June 16, 2023

Yoshihiro Monzaki, PE
City of Snohomish
116 Union Avenue
Snohomish, Washington 98290

Subject: City of Snohomish Public Works Facility Feasibility Study

PACE has prepared the following updated study to identify development constraints and potential civil engineering feasibility concerns which may negatively impact the development of the City's property for the new Public Works site.

The potential City of Snohomish Public Works Property is in the City of Snohomish, Parcel # 28060500301100 located on 123rd Avenue SE, directly adjacent to Highway 2 and northwest of the intersection of Three Lakes Rd and 123rd Ave SE. The development proposes a new public works facilities site to replace the current public works site located on 1st Street along the Snohomish River. The proposed site is on a 12.94-acre parcel that is currently owned and used by the City to store deicing and other materials (sand, gravel, crushed asphalt) and to dispose of excavation spoils. The following structures, buildings and features, including size expectations, are anticipated for the new site:

- Public Works Office and Meeting building (210' x 50')
- Four storage buildings for public work materials (100'x50')
- Covered parking (150'x50')
- Fleet maintenance building (100'x75')
- Covered Vehicle Wash Bay (25'x75')
- Covered Vactor Truck Bay (25'x75')
- Decant Facility (25'x75')
- 40 parking stalls
- Enclosed structure for storing de-Icing materials (to re-use existing building on site)
- Two material bunkers (100'x50')
- Exterior fencing and gates.
- Security measures.

Pre-fabricated/modular structures will be constructed for all new facility buildings. These structures typically are installed by the vendors and include construction of building slabs. The proposed site would include the installation of water, sewer, stormwater, power, and communication facilities. Water service in this area is provided by Snohomish County PUD, whose system will be extended under and developers' extension around the site to provide service to the buildings and for fire hydrant coverage. The sewer and stormwater systems will be completely contained, treated, and infiltrated on site.

The new site can generally be divided into three areas; the upper level, a relatively flat area immediately adjacent to 123rd Ave SE that is a little over 4-acres in size (not including slope areas), the middle level that is

roughly 1 ½ acres of fill material, and the remainder being the lower level that mainly consists of a flat, open grass area. The flat upper level, consisting mostly of gravel and other compacted material, as well as some grass areas, is slightly larger in area than the currently used Public Works facility on First Street. The buildings are proposed to be concentrated in the upper level. The middle and lower levels are to provide space for the decant facility and the material bunkers. Drainage facilities and onsite sewer system facilities are proposed for the lower level.

Much of the information presented herein was obtained from public agency records and the geotechnical engineering subconsultant. The information obtained and provided is considered sufficient for preliminary planning and feasibility purposes.

Site Review and Research

See Figure 1 attached in Appendix A for the Existing Project Site map. The Geotechnical Report for the site is included in Appendix B. Below is the detailed breakdown of the research and resources reviewed (not attached, available upon request) in order to determine the existing conditions of the site, including;

- Parcel information from SCOPI and TICOR title reports.
- Existing utilities and easements from TICOR title reports.
- Existing utilities and easements from city and utility district records.
- Correspondence with city, county and utility district staff.
- City zoning from City records.
- City of Snohomish municipal code (SMC).
- Snohomish County identified sensitive, critical, and hazard area maps.
- Geotechnical Report prepared by AESI on August 30, 2022. See Appendix B.

It is PACE's understanding from correspondence with the Geotechnical Engineer that the site was originally mined and has since been decommissioned and backfilled. The geotechnical report supports this as fill material was identified throughout the site with varying debris and depths. It is the recommendation of the Geotechnical engineer to remove this fill material and replace with structural fill for foundations for buildings. Removal of fill may also be necessary and construction of drainage and onsite sewer facilities to promote infiltration. The existing soil beneath the fill, known as Vashon Recessional Outwash, is conducive to infiltration with rates estimated to be 8 inches/hour. This infiltration rate was used to size the onsite stormwater and sewer infiltration systems.

The site is currently zoned as industrial which will allow the development of the proposed buildings on the site, as well as allow for the storage of materials and movement of pedestrian and heavy vehicles alike. According to SMC 14.210.330 the industrial zoning designation also allows the site to maximize the lot space as there are no setback requirements from the street and property lines. Per the code, open vegetated space can be as little as 15% of the lot area, but still needs to meet at least 5% landscaped. This can easily be achieved by landscaping and/or vegetating the steeper slopes on-site that could not otherwise be used for any other purpose.

City Water records and mapping show that a 48-inch water transmission main belonging to the City of Everett passes through the site near to the north parcel border. This transmission main is known as Everett

Transmission Main No. 5. Easement and documents indicate that this transmission main was designated a 70 feet wide right-of-way through the property to allow for maintenance and possible installation of additional water pipelines. This right-of-way occupies approximately 1.08 acres within the parcel and as such, work within this area will necessitate a transmission line right of way use permit from the City of Everett and any proposed improvements in that the area should be limited. The right-of-way will not allow any structures or storage of materials. Grading and paving require separate permits with the City of Everett. As such, all construction activities should be concentrated in areas of the parcel outside of this right of way area and work within this area should be limited to grading and paving work with roadside ditches to allow access to the bottom portion of the site (similar to the existing condition) under a permit with the City of Everett. This area must remain accessible to the City of Everett for maintenance. The existing gravel access road will be relocated south of its current location to stay outside of the transmission main alignment, and where possible through coordination with the City of Everett, install paved road. Title documents and city mapping also indicate that there was once a service intertie connected to Everett Transmission Main No. 5 in the northwest corner of the site to service the lot just south of the site parcel known as “NEPA Pallet”. Correspondence with the City indicates that this connection has been disconnected and the associated 1-inch connection pipe was either abandoned or removed.

Mapping also shows that an above head power transmission line belonging to the Bonneville Power Administration (BPA) passes from east-to-west just north of the project parcel. Given that most proposed improvements will be located south of the existing Everett transmission main right of way, construction activities should not affect the power transmission line, nor should any additional consideration be taken. Easement documents for the site also indicate that there were at least two easements for overhead power lines, however no overhead power lines are visible through the property at this time and should not interfere with development. Any utilities constructed in the area under the high voltage power lines should be constructed of PVC.

Hazard area maps provided by Snohomish County indicate that there two hazard areas on site. The site is contained within a moderate aquifer sensitivity area according to USGS due to its proximity to the Pilchuck River located within a quarter mile to the west. The depth to the aquifer ranges from 40 to 100 ft in this area, and as a result infiltration facilities onsite may need to meet additional treatment requirements prior to infiltration.

Hazard maps also identify the slopes as greater than 33 percent grade on site although the site is not contained in an erosion hazard area. According to the Geotechnical report, the slopes on site would be categorized as landslide hazard areas per SMC 14.275 as the slopes are 40 percent or steeper with vertical relief of ten or more feet. However, the existing slopes are man-made and site grading will eliminate the steep slopes through cuts and fills, and/or construction of rockery retaining walls and/or slope buttresses. These grading and construction activities must be carefully considered for the feasibility of development for the property as slope management clearing and grading to achieve 2:1 (or flatter slopes) requires space that will no longer be available for development. An approximate balance of cut and fill would minimize the need for costly import fill material.

According to the City utility map records, there are no current storm or sewer facilities located nearby to the property. This report assumes that storm and sewer flows will be completely collected and contained on site

through the construction of on-site conveyance, treatment, and/or infiltration systems. According to the City staff, there is availability of water service owned and operated by Snohomish County PUD on Threes Lakes Rd just south of the property and an accessible water main exists within 123rd Ave SE to serve the mobile park development located directly to the east of the site. A developer extension agreement shall be made with the Snohomish County PUD to extend water service into the site and provide a hydrant for fire safety coverage.

From available mapping and aerial imagery, an overhead power line exists along 123rd Ave SE so it is assumed that single phase power service to the site can be obtained by connecting to this existing power line owned and operated by Snohomish County PUD. No research has been done on the availability of three (3) phase power.

Site Grading and Building Layout Feasibility

As stated in this report, the existing site is generally separated into three areas; the upper level, a relatively flat upper area immediately adjacent to 123rd Ave SE, a middle level that is roughly 1 ½ acres of fill material, and the lower level that mainly consists of a flat, open grass area. The upper level will generally be utilized to the maximum extent possible for locating buildings, parking and paved access roads and the lower level will be used for drainage and sewer facilities. The middle level is relatively small compared to the other areas but is proposed for a future decant facility. Use of this area is otherwise not intended due to its small usable area, loose fill material, and proximity to the transmission main right-of-way. Because of the fill material in this area, the future decant facility will require over-excavation and import foundation material for construction. Considering all three levels are relatively flat apart from the southern portion of the upper area, grading on these levels will likely be minor and limited to removing of fill material beneath structures and infiltration facilities as well as general softening of grades to construct the proposed access roads and parking lots. The most significant grading effort will take place in cutting and filling the existing steep slopes to achieve a 2:1 maximum slope throughout the site. This would necessitate clearing and grading of approximately 2.18 acres of slope, which does not constitute the entirety of the slope areas as some existing slopes already meet the 2:1 slope maximum. The amount of import or export fill material will vary depending on the final grading design for the slope, but it is assumed that the import fill volume will be relatively small based upon the areas shown in the preliminary layout.

See Figure 2 in Appendix A, for preliminary layout and grading of the site. This includes all structures and features mentioned earlier in this report, drainage and sewer facilities detailed in the next section, as well as a 25-foot-wide access road. Below are additional considerations and assumptions applied in preparation of the conceptual site layout:

- 25-foot minimum width for road for fire truck access.
- 25-foot minimum interior road radius on entries and curves.
- Parking facilities located closely to commonly inhabited structures (office and maintenance buildings).
- Maintain existing de-icing salt storage building.
- 5-foot minimum offsets between buildings, road edges, and property lines.
- 25-foot minimum offset from structures to top of 2:1 slope.
- Structures, paved roads, and storage areas outside of transmission right-of-way.

- Drainage and sewer infiltration facilities located near lowest elevations on site through separate access.
- Materials bunkers located in lower levels through separate access.

The proposed development and construction activities will require numerous permits provided by the City of Snohomish including, but not limited to, building permits, right-of-way permit, site civil permits, retaining wall permit, and fence permit.

Upon request from the District, an alternative site and utility layout at the proposed site location was evaluated. The alternative layout contains the same buildings and onsite features as the original site layout, however, buildings are arranged and located differently. The alternative layout also differs by providing a looped driveway and looped water main for the lower level. The looped main allows for a hydrant to provide fire protection to the decant facility that is in the lower level in this alternate layout. See Figure 4 in Appendix A for an overview of the alternative layout.

Site Utility and Layout Feasibility

Water – Snohomish County PUD

The Snohomish County PUD provides water service to properties nearby from a water main within 123rd Ave SE. The size and exact location of this water main is unknown, but if it provides service to the mobile home park directly to the east of the site then it can be assumed that it most likely has the capacity to serve the proposed development as well. The proposed water improvements for the development would include a connection to the existing main in 123rd Ave SE in two places to provide a loop for most of the new facilities situated in the upper level, an onsite water main with a minimum diameter of 8 inches to provide domestic and fire service, four hydrant assemblies, and multiple service saddle connections to the onsite main to provide flow to the inhabited buildings and any spigots or hose bibs necessitated on site for use. The proposed water service main is to be located within the access road, and the hydrant in front of the property within the right-of-way. The southerly portion of the site would be served by a dead-end main. Water services will not be provided to the lower level. A service line will be provided to the decant facility located in the middle level. Fire protection for the decant facility would be provided by a fire hydrant off the water main loop from the upper level, approximately 200 fee northeast from the decant facility. See Figure 3 in Appendix A for preliminary utility layout.

The Alternative Preliminary layout (see Figure 4 in Appendix A) provides looped water mains through all parts of the site and allows for additional fire hydrants to be added at the mid and lower levels of the site.

The water main extension improvements shall conform to the specified standards for construction and materials of the Snohomish County PUD. These proposed water improvements will require a fire permit as well as a developer extension agreement with the Snohomish County PUD to provide the water main extension pipe through the development. A right-of-way permit is also required for connection to the exiting water main. Additional permitting may be required.

Power – Snohomish County PUD

An existing overhead power line runs along 123rd Ave SE and it assumed that power service can be provided to the development by connecting to one of the existing power poles. The power connection must be underground. The development may need to also provide a power transformer and vault on site to control and measure the power usage. These power connections and facilities shall be permitted through the Snohomish County PUD in accordance with its guidelines.

Communications – Ziply Fiber

Ziply Fiber has existing infrastructure at the proposed project location that makes the site "Fiber Ready" per its website. Comcast Xfinity has cable available in the area but does not have fiber available. All communications utilities must be installed underground. Communications connections and facilities shall be permitted through the City of Snohomish in accordance with its guidelines.

Sewer – Private

Sewer flows will be collected through a series of sewer stubs, pipes and manholes located within the main access road. Based upon the proposed buildings, sewer service is only anticipated to be needed for the two inhabited buildings and the vehicle wash bay, or an equivalent service for 60 persons on site. Sewer service will also be provided to the sewer decant facility which will require a settling area, oil-water separator, and filter. Sewer flows were estimated per capita (40 gpd per capita) and the resultant average daily flow (ADF) would be approximately 1.82 gpm with a peak flow of 7.28 gpm (peaking factor equal to 4). No inflow or infiltration (I/I) were included as all proposed structures and pipe are brand new and water-tight, so no stormwater or groundwater is expected to enter the system. See Appendix C for sewer flow estimate calculations.

In order to convey the peak flow, a 8-inch diameter pipe at a minimum of 1% slope is to be installed. The collected sewer flow will first pass through a 3,600-gallon septic tank to separate the solid waste, oils and greases. The tank is sized to retain the ADF for a minimum of 36 hours to allow for settling and separation. The outlet from the septic tank then leads to an on-site drainfield, a network of underground perforated pipes to allow the sewer flow to infiltrate into the ground. Using the estimate infiltration rate from the Geotechnical report of 8 in/hr, this would require an infiltration area of 80 square feet or 102 feet of perforated 6-inch pipe. Assuming that each perforated pipe will be separated by 4 feet if installed in row, the entire drainfield would occupy about 408 square feet minimum. For preliminary layout out of the site, the drainfield is assumed to be a 25 foot by 25-foot area, well over the minimum area required. An additional, equivalent size area must be designated for future installation of a replacement drainfield when the initial system requires cleaning or repair. The septic tank and drainfield areas should be in the lowest portion of the site near the southwest corner and accessible via an access road shown in the site layout. See Figure 3 in Appendix A for preliminary utility layout.

The Alternative Preliminary layout does not result in any changes to the preliminary septic and drainfield sizing.

The on-site sewer system shall be permitted by the Snohomish Health District (District) and built to meet the District's specified standards for construction and materials.

Stormwater

Stormwater flows will be collected through a series of roof drains, catch basins and ditches and conveyed through the site to an on-site treatment and infiltration facility. This includes probable frontage improvements. A Western Washington Hydrology Model (WWHM) was created and used to estimate the stormwater flow from the site for design storm events. The model is split into two parts: the predeveloped and post developed conditions.

The predeveloped conditions assumed conditions prior to any development activity on-site including those that currently exist. The post developed conditions estimated the surface coverage for impervious surfaces including roofs, parking lots, paved roads as well as remaining pervious surfaces like lawns, vegetated slopes, or undisturbed areas. Undisturbed areas were modelled the same as the predeveloped conditions. See calculations for area estimates in Appendix C for inputting into the WWHM Model. Assuming an infiltration rate of 8 in/hr, the WWHM model was used to size an infiltration pond that has enough capacity to detain and infiltrate 100-percent of the stormwater runoff on the site. The 24-hour water quality volume was used to size a pre-settling basin for the stormwater influent prior to infiltration. The capacity of the pre-settling basin must be a minimum of 30-percent of the 24-hour water quality volume.

The infiltration pond will be approximately 100-feet by 50-feet with a storage depth of 4 feet and 3:1 side slope. The total footprint of the infiltration pond will be about 130-feet by 80-feet, and the pre-settling basin 42-feet by 95-feet based upon the required water quality volume. See WWHM model results in Appendix C and preliminary layout of stormwater facilities in Figure 3 in Appendix A. The stormwater infiltration and treatment facilities must be located a minimum of 100-feet away from a sewer septic tank and drain field which is reflected in the preliminary layout.

The sizing of the infiltration pond is currently assumed to be feasible based on the Geotechnical Report that indicated that groundwater is roughly 9' below the surface. It is noted that groundwater levels can vary in the wet season, and it is recommended that water level be checked in a groundwater monitoring well through the rainy months. The wet season groundwater level must be at least 3' below the bottom of the infiltration facility. However, an infiltration mounding analysis would be required if the groundwater lever is higher than 5' below the proposed facility.

The Alternative Preliminary layout, which proposes an increase in the total impervious area, does not significantly increase the size of the infiltration facility. An alternative layout model was not constructed, but the size of the infiltration pond was interpolated based on the increase in impervious area. Should the alternative scenario be selected by the City, it is recommended that a model be created to ensure the infiltration facility can accommodate the anticipated stormwater.

The on-site stormwater system shall be permitted by the City of Snohomish and built to meet the City's specified standards for construction and materials.

Preliminary Relocation Cost Estimate

Development of Proposed Site

A preliminary cost estimate has been created to better understand the costs for the relocation of the existing Snohomish Public Works facilities. Included in the estimate is costs for all new utilities and their facilities, including water, sewer, stormwater, and power. Also included are costs for on-site grading, building slabs, new buildings, and frontage improvements. Frontage improvements and right-of-way dedication requirements will need to be determined during the design and permitting process if this site is selected. Please see Appendix D for specific details regarding the preliminary cost estimate to develop the proposed site.

Upon request from the District, an additional cost estimate was procured for an alternative layout at the proposed site location. Similarly to the original cost estimate, the alternative layout cost estimate can also be located in Appendix D.

Decommission and Demolition of Existing Site

Similarly to the development of the site under analysis, a preliminary cost estimate was developed for the existing site would be decommissioned. Included in this estimate is the cost for demolishing and disposing of existing building, capping, and removing existing utilities such as water, sewer, and power, and general site cleanup and restoration. Potential savings for salvaging existing building materials were not included in the calculation. Please see Appendix D for specific details regarding the preliminary cost estimate to decommission the existing site.

Existing and Proposed Site Comparison

In Table 1, the existing site and proposed site for the public work facilities are ranked against each other to see how they compare. The categories for these rankings are cost, available space, availability of utilities, frequency, and difficulty of maintenance for utilities, community and environmental impact, and ease of permitting and construction. Each site will be ranked from 1 to 5, where 1 is very favorable with little to no apparent difficulty or repercussions, and 5 is least favorable meaning clear and guaranteed hardships. If the sites are very similar in any one category, then the existing site will be ranked better. Beneath Table 1 is a description and brief discussion of each category and rankings.

Table 1: Site Ranking Comparison			
Category	Alternative		
	Proposed Site	Alternative Site	Existing Site
Cost	4	5	1
Available Space	2	2	4
Utility Availability	3	3	1
Frequency & Difficulty of Maintenance for Utilities	3	2	2
Community & Environmental Impact	2	2	4
Ease of Permitting & Construction	3	5	2
Employee Survey	4	4	2
Total Score	**21**	**23**	**16**

Cost

See the previous section for preliminary cost estimate for developing the proposed site and demolishing the existing public works site.

It is assumed there would be no additional cost to Owner for maintaining the existing site.

Available Space

Based upon the preliminary layout for proposed site, there is just enough space for the proposed improvements and additional available space for storage of materials, parking, and other nonpermanent uses. Although the total area is hampered by the transmission right-of-way and steep slopes, with additional grading and/or construction of walls on the lot slightly more space could be provided for other permanent structures.

The existing site is considered at capacity for its available space and could not fit all the proposed improvements, although storage of materials can be done elsewhere so that should be considered.

Utility Availability

Based upon available information, it is assumed that water and power utilities can be connected directly in front of the proposed site on 123rd Ave SE and would require approval by the Snohomish County PUD. Stormwater and sewer utilities are not readily available. Private conveyance and infiltration facilities must be constructed on site and based upon the Geotechnical evaluation and preliminary calculations these facilities should perform well and not have abnormally large footprints or impacts on the site layout.

It is assumed that the existing site has all relevant utilities connected and have no need to increase the service capacity of such utilities.

Frequency & Difficulty of Maintenance for Utilities

The on-site stormwater and sewer facilities on the proposed site will require regular maintenance to remove solids, sludge, sediments, overgrown vegetation as well as cleaning routines. This sort of maintenance work should be considered ordinary as it is anticipated that no abnormal debris or influent would flow into these facilities. An access road should be provided to move any necessary vehicles or equipment into place to perform the work.

It is assumed that the utilities on the existing site have not deteriorated and require no special attention for maintenance.

Community and Environmental Impacts

Based upon the research and resources review, the proposed site is currently zoned as industrial. The parcel directly to the south is zoned as industrial as well, and the property to the North is used as a mine or quarry. Directly west of the site is Highway 2 and to the east, across 123rd Ave SE, a residential mobile home park. The proposed development and use for the proposed site conform with the use and appearance of several nearby lots, however the negative impacts to the mobile home park are difficult to determine. A more detailed analysis into additional traffic and noise pollution because of the development should be considered to determine if it would create a nuisance to nearby residents, especially those within the mobile home park. 123rd Ave SE turns into a private road just north of the proposed site and is the sole road leading to dozens of single-family home and farms within unincorporated Snohomish County and these properties should also be considered when determining the additional traffic flow to the proposed site. This analysis could also determine if road upgrades to 123rd Ave SE within the City of Snohomish city limits would be required to accommodate the increased traffic of commuter and heavy vehicles to and from the developed site.

The proposed site is in a moderate aquifer sensitivity area. It is not anticipated that the infiltration facilities onsite would have any negative effect on the nearby aquifer as they are not located within a critical aquifer area, which would typically require additional water treatment prior to infiltration. The proposed site is not located within any other environmentally sensitive or tree retention area, so the development's environmental impact is expected to be negligible.

The utility office building is within the Snohomish River buffer area and needs to be removed from the site according to the Hearing Examiners Conditions. These buffer areas are designated to maintain vegetation and existing qualities around bodies of water to maintain water quality, stream integrity and wildlife habitat. Under these requirements, the existing public works site poses a possible negative impact to the environment. The existing public works site does not pose a clear impact on the community, however repurposing of the site for public or commercial use would certainly be a positive impact onto the community.

Public Works Maintenance Facility Survey

A survey was provided to City staff to gather their input regarding the existing and proposed Public Works Maintenance Facility. A total of five surveys were completed and the survey responses are included in Appendix E.

Ease of Construction

Generally, most construction of new buildings and other improvements will be located on the flat areas of the upper and lower levels. There currently exists a gravel access road that extends through the upper level and down to the lower level that will provide heavy vehicles the ability to traverse the site without much additional work. Based upon these minor improvements of graded flat areas and the access road, this allows construction activities to commence relatively quickly without many preparations to the site. The substantial construction effort on site will likely be clearing and grading of the existing steep slopes and would prove both costly and time consuming as this steep slope area is 2.18 acres. Also, since nearly the entire site has fill material, excavation efforts to remove the fill for all building foundations and infiltration facilities could also prove to be costly.

In the alternative layout, a significant challenge will be the construction of the looped road in the southern portion of the site, where a significant amount of complex grading and retaining walls would need to be constructed.

In summary, grading and excavation activities during the first phase of the project will be a significant effort, however the existing conditions do provide a relatively prepared site for construction activities. As stated, the utility office building will be removed from the site. If the facility remains at the current site, other existing buildings and structures will be replaced in the future. Security upgrades and utility improvements are also planned for the site.

Alternative Public Works Site Layout

The City requested an alternative public works site layout to be evaluated as part of this feasibility report. The alternative site layout can be found in Appendix A of this report. The alternative generally includes the same onsite structures as the original layout, however, it does feature a looped water main, additional fire hydrants, a looped paved road, additional grading and fill for the southern roadway connection, and additional retaining walls.

It is important to note that the cost estimate for the alternative site layout is somewhat limited. Assumption and limitations include:

- Stormwater pond sizing was increased through interpolation of the original model. Knowing the original pond size and impervious area, as well as the alternative impervious area, the alternative pond size was calculated A model run for the alternative was not completed but should be completed if the alternative layout is selected.
- Water main construction is allowed within the City of Everett easement.
- No additional onsite sidewalks were included.
- A full grading and retaining wall design was not completed for the loop connection in the southern portion of the site. Structural Fill and Retaining Wall cost estimates assumed 4’ non-structural retaining walls and 2:1 slope. Future design costs were not included in this construction estimate.

Sincerely,
PACE Engineers, Inc.

H. Peter Paulsen
Sr. Principal Engineer

Attachments

Appendix A – Figures
Appendix B – Geotechnical Report
Appendix C – Calculations
Appendix D – Cost Estimate
Appendix E – Public Works Maintenance Facility Survey

Public Works Site Feasibility
Snohomish, Washington

APPENDIX A
Figures

PACE
An Engineering Services Company

THIS PAGE IS INTENTIONALLY LEFT BLANK.

Figure 1 – Existing Project Site

Legend

- Everett Transmission Main
- BPA Transmission Lines
- Contours 2ft
- Utility Easement
- Parcel of Interest
- Parcels

0 100 200 400 Feet

N W E S

1 inch = 150 feet

July 2022

Document Path: P:\P22\22508 SNOHOMISH PUBLIC WORKS SITE FEAS\GIS\3_Cartographic\22508_Figure 1 – Existing Project Site.mxd

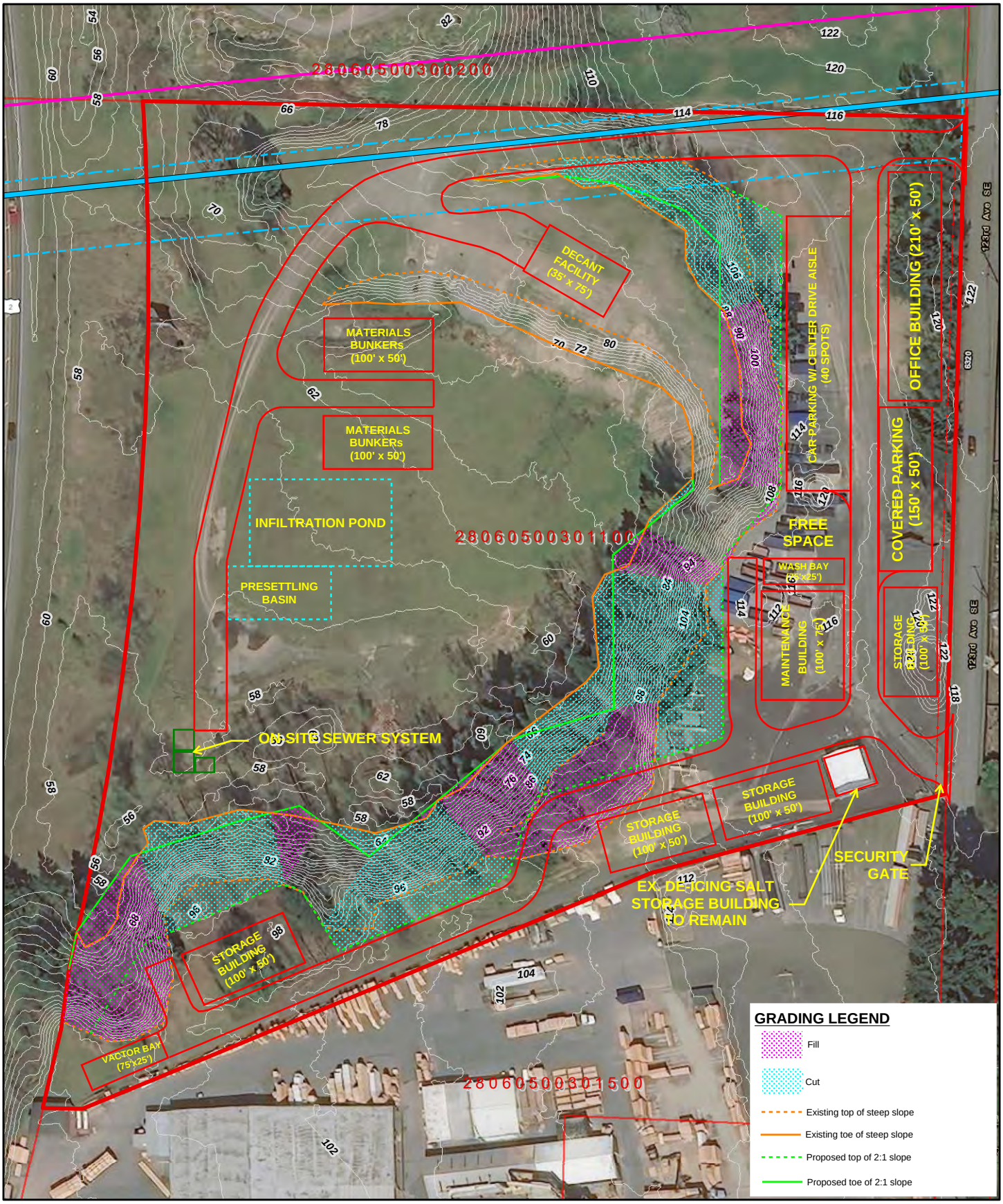


Figure 2 – Preliminary Site Layout

0 75 150 300 Feet

1 inch = 120 feet

Legend

- Everett Transmission Main
- BPA Transmission Lines
- Contours 2ft
- Utility Easement
- Parcel of Interest
- Parcels

July 2022

Document Path: P:\P22\22508 SNOHOMISH PUBLIC WORKS SITE FEAS\GIS\3_Cartographic\22508_Figure 2 – Preliminary Site Layout.mxd

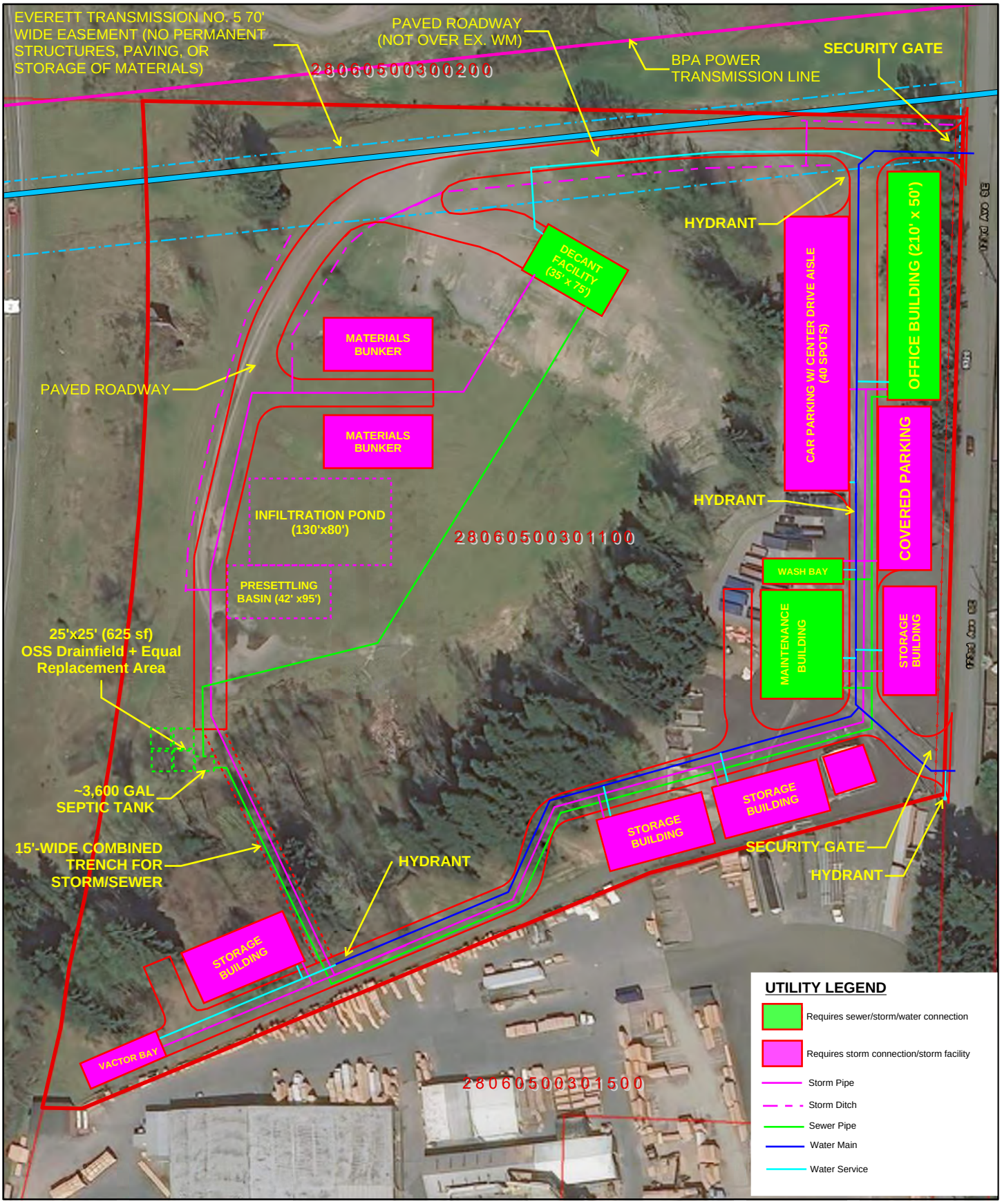


Figure 3 – Preliminary Utility Plan

0 75 150 300 Feet

1 inch = 120 feet

Legend

- Everett Transmission Main
- BPA Transmission Lines
- Contours 2ft
- Utility Easement
- Parcel of Interest
- Parcels

July 2022

Document Path: P:\P22\22508 SNOHOMISH PUBLIC WORKS SITE FEAS\GIS\3_Cartographic\22508_Figure 3 – Preliminary Utility Layout.mxd

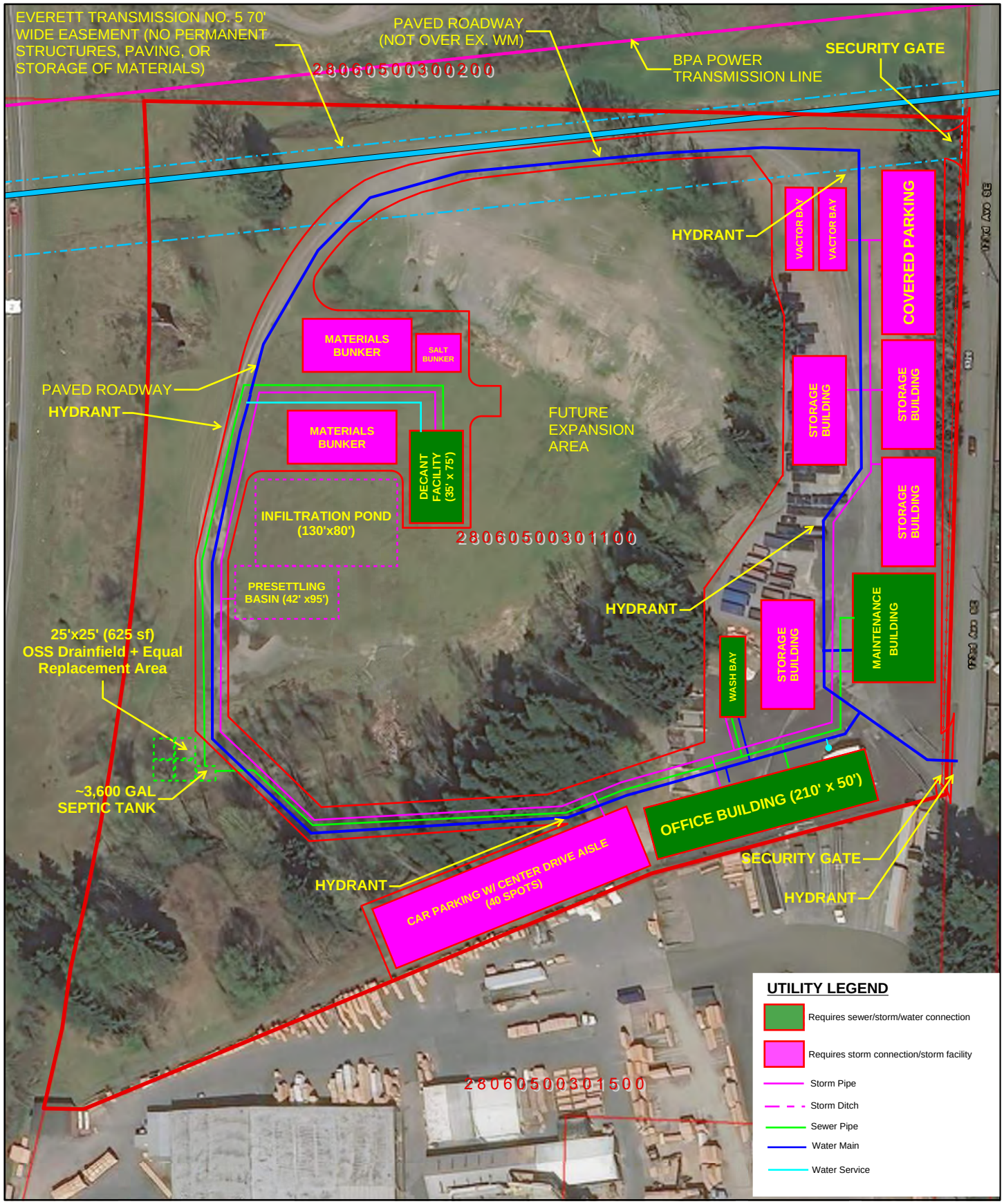


Figure 4 - Alternative Preliminary Site and Utility Layout

0 75 150 300 Feet

1 inch = 120 feet

Legend

- Everett Transmission Main
- BPA Transmission Lines
- Contours 2ft
- Utility Easement
- Parcel of Interest
- Parcels

July 2022

Document Path: P:\P22\22508 SNOHOMISH PUBLIC WORKS SITE FEAS\GIS\3_Cartographic\22508_Figure 3 – Preliminary Utility Layout.mxd

Public Works Site Feasibility
Snohomish, Washington

APPENDIX B
Geotechnical Report

PACE
An Engineering Services Company

THIS PAGE IS INTENTIONALLY LEFT BLANK.

associated earth sciences incorporated

August 30, 2022
Project No. 20220157E001

PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
Kirkland, Washington 98033

Attention: Mr. Peter Paulson, P.E.

Subject: Preliminary Geotechnical Assessment
Snohomish Public Works Feasibility Study
64XX 123rd Avenue SE
Snohomish, Washington

Dear Mr. Paulson:

As requested, Associated Earth Sciences, Inc. (AESI) is pleased to present this preliminary geotechnical assessment prepared for the undeveloped City of Snohomish property located at 64XX 123rd Avenue SE, in Snohomish, Washington. Our study is based on email and telephone correspondence with PACE Engineers, Inc. (PACE). The property location is shown on the "Vicinity Map," Figure 1. The approximate locations of explorations completed for this study are shown on the "Site and Exploration Plan," Figure 2. Interpretive exploration logs and laboratory test results are included in the Appendix. This preliminary geotechnical assessment relies on explorations completed by AESI at locations selected based on potential site use and generalized building locations provided by PACE.

Purpose and Scope

The purpose of this study was to provide preliminary geotechnical design recommendations and summarize the site-specific development and building construction approaches required to develop the site. Our study included a review of available geologic literature, excavating ten exploration pits, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the shallow subsurface sediments and groundwater. We recommend that once the project development plan has been established, additional studies be performed in order to formulate project-specific recommendations for site preparation, grading, foundation type, ground improvement, slab and pavement subgrade preparation, drainage considerations, and infiltration feasibility. This report summarizes our fieldwork and subsurface characterization and offers preliminary site development and construction considerations based on our present understanding of the future site use and development options.

Authorization

Our study was accomplished in general accordance with our scope of work and cost proposal dated May 2, 2022. We received notice to proceed in an email dated July 11, 2022. This report has been prepared for the exclusive use of PACE and their agents, for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

PROJECT AND SITE DESCRIPTION

The project site is located at 64XX 123rd Avenue SE in Snohomish, Washington, and is identified as Snohomish County Parcel No. 28060500301100. The property is owned by the City of Snohomish and is occupied by a storage building and is used to stockpile gravel and other materials and steel containers, and as a parking area by the City. Topography on the eastern portion of the site slopes gently toward the west, with elevations ranging from about 120 to 110 feet. The western approximately two-thirds of the site has been used as a gravel borrow source. A steep sloped area separates the eastern, gently sloping area from the western area, which slopes gently to the southeast, towards State Route 2, with elevations between about 70 and 60 feet. It is our understanding there may be areas of the site that have been filled. The property is bounded by 123rd Avenue SE to the east, an industrial facility to the south, open land/former gravel borrow source to the north, and State Route 2 to the west.

We understand the City is considering relocating their Public Works and Parks Departments. According to PACE, the plan would include relocating the administrative buildings as well as operational buildings for equipment. The type, size, and location of the new administration and operational buildings have not been determined. The proposed city site use and the existing site topography suggests that significant cuts and fills could be required to achieve desired grades, site access, parking and equipment storage.

The regional geologic map of the area indicates the site is underlain by Vashon recessional outwash and Vashon advance outwash, with younger alluvium mapped nearby to the west, across State Route 2, and Vashon lodgement till mapped in the vicinity of the site.

Exploration Pits

The exploration pits were excavated using a subcontracted, steel-tracked excavator with a 36-inch-wide bucket, owned and operated by Northwest Excavating and Trucking of Mill Creek, Washington. The pits permitted direct, visual observation of in-situ subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by a representative from our firm. All exploration pits were backfilled after examination and logging.

Selected samples were then transported to our laboratory for further visual classification and laboratory testing, as summarized in this report.

SUBSURFACE CONDITIONS

The following text sections describe current site conditions, including vegetation, regional and local topography, regional geology, local soils, and local groundwater. Our sources of information include topographic and geologic maps published by the U.S. Geological Survey (USGS), Light Detection and Ranging (LIDAR) data, and aerial photographs published by Google Earth. Subsurface conditions at the project site were inferred from field explorations accomplished for this study, similar studies in the project vicinity, visual reconnaissance of the site, and review of selected applicable geologic literature.

Published Geologic and Soils Mapping

Review of the regional geologic map, the *Geologic Map of the Snohomish 7.5-Minute Quadrangle, Snohomish County, Washington*, USGS, J.P. Minard, 1985 shows the site lies on the border between two different geologic deposits. Vashon recessional outwash is mapped on the east portion of the site and Vashon advance outwash is mapped on the west portion. Vashon recessional outwash typically comprises a loose to medium dense, stratified mixture of sands and gravels, with variable silt, cobbles, and boulders, deposited by streams as the glaciers receded. The recessional outwash has not been overridden and consolidated by glacial ice. Locally, thicknesses can range from a few feet to several tens of feet. These sediments can typically have moderate to high permeability and can be well suited for use as an infiltration receptor. Vashon advance outwash typically comprises dense to very dense sands with varying amounts of silts and gravels and stratigraphically underlies Vashon recessional outwash and Vashon lodgement till where present. The advance outwash was deposited by meltwater streams from the advancing glacial ice during the Vashon Stade of the Fraser Glaciation approximately 15,000 years ago and was subsequently overridden by the ice sheet. Where encountered as permeable and unsaturated, these sediments have a potential for use as an infiltration receptor. The mapped geology was consistent with our site-specific subsurface soil observations.

Review of regional soils mapping available via the Natural Resources Conservation Service (NRCS) *Web Soil Survey* web application indicates that the majority of the subject site is underlain by *Everett very gravelly sandy loam*. The survey describes Everett Series as formed from the weathering of glacial outwash. Our interpretation of the soils encountered in our explorations is in general agreement with the Everett Series mapping.

Stratigraphy

Subsurface conditions at the project site were inferred from ten exploration pits excavated on the site, from a review of applicable geologic literature, and from our experience in the project area. The number, locations, and depths of our explorations were completed within site and budget constraints. The locations of the exploration pits were measured in the field from landmarks visible on the aerial photograph used as a basis for Figure 2. Interpretive exploration logs and laboratory test results are presented in the Appendix.

Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. Our explorations revealed sediments generally consistent with published literature. Native sediments included Vashon recessional outwash and Vashon advance outwash. Fill was encountered in all ten exploration pits, ranging in depth from less than 1 foot to greater than 14 feet.

The following section presents more detailed subsurface information organized from the shallowest (youngest) to deepest (oldest) units.

Fill

Fill soils (those not naturally placed) were observed in all ten explorations ranging in depth from 1 foot to more than 14 feet. Fill soils encountered in EP-1, EP-2, EP-4, and EP-8 ranged from 8 inches to 1 foot, and consisted of crushed aggregate or asphalt. Fills encountered in EP-3, EP-6, and EP-7 ranged from approximately 2 to 7 feet, and was comprised of sand and gravel clasts of asphalt and concrete. Fill encountered in EP-5 was about 2 feet thick and was comprised of sandy silt. In EP-9 and EP-10, the fills were 11 feet (EP-9) thick, and in EP-10 extended beyond the maximum reach of the excavator of 14 feet (EP-10). The fill materials were comprised of gray grading to dark gray, silty fine sand, variable gravel, and included concrete and asphalt debris. EP-10 fill also included construction-related debris, including filter fabric, PVC pipe fragments, aluminum cans, and woody debris.

We anticipate that excavated existing fill materials similar to those encountered in EP-1 through EP-8 could be suitable for reuse for fill applications if soil moisture content is adjusted to allow compaction to the specified level and to a firm and unyielding condition. Existing fill is not suitable for infiltration of stormwater.

Vashon Recessional Outwash Deposits

Immediately below the surficial fill in explorations EP-1 through EP-6, we observed a thick deposit of stratified, gravelly sand and sandy gravel, with generally a small silt percentage interpreted to be Vashon recessional outwash sediments. The recessional outwash sediments

were deposited by meltwater streams flowing from the receding glacial ice during the Vashon Stade of the Fraser Glaciation approximately 12,000 years ago and have not been consolidated by the weight of an ice sheet. These sediments have moderate to high permeability and are generally suitable for stormwater infiltration provided there is adequate separation from groundwater. When present below groundwater, recessional outwash is susceptible to liquefaction during strong seismic shaking. In EP-2 and EP-3, small diamict clasts were recovered from the excavator bucket from a depth of about 10 feet (EP-2) and 17 feet (EP-3), though no continuous till interval was observed. In EP-1, EP-4, EP-5, and EP-6, the recessional outwash extended below the base of our explorations.

Vashon Advance Outwash

In exploration pits EP-7 through EP-9, we observed stratified, dense, sand and gravel with variable silt content immediately below the fill that we interpret to be Vashon advance outwash. The advance outwash extended to the base of each of these explorations. The Vashon advance outwash consists of sediments that were deposited by meltwater streams that emanated from the advancing Vashon glacier, and were subsequently consolidated by the massive weight of the glacial ice. Because of the densification resulting from glacial over-consolidation, the advance outwash sediments below the groundwater table are typically not susceptible to significant liquefaction during strong seismic shaking. Where permeable and unsaturated, these sediments are suitable for stormwater infiltration.

Laboratory Testing

Laboratory testing of samples from our explorations were completed to determine the grain-size distribution of the on-site soils in the western portion of the site to evaluate stormwater infiltration potential. Further discussions of the test results are provided in the following sections and results are presented in Appendix B.

Grain-Size Analyses

Grain-size (sieve) analyses were performed by AESI's in-house laboratory on two representative samples collected during AESI's subsurface exploration. Each sample was collected at a depth of 4 feet below ground surface (bgs) in exploration pits EP-7 and EP-8 within the Vashon advance outwash deposits. The sieve results are summarized in Table 1, below. Based on the *ASTM International* (ASTM) D-2487 Unified Soil Classification System (USCS), the grain-size analyses (included in Appendix B) indicate that the samples of the advance outwash deposits correlate to sandy gravel and very sandy gravel with trace silt. As shown below the fines content in both samples of the advance outwash deposits was only 1.9 percent.

Table 1
Laboratory Grain-Size Analyses Summary

Exploration No.	Depth (feet)	Geologic Unit	Sieve Results - Calculated Percent			USCS
			Gravel (%)	Sand (%)	Fines (%)	
EP-7	4	Qva	71.6	26.5	1.9	GW
EP-8	4	Qva	58.1	40.0	1.9	GW

USCS = Unified Soil Classification System
Qva = Vashon advance outwash deposits

Hydrology

Groundwater is expected to be present in two zones at the site: shallow perched groundwater and the regional Vashon advance outwash aquifer.

Shallow perched groundwater was not encountered in our explorations; however, it may be anticipated during certain times of the year. Shallow perched groundwater seepage can occur above silty, lower-permeability layers within the fill or outwash sediments, and is typically discontinuous and transient, and varies in response to variations in precipitation, time of year, degree of stratification and fines content in native sediments, fines content in fill, and other factors.

Groundwater was encountered within sediments interpreted to be Vashon advance outwash in exploration pits EP-7, EP-8, and EP-9, at depths ranging from about 9.5 to 14 feet bgs. Based on LIDAR-based elevation contours, these depths equate to groundwater elevations between about 45 and 48.5 feet. This elevation range appears to be generally consistent with the elevation of the Pilchuck River, located approximately ¼ mile west of the site on the west side of State Route 2. This groundwater occurrence is interpreted to represent the regional advance outwash aquifer (Thomas et al., 1997 and Newcomb, 1952). The regional Qva aquifer is laterally continuous with the Alluvial valley aquifer system. Alluvial deposits, Qal, are mapped between the site and the Pilchuck River. It should be noted that the depth to groundwater may vary in response to changes in season, amount of precipitation, river levels, and on- and off-site land use.

Groundwater elevations observed during our exploration program should not be considered seasonal high groundwater elevations. Groundwater level monitoring through at least one wet season would be required to establish a site-specific seasonal high groundwater elevation. It should be noted that fluctuations in the level of the groundwater may occur due to the time of year, variations in rainfall, and nearby river levels.

GEOLOGIC HAZARDS ANALYSIS

The following discussion of potential geologic hazards is based on the geologic conditions as observed and discussed herein. The *City of Snohomish Municipal Code* (SMC), Chapter 14.275, "Geologically Hazardous Areas," references *Washington Administrative Code* (WAC) 365-190-120, which identifies geologically hazardous areas as areas that are susceptible to one or more of the following types of hazards: (a) erosion hazard, (b) landslide hazard, (c) seismic hazard, or (d) areas subject to other geological events such as coal mine hazards and volcanic hazards including: mass wasting, debris flows, rock falls, and differential settlement.

Erosion Hazards and Mitigations

SMC *Chapter 14.275* identifies erosion hazard areas as areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a moderate-to-severe, severe, or very severe rill and inter-rill (sheet wash) erosion hazard. No detailed assessment of erosion hazards was prepared as part of this report and none is warranted provided site development and grading plans employ the code-required best management practices.

Landslide Hazards and Mitigations

SMC Chapter 14.275 identifies landslide hazard areas as areas subject to landslides based on geology, soils, topography, and hydrology, and lists eleven scenarios including: slopes of forty percent or steeper with a vertical relief of ten or more feet except areas composed of consolidated rock. This site was mined extensively, and maximum site slopes range to around 60 percent with greater than 40 feet of vertical relief, based on LIDAR-based topography (Figure 2). Site grading will need to address these man-made steep slopes through cuts and fills or the construction of retaining walls or slope buttresses. Based on our review, there do not appear to be nearby slopes that meet the definition of a landslide hazard as defined by the cited SMC chapter.

Seismic Hazards and Mitigations

The following discussion is a general assessment of seismic hazards that is intended to be useful to the project design team in terms of understanding seismic issues, and to the structural engineer for design.

All of Western Washington is at risk of strong seismic events resulting from movement of the tectonic plates associated with the Cascadia Subduction Zone (CSZ), where the offshore Juan de Fuca plate subducts beneath the continental North American plate. The site lies within a zone of strong potential shaking from subduction zone earthquakes associated with the CSZ. The CSZ can produce earthquakes up to magnitude 9.0, and the recurrence interval is estimated to be on the order of 500 years. Geologists infer the most recent subduction zone earthquake occurred in 1700 (Goldfinger et al., 2012). Three main types of earthquakes are typically

associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound region document a distinct zone of shallow crustal seismicity (e.g., the Seattle Fault Zone). These shallow fault zones may include surficial expressions of previous seismic events, such as fault scarps, displaced shorelines, and shallow bedrock exposures. The shallow fault zones typically extend from the surface to depths ranging from 16 to 19 miles. A deeper zone of seismicity is associated with the subducting Juan de Fuca plate. Subduction zone seismic events produce intraplate earthquakes at depths ranging from 25 to 45 miles beneath the Puget Lowland including the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event and interplate earthquakes at shallow depths near the Washington coast including the 1700 earthquake, which had a magnitude of approximately 9.0. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides or lateral spreading, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

Surficial Ground Rupture

Current research indicates that surficial ground rupture is possible in areas close to the Seattle Fault Zone and South Whidbey Island Fault Zone (SWIFZ). The site is located more than 20 miles north of the Seattle Fault Zone and 3 miles north of the SWIFZ. Based on the lack of mapped or inferred fault traces within 3 miles of the site, and due to the suspected long recurrence interval of these faults, the potential for surficial ground rupture at the site is considered to be low.

Seismically Induced Landslides

As currently graded, there are site slopes that pose a potential risk of damage to the proposed development caused by seismically induced on-site slope failures. Based on the observed exposed recessional outwash soil and the existing slope geometry the risk of seismically induced slope failures is defined as being “high” during a design-level seismic event. Site development will need to address these man-made slopes to reduce slope inclinations or provide adequate retaining or buttressing to lower the seismic risk to acceptable levels. There are no nearby off-site slopes that meet the code definition of a landslide hazard. A detailed slope stability analysis was not completed as part of this preliminary report, but one will likely be required as part of site development and earthwork planning.

Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by non-cohesive silt and sand with low relative densities, accompanied by a shallow water table.

A detailed liquefaction analysis was not completed as part of this feasibility study. Additional exploration borings and testing are needed to evaluate site-specific liquefaction settlement risks and mitigation measures, if required. The following discussion presents our preliminary estimate of liquefaction risk based on the exploration pits completed for this evaluation. The eastern, upland portion of the property, where structures are proposed, is underlain by medium dense, granular recessional outwash sediment with a relatively deep groundwater table. The recessional outwash is underlain by dense glacially consolidated advance outwash. Considering the thickness of near-surface unsaturated recessional outwash and the limited thickness of saturated recessional outwash, the risk of significant liquefaction-induced surface settlement during the design seismic event would likely be determined to be "low." The western portion of the site, adjacent to State Route 2 is underlain by granular, dense, glacially consolidated advance outwash, with a relatively shallow groundwater table. Because of the dense nature of the advance outwash soils, the risk of significant liquefaction-induced surface settlements during the design seismic event would likely be determined to be "low."

Ground Motion/Seismic Site Class (2018 *International Building Code*)

Structural design of the buildings should follow 2018 *International Building Code* (IBC) standards. If significant liquefaction settlement is predicted, the IBC site class will default to "F". The IBC allows the site class to change to "E" for predicated building periods of 0.5 seconds or less. For building periods greater the 0.5 seconds, the code requires a site-specific response spectral analysis be developed for use in building design. If no significant liquefaction risk is identified, we recommend that the project be designed in accordance with Site Class "D" as defined in IBC Table 20.3-1 of American Society of Civil Engineers (ASCE) *7 - Minimum Design Loads for Buildings and Other Structures*.

DESIGN CONSIDERATIONS

The explorations completed for this assessment indicate that, from a geotechnical standpoint, the subject property is suitable for the proposed development including prefabricated buildings and parking with conventional, shallow subgrade preparation. Specific recommendations for subgrade preparation and foundation support will depend on type, size, and location of buildings and other site improvements. Explorations in the eastern, upper portion of the site encountered fill thicknesses ranging from 8 inches to 7 feet. Deeper fills may be encountered at other locations on the site.

Infiltration in the western, lower portion of the site near State Route 2 appears to be feasible, provided there is sufficient separation between the infiltration facility subgrade and the seasonal high groundwater table. We recommend groundwater level monitoring be conducted through at least one wet season to establish a seasonal high groundwater elevation.

Site Preparation

Site preparation will be a function of development plans and site grades. We expect that site preparation will involve removal of existing surficial vegetation and topsoil followed by cutting and filling to reach planned site grades.

The on-site naturally deposited soils contain a relatively low amount of fine-grained material, which makes them relatively non-moisture-sensitive and not subject to disturbance when wet. During site preparation and excavation operations care should be taken so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed, and the area brought to grade with structural fill. Temporary slope inclinations within the existing fill and shallow alluvial soils will be limited to 1.5H:1V (Horizontal:Vertical) due to their loose to medium dense consistency. All permanent slopes should be 2H:1V or flatter.

Structural Fill

We expect that structural fill will be needed for site grading, foundation backfill, retaining wall backfill, and utility trench backfill. Excavation to reach desired development grades will encounter existing fill and variable alluvial soils as identified in explorations completed for this study. The existing fill and shallow alluvial soils are considered highly moisture-sensitive and could be reused as structural fill only during the drier months of the year when soil moisture can be controlled by aeration and drying. Alternatively, the soil moisture of the excavated site soils can be adjusted for compaction by the application of cement powder.

If fill is placed during wet weather or if proper compaction cannot be obtained with the available site soils, a select, import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil, with the amount of

fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction, and at least 25 percent retained on the No. 4 sieve.

Foundations

Site explorations in the eastern area where structures are anticipated encountered a sequence of minor fill ranging from less than 1 foot and up to 7 feet thick, overlying medium dense recessional outwash soils with a deep groundwater table. The fill may not be suitable for support of shallow foundations without improvement. The underlying recessional outwash deposits are suitable for support of lightly-loaded conventional foundations depending on the building type, size, and location and the City's post-construction total and differential settlement tolerance. Depending on final grades and building loads, ground improvement could consist of just the localized overexcavation and replacement of fill, where encountered, with structural fill. We anticipate new buildings can be supported on a conventional shallow foundation system bearing on native recessional outwash sediments.

Floor Support

Slab-on-grade floors can be supported on native recessional outwash or structural fill depending on building type, size, and location and predicated post-earthquake liquefaction settlement performance risk. The approach selected depends on final floor slab elevations, floor slab coverings, underlying thickness of fill, and the amount of total and differential settlement that floor slabs can tolerate.

Infiltration Potential

The current site concept conveyed to AESI by PACE includes stormwater infiltration facilities and a septic drainfield in the lower, western portion of the site. AESI advanced three exploration pits, EP-7, EP-8, and EP-9, to evaluate the subsurface conditions for infiltration. Exploration pits EP-7 and EP-8 encountered up to 2 feet of fill in the southwestern portion of the site, and approximately 12 feet of fill in EP-9, in the western central part of the site. Beneath the fill, we observed dense sandy gravels interpreted to represent Vashon advance outwash. Groundwater was encountered at depths of 10 and 9.5 feet, respectively, in EP-7 and EP-8.

Infiltration testing was not completed as part of this scope of work. However, we have an in-house database that includes comparisons of hundreds of in-situ infiltration tests with grain-size data. Based on similarities in grain-size distribution, geology, and subsurface conditions, we were able to compare and correlate the recent grain size data to our in-house database and estimate a preliminary infiltration rate of 8 inches per hour. This value may be used for preliminary planning purposes. Facility-specific in-situ infiltration testing is required by the governing stormwater design manual adopted by the City of Snohomish. According to the *2019 Stormwater Management Manual for Western Washington*, the base of an infiltration

facility shall be a minimum 5 feet above the seasonal high groundwater level. A separation down to 3 feet may be considered if a groundwater mounding analysis indicates the system is adequate to prevent overtopping of the infiltration facility. AESI recommends the completion of a groundwater mounding analysis as site development progresses. Fill soils are not suitable for stormwater infiltration. AESI recommends installation of a groundwater monitoring well in the western portion of the site, and groundwater monitoring through at least one winter wet season, to establish a seasonal high groundwater elevation.

CLOSURE

If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Stanley S. Thompson, L.Hg.
Senior Project Hydrogeologist

Kurt D. Merriman, P.E.
Senior Principal Engineer

Attachments: Figure 1: Vicinity Map
Figure 2: Site and Exploration Plan
Appendix: Exploration Logs
Laboratory Testing Results

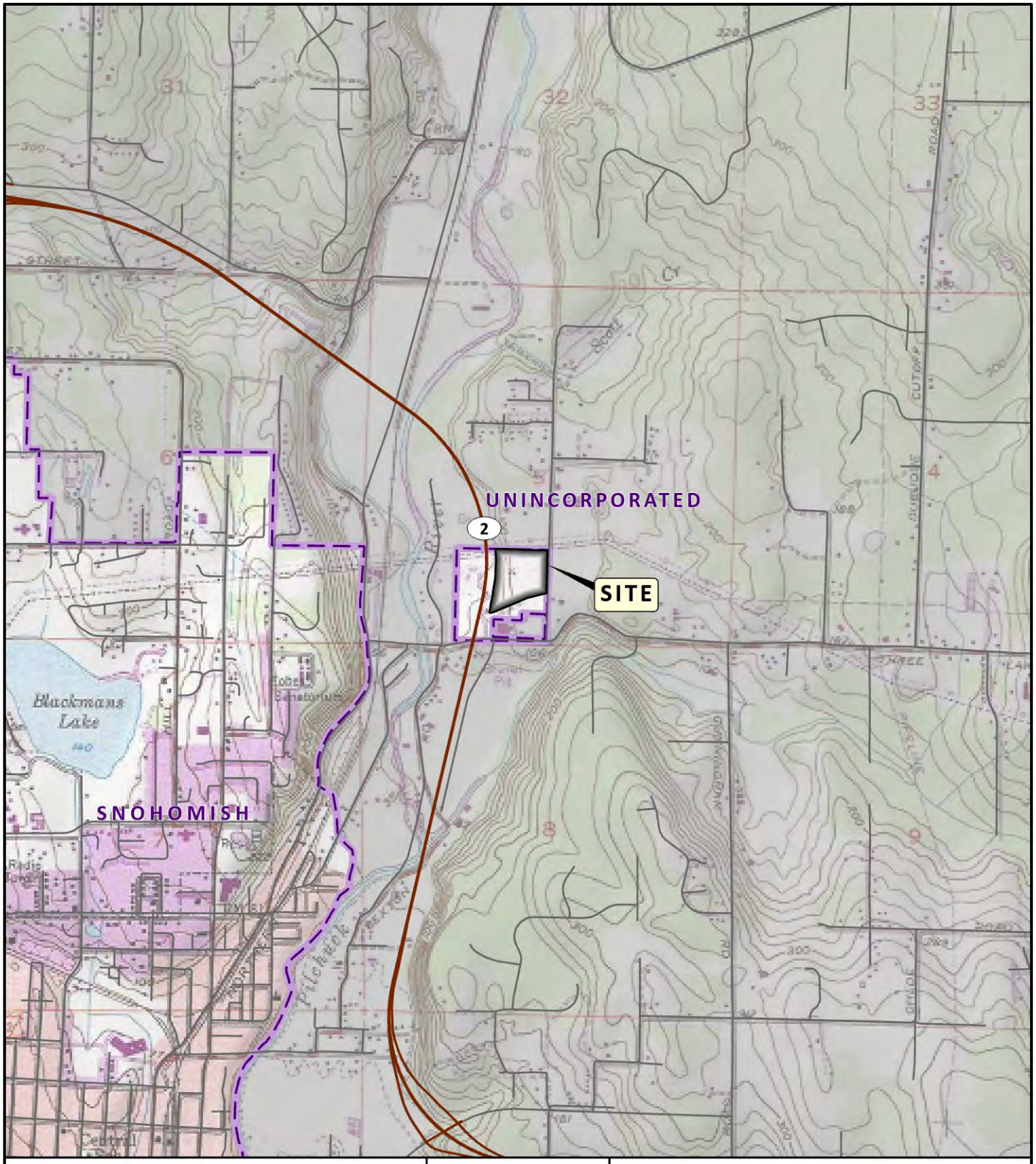
REFERENCES

Goldfinger, C., Nelson, C.H., Morey, A.E., Johnson, J.E., Patton, J.R., Karabanov, E., Gutierrez-Pastor, J., Eriksson, A.T., Gracia, E., Dunhill, G., Enkin, R.J., Dallimore, A., and Vallier, T., 2012, Turbidite event history—Methods and implications for Holocene Paleoseismicity of the Cascadia Subduction Zone: U.S. Geological Survey Professional Paper 1661–F, 170.

Newcomb, R.C., 1952, Ground-water resources of Snohomish County, Washington: United States Geological Survey Water-Supply Paper 1135, 1:62,500.

Thomas, B.E., Wilkinson, J.M., and Embrey, S.S., The Ground-water system and ground-water quality in western Snohomish County, Washington: United States Geological Survey Water-Resources Investigations Report 96-4312, 1997.

Washington State Department of Ecology, 2019, Stormwater management manual for western Washington, 2019.



DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
SNOHOMISH CO: STREETS, CITY LIMITS, PARCELS, 3/21
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 2000

FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

associated earth sciences incorporated

VICINITY MAP

SNOHOMISH PUBLIC WORKS FEASIBILITY STUDY
SNOHOMISH, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20220157E001	8/22	1

G:\GIS_Projects\aaY2022\220157 Sno Ops and Maint\APRX\20220157E001 F1 VM_SnoOM.aprx | 20220157E001 F1 VM_SnoOM | 8/25/2022 2:06 PM

LEGEND

- SITE
- EXPLORATION PIT
- CITY BOUNDARY
- PARCEL
- CONTOUR 10 FT
- CONTOUR 2 FT

DATA SOURCES / REFERENCES:
WA STATE LIDAR PORTAL: NORTH PUGET SOUND 2016
ACQUIRED MARCH - SEPT 2016, GRID CELL SIZE IS 3'
CONTOURS FROM LIDAR
SNOHOMISH CO: STREETS, PARCELS 3/21
AERIAL: BING IMAGERY 7/20

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 200

FEET

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

associated earth sciences incorporated

EXISTING SITE AND EXPLORATION PLAN

SNOHOMISH PUBLIC WORKS FEASIBILITY STUDY
SNOHOMISH, WASHINGTON

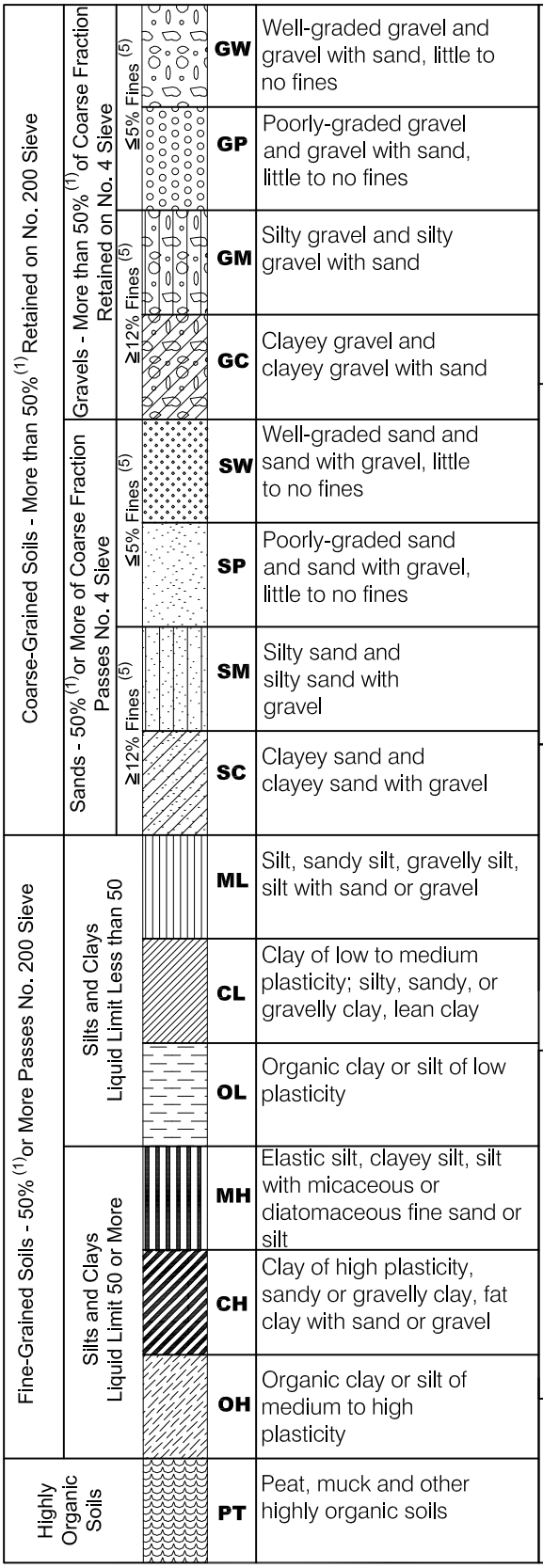
PROJ NO.	DATE:	FIGURE:
20220157E001	8/22	2

G:\GIS_Projects\aaY2022\220157 Sno Ops and Maint\APRX\20220157E001 F2 ES_SnoOM.aprx | 20220157E001 F2 ES_SnoOM | 8/25/2022 2:11 PM

APPENDIX

Exploration Logs

Laboratory Testing Results



Terms Describing Relative Density and Consistency

Coarse-Grained Soils	Density	SPT (2) blows/foot
	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

Fine-Grained Soils	Consistency	SPT (2) blows/foot
	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

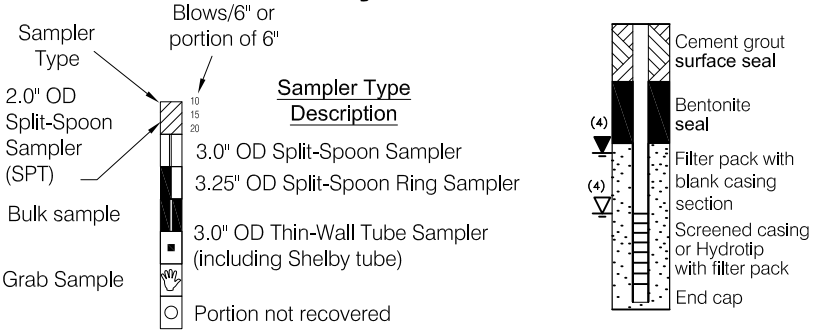
(3) Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols



(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

associated earth sciences incorporated

Exploration Pit EP-1

Snohomish Public Works Feasibility Study Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 15	Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: 116 ft NAVD88	
0	**Fill** Medium dense, slightly moist, gray, sandy, fine to coarse angular GRAVEL and crushed asphalt, some silt (GW-GM).	
	Vashon Recessional Outwash Medium dense, moist, brown, medium to coarse sandy, GRAVEL, some cobbles, trace silt (GW).	
2.5		
5	Medium dense, moist, brown, medium SAND, some fine gravel, trace silt (SP).	
7.5		
10	Becomes brownish gray, trace fine gravel (SP).	
12.5	Medium dense, moist, brownish gray, sandy, fine to coarse GRAVEL, trace silt; occasional cobbles (GW).	
15	Occasional clasts of hard, moist, light brown, fine sandy, SILT (ML).	
	No seepage. No caving.	
17.5		
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit EP-2

Snohomish Public Works Feasibility Study Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 16	Approved By: JHS

Elev.: 114 ft NAVD88

Depth (ft)	Description	USCS
0	**Crushed Asphalt/Import Gravel**	
	Vashon Recessional Outwash	
2.5	Medium dense, slightly moist to moist, grayish brown to brown, sandy, fine to coarse GRAVEL/gravelly SAND, trace silt; occasional cobbles (GW/SP).	
5		
7.5		
10	Medium dense, moist, grayish brown, gravelly, medium SAND (SP). Includes clasts of partially consolidated medium dense to dense, brown, fine sandy, SILT, some fine to coarse gravel; diamict; not a contiguous diamict layer (ML).	
	Medium dense, moist, gray, medium to coarse SAND, trace fine gravel, trace silt (SP).	
12.5		
15	Medium dense, moist, grayish brown, gravelly, medium to coarse SAND, trace silt (SP).	
	No seepage. Slight caving at 0 to 15 feet.	
17.5		
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit EP-3

Snohomish Public Works Feasibility Study Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 17	Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈117 ft NAVD88	
0	**Fill**	
2.5	Dense to medium dense, moist, gray, silty, sandy, GRAVEL; includes clasts of asphalt and concrete; unsorted (GM).	
5		
7.5	**Vashon Recessional Outwash** Medium dense, moist, yellowish brown, fine to medium SAND, some gravel, trace silt; stratified (SP).	
10	Medium dense, moist, brown, sandy, fine to coarse GRAVEL, trace silt; occasional cobbles; occasional clasts of silt (GW).	
12.5		
15	Medium dense, very moist, brownish gray, sandy, fine to coarse GRAVEL, trace cobbles, trace silt; stratified (GW).	
17.5	Medium dense, moist to very moist, brown, gravelly, medium to coarse SAND, trace silt; occasional clasts of diamict (SP).	
	No seepage. No caving.	
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit EP-4

Snohomish Public Works Feasibility Study Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 14	Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈114 ft NAVD88	
0	**Crushed Asphalt - 8 inches**	
	Vashon Recessional Outwash	
2.5	Loose, slightly moist, oxidized orange to brown, silty, fine SAND, trace gravel, trace charcoal; bedded (SM).	
5	Medium dense, moist, tannish brown, silty, fine SAND (SM).	
7.5	Medium dense, moist, brownish gray, medium sandy, fine to coarse GRAVEL, trace silt; occasional cobbles (GW).	
10		
12.5	Thin interval of hard, grayish tan, moist, fine sandy, SILT (ML). Medium dense, moist, gray, medium to coarse sandy, fine to coarse GRAVEL trace silt (GW).	
	Medium dense, moist, orangish gray, fine to medium SAND, trace gravel, trace silt (SP).	
15	No seepage. Slight caving at 2 to 12 feet.	
17.5		
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit EP-5

Snohomish Public Works Feasibility Study Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 15	Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈116 ft NAVD88	
0	**Fill**	
	Medium stiff, dry, tan, fine sandy, SILT (ML).	
2.5	**Vashon Recessional Outwash**	
	Medium dense, moist, grayish brown, sandy, fine to coarse GRAVEL (GW).	
	Medium dense, moist, gray, fine to medium SAND, trace fine gravel; stratified (SP).	
5		
7.5		
	Medium dense, moist, grayish, brown, fine SAND, trace silt; stratified (SP).	
10		
12.5		
15	As above; slightly coarser (SP).	
	No seepage. No caving.	
17.5		
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit — EP-6

Snohomish Public Works Feasibility Study — Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 14	Approved By: JHS

Elev.: ≈115 ft NAVD88

Depth (ft)	Description	USCS
0	**Fill** Loose to medium dense, moist, brown, silty, SAND, some gravel; clasts of asphalt (SM).	
2.5		
5	**Vashon Recessional Outwash** Medium dense, moist, brown, gravelly, medium to coarse SAND, trace silt; stratified (SP).	
7.5	Medium dense, moist, gray, medium SAND, some fine to coarse gravel, trace silt; stratified (SP).	
10		
12.5	Medium dense, moist, gray, medium SAND, trace silt; stratified (SP).	
	No seepage. No caving.	
15		
17.5		
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit EP-7

Snohomish Public Works Feasibility Study Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 18	Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈56 ft NAVD88	
0	**Fill** Loose, dry to slightly moist, gray to brownish gray, sandy, silty, crushed GRAVEL; includes clasts of concrete and asphalt (GM).	
2.5	**Vashon Advance Outwash** Dense, moist, gray, sandy, fine to coarse GRAVEL, some medium sand, trace silt (GW).	
5		
7.5	As above.	
10	Dense, wet, gray, medium to coarse sandy, fine to coarse GRAVEL, trace silt; stratified (GW).	
12.5	Dense, wet, gray, sandy, fine to coarse GRAVEL; stratified (GW).	
15		
17.5	As above.	
	Water table at 10 feet. No caving.	
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit EP-8

Snohomish Public Works Feasibility Study Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 15	Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈58 ft NAVD88	
0	**Field Grass/Fill - 8 inches**	
	Vashon Advance Outwash	
2.5		
	Dense, slightly moist grading to moist, brown, very sandy, GRAVEL, trace silt; occasional cobbles (GW).	
5		
7.5		
10	Dense, wet, gray, fine to coarse GRAVEL, some sand, trace silt; occasional cobbles; stratified (GW).	
12.5		
15	Dense, wet, gray, sandy, fine to coarse GRAVEL, trace silt (GW).	
	Water table at 9.5 feet. No caving.	
17.5		
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit EP-9

Snohomish Public Works Feasibility Study Sheet: 1 of 1

Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 15	Approved By: JHS

Elev.: ≈59 ft NAVD88

Depth (ft)	Description	USCS
0	**Fill** Loose, dry grading to moist, dark gray, silty, fine SAND, some gravel; includes concrete and asphalt debris; unsorted (SM).	
2.5		
5		
7.5		
10		
12.5	**Vashon Advance Outwash** Dense, moist, gray, medium to coarse sandy, fine to coarse GRAVEL, trace silt; stratified (GW).	
	Becomes wet.	
15	Dense, wet, grayish brown, fine to medium sandy, fine to coarse GRAVEL, trace silt; stratified (GW).	
	Water table at 14 feet. No caving.	
17.5		
20		

8/29/2022

20220157E001

associated earth sciences incorporated

Exploration Pit EP-10

Snohomish Public Works Feasibility Study Sheet: 1 of 1

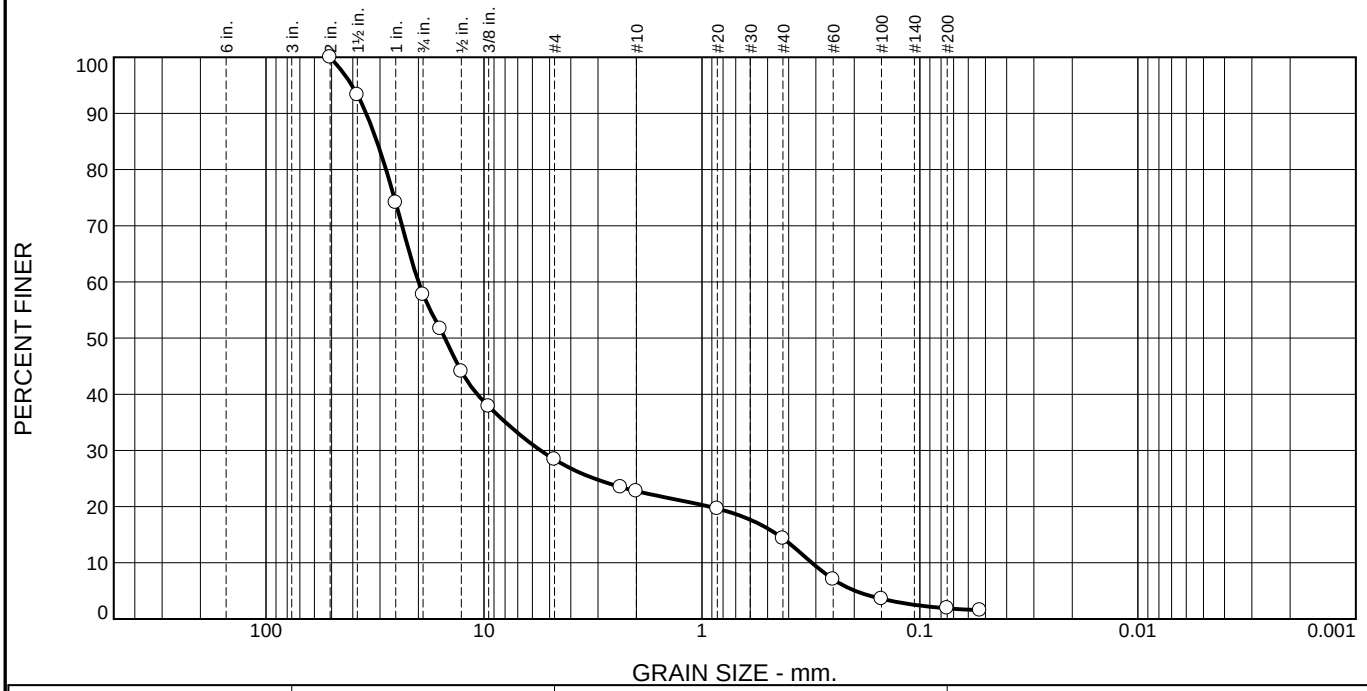
Snohomish, WA	Date: 8/1/2022	Logged By: SST
20220157E001	Total Depth (ft): 14	Approved By: JHS

Depth (ft)	Description	USCS
	Elev.: ≈84 ft NAVD88	
0	**Fill** Loose, dry grading to moist, tan grading to dark gray, silty, fine SAND to fine sandy SILT; variable gravel; includes woody debris, shards of filter fabric, PVC pipe fragments, aluminum cans, concrete chunks, asphalt chunks throughout (SM/ML).	
2.5		
5		
7.5		
10		
12.5		
	No seepage. Minor caving at 10 to 14 feet on south side of pit.	
15		
17.5		
20		

8/29/2022

20220157E001

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	42.3	29.3	5.6	8.5	12.4	1.9	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2"	100.0		
1.5"	93.3		
1"	74.1		
3/4"	57.7		
5/8"	51.7		
1/2"	44.1		
3/8"	37.9		
#4	28.4		
#8	23.5		
#10	22.8		
#20	19.6		
#40	14.3		
#60	7.1		
#100	3.6		
#200	1.9		
#270	1.5		

* (no specification provided)

Material Description

sandy GRAVEL, trace silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GP **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 34.7199 D_{85}= 30.9960 D_{60}= 20.0029
D_{50}= 15.1073 D_{30}= 5.5026 D_{15}= 0.4495
D_{10}= 0.3127 C_u= 63.98 C_c= 4.84

Remarks

Date Received: 8/2/2022 **Date Tested:** 8/5/2022

Tested By: CI

Checked By: SST/KDM

Title:

Location: Onsite
Sample Number: EP-7 **Depth:** 4'

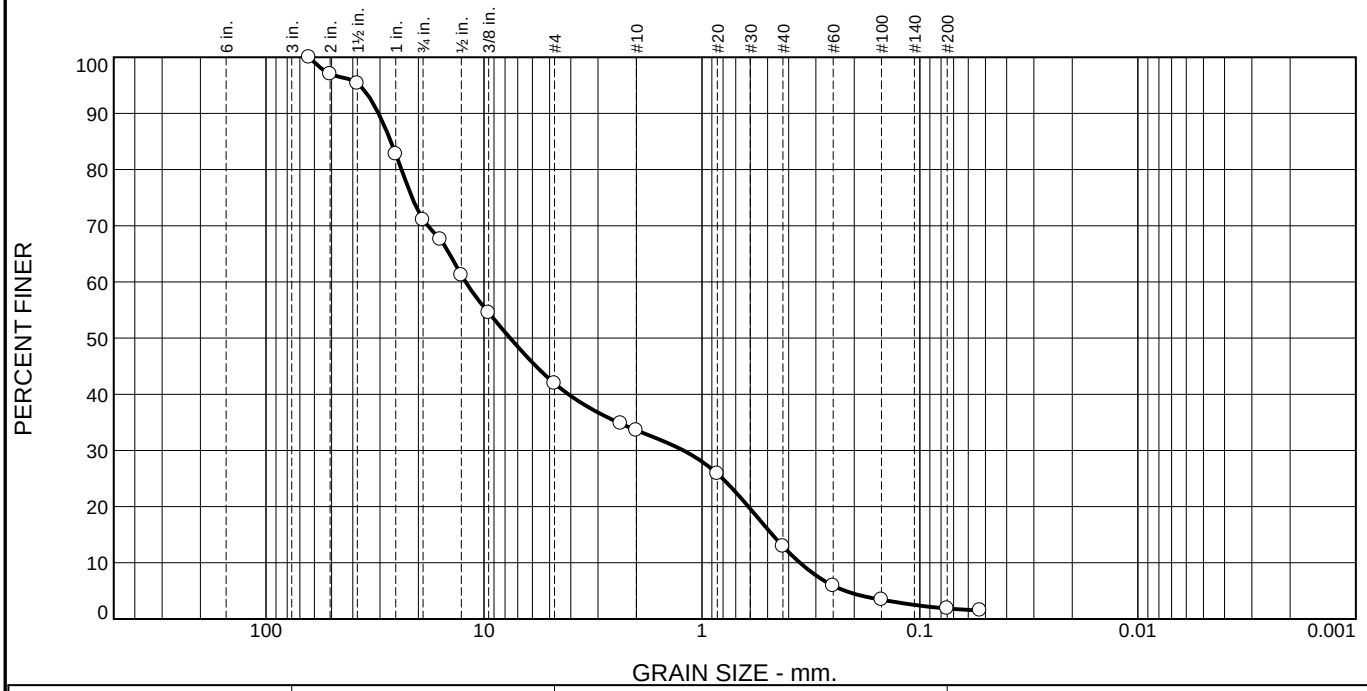
Date Sampled: 8/1/2022

associated earth sciences incorporated

Client: Pace Engineers, Inc.
Project: Snohomish Public Works Feasibility Study

Project No: 20220157 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	28.9	29.2	8.3	20.7	11.0	1.9	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2.5"	100.0		
2"	97.0		
1.5"	95.3		
1"	82.8		
3/4"	71.1		
5/8"	67.6		
1/2"	61.2		
3/8"	54.5		
#4	41.9		
#8	34.8		
#10	33.6		
#20	25.9		
#40	12.9		
#60	5.9		
#100	3.4		
#200	1.9		
#270	1.5		

* (no specification provided)

Material Description

very sandy GRAVEL, trace silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GP **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 30.4693 D_{85}= 26.7330 D_{60}= 12.1515
D_{50}= 7.5869 D_{30}= 1.2154 D_{15}= 0.4752
D_{10}= 0.3550 C_u= 34.23 C_c= 0.34

Remarks

Date Received: 8/2/2022 **Date Tested:** 8/5/2022

Tested By: CI

Checked By: SST/KDM

Title:

Location: Onsite
Sample Number: EP-8 **Depth:** 4'

Date Sampled: 8/1/2022

associated earth sciences incorporated

Client: Pace Engineers, Inc.
Project: Snohomish Public Works Feasibility Study

Project No: 20220157 E001 **Figure**

Public Works Site Feasibility
Snohomish, Washington

APPENDIX C
Calculations

PACE
An Engineering Services Company

THIS PAGE IS INTENTIONALLY LEFT BLANK.

PACE
An Engineering Services Company
11255 Kirkland Way, Suite 300
Kirkland, Washington 98033
Phone: 425.827.2014 | Fax: 425.827.5043

JOB NO.	21508		
JOB NAME	City of Snomhish Public Work Site Feasbility		
SHEET NO.	1	OF	1
CALCULATED BY	LC	DATE	10/4/2022
CHECKED BY		DATE	

Sewer Demand and Drainfield Calculations

Per capita flow =	40	gpd	
# of persons =	40	persons	
ADF =	1600	gpd	
	1.11	gpm	
	0.15	cfm	
	0.0025	cfs	>>> design flow for drainfield sizing
PF =	4		
I/I =	0	gpm (all new pipes and structures)	
PIDF=	4.44	gpm	
	0.59	cfm	
	0.010	cfs	>>> design flow for pipe sizing

Pipe Sizing

Assumed pipe I.D.= 8 inches

Manning's Equation

$$v = (k_n/n)R_h^{2/3}S^{1/2}$$

k_n= 1.486

n= 0.01 (smooth wall PVC)

$$R_h = A/P_W$$

Pipe flow fills *leave blank if full, or type "full"

A = 0.35 sf

P_w= 2.09 ft

R_h= 0.17 ft

S = 0.02 (assume 2% slope)

v = 6.36 fps

Q = 2.22 cfs *check that it exceeds design flow

Actual Average Flow

Manning's Equation

$$v = (k_n/n)R_h^{2/3}S^{1/2}$$

k_n= 1.486

n= 0.01 (smooth wall PVC)

$$R_h = A/P_W$$

% of pipe full =	0.13%		*iterative value to achieve ADF
A =	0.0005	sf	
Θ =	0.0082	rad	
P_w=	0.0027	ft	
R_h=	0.17	ft	
S =	0.02	(assume 2% slope)	
v =	6.36	fps	
Q =	0.0029	cfs	

Septic Tank Sizing

Min. hydraulic retention time =	36	hr
	2160	min
Min. tank volume =	2400	gal (per ADF)

Drainfield Sizing

Assumed pipe I.D.=	6	inches	
Infiltration rate =	8	in/hr	
	0.000185	fps	
Infiltration area req'd =	53	sf	
Pipe length needed =	68.09	ft	
Spacing between pipe =	4	ft	
Total area =	272.35	sf	
Estimate dimension=	20	x	20 ft

Residence Time (for ADF)

Max. pipe run length =	1230	ft (property corner to opposite corner)
Residence time in pipe=	193.26	sec
	3.22	min
Residence time in tank=	2160	min
Total residence time =	2163.22	min
	36.05	hrs

Residence time is drainfield shall be negligible as no odor allowed to escape.

PACE
An Engineering Services Company
11255 Kirkland Way, Suite 300
Kirkland, Washington 98033
Phone: 425.827.2014 | Fax: 425.827.5043

JOB NO.	21508	
JOB NAME	City of Snohomish Public Wor	
SHEET NO.	1	OF
CALCULATED BY	MAB	DATE
CHECKED BY		DATE

Stormwater Area Calculations

Predeveloped Conditons:

Total Lot Area =	13.08	acres
	569765	sf
Predeveloped:	**2**	**acres A/B steep forest**
	11.08	**acres A/B pasture flat**

Postdeveloped Conditions:

Total Disturbed Area Perimter	505580	sf
Undisturbed interior area:	122027	sf
Undisturbed=	**4.275**	**acres A/B pasture flat**

Impervious:

Roofs:

4 storage buildings	20000	sf
2 bays	3750	sf
Covered parking	7500	sf
2 inhabited buildings	18000	sf
Ex building	1600	sf
Bunkers =	7500	sf
Total Roof =	58350	sf
	1.340	**acres Roof Tops**

Roads:

Length	2698	ft
Typ Width	25	ft
	67450	sf
	1.548	**acres Roads Flat**

Right-of-Way

Length	400	ft
Typ Width	23	ft
	9200	sf
	0.211	**acres Roads Flat**

Parking:	12132	sf

	0.279	**acres Parking Flat**
Steep "Lawn"	94245.00	sf
	2.164	**acres Lawn Steep**
In between Areas =	3.26	acres
Assume 50% imp.	1.632	**acres Roads flat** (gravel shoulders/staging areas)
50% flat lawn	1.632	**acres Lawn Flat** (area allowed to vegetate)

Mitigated

4.275	**acres A/B pasture flat**
1.340	**acres Roof Tops**
3.392	**acres Roads flat**
0.279	**acres Parking Flat**
2.164	**acres Lawn Steep**
1.632	**acres Lawn Flat**

The above parameters input into WWHM to size infiltration pond. Infiltration shall be 130'x50' footrpint w/ 3:1 side slopes.

Per WWHM model, 24-hour water qualtiy volume is	0.6108	acre x ft
	26606.45	cf
30% volume for presettling basin	7981.934	cf

x = bottom width=	17	ft
3x=bottom length=	67.59694344	ft
Depth =	4	ft
Top width=	41	ft
Top Length=	92	ft
Volume=	7814.000048	cf

k Site Feasbility

1

11/15/2012

WWHM2012
PROJECT REPORT

Project Name: 2022-11-15_Infil Pond
Site Name: Snohomish PW
Site Address:
City :
Report Date: 11/15/2022
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2019/09/13
Version : 4.2.17

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Predev
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Steep	2
A B, Pasture, Flat	11.08
Pervious Total	13.08

Impervious Land Use	acre
Impervious Total	0
Basin Total	13.08

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	1.632
A B, Pasture, Flat	4.275
A B, Lawn, Steep	2.164
Pervious Total	8.071

Impervious Land Use	acre
ROADS FLAT	3.392
ROOF TOPS FLAT	1.34
PARKING FLAT	0.279
Impervious Total	5.011
Basin Total	13.082

Element Flows To:

Surface	Interflow	Groundwater
Infiltration Pond 1	Infiltration Pond 1	

Name : Infiltration Pond 1
Bottom Length: 100.00 ft.
Bottom Width: 50.00 ft.
Depth: 5 ft.
Volume at riser head: 0.6538 acre-feet.
Infiltration On
Infiltration rate: 8
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 976.374
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 976.374
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 4 ft.
Riser Diameter: 12 in.

Element Flows To:

Outlet 1	Outlet 2

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)

0.0000	0.114	0.000	0.000	0.000
0.0556	0.115	0.006	0.000	0.925
0.1111	0.117	0.012	0.000	0.925
0.1667	0.118	0.019	0.000	0.925
0.2222	0.119	0.026	0.000	0.925
0.2778	0.120	0.032	0.000	0.925
0.3333	0.121	0.039	0.000	0.925
0.3889	0.122	0.046	0.000	0.925
0.4444	0.124	0.053	0.000	0.925
0.5000	0.125	0.060	0.000	0.925
0.5556	0.126	0.067	0.000	0.925
0.6111	0.127	0.074	0.000	0.925
0.6667	0.128	0.081	0.000	0.925
0.7222	0.130	0.088	0.000	0.925
0.7778	0.131	0.095	0.000	0.925
0.8333	0.132	0.103	0.000	0.925
0.8889	0.133	0.110	0.000	0.925
0.9444	0.135	0.117	0.000	0.925
1.0000	0.136	0.125	0.000	0.925
1.0556	0.137	0.133	0.000	0.925
1.1111	0.138	0.140	0.000	0.925
1.1667	0.140	0.148	0.000	0.925
1.2222	0.141	0.156	0.000	0.925
1.2778	0.142	0.164	0.000	0.925
1.3333	0.143	0.172	0.000	0.925
1.3889	0.145	0.180	0.000	0.925
1.4444	0.146	0.188	0.000	0.925
1.5000	0.147	0.196	0.000	0.925
1.5556	0.148	0.204	0.000	0.925
1.6111	0.150	0.212	0.000	0.925
1.6667	0.151	0.221	0.000	0.925
1.7222	0.152	0.229	0.000	0.925
1.7778	0.154	0.238	0.000	0.925
1.8333	0.155	0.246	0.000	0.925
1.8889	0.156	0.255	0.000	0.925
1.9444	0.158	0.264	0.000	0.925
2.0000	0.159	0.273	0.000	0.925
2.0556	0.160	0.282	0.000	0.925
2.1111	0.162	0.291	0.000	0.925
2.1667	0.163	0.300	0.000	0.925
2.2222	0.164	0.309	0.000	0.925
2.2778	0.166	0.318	0.000	0.925
2.3333	0.167	0.327	0.000	0.925
2.3889	0.168	0.336	0.000	0.925
2.4444	0.170	0.346	0.000	0.925
2.5000	0.171	0.355	0.000	0.925
2.5556	0.173	0.365	0.000	0.925
2.6111	0.174	0.375	0.000	0.925
2.6667	0.175	0.384	0.000	0.925
2.7222	0.177	0.394	0.000	0.925
2.7778	0.178	0.404	0.000	0.925
2.8333	0.180	0.414	0.000	0.925
2.8889	0.181	0.424	0.000	0.925
2.9444	0.182	0.434	0.000	0.925
3.0000	0.184	0.444	0.000	0.925
3.0556	0.185	0.455	0.000	0.925
3.1111	0.187	0.465	0.000	0.925

3.1667	0.188	0.475	0.000	0.925
3.2222	0.189	0.486	0.000	0.925
3.2778	0.191	0.496	0.000	0.925
3.3333	0.192	0.507	0.000	0.925
3.3889	0.194	0.518	0.000	0.925
3.4444	0.195	0.529	0.000	0.925
3.5000	0.197	0.540	0.000	0.925
3.5556	0.198	0.551	0.000	0.925
3.6111	0.200	0.562	0.000	0.925
3.6667	0.201	0.573	0.000	0.925
3.7222	0.203	0.584	0.000	0.925
3.7778	0.204	0.595	0.000	0.925
3.8333	0.206	0.607	0.000	0.925
3.8889	0.207	0.618	0.000	0.925
3.9444	0.209	0.630	0.000	0.925
4.0000	0.210	0.642	0.000	0.925
4.0556	0.212	0.653	0.138	0.925
4.1111	0.213	0.665	0.389	0.925
4.1667	0.215	0.677	0.703	0.925
4.2222	0.216	0.689	1.046	0.925
4.2778	0.218	0.701	1.383	0.925
4.3333	0.219	0.713	1.683	0.925
4.3889	0.221	0.726	1.921	0.925
4.4444	0.222	0.738	2.088	0.925
4.5000	0.224	0.750	2.203	0.925
4.5556	0.226	0.763	2.347	0.925
4.6111	0.227	0.775	2.462	0.925
4.6667	0.229	0.788	2.571	0.925
4.7222	0.230	0.801	2.676	0.925
4.7778	0.232	0.814	2.777	0.925
4.8333	0.234	0.827	2.875	0.925
4.8889	0.235	0.840	2.969	0.925
4.9444	0.237	0.853	3.060	0.925
5.0000	0.238	0.866	3.149	0.925
5.0556	0.240	0.879	3.235	0.925

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:13.08
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:8.071
Total Impervious Area:5.011

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)

2 year	0.029633
5 year	0.092111
10 year	0.177334
25 year	0.37432
50 year	0.6232
100 year	1.004125

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.009	0.000
1950	0.075	0.000
1951	0.058	0.000
1952	0.010	0.000
1953	0.010	0.000
1954	0.335	0.000
1955	0.182	0.000
1956	0.012	0.000
1957	0.014	0.000
1958	0.075	0.000
1959	0.071	0.000
1960	0.094	0.000
1961	0.155	0.000
1962	0.010	0.000
1963	0.010	0.000
1964	0.134	0.000
1965	0.009	0.000
1966	0.010	0.000
1967	0.081	0.000
1968	0.019	0.000
1969	0.077	0.000
1970	0.014	0.000
1971	0.247	0.000
1972	0.015	0.000
1973	0.023	0.000
1974	0.059	0.000
1975	0.014	0.000
1976	0.094	0.000
1977	0.010	0.000
1978	0.012	0.000
1979	0.116	0.000
1980	0.034	0.000
1981	0.011	0.000
1982	0.037	0.000
1983	0.020	0.000
1984	0.010	0.000
1985	0.146	0.000

1986	0.249	0.000
1987	0.139	0.000
1988	0.010	0.000
1989	0.032	0.000
1990	0.048	0.000
1991	0.024	0.000
1992	0.010	0.000
1993	0.009	0.000
1994	0.010	0.000
1995	0.038	0.000
1996	0.277	0.000
1997	0.631	0.000
1998	0.010	0.000
1999	0.013	0.000
2000	0.108	0.000
2001	0.009	0.000
2002	0.010	0.000
2003	0.010	0.000
2004	0.010	0.000
2005	0.010	0.000
2006	0.894	0.000
2007	0.078	0.000
2008	0.033	0.000
2009	0.010	0.000

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.8941	0.0000
2	0.6308	0.0000
3	0.3346	0.0000
4	0.2768	0.0000
5	0.2492	0.0000
6	0.2468	0.0000
7	0.1817	0.0000
8	0.1548	0.0000
9	0.1457	0.0000
10	0.1394	0.0000
11	0.1340	0.0000
12	0.1156	0.0000
13	0.1077	0.0000
14	0.0943	0.0000
15	0.0938	0.0000
16	0.0808	0.0000
17	0.0775	0.0000
18	0.0771	0.0000
19	0.0748	0.0000
20	0.0746	0.0000
21	0.0710	0.0000
22	0.0586	0.0000
23	0.0578	0.0000
24	0.0476	0.0000
25	0.0380	0.0000
26	0.0375	0.0000
27	0.0337	0.0000
28	0.0326	0.0000

29	0.0321	0.0000
30	0.0237	0.0000
31	0.0229	0.0000
32	0.0199	0.0000
33	0.0186	0.0000
34	0.0154	0.0000
35	0.0141	0.0000
36	0.0136	0.0000
37	0.0135	0.0000
38	0.0130	0.0000
39	0.0122	0.0000
40	0.0116	0.0000
41	0.0107	0.0000
42	0.0101	0.0000
43	0.0101	0.0000
44	0.0100	0.0000
45	0.0100	0.0000
46	0.0100	0.0000
47	0.0100	0.0000
48	0.0099	0.0000
49	0.0099	0.0000
50	0.0099	0.0000
51	0.0099	0.0000
52	0.0099	0.0000
53	0.0097	0.0000
54	0.0097	0.0000
55	0.0097	0.0000
56	0.0097	0.0000
57	0.0096	0.0000
58	0.0095	0.0000
59	0.0092	0.0000
60	0.0092	0.0000
61	0.0086	0.0000

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0148	327	0	0	Pass
0.0210	237	0	0	Pass
0.0271	180	0	0	Pass
0.0333	150	0	0	Pass
0.0394	124	0	0	Pass
0.0455	101	0	0	Pass
0.0517	91	0	0	Pass
0.0578	79	0	0	Pass
0.0640	68	0	0	Pass
0.0701	64	0	0	Pass
0.0763	56	0	0	Pass
0.0824	50	0	0	Pass
0.0886	49	0	0	Pass
0.0947	47	0	0	Pass
0.1009	43	0	0	Pass

0.1070	42	0	0	Pass
0.1131	37	0	0	Pass
0.1193	30	0	0	Pass
0.1254	28	0	0	Pass
0.1316	28	0	0	Pass
0.1377	26	0	0	Pass
0.1439	25	0	0	Pass
0.1500	23	0	0	Pass
0.1562	22	0	0	Pass
0.1623	20	0	0	Pass
0.1684	19	0	0	Pass
0.1746	19	0	0	Pass
0.1807	19	0	0	Pass
0.1869	18	0	0	Pass
0.1930	18	0	0	Pass
0.1992	18	0	0	Pass
0.2053	18	0	0	Pass
0.2115	16	0	0	Pass
0.2176	16	0	0	Pass
0.2238	16	0	0	Pass
0.2299	15	0	0	Pass
0.2360	14	0	0	Pass
0.2422	13	0	0	Pass
0.2483	11	0	0	Pass
0.2545	10	0	0	Pass
0.2606	10	0	0	Pass
0.2668	10	0	0	Pass
0.2729	10	0	0	Pass
0.2791	9	0	0	Pass
0.2852	8	0	0	Pass
0.2914	8	0	0	Pass
0.2975	8	0	0	Pass
0.3036	8	0	0	Pass
0.3098	8	0	0	Pass
0.3159	8	0	0	Pass
0.3221	8	0	0	Pass
0.3282	7	0	0	Pass
0.3344	7	0	0	Pass
0.3405	6	0	0	Pass
0.3467	6	0	0	Pass
0.3528	6	0	0	Pass
0.3590	6	0	0	Pass
0.3651	6	0	0	Pass
0.3712	6	0	0	Pass
0.3774	6	0	0	Pass
0.3835	6	0	0	Pass
0.3897	6	0	0	Pass
0.3958	6	0	0	Pass
0.4020	6	0	0	Pass
0.4081	6	0	0	Pass
0.4143	6	0	0	Pass
0.4204	6	0	0	Pass
0.4266	6	0	0	Pass
0.4327	6	0	0	Pass
0.4388	5	0	0	Pass
0.4450	5	0	0	Pass
0.4511	4	0	0	Pass

0.4573	4	0	0	Pass
0.4634	4	0	0	Pass
0.4696	4	0	0	Pass
0.4757	4	0	0	Pass
0.4819	4	0	0	Pass
0.4880	4	0	0	Pass
0.4941	4	0	0	Pass
0.5003	4	0	0	Pass
0.5064	4	0	0	Pass
0.5126	4	0	0	Pass
0.5187	4	0	0	Pass
0.5249	4	0	0	Pass
0.5310	3	0	0	Pass
0.5372	3	0	0	Pass
0.5433	3	0	0	Pass
0.5495	3	0	0	Pass
0.5556	3	0	0	Pass
0.5617	3	0	0	Pass
0.5679	3	0	0	Pass
0.5740	3	0	0	Pass
0.5802	3	0	0	Pass
0.5863	3	0	0	Pass
0.5925	3	0	0	Pass
0.5986	3	0	0	Pass
0.6048	3	0	0	Pass
0.6109	3	0	0	Pass
0.6171	2	0	0	Pass
0.6232	2	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.6108 **acre-feet**
On-line facility target flow: 0.987 **cfs.**
Adjusted for 15 min: 0.987 **cfs.**
Off-line facility target flow: 0.5571 **cfs.**
Adjusted for 15 min: 0.5571 **cfs.**

LID Report

LID Technique	Used for Treatment?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Volume Infiltration Credit	Percent Water Quality Treated	Percent Infiltrated	Comment
Infiltration Pond 1 POC	N	888.50			N	100.00		
Total Volume Infiltrated		888.50	0.00	0.00		100.00	0.00	No Treat. Credit

Compliance with LID Standard 8
Duration Analysis Result = Passed

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run. POC #3 was not reported because POC must exist in both scenarios and both scenarios must have been run.**Perlnd and Implnd Changes**

No changes have been made.

Public Works Site Feasibility
Snohomish, Washington

APPENDIX D
Cost Estimate

PACE
An Engineering Services Company

THIS PAGE IS INTENTIONALLY LEFT BLANK.

Existing Public Works Location

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	$ 23,000.00	$ 23,000.00
2	Clearing and Grubbing	2000	SY	$ 5.00	$ 10,000.00
3	Demolition and Disposal of Existing Office Building	1	EA	$ 30,000.00	$ 30,000.00
4	Demolition of Existing Storage Building	3	EA	$ 20,000.00	$ 60,000.00
5	Demolition of Existing Vehicle Bay	4	EA	$ 10,000.00	$ 40,000.00
6	Demolition of Existing Maintenance Building	1	EA	$ 30,000.00	$ 30,000.00
7	Cut and Cap Existing Water Service	1	EA	$ 2,500.00	$ 2,500.00
8	Cut and Cap Existing Sewer Service	1	EA	$ 2,500.00	$ 2,500.00
9	Remove Existing Communications Connection	1	EA	$ 1,500.00	$ 1,500.00
10	Remove Existing Power Connection	1	EA	$ 1,500.00	$ 1,500.00
11	General Site Restoration	1	EA	$ 50,000.00	$ 50,000.00
				Subtotal	$ 251,000.00
				Sales Tax - 9.3%	$ 23,343.00
				Contingency (25%)	$ 68,585.75
				Total	**$ 342,928.75**

Proposed Public Works Location
Original Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	$ 1,164,000.00	$ 1,164,000.00
2	Clearing and Grubbing	60000	SY	$ 5.00	$ 300,000.00
3	Storm Ponds Excavation incl. Haul	3000	CY	$ 12.00	$ 36,000.00
4	Structure Excavation Including Haul	9500	CY	$ 12.00	$ 114,000.00
5	Trench Excavation including Haul	3500	CY	$ 12.00	$ 42,000.00
6	Import Infiltration Rock	300	TON	$ 35.00	$ 10,500.00
7	Import Structural Fill	13000	TON	$ 35.00	$ 455,000.00
8	Crushed Rock	5,750	TON	$ 30.00	$ 172,500.00
9	Bank Run Gravel for Pipe Backfill	5000	TON	$ 25.00	$ 125,000.00
10	Rockery Retaining Wall	6000	SF	$ 25.00	$ 150,000.00
11	HMA	1,800	TON	$ 200.00	$ 360,000.00
12	Sidewalk	200	SY	$ 75.00	$ 15,000.00
13	Sewer Pipe, 6" Diam.	100	LF	$ 90.00	$ 9,000.00
14	Sewer Pipe, 8" Diam.	1500	LF	$ 150.00	$ 225,000.00
15	Stormwater Pipe 12" Diam.	2650	LF	$ 140.00	$ 371,000.00
16	Water Pipe, 8" Diam.	1700	LF	$ 125.00	$ 212,500.00
17	Water Pipe, 2" Diam.	200	LF	$ 50.00	$ 10,000.00
18	Hydrant Assembly	4	EA	$ 8,500.00	$ 34,000.00
19	Catch Basin	16	EA	$ 6,000.00	$ 96,000.00
20	Topsoil & Planting	20000	SY	$ 10.00	$ 200,000.00
21	Sewer Manhole	7	EA	$ 8,500.00	$ 59,500.00
22	Septic Tank	1	EA	$ 20,000.00	$ 20,000.00
23	Sewer Drainfield	4	EA	$ 7,500.00	$ 30,000.00
24	Decant Facility (1 Bay)	1	EA	$ 500,000.00	$ 500,000.00
25	Proposed Power Line	1200	LF	$ 60.00	$ 72,000.00
26	Proposed Communications Line	1000	LF	$ 60.00	$ 60,000.00
27	Proposed Fencing	1200	LF	$ 45.00	$ 54,000.00
28	Storage Building (100'x50')*	4	EA	$ 350,000.00	$ 1,400,000.00
29	Vactor Bay (75'x25')	2	EA	$ 200,000.00	$ 400,000.00
30	Material Bunker (100'x50')**	2	EA	$ 125,000.00	$ 250,000.00
31	Covered Parking Structure	1	EA	$ 100,000.00	$ 100,000.00
32	Maintenance Building (100'x75')	1	EA	$ 650,000.00	$ 650,000.00
33	Office Building (210'x50')	1	EA	$ 5,000,000.00	$ 5,000,000.00
34	Furnishings for Staff	40	EA	$ 2,500.00	$ 100,000.00
				Subtotal	$ 12,797,000.00
				Sales Tax - 9.3%	$ 1,190,121.00
				Engineer/Survey/Permit (25%)	$ 3,496,780.25
				Contingency (25%)	$ 3,496,780.25
				Total	**$ 20,980,681.50**

Proposed Public Works Location
Original Cost Estimate, No Office Building

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	$ 664,000.00	$ 664,000.00
2	Clearing and Grubbing	60000	SY	$ 5.00	$ 300,000.00
3	Storm Ponds Excavation incl. Haul	3000	CY	$ 12.00	$ 36,000.00
4	Structure Excavation Including Haul	9500	CY	$ 12.00	$ 114,000.00
5	Trench Excavation including Haul	3500	CY	$ 12.00	$ 42,000.00
6	Import Infiltration Rock	300	TON	$ 35.00	$ 10,500.00
7	Import Structural Fill	13000	TON	$ 35.00	$ 455,000.00
8	Crushed Rock	5,750	TON	$ 30.00	$ 172,500.00
9	Bank Run Gravel for Pipe Backfill	5000	TON	$ 25.00	$ 125,000.00
10	Rockery Retaining Wall	6000	SF	$ 25.00	$ 150,000.00
11	HMA	1,800	TON	$ 200.00	$ 360,000.00
12	Sidewalk	200	SY	$ 75.00	$ 15,000.00
13	Sewer Pipe, 6" Diam.	100	LF	$ 90.00	$ 9,000.00
14	Sewer Pipe, 8" Diam.	1500	LF	$ 150.00	$ 225,000.00
15	Stormwater Pipe 12" Diam.	2650	LF	$ 140.00	$ 371,000.00
16	Water Pipe, 8" Diam.	1700	LF	$ 125.00	$ 212,500.00
17	Water Pipe, 2" Diam.	200	LF	$ 50.00	$ 10,000.00
18	Hydrant Assembly	4	EA	$ 8,500.00	$ 34,000.00
19	Catch Basin	16	EA	$ 6,000.00	$ 96,000.00
20	Topsoil & Planting	20000	SY	$ 10.00	$ 200,000.00
21	Sewer Manhole	7	EA	$ 8,500.00	$ 59,500.00
22	Septic Tank	1	EA	$ 20,000.00	$ 20,000.00
23	Sewer Drainfield	4	EA	$ 7,500.00	$ 30,000.00
24	Decant Facility (1 Bay)	1	EA	$ 500,000.00	$ 500,000.00
25	Proposed Power Line	1200	LF	$ 60.00	$ 72,000.00
26	Proposed Communications Line	1000	LF	$ 60.00	$ 60,000.00
27	Proposed Fencing	1200	LF	$ 45.00	$ 54,000.00
28	Storage Building (100'x50')*	4	EA	$ 350,000.00	$ 1,400,000.00
29	Vactor Bay (75'x25')	2	EA	$ 200,000.00	$ 400,000.00
30	Material Bunker (100'x50')**	2	EA	$ 125,000.00	$ 250,000.00
31	Covered Parking Structure	1	EA	$ 100,000.00	$ 100,000.00
32	Maintenance Building (100'x75')	1	EA	$ 650,000.00	$ 650,000.00
33	Furnishings for Staff	40	EA	$ 2,500.00	$ 100,000.00
				Subtotal	$ 7,297,000.00
				Sales Tax - 9.3%	$ 678,621.00
				Engineer/Survey/Permit (25%)	$ 1,993,905.25
				Contingency (25%)	$ 1,993,905.25
				Total	**$ 11,963,431.50**

Proposed Public Works Location
Alternative Layout Cost Estimate

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	$ 1,251,000.00	$ 1,251,000.00
2	Clearing and Grubbing	60000	SY	$ 5.00	$ 300,000.00
3	Storm Ponds Excavation incl. Haul	6000	CY	$ 12.00	$ 72,000.00
4	Structure Excavation Including Haul	9500	CY	$ 12.00	$ 114,000.00
5	Trench Excavation including Haul	3500	CY	$ 12.00	$ 42,000.00
6	Import Infiltration Rock	600	TON	$ 35.00	$ 21,000.00
7	Import Structural Fill	18000	TON	$ 35.00	$ 630,000.00
8	Crushed Rock	9,000	TON	$ 30.00	$ 270,000.00
9	Bank Run Gravel for Pipe Backfill	5000	TON	$ 25.00	$ 125,000.00
10	Rockery Retaining Wall	18000	SF	$ 25.00	$ 450,000.00
11	HMA	3,300	TON	$ 200.00	$ 660,000.00
12	Sidewalk	200	SY	$ 75.00	$ 15,000.00
13	Sewer Pipe, 6" Diam.	100	LF	$ 90.00	$ 9,000.00
14	Sewer Pipe, 8" Diam.	1350	LF	$ 150.00	$ 202,500.00
15	Stormwater Pipe 12" Diam.	1800	LF	$ 140.00	$ 252,000.00
16	Water Pipe, 8" Diam.	2550	LF	$ 125.00	$ 318,750.00
17	Water Pipe, 2" Diam.	200	LF	$ 50.00	$ 10,000.00
18	Hydrant Assembly	5	EA	$ 8,500.00	$ 42,500.00
19	Catch Basin	16	EA	$ 6,000.00	$ 96,000.00
20	Topsoil & Planting	20000	SY	$ 10.00	$ 200,000.00
21	Sewer Manhole	7	EA	$ 8,500.00	$ 59,500.00
22	Septic Tank	1	EA	$ 20,000.00	$ 20,000.00
23	Sewer Drainfield	4	EA	$ 7,500.00	$ 30,000.00
24	Decant Facility (1 Bay)	1	EA	$ 500,000.00	$ 500,000.00
25	Proposed Power Line	1200	LF	$ 60.00	$ 72,000.00
26	Proposed Communications Line	600	LF	$ 60.00	$ 36,000.00
27	Proposed Fencing	1200	LF	$ 45.00	$ 54,000.00
28	Storage Building (100'x50')*	4	EA	$ 350,000.00	$ 1,400,000.00
29	Vactor Bay (75'x25')	2	EA	$ 200,000.00	$ 400,000.00
30	Material Bunker (100'x50')**	2	EA	$ 125,000.00	$ 250,000.00
31	Covered Parking Structure	1	EA	$ 100,000.00	$ 100,000.00
32	Maintenance Building (100'x75')	1	EA	$ 650,000.00	$ 650,000.00
33	Office Building (210'x50')	1	EA	$ 5,000,000.00	$ 5,000,000.00
34	Furnishings for Staff	40	EA	$ 2,500.00	$ 100,000.00
				Subtotal	$ 13,752,250.00
				Sales Tax - 9.3%	$ 1,278,959.25
				Engineer/Survey/Permit (25%)	$ 3,757,802.31
				Contingency (25%)	$ 3,757,802.31
				Total	**$ 22,546,813.88**

Proposed Public Works Location
Alternative Cost Estimate - No Office Building

Item	Description	Estimated Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	$ 751,000.00	$ 751,000.00
2	Clearing and Grubbing	60000	SY	$ 5.00	$ 300,000.00
3	Storm Ponds Excavation incl. Haul	6000	CY	$ 12.00	$ 72,000.00
4	Structure Excavation Including Haul	9500	CY	$ 12.00	$ 114,000.00
5	Trench Excavation including Haul	3500	CY	$ 12.00	$ 42,000.00
6	Import Infiltration Rock	600	TON	$ 35.00	$ 21,000.00
7	Import Structural Fill	18000	TON	$ 35.00	$ 630,000.00
8	Crushed Rock	9,000	TON	$ 30.00	$ 270,000.00
9	Bank Run Gravel for Pipe Backfill	5000	TON	$ 25.00	$ 125,000.00
10	Rockery Retaining Wall	18000	SF	$ 25.00	$ 450,000.00
11	HMA	3,300	TON	$ 200.00	$ 660,000.00
12	Sidewalk	200	SY	$ 75.00	$ 15,000.00
13	Sewer Pipe, 6" Diam.	100	LF	$ 90.00	$ 9,000.00
14	Sewer Pipe, 8" Diam.	1350	LF	$ 150.00	$ 202,500.00
15	Stormwater Pipe 12" Diam.	1800	LF	$ 140.00	$ 252,000.00
16	Water Pipe, 8" Diam.	2550	LF	$ 125.00	$ 318,750.00
17	Water Pipe, 2" Diam.	200	LF	$ 50.00	$ 10,000.00
18	Hydrant Assembly	5	EA	$ 8,500.00	$ 42,500.00
19	Catch Basin	16	EA	$ 6,000.00	$ 96,000.00
20	Topsoil & Planting	20000	SY	$ 10.00	$ 200,000.00
21	Sewer Manhole	7	EA	$ 8,500.00	$ 59,500.00
22	Septic Tank	1	EA	$ 20,000.00	$ 20,000.00
23	Sewer Drainfield	4	EA	$ 7,500.00	$ 30,000.00
24	Decant Facility (1 Bay)	1	EA	$ 500,000.00	$ 500,000.00
25	Proposed Power Line	1200	LF	$ 60.00	$ 72,000.00
26	Proposed Communications Line	600	LF	$ 60.00	$ 36,000.00
27	Proposed Fencing	1200	LF	$ 45.00	$ 54,000.00
28	Storage Building (100'x50')*	4	EA	$ 350,000.00	$ 1,400,000.00
29	Vactor Bay (75'x25')	2	EA	$ 200,000.00	$ 400,000.00
30	Material Bunker (100'x50')**	2	EA	$ 125,000.00	$ 250,000.00
31	Covered Parking Structure	1	EA	$ 100,000.00	$ 100,000.00
32	Maintenance Building (100'x75')	1	EA	$ 650,000.00	$ 650,000.00
33	Furnishings for Staff	40	EA	$ 2,500.00	$ 100,000.00
				Subtotal	$ 8,252,250.00
				Sales Tax - 9.3%	$ 767,459.25
				Engineer/Survey/Permit (25%)	$ 2,254,927.31
				Contingency (25%)	$ 2,254,927.31
				Total	**$ 13,529,563.88**

Public Works Site Feasibility
Snohomish, Washington

APPENDIX E
Public Works Maintenance Facility Survey

PACE
An Engineering Services Company

THIS PAGE IS INTENTIONALLY LEFT BLANK.

CITY OF SNOHOMISH
116 UNION AVENUE | SNOHOMISH, WASHINGTON 98290 | (360) 568-3115 | WWW.SNOHOMISHWA.GOV

2022 Public Works Maintenance Facility Survey

A staff survey was conducted to gather opinions and comments regarding the future of the Public Works Maintenance Facility. The survey was announced in the "Friday Digest for November 4, 2022" email with a SurveyMonkey link included. It was conducted from November 4, 2022 to November 17, 2022.

There were six questions asked in the survey. Five completed surveys were submitted. Following are the six questions and the responses.

Question 1. Which is your preferred location for Public Works Shops?

Three out five responded that the current location was preferred.

- A place inside the city/uga centrally located and not near critical areas/prime commercial sites
- Current Site
- Closer to town
- Current Site
- Current Site or lower portion of the old Snohomish County Yard

Question 2. Why did you select that as your preferred location?

- The pit and current locations are bad
- Near Wastewater Treatment Plant, City Hall and CSO Lift Station (EOC).
- Somewhere that is closer to town or in town.
- The Pit is too far away, and I fear it that will increase the disconnect between CH and the Shop. There is only one way in and out of the site. It is outside city limits. The current site if more convenient.
- Not out of City

Question 3. If the facility stayed at its current location, what needs to be considered or addressed?

Three out five responded that security needs to be improved.

- A myriad of issues that folks who work/manage down there will address in the survey.
- Improve and/or replace buildings, improve security, stabilize river bank, and future growth.
- Security of building, ease of getting out of shop area in emergencies. Better/effective parking.

- take advantage of the river and the view. A nice outdoor eating area, break area. offices with a view.
- Needs good security

Question 4. If the facility moved to another location, what needs to be considered or addressed?

- Not near critical areas or prime commercial sites.
- Buildings, material and equipment storage areas, parking, utilities, security, vehicle circulation, and future growth.
- If location is in a stable and secured area, potentially make this site the main data center or a solid backup site. Also, security of building, ease of getting out of shop area in emergencies. Better/effective parking.
- I really think it needs to stay inside city limits.
- Be nice to have all City together in one location for better communication and camaraderie.

Question 5. In your opinion, would you prefer to have a joint facility with City Hall (such as a civic campus) or be at a separate location? Why?

A joint facility was the preference among the respondents to have all staff working at one location.

- Joint facility would be perfect, so we are all together, but I understand that is not likely feasible given the size needed to make it happen.
- Joint facility. Access to staff and resources.
- Joint facility for better overall infrastructure support.
- I like to idea of a civic campus. Office building could be 3 stories. Could that end of First street become a dead-end? That would move the tallest building further away from the river and might need less seismic stability?
- I think a civic campus is the way to go. Not only is city hall bursting with no room but it would allow all aspects of City business to work cohesively.

Question 6. What would you most look forward to in a new/renovated facility?

- Selfishly, I am content with City Hall as-is. I do not need bells and whistles to do my job, or feel appreciated. I understand the shop cannot stay as-is. My hope is to give that part of our City team what they need to be successful and feel appreciated as it appears to me it has been scabbed together to meet their needs. They will have to weigh in on this as I do not feel comfortable speaking on their behalf.
- An improved, secure work space.
- Proper setup of IT/Tech physical infrastructure throughout the entire facility.

- The river is a large part of Snohomish's identity and having a civic campus at the river would be something to be proud of. A common outdoor area for breaks and lunch. Everyone together. An automatic front gate!
- Hopefully pride in the new building and grounds

#1

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, November 04, 2022 6:06:01 AM
Last Modified:	Friday, November 04, 2022 9:30:43 AM
Time Spent:	03:24:41
IP Address:	76.104.169.27

Page 1: 2022 Shop Survey

Q1

Which is your preferred location for Public Works Shops?

Other (please specify):

A place inside the city/uga centrally located and not near critical areas/prime commercial sites

Q2

Why did you select that as your preferred location?

The pit and current locations are bad

Q3

If the facility stayed at its current location, what needs to be considered or addressed?

A myriad of issues that folks who work/manage down there will address in the survey.

Q4

If the facility moved to another location, what needs to be considered or addressed?”

Not near critical areas or prime commercial sites.

Q5

In your opinion, would you prefer to have a joint facility with City Hall (such as a civic campus) or be at a separate location? Why?

Joint facility would be perfect, so we are all together, but I understand that is not likely feasible given the size needed to make it happen.

Q6

What would you most look forward to in a new/renovated facility?

Selfishly, I am content with City Hall as-is. I do not need bells and whistles to do my job, or feel appreciated. I understand the shop cannot stay as-is. My hope is to give that part of our City team what they need to be successful and feel appreciated as it appears to me it has been scabbed together to meet their needs. They will have to weigh in on this as I do not feel comfortable speaking on their behalf.

#2

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Friday, November 04, 2022 3:02:34 PM
Last Modified: Friday, November 04, 2022 3:51:58 PM
Time Spent: 00:49:23
IP Address: 74.85.94.50

Page 1: 2022 Shop Survey

Q1 **Current Site**

Which is your preferred location for Public Works Shops?

Q2

Why did you select that as your preferred location?

Near Wastewater Treatment Plant, City Hall and CSO Lift Station (EOC).

Q3

If the facility stayed at its current location, what needs to be considered or addressed?

Improve and/or replace buildings, improve security, stabilize river bank, and future growth.

Q4

If the facility moved to another location, what needs to be considered or addressed?”

Buildings, material and equipment storage areas, parking, utilities, security, vehicle circulation, and future growth.

Q5

In your opinion, would you prefer to have a joint facility with City Hall (such as a civic campus) or be at a separate location? Why?

Joint facility. Access to staff and resources.

Q6

What would you most look forward to in a new/renovated facility?

An improved, secure work space.

#3

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Thursday, November 10, 2022 1:52:21 PM
Last Modified:	Thursday, November 10, 2022 2:34:11 PM
Time Spent:	00:41:50
IP Address:	74.85.94.50

Page 1: 2022 Shop Survey

Q1

Which is your preferred location for Public Works Shops?

Other (please specify):

Closer to town

Q2

Why did you select that as your preferred location?

Somewhere that is closer to town or in town.

Q3

If the facility stayed at its current location, what needs to be considered or addressed?

Security of building, ease of getting out of shop area in emergencies. Better/effective parking.

Q4

If the facility moved to another location, what needs to be considered or addressed?”

If location is in a stable and secured area, potentially make this site the main data center or a solid backup site. Also, security of building, ease of getting out of shop area in emergencies. Better/effective parking.

Q5

In your opinion, would you prefer to have a joint facility with City Hall (such as a civic campus) or be at a separate location? Why?

Joint facility for better overall infrastructure support.

Q6

What would you most look forward to in a new/renovated facility?

Proper setup of IT/Tech physical infrastructure throughout the entire facility.

#4

COMPLETE

Collector: Web Link 1 (Web Link)
Started: Monday, November 14, 2022 7:02:46 AM
Last Modified: Monday, November 14, 2022 7:21:00 AM
Time Spent: 00:18:13
IP Address: 74.85.94.50

Page 1: 2022 Shop Survey

Q1 **Current Site**

Which is your preferred location for Public Works Shops?

Q2

Why did you select that as your preferred location?

1. The Pit is too far away, and I fear it that will increase the disconnect between CH and the Shop.
2. There is only one way in and out of the site.
3. It is outside city limits.
4. The current site if more convenient.

Q3

If the facility stayed at its current location, what needs to be considered or addressed?

take advantage of the river and the view. A nice outdoor eating area, break area. offices with a view.

Q4

If the facility moved to another location, what needs to be considered or addressed?”

I really think it needs to stay inside city limits.

Q5

In your opinion, would you prefer to have a joint facility with City Hall (such as a civic campus) or be at a separate location? Why?

I like to idea of a civic campus. Office building could be 3 stories.
Could that end of First street become a dead-end? That would move the tallest building further away from the river and might need less seismic stability?

Q6

What would you most look forward to in a new/renovated facility?

1. The river is a large part of Snohomish's identity and having a civic campus at the river would be something to be proud of.
2. A common outdoor area for breaks and lunch. Everyone together.
3. An automatic front gate!

#5

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, November 15, 2022 6:45:25 AM
Last Modified:	Tuesday, November 15, 2022 6:50:48 AM
Time Spent:	00:05:22
IP Address:	74.85.94.50

Page 1: 2022 Shop Survey

Q1

Which is your preferred location for Public Works Shops?

Current Site,

Other (please specify):

Or lower portion of the old Snohomish County Yard

Q2

Why did you select that as your preferred location?

Not out of City

Q3

If the facility stayed at its current location, what needs to be considered or addressed?

Needs good security

Q4

If the facility moved to another location, what needs to be considered or addressed?”

Be nice to have all City together in one location for better communication and camaraderie.

Q5

In your opinion, would you prefer to have a joint facility with City Hall (such as a civic campus) or be at a separate location? Why?

I think a civic campus is the way to go. Not only is city hall bursting with no room but it would allow all aspects of City business to work cohesively.

Q6

What would you most look forward to in a new/renovated facility?

Hopefully pride in the new building and grounds