fuca tectonic plates, which forms the subduction zone known as the Cascadia Subduction Zone (CSZ). Subduction of the Juan de Fuca plate below the North American continent is capable of producing earthquakes of magnitude 9 or greater. Earthquakes on the CSZ are believed to have a recurrence interval of between 200 and 700 years. The last CSZ earthquake was recorded in 1700 (PNSN 2021).

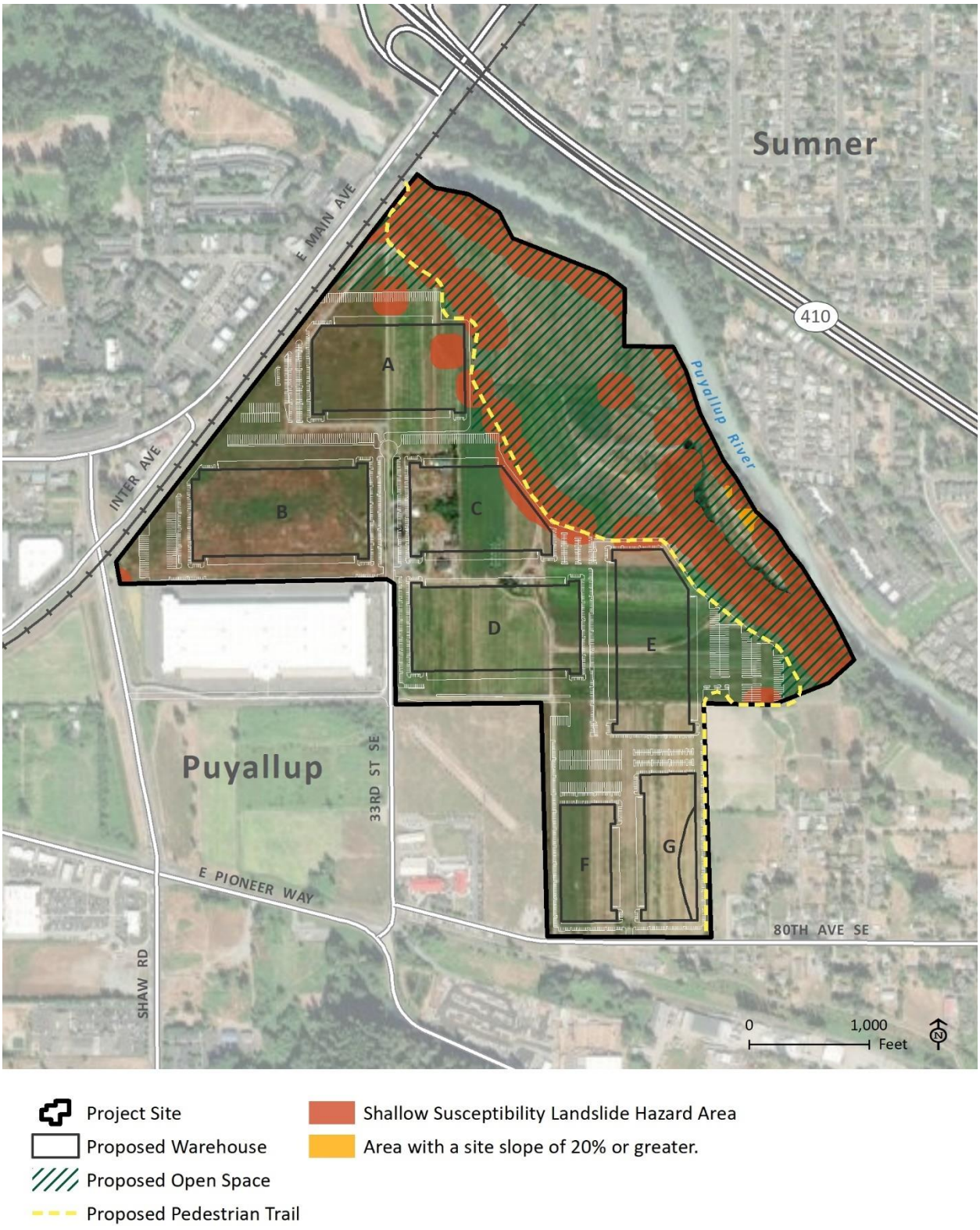

Figure 4-3. Landslide Hazards in the Project Site

Earthquakes can also result from movement along shallow fault lines. According to the WDNR, there are no fault trenches at the proposed Project site. The closest fault is approximately 3 miles north of the proposed Project site, east of Tacoma, Washington. Historical data show no earthquakes occurring within the study area (WDNR 2021b).

Earthquakes can also occur in association with volcanic activity. Volcanic earthquakes are not caused by tectonic plate motion, but rather by the movement of magma upward beneath active volcanoes. These earthquakes are localized to volcanic centers and rarely impact areas distant from the volcano. In the case of large volcanic eruptions, such as that of Mount St. Helens in 1980, volcanic earthquakes may cause shaking several miles from the volcano.

Fault Rupture

The initial motion along a fault (fault rupture) causes compressional seismic waves that release strong jolts of energy on the surface. Fault rupture can lead to structural damage of nearby buildings, bridges, and other infrastructure. If infrastructure is located directly on top of a fault that ruptures, damage can be significant. According to the WDNR, there are no fault trenches at the proposed Project site or in the surrounding region (WDNR 2021b). Fault rupture is not a seismic hazard risk at the Project site; therefore, the relevant design standards for fault rupture in Title 18E.90.040 PCC are not applicable.

Ground Motion/Shaking

Following an initial fault rupture, seismic waves cause shaking of the ground surface. The ground shaking that occurs during an earthquake is generally what causes damage to overlying structures, especially when the shaking lasts for more than a minute. Earthquake damage from ground motion at a given location depends on the properties of the arriving seismic waves, the properties of the soil at the site, and the structures involved. The amount of ground motion that may occur during an earthquake can be predicted based on the rock and soil properties in a given area.

Some geologic areas are more susceptible to ground shaking during a seismic event than others. The structures of certain soils can amplify shaking and create an increased hazard. Site classes are established and categorized by the National Earthquake Hazard Reduction Program to evaluate this risk. Site classes are designated as B through F, in which site class B represents geologic areas that do not dampen or amplify shaking; site classes C through E are areas that amplify shaking; and site class F represents areas that have unusual soil conditions that need to be evaluated in person. The soils in the proposed Project site are categorized as site classes D though E, suggesting that they have high potential to amplify ground shaking during an earthquake event (WDNR 2021b). Although the Project site is mapped as having high potential to amplify ground shaking and it is noted as a potential seismic hazard area, there are no seismic design standards in Title 18E.90.040 PCC related to ground shaking.

Soil Liquefaction

Soil liquefaction can occur from shaking during a seismic event when loose, water-saturated soils or artificial fills behave like a liquid. Risk of liquefaction was noted as a concern in the geotechnical report for the proposed Project site (Earth Solutions NW, LLC 2015). Risk in the proposed Project site of this hazard is confirmed by the WDNR liquefaction susceptibility map, which classifies the area as “Moderate to High” and “High” (WDNR 2021b). Moderate to high liquefaction susceptibility areas are defined as

seismic hazard areas per Title 18E.90.020 PCC. See Figure 4-4 for soil liquefaction susceptibilities in the Project site.

Per Title 18E.90.030 PCC, facilities sited within a seismic hazard area are required to have a geological assessment performed. A geotechnical letter shall be prepared per the requirements outlined in Title 18E.90.060 PCC if the assessment determines that no liquefaction hazard exists. A geotechnical evaluation shall be prepared If the assessment determines that a liquefaction hazard exists on the site but is outside of the proposed Project area per the requirements outlined in Title 18E.90.060 PCC. A geotechnical report shall be prepared if the assessment determines that a liquefaction hazard exists within the proposed Project area per the requirements outlined in Title 18E.90.060 PCC. The geotechnical report shall include a detailed engineering evaluation of expected ground displacements or other liquefaction and/or dynamic settlement effects (e.g., bearing failures, flotation of buried tanks) and proposed mitigation measures to ensure an acceptable level of risk for the proposed structure type or other development facilities, as well as the proposed land use type (i.e., occupancy category). The minimum level of acceptable risk for any proposed structure or development facility shall ensure the life safety of any occupant. Designs shall evaluate the range of alternatives for achieving limited structural damage to no structural damage based on the proposed use intended for the structure.

Tsunamis and Seiches

During a seismic event, a large amount of water can be displaced, possibly triggering a tsunami. Since the Project site is not located adjacent to Puget Sound marine waters, lakes, or ponds, the Project site is unlikely to be affected by a seiche, as seiches do not occur in free-flowing water bodies. Tsunamis and seiches are not a seismic hazard risk at the Project site; therefore, the relevant design standards in Title 18E.90.040 PCC are not applicable.

Seiches are temporary disturbances or oscillations in water level typically caused when strong winds and rapid changes in atmospheric pressure push water from one end of a body of water to the other.

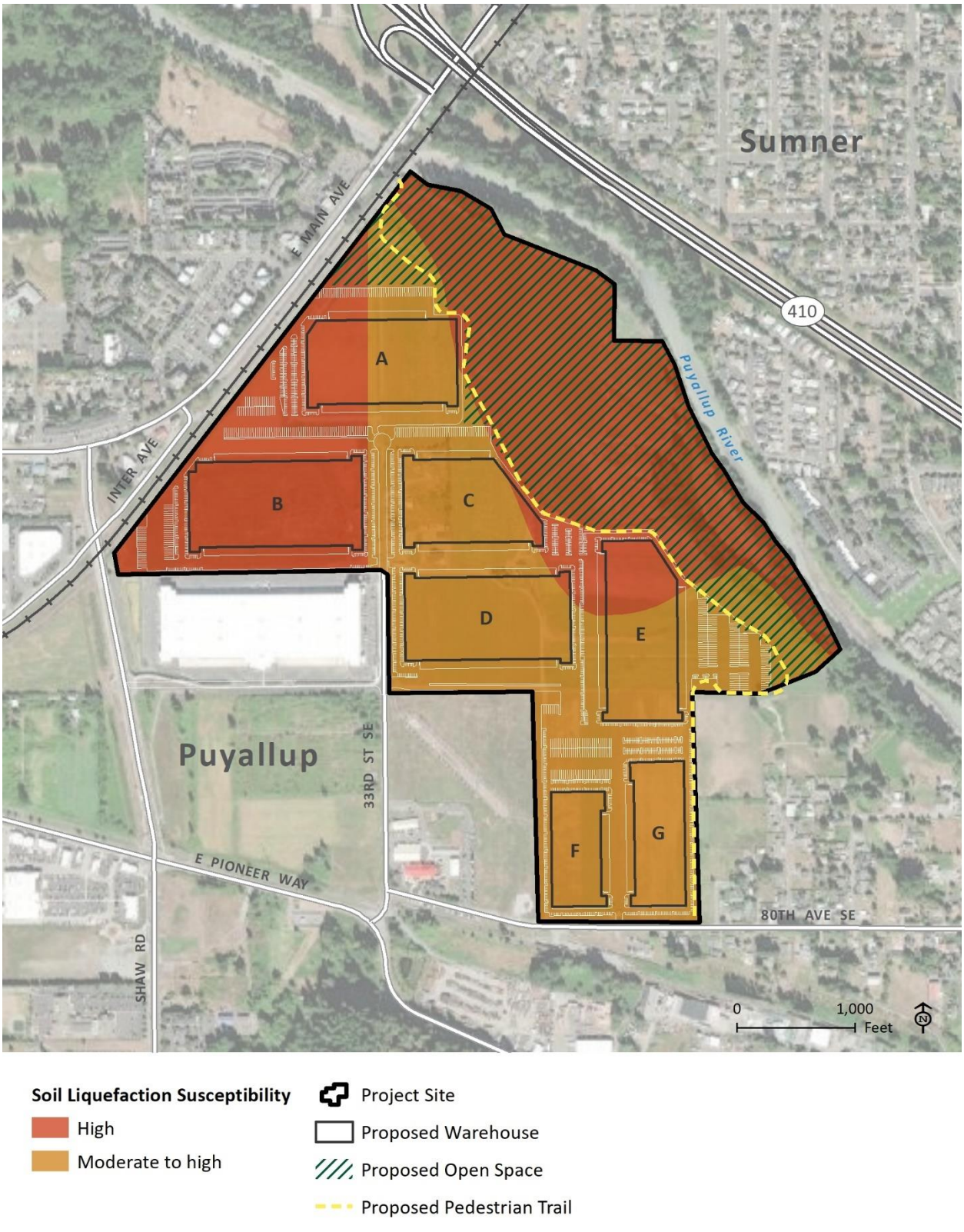

Figure 4-4. Soil Liquefaction Susceptibilities in the Project Site

Mines

Pierce County defines a mine hazard area as an area directly underlain by, adjacent to, or directly affected by mine workings such as mine entrances, tunnels, drifts, or air shafts. No known mine hazards are present within the Project site (WDNR 2021b).

Erosion

Pierce County defines erosion hazard areas as those areas that, because of natural characteristics including vegetative cover, soil texture, slope, gradient, and rainfall patterns, or because of human-induced changes to such characteristics, are vulnerable to erosion (Title 18.25.030 PCC) and can include hazards from shoreline, riverine (also referred to as Channel Migration Zones [CMZs]), or soil erosion. Pierce County Critical Areas development regulations includes specific requirements and standards for identified Erosion Hazard Areas (Title 18E.110 PCC and 18E.70.020). No shoreline or soil erosion hazard areas are mapped on the site.

A CMZ is an area where a channel is likely to move over a period of time. The Pierce County CMZ study for the Puyallup, White, and Carbon rivers and adopted by Pierce County for CMZ delineation, identifies areas at a severe, moderate, or low risk of erosion per the criteria below (GeoEngineers 2003).

Severe Migration Potential Area: Areas adjacent to the outside edges of the historic channel occupation tract boundaries, as determined by the results of the historic aerial photographic evaluation. The width of the severe migration potential area will be determined for each individual geomorphic stream reach, based on the distance the channel edge could travel in 5 years of steady lateral migration. The rate of migration used in the calculation will be the maximum rate of migration measured for each geomorphic reach. This distance will be measured from the outside boundary of the historic channel occupation tract.

Moderate Migration Potential Area: Areas adjacent to the outside boundaries of severe migration potential areas. The width of the moderate migration potential area will be determined for each individual geomorphic stream reach, based on the distance the channel could travel in 10 years of steady lateral migration at the maximum rate of migration for each reach.

Low Migration Potential Areas: Areas unlikely to experience channel migration within a 15- to 20-year period, depending on the presence of geomorphic features in the moderate migration potential area.

Severe risk CMZ areas are regulated under Pierce County's floodway code (PCC 18E.70.020). The portion of the Project site that is set aside for open space located near the Puyallup River is mapped as a severe CMZ (Figure 4-5). The existing stormwater outfall is located within the CMZ of the Puyallup River as shown on Figure 4-5. Per Title 18E.70.040 PCC, any development, encroachment, filling, clearing, grading, new construction, and substantial improvement is prohibited within the floodway (including the CMZ floodway). With the exception of the stormwater outfall, proposed Project structures would be located outside of the mapped severe CMZ of the Puyallup River (for more information on the outfall, see Section 4.2 Surface Water).

Portions of Buildings A and E and the parking area would be located in low and moderate CMZ areas. Portions of Buildings C and D would be located in a moderate CMZ area. Pierce County has taken the

position that under the version of the County Code that applies to the Project application, development may occur in low and moderate risk CMZ areas.

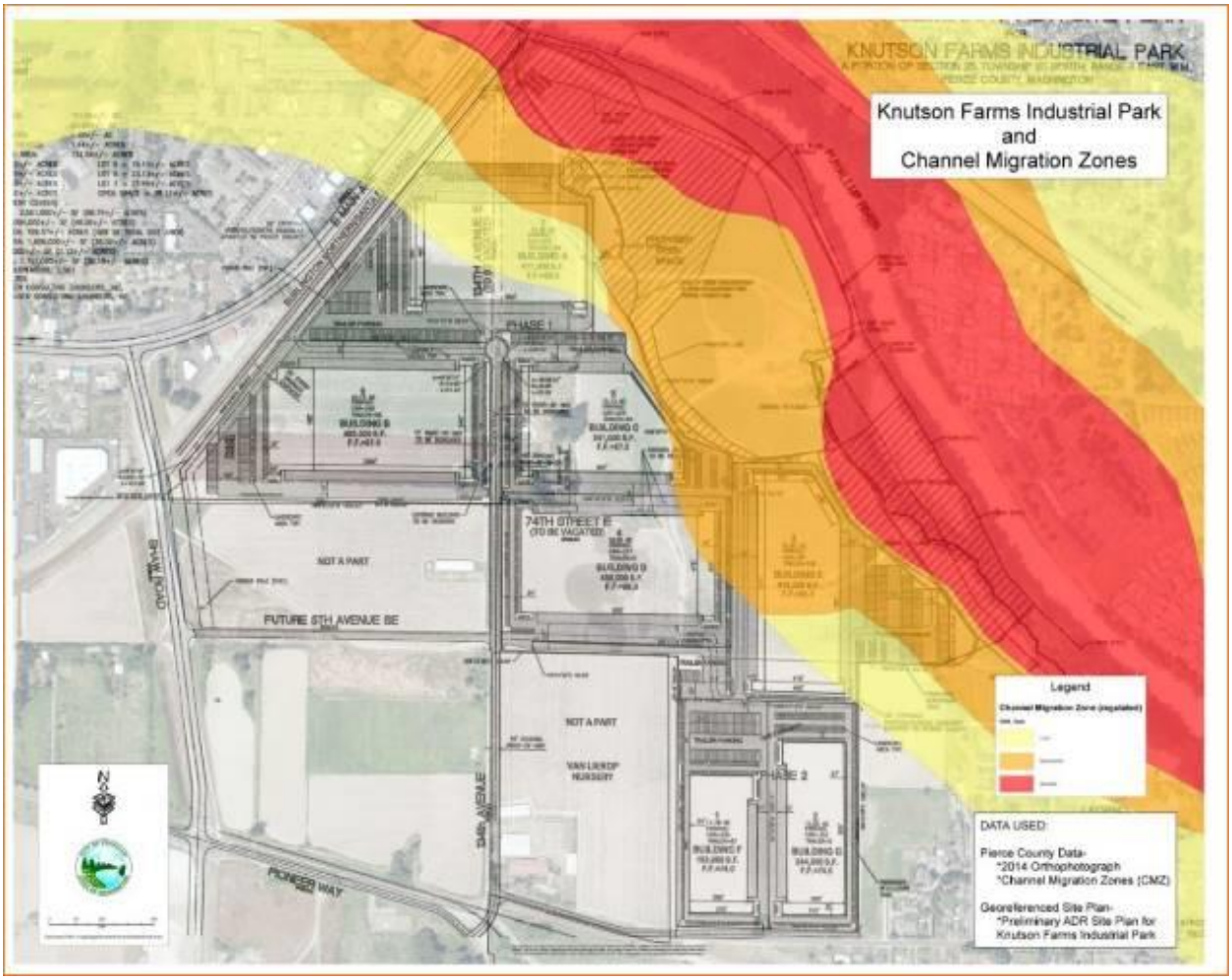

Figure 4-5. Erosion Hazard Areas and Channel Migration Zones

When the Pierce County's maps, sources, or field investigations indicate that the proposed Project area for a regulated activity is located within a riverine erosion hazard area (CMZ), the standards set forth in Title 18E.70 PCC would apply to riverine erosion hazard areas (CMZs); see Figure 4-6.

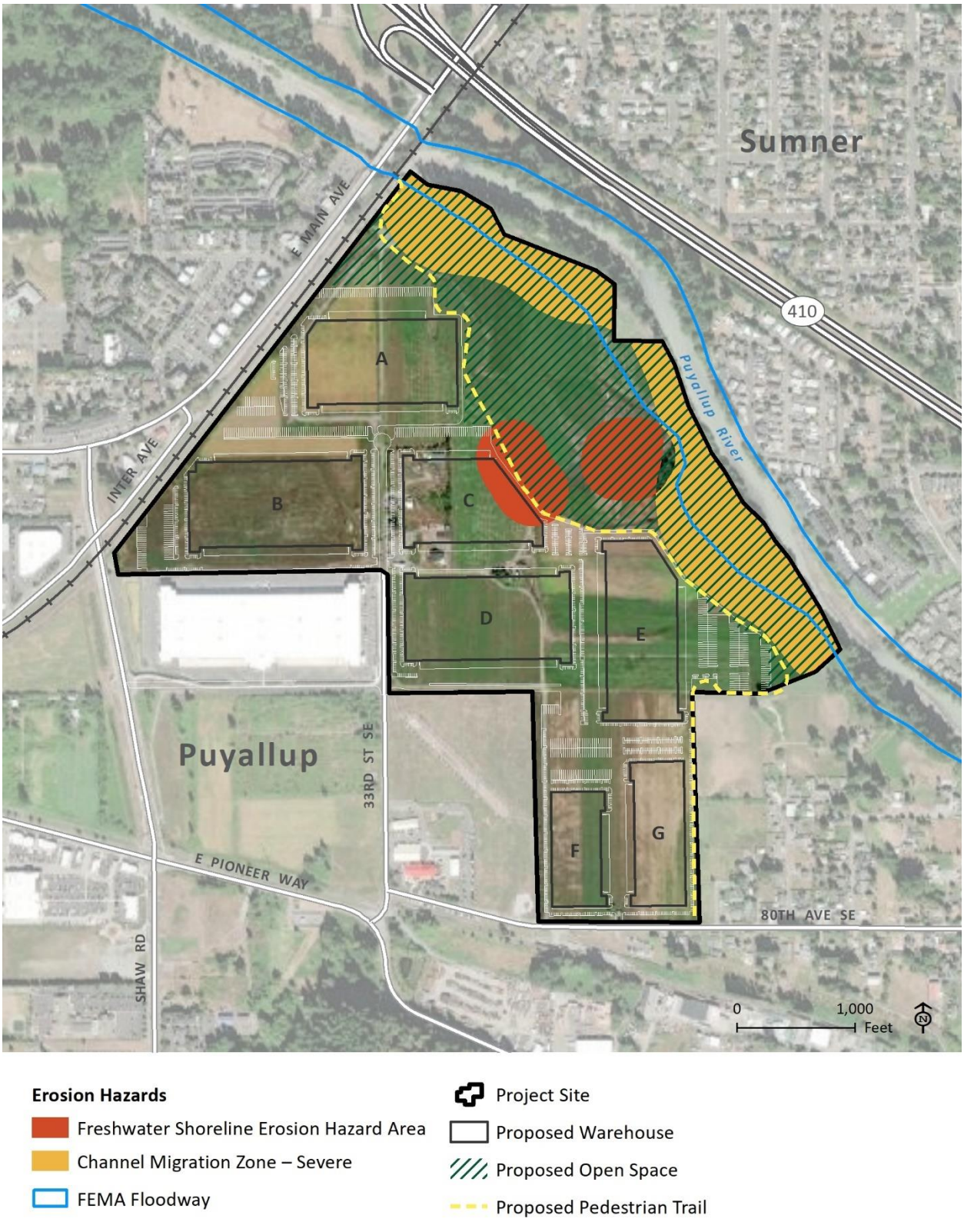

Figure 4-6. Erosion Hazard Areas and Channel Migration Zones

4.1.4 Impacts

Methodology

The potential impacts of the proposed Project construction on slopes and soils were determined based on locations of site grading, cuts, and fills relative to soil types and topographic features and the permanence of activity. Potential impacts related to soil erosion and sediment transport are discussed in qualitative terms.

The potential for the proposed Project to result in operational impacts was assessed based on geologic processes and geologic hazards that could impact slope stability, soil structure, and ground motion. The potential for the proposed Project to be altered or damaged by geologic hazards was determined based on the Project's proximity to the hazard and the existing geologic features that would influence the relative risk.

Impacts Analysis

No Action Alternative

Under the No Action Alternative, the construction and operation of the proposed Project would not occur. Existing conditions regarding the potential for geologic hazards including earthquakes, soil liquefaction, and volcanic activity would be maintained. The No Action Alternative would have no impact associated with development of the Project in geologically hazardous areas. Permanent conversion of the Project site on soils that lend to agricultural practices would not occur.

Project

Construction Impacts

Soils and Erosion

Mitigated Significant Impact. Construction activities such as soil removal, grading, and clearing necessary to complete construction of the Project would cause permanent alterations to the topography of the Project site. Construction impacts would include ground disturbance, which would include up to 450,000 CY of on-site excavation and fill. Excavated material would be tested for contamination. If contaminants were found, the materials would be removed from the proposed Project site and disposed of in accordance with state and local regulations. Clearing and excavation during construction could result in impacts from erosion as bare soils become exposed to wind, rainfall, a major flood event, or vehicle activity within the proposed Project site.

Prior to construction, the Applicant would be required to comply with Washington State Department of Ecology (Ecology) Stormwater Quality Regulations, obtain coverage under the National Pollutant Discharge Elimination System (NPDES) through a Construction Stormwater General Permit to help control runoff and reduce water pollution from the construction site. Prior to construction, the Applicant would be required to develop a Stormwater Pollution Prevention Plan (SWPPP) in conformance with requirements in the PCSWDM, implement sediment erosion and pollution prevention control measures, and receive an approved permit under the NPDES program.

The topography of the proposed Project site would be permanently altered during construction. Site grading for utilities, paving, and building construction would result in a large quantity of earth movement and filling. Because much of the area has been altered by only minimally invasive agricultural practices, the changes from the proposed site development and soil grading would alter the use of the existing landscape form. The soils classified as prime farmland would no longer be available for agricultural land uses. This impact is discussed further in Section 4.5 – Land and Shoreline Use (see mitigation measure LU-4).

Construction of the Project would result in permanent impacts from alterations to the surface geology, topography, and soils. Impacts would be less than significant with the implementation of mitigation measures ER-1 through ER-5:

- ***ER-1: Implement BMPs during construction.*** Implementation of BMPs during construction to limit soil erosion to the maximum extent possible, consistent with Pierce County Comprehensive Plan Goal ENV-10 and City of Puyallup's Comprehensive Plan Policy NE-4.5.
- ***ER-2: Implement low impact development principles.*** Implementation of low-impact development (LID) principles during site planning to the maximum extent feasible to minimize impacts to soils and geological resources, consistent with Pierce County Comprehensive Plan Policies ENV-10.2.1 and D-18.6 and City of Puyallup's Comprehensive Plan Policy NE-5.6.
- ***ER-3: Develop Geotechnical Assessment from a WA Licensed Geotechnical Engineer.*** A geotechnical engineer licensed in Washington State would be retained to develop a geotechnical assessment to determine the presence of geologic hazards, including active landslide hazards, seismic hazards, and shoreline erosion hazard areas, in accordance with Title 18E.80.030 PCC, Title 18E.90.030 PCC, and Title 18E.110.030 PCC. The geotechnical engineer should also review and approve all grading, erosion, and drainage control plans prior to construction to assist in reducing liquefaction and landslide risks from and to the Project. The licensed engineer of record should determine the appropriate foundation, footing, and structural design to conform to the International Building Code standards for seismic and landslide hazards and establish buffers to site the Project away from shoreline erosion/ channel migration hazard zones in accordance with best practices.
- ***ER-4: Prepare and Implement SWPPP for Erosion and Sedimentation Hazards.*** Consistent with the Clean Water Act (CWA) and NPDES permit program, and the PCSWDM, the Applicant should implement a Construction SWPPP that will satisfy the requirements of the NPDES General Permit for Stormwater Discharges Associated with Construction Activities. The Construction SWPPP should include measures for temporary erosion and sedimentation control and identify a regular inspection and maintenance schedule for all erosion control structures. The SWPPP should include descriptions of all BMPs to be implemented during construction to minimize erosion and sediment entering surface waters.

  Erosion and sedimentation control measures should be implemented at the beginning of the construction process and maintained throughout all phases of construction. Measures may include, but are not limited to, installation of a stabilized construction entrance, a wheel wash, silt fences, seeding, mulching, and dust control, and all other BMPs as recommended by a

licensed civil engineer. Additional erosion control supplies, including sandbags and channel-lining materials, should be stored on-site for emergency use.

The Project site should be monitored for erosion on a weekly basis and after large rainfall events, and corrective action should be taken as needed. Soil stockpiles should be stabilized and protected from erosion, and soils should also be stabilized before a holiday or weekend if needed, based on forecasts of precipitation.

- ***ER-5: Prepare Emergency Site Management Plans for large scale weather events for Erosion and Sedimentation Hazards.*** Due to the presence of active floodway, floodplain, and known severe CMZ areas that present a risk of large-scale geological impacts to the site, the Applicant should prepare emergency site management plans that would be implemented in the event of large-scale weather events that may cause flooding on or directly adjacent to the Project site. The Applicant should consult with Pierce County Surface Water Management, Emergency Management, and Planning Departments on the site emergency management planning pursuant to approval during site development approval permitting processes.

Volcanic Hazards

Mitigated Significant Impact. Lahar debris flow and/or ashfall caused by the eruption of Mount Rainier could occur on site. Impacts from a lahar debris flow could include inundation of the Project site. Impacts from ashfall could include ash accumulation on infrastructure and suspension of fine particles in the air. However, as described, there is between 0.1 and 0.2 percent probability that a damaging eruption would occur in any given year.

Development of the Project would be required to comply with Pierce County Critical Areas regulations for developments within Lahar Inundation zones (Title 18E.60 PCC). The Pierce County Critical Areas regulations prohibits development of specific facilities within Case II Lahar Inundation Zones (Title 18E.60.040 PCC). This includes essential facilities (i.e., facilities that are meant to maintain life, health, welfare, and safety functions) and hazardous facilities (i.e., occupancies or structures housing or supporting toxic or explosive chemicals or substances and any non-building structures housing, supporting, or containing quantities of toxic or explosive substances that, if contained within a building, would cause that building to be defined as a hazardous facility) as defined in Title 18.25 PCC. Any use within either of these two categories at the proposed facility would be in violation of the County's Critical Areas development regulations and would have potential impacts to safety and disaster responsiveness in the event of an eruption of Mount Rainier.

The City of Puyallup has similar regulations for development in lahar zones. Following annexation, operation of the Project would be required to comply with City codes for developments within Lahar Inundation zones. In addition to generally prohibiting hazardous facilities, the code limits building occupancy to 1,000 people or less (Chapter 21.06.1260 PMC). Pierce County's Critical Areas development regulations also regulates occupancies in Case I or Case II lahar inundation zone in time zone C but does not appear to limit warehouse uses (Title 18E.60.040 PCC). Limiting occupancy of the Project facilities could reduce risk to life posed by lahars and would make it easier to evacuate in a timely manner.

Due to the infrequency of eruptions, the probability of an impact from either ashfall or lahars during construction is low. However, the subsequent damage or safety risk should a volcanic eruption occur would be significant/catastrophic. Implementation of mitigation measures ER-6, ER-7, and ER-8 would be required to minimize the potential for significant impacts.

- ***ER-6. Comply with Title 18E.60 PCC for Volcanic Hazards.*** Consistent with Pierce County Critical Areas development regulations for Lahar Inundation Zones, no hazardous facilities (those supporting toxic or explosive chemicals or substances) should operate on the Project site (Title 18E.60 PCC). The prohibition on uses should include essential facilities (i.e., facilities that are meant to maintain life, health, welfare, and safety functions). The Applicant should comply with this guidance as they determine final uses for the site.
- ***ER-7. Prepare Emergency Management Plan for Volcanic Activity.*** An emergency management plan should be put in place prior to construction for use in the event of volcanic activity, consistent with Pierce County Comprehensive Plan Policy ENV-10.7.1, including the following elements in accordance with Title 18E.60.010 PCC and the Mount Rainier Volcanic Hazards Plan (Pierce County 2008a):
  - A campus-wide critical alert notification system in place which coordinates with local and regional emergency monitoring systems;
  - An emergency evacuation plan that adequately demonstrates the ability to evacuate all expected occupants in a lahar situation to an acceptable area outside of the volcanic hazard lahar area, in coordination with regional and local emergency management plans;
  - That the warehouse complex has procedures in place to ensure the emergency evacuation plan is maintained over the life of the development and that occupants are involved in periodic drills and/or other instruction regarding those emergency evacuation procedures; and
  - Record on the title of each parcel included in the Project site a notice of the presence of active volcanic hazards and limitations on certain types of land uses and building occupancies, consistent with the Critical Areas regulations (Title 18E.10.080C.2 PCC).
- ***ER-8. Building Occupancy Limits for Volcanic Hazards.*** When identifying an end user, consider uses that will have building occupancies of less than 1,000 people. This would minimize risks to life posed by volcanic hazards.

Landslide Hazards

Mitigated Significant Impact. Portions of Warehouses A and C are mapped within a landslide hazard area, and there are portions of the Project site topography that would be susceptible to landslides. Construction of the Project would mostly occur outside of the mapped landslide hazard areas and away from the associated buffer area of such landslide features. Except for stormwater facilities, utility lines, and trails, development would not be allowed within an *active* landslide area (Title 18E.80.040A PCC). Per Title 18E.80.020 PCC, when a proposed regulated activity may be located within a mapped active or potential landslide hazard area, a geological assessment conducted in accordance with Title 18E.80.030 PCC is required. As such, areas mapped as a *potential* landslide hazard may be deemed to be stable per

a geotechnical analysis and the criteria set forth in Title 18E.80.20C(2) PCC. Therefore, the potential risk of a landslide impacting the construction of Warehouses A and C would need to be minimized by adhering to the results of a geotechnical assessment as outlined in mitigation measure ER-3.

Seismic Hazards

Mitigated Significant Impact. There is the potential for earthquakes to occur in the Project site during construction. Prolonged earthquake-related ground shaking has the potential to disrupt construction activities, damage equipment and existing utilities, and expose construction workers to outcomes of those risks. The potential for ground motion to disrupt construction activities and cause damage depends on the type and strength of seismic motion and the ground/soil conditions. Soils in the Project site are mapped as having a moderate-to-high to high susceptibility for liquefaction in the event of an earthquake, and liquefaction-induced settlement may occur during a strong seismic event. The required geological assessment identified under mitigation measure ER-3, also requires a seismicity review and risk evaluation relative to the proposed development be included (Title 18E.90.060(A(3)(f)(2) PCC). Prior to construction, the Applicant would need approved permits (Grading, Site Development, and Building) for earth-disturbing activities, which would reflect conditions of the site. When a spontaneous incident occurs, such as a severe earthquake, the contractor would implement and follow their own Standard Operating Procedures and Emergency Operations Plans. This plan would need to be developed as outlined in mitigation measure ER-9. Therefore, the potential earthquake hazards during construction are considered a less than significant impact with mitigation. Implementation of mitigation measures ER-9 and ER-10 would reduce impacts to the extent feasible.

- ***ER-9: Prepare Emergency Management Plan for Seismic Events.*** An emergency management plan should be put in place prior to construction for use in the event of an earthquake, consistent with Pierce County Comprehensive Plan Goal ENV-10.
- ***ER-10: Conform with Title 17C PCC for Seismic Design.*** Seismic design parameters would be incorporated into the design of Project facilities to minimize potential damage due to liquefaction in conformance with the standards set forth in Title 17C PCC, Construction and Infrastructure Standards – Building and Fire Codes.

Mines

No Impact. No mines are mapped within the Project site; no impacts during construction are anticipated. No mitigation is required.

Channel Migration Zones

Mitigated Significant Impact. Per Title 18E.70.040 PCC, any development, encroachment, filling, clearing, grading, new construction, and substantial improvement is prohibited within the floodway (including the CMZ floodway). With the exception of the stormwater outfall and open space area, proposed Project structures would be located outside of the mapped severe CMZ of the Puyallup River. Portions of the development site building area is located within the low to moderate mapped CMZ. Low to moderate CMZs are anticipated to have a 10–20-year time window in which lateral movement of the river toward the site might occur, allowing for potential adaptation on site against catastrophic impacts. As such, anticipated impacts from development in low to moderate CMZs on the site is limited, as BMPs

to address channel migration could be reasonably expected to be applied to protect, preserve, or modify the site to prevent losses or damage.

If severe channel migration occurs south toward the Project site, the stormwater outfall could become permanently modified by the river and would no longer be functional as designed. Some of these impacts are observed to be occurring; see Section 4.2 – Surface Water for additional detail. If severe channel migration occurs near the north bank of the Puyallup River, the riverbank could shift away from the stormwater outfall and the stormwater outfall may no longer be located adjacent to the river and would no longer function as designed. The risk of CMZ erosion because of the proposed Project is considered less than significant with implementation of the design measures required per a geotechnical assessment as outlined in mitigation measure ER-3.

Operations Impacts

Soils and Erosion

Mitigated Significant Impact. During operation, no additional excavation or disturbance of ground surfaces would be required during the operation of the Project. However, impervious surfaces are proposed to cover about 77 percent of the site. Additional impervious surfaces would increase the amount of stormwater runoff generated in the Project site, leading to the increased potential of erosion of receiving water bodies. Additionally, sources of runoff discharged from the site through storm water conveyance systems could cause erosion or earth movement if inappropriately designed or placed. Mitigation measure SW-1 is identified to reduce impacts related to increased impervious surfaces. See the discussion of operational surface water impacts and identified mitigation related to stormwater runoff and stormwater conveyance systems in Section 4.2.5.

A loss of soil productivity and quality for local agricultural production would occur because of the construction of permanent Project facilities and infrastructure. The soils classified as prime farmland would no longer be available for agricultural uses. This impact is discussed further in Section 4.5 – Land and Shoreline Use (see mitigation measure LU-4).

Volcanic Hazards

Mitigated Significant Impact. During operations, the same risk of volcanic hazards in the Project site would be present, and there would be an increase of employees and facilities on site. Due to the infrequency of eruptions, the probability of an impact from either ashfall or lahars during operation is low, but the potential subsequent damage or safety risks during operation is considered a significant impact. Implementation of code requirements for developments within Lahar Inundation zones mitigation measures ER-7 and ER-8 would reduce impacts to the extent feasible.

Landslide Hazards

Mitigated Significant Impact. During operations, the same risk of landslide hazards as during construction in the Project site would be present, but established infrastructure and the presence of employees would be at risk. The requirement for geotechnical assessment per Title 18E.80.020 PCC (mitigation measure ER-3) and the limitation of development within *active* landslide hazard area, would avoid the potential risk of a landslide impacting the operation of warehouses to the extent practical. Therefore, impacts to landslide hazard areas during operations would be less than significant.

The existing stormwater outfall is located within a mapped, shallow-susceptibility landslide hazard area near the Puyallup River. Impacts on the stormwater outfall could occur from a landslide or scour from discharge that could cause mass erosion into the Puyallup River. The proposed infiltration trenches are located near the top of the upper topographical bench landform; inappropriate siting of such trenches and the associated discharge near the slopes could cause erosion and/or landslides during operation. Mitigation measure SW-8 is identified to reduce potential landslide hazard impacts to the stormwater outfall and infiltration trenches.

Seismic Hazards

Mitigated Significant Impact. During operations, the same risk of seismic hazards in the Project site would be present but established infrastructure and employees would be on-site. The potential for ground motion to damage infrastructure depends on the type and strength of seismic motion and the ground/soil conditions. Soils in the Project site are mapped as having a moderate-to-high to high susceptibility for liquefaction in the event of an earthquake, and liquefaction-induced settlement may occur during a strong seismic event. As outlined in mitigation measure ER-10, seismic design parameters would be incorporated into the design of Project facilities to minimize potential damage in conformance with the standards set forth in Title 17C PCC, Construction and Infrastructure Standards – Building and Fire Codes. If these design standards are implemented, the risk of severe structural damage or failure of facility elements from shaking because of ground motion associated with earthquakes from the CSZ or other faults would be minimized, but not eliminated irrespective of design of a facility. The required geological assessment conducted in accordance with Title 18E.80.030 PCC and identified under mitigation measure ER-3, also requires a seismicity review and risk evaluation relative to the proposed development be included. Therefore, the potential risk of a seismic hazards impacting the operation of proposed Project is considered less than significant.

Mines

No Impact. No mines are mapped within the Project site; no impacts during operation are anticipated.

Channel Migration Zones

Less than Significant. The existing stormwater outfall is located within the severe CMZ of the Puyallup River as shown on Figure 4-4. Portions of the site development building area are located in the low to moderate CMZ areas mapped by Pierce County. If severe channel migration occurs south towards the Project site, the stormwater outfall could become inundated by the river and would no longer be functional as designed. If severe channel migration occurs near the north bank of the Puyallup River, the stormwater outfall may no longer be on the shoreline of the river since the river moved north and would no longer function as designed, as it would be too far from the riverbank to function. If channel migration occurs in the low to moderate CMZ, the impacts could include risk of damage to improvements (utility, paving, and other appurtenances) and buildings, although the probability of that scenario is low due to the anticipated timeline for moderate to low CMZ changes to uplands. The risk of CMZ erosion as a result of the proposed Project is considered less than significant with implementation of the design measures required per a geotechnical assessment as outlined in mitigation measure ER-3.

Alternative 1 – Rail Transport

Construction Impacts

Mitigated Significant Impact. The construction impacts associated with Alternative 1 would be similar to those described for the proposed Project; Alternative 1 would result in alterations to surface geology, topography, and soils. Additional impacts for Alternative 1 would be associated with the small area between the Project site and the Meeker Southern railroad where construction of track extensions from the BNSF mainline/Meeker Southern interchange. Most of the ground disturbance for the construction of the rail line would occur within the same construction footprint as the proposed Project, and the additional ground disturbance would result in an incremental increase in soil removal, grading, and clearing necessary to complete construction. This additional ground disturbance would result in erosion as bare soils become exposed to wind, rainfall, or vehicle activity. In addition, Alternative 1 would have the same risk of seismic, landslide, and volcanic hazards and would require construction in the CMZ. Implementation of mitigation measures ER-1 through ER-10 would reduce impacts associated with the construction of Alternative 1.

Operations Impacts

Mitigated Significant Impact. The operations impacts associated with Alternative 1 would be similar to those described for the proposed Project. The amount of impervious surface is not expected to increase when compared to the proposed Project, as the rail line may be considered pervious surface. No additional excavation or disturbance of ground surface would be required during the operation of the Project. As such, Alternative 1 operations impacts include a permanent increase in impervious surfaces, resulting in increased runoff and potential erosion or earth movement. In addition, Alternative 1 would have the same risk of seismic, landslide, and volcanic hazards and would require construction in the CMZ. Implementation of mitigation measures SW-8, ER-3, ER-6, ER-7, ER-8, ER-9, and ER-10 would minimize impacts associated with the operation of Alternative 1.

Alternative 2 – Reduced Intensity Alternative

Alternative 2 considers the potential impacts that would result if the mitigation measures that reduce the site footprint of the facility (AES-2, LU-1, REC-1, and SW-4) as outlined in this Draft EIS for the proposed Project) were adopted by the Applicant. As noted below, Alternative 2 would still require Project implementation mitigation measures to reduce impacts to earth resources.

Construction Impacts

Mitigated Significant Impact. The construction impacts associated with Alternative 2 would be less than those described for the proposed Project. Similar to the proposed Project, construction of Alternative 2 would result in alterations to surface geology, topography, and soils. Site grading for utilities, paving, and building construction would result in earth movement and filing at a smaller quantity under Alternative 2. The potential for exposure to geologic hazards would be the same as the proposed Project under Alternative 2, except for landslide hazards. Under Alternative 2, landslide hazard areas would be outside of the Alternative 2 Project footprint and would no longer be of concern. Even with a smaller footprint, mitigation for soil and erosion impacts would still be required as outlined under the proposed

Project. Mitigation measures ER-1 through ER-10 would reduce impacts associated with the construction of Alternative 2 to the extent feasible.

Operations Impacts

Mitigated Significant Impact. Operational impacts related to Alternative 2 would be less than the impacts listed for the proposed Project. This includes decreasing the potential for increased stormwater runoff generated in the Project site from impervious surfaces, the long-term or permanent loss of soil productivity for local agricultural production, and the potential for exposure to geologic hazards. The potential for exposure to geologic hazards would be the same under Alternative 2, except for landslide hazards and CMZs. Under Alternative 2, landslide hazard areas would be outside of the Alternative 2 Project footprint and would no longer be of concern; additionally, although not entirely, the majority of the portions of the Project within the moderate and low CMZs would be removed from those mapped hazard areas, limiting the need for long-term monitoring of impacts from changes to the Puyallup River channel area relative to site improvements and buildings. Even with a smaller footprint, mitigation would still be required as outlined under the proposed Project. Implementation of mitigation measures ER-3, ER-6, ER-7, ER-8, ER-9, and ER-10 would minimize impacts associated with the operation of Alternative 2 to the extent feasible.