INSIGHT ENGINEERING CO.

PRELIMINARY STORMWATER SITE PLAN

For
Pioneer Point

Prepared for
City of Arlington
238 N. Olympic Ave
Arlington, WA 98223
360.403.3500

Project Site Location:
8500 Block of 207th Pl NE
Arlington, WA 98223

Applicant:
Portage Creek, LLC
11926 127th Ave. NE
Lake Stevens, WA 98258

Contact:
IECO
P.O. Box 1478
Everett, WA 98206
425-303-9363

Tax Id's: 31051200301000, 31051200301400, 31051200301500,
IECO Project: 17-0828

Certified Erosion and Sedimentation Control Lead:
To be named by contractor

Stormwater Site Plan Prepared By:

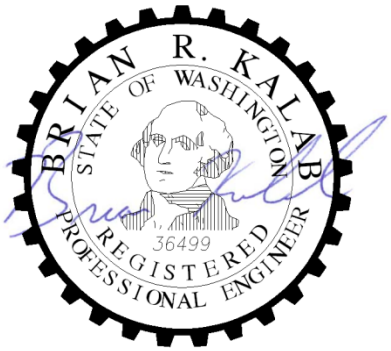
Sithara George, BSCE.

Stormwater Site Plan Preparation Date:

July 20, 2021

Approximate Construction Date:

May 1, 2022



10/08/2021

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Acronyms and Abbreviations

BMP	Best Management Practices
DOE	Department of Ecology
EDDS	Engineering Design and Development Standards
ESC	Erosion and Sediment Control
IECO	Insight Engineering Company
MR	Minimum Requirement
SWPPP	Stormwater Pollution Prevention Plan
SWMMWW	Stormwater Management Manual for Western Washington
TESC	Temporary Erosion and Sediment Control
WWHM	Western Washington Hydrology Model

1.0 Executive Summary

The proposed project ***Pioneer Point*** is located at 8500 Block of 207th ST NE Arlington, Washington. More generally, the site is located in Section 12, Township 31 North, and Range 5 East of the Willamette Meridian in Snohomish County, Washington. Please refer to the Vicinity Map attached later in the section. This report follows the requirements defined in the SWMMWW 2014 and the City of Arlington Requirements.

The project site contains approximately 16 Acres. The development area includes 3 parcels (APN# 31051200301000, APN# 31051200301400, APN#31051200301500) The property to the west of the site has been approved for construction. The existing drainage basin includes the development area and two upstream parcels located south of the property. The existing site is currently undeveloped and exists as low growing foliage with few trees and a man-made pond located on the northern portion of the site. There are two wetlands located on the northern portion of the site which will remain undisturbed. The existing site contains two drainage basins. Basin-1 that slopes to the northwest into the existing pond includes the development area. Basin-2 slopes northeast towards the Type-F stream. Basin-2 is a part of the property and will remain undisturbed. Based on the topographic survey of the site, there are upstream flows entering the site. Please refer to the upstream and downstream analysis for more details. Per SCC survey of Snohomish County, the project site contains Norma and Pastik type soils that have a hydrologic classification of Type "C". Please refer to the soils map and descriptions attached later in this report for more details.

The site is zoned RHD. The clearing area for the proposed development contains 8.55 Acres. The proposal is to construct 94 townhome units and access road with associated utilities. The access to the new units will be from new public local access street. The driveway entrances will be constructed per the city of Arlington standards.

Per Figure 2.2, (flow chart for new development requirements) Volume I Snohomish County Drainage Manual, Minimum requirements #1 through 9 shall apply for this project. See

the Minimum Requirements Summary included later in this report. Flow control requirements will be met by the existing onsite pond on the northern portion of the site. A discharge structure in the form of weir has been designed to provide adequate flow control for the developed basin. The total existing drainage basin as well as the proposed development was included in the developed drainage basin in order to calculate the required volume for the pond. The water surface elevation for the existing pond will rise 1 foot (with sufficient freeboard) due to the proposed development based on the hydraulic calculations for the pond. The detention volume was calculated in WWHM 2012, refer to section 5.0 for the hydraulic analysis. The total required detention volume is 125,888 CF. Enhanced Water quality for the site will be provided by two MWS filters manufactured by Bioclean Environmental services Inc. located upstream of detention pond.

Per Minimum Requirement #5 (Section 2.5.5 of the SWMMWW), the following NPGIS BMPs shall be applied to provide onsite stormwater management and must be considered in the following order per List #2: Full Dispersion, Infiltration, Bioretention, Basic Dispersion, and then Perforated Stub-Out Connections. Full Dispersion is infeasible because the required native vegetation preservation could not be achieved. Full Infiltration, Bioretention, Basic dispersion, Permeable Pavement and Perforated stub out are not feasible due to the presence of steep slopes present on the site. Refer to the geotechnical report located within the Section 6 for more information. The following BMPs shall be applied to the other hard surfaces: Full dispersion, Permeable Pavement, Bioretention, and then Sheet flow Dispersion. Full dispersion and is not feasible per explanation above. Permeable Pavement, Bioretention, and then Sheet flow Dispersion are not feasible due to the presence of steep slopes present on the site. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site.

Figure 1 - Minimum Requirements (MR's) for New Development Projects

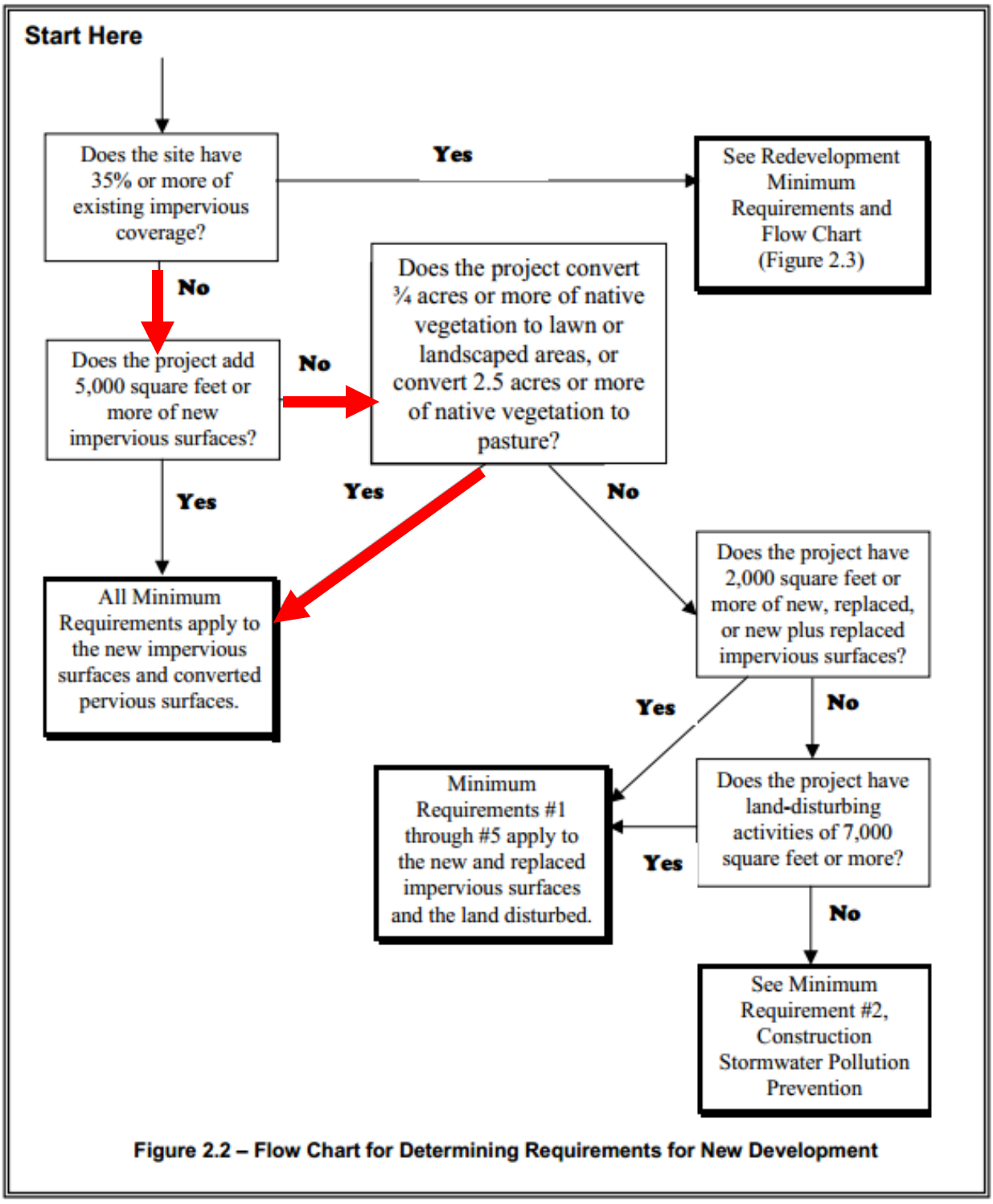


Figure 2.2 – Flow Chart for Determining Requirements for New Development

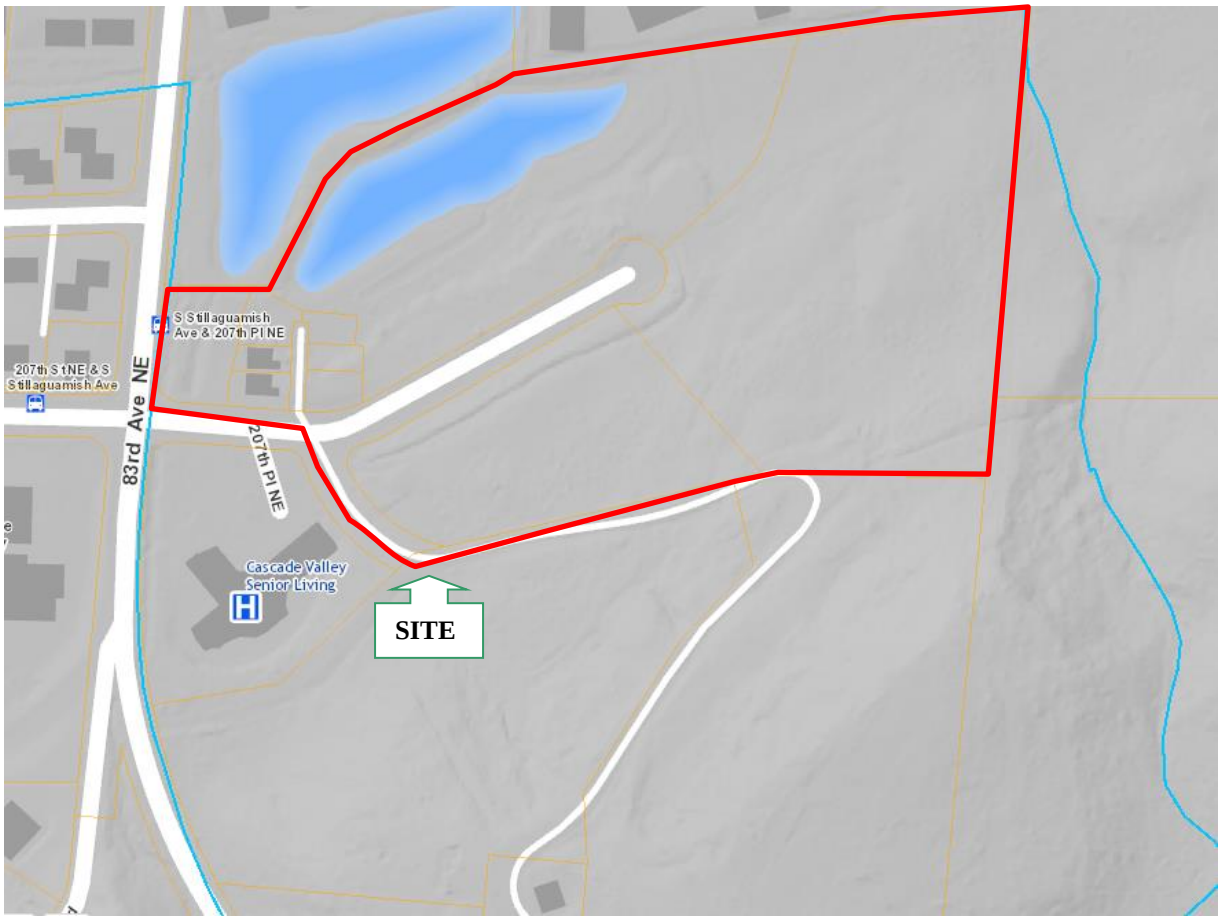
1.1 Drainage Information Summary

Project Name: **Pioneer Point** Project Engineer: **INSIGHT ENGINEERING COMPANY** Project Applicant: **Portage Creek LLC** Total Site Area**: 16 Ac;** Upstream Basin **:7.08 Ac** Project Development Area: **8.55 Ac** Onsite Basin + Upstream Basin**: 23.08 Ac**	Number of Units: **94**

Summary Table

Drainage Basin Information		*IndividualBasin Designation*			
		A	*B*	*C*	*D*
On-site Sub-basin Area (Acres)		**23.08**			
Type of Storage Proposed		**Detention pond**			
Approximate Storage Volume (CF)		**NA**			
Soil types (Natural Resource Conservation Service)		**Norma and Pastik(Type C)**			
Pre-developed Runoff Rate					
Q (cfs)	2-year	**1.76**			
	10-year	**3.04**			
	50-year	**4.35**			
Post-developed Runoff Rate (without quantity controls)					
Q (cfs)	2-year	**3.55**			
	10 year	**6.01**			
	50 year	**8.49**			
Post-developed Runoff Rate (with quantity controls)					
Q (cfs)	2-year	**1.04**			
	10 year	**1.72**			
	50 year	**2.51**			
Offsite Upstream Area					
Number of acres		**7.08**			
Offsite Downstream Flow		*2.92*			
Q (cfs)	*50 yr*	**NA**			

FIGURE 2. VICINITY MAP



TAKEN FROM THE PDS Portal MAPS

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Figure 2 -Vicinity Map
Pioneer Point
Arlington, Washington

SCALE: NTS	**DATE:** 10/8/21	**JOB #:** 17-0828
BY: JDM	**FILE NAME:** 17-0828 /doc/Stormwater Site Plan	

1.1 Minimum Requirements Summary

MR : Minimum Requirement

SWPPP : Stormwater Pollution Prevention Plan

MR #1 Stormwater Site Plan Narrative: The Stormwater Site Plan preparation follows the City of Arlingon requirements and in accordance with DOE's 2014 SWMMWW. Refer to the executive summary within Section 1.0.

MR #2 SWPPP Narrative: A SWPPP has been included in the Appendix A under Section 6.

MR #3 Water pollution source control for new development: No source control pollutants pertain to the proposed project.

MR #4 Preservation of Natural Drainage Systems and outfalls: The outlet for the proposed flows will be connected to a dispersion trench to disperse the outlet flows to drain into the existing onsite pond. The pond's outlet will continue to its natural drainage path.

MR #5 Onsite Stormwater Management: Per Minimum Requirement #5 (Section 2.5.5 of the SWMMWW), the following NPGIS BMPs shall be applied to provide onsite stormwater management and must be considered in the following order per List #2: Full Dispersion, Infiltration, Bioretention, Basic Dispersion, and then Perforated Stub-Out Connections. Full Dispersion is infeasible because the required native vegetation preservation could not be achieved. Full Infiltration, Bioretention, Basic dispersion, Permeable Pavement and Perforated stub out are not feasible due to the presence of steep slopes present on the site. Refer to the geotechnical report located within the Section 6 for more information. The following BMPs shall be applied to the other hard surfaces: Full dispersion, Permeable Pavement, Bioretention, and then Sheet flow Dispersion. Full dispersion and is not feasible per explanation above. Permeable Pavement, Bioretention, and then Sheet flow Dispersion are not feasible due to the presence of steep slopes present on the site. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site.

MR #6 Runoff Treatment: Enhanced Water quality for the site will be provided by two MWS filters manufactured by Bioclean Environmental services Inc. located upstream of detention pond.

MR #7 Flow Control: Flow control requirements will be met by the existing onsite pond on the northern portion of the site. A discharge structure in the form of weir has been designed to provide adequate flow control for the developed basin. The total existing drainage basin as well as the proposed development was included in the developed drainage basin in order to calculate the required volume for the pond. The water surface elevation for the existing pond will rise 1 foot (with sufficient freeboard) due to the proposed development based on the hydraulic calculations for the pond. The detention volume was calculated in WWHM 2012, refer to section 5.0 for the hydraulic analysis. The total required detention volume is 125,888 CF.

MR #8 Wetlands protection: Appropriate signage and buffer will be provided to meet jurisdictional and environmental requirements for the wetlands.

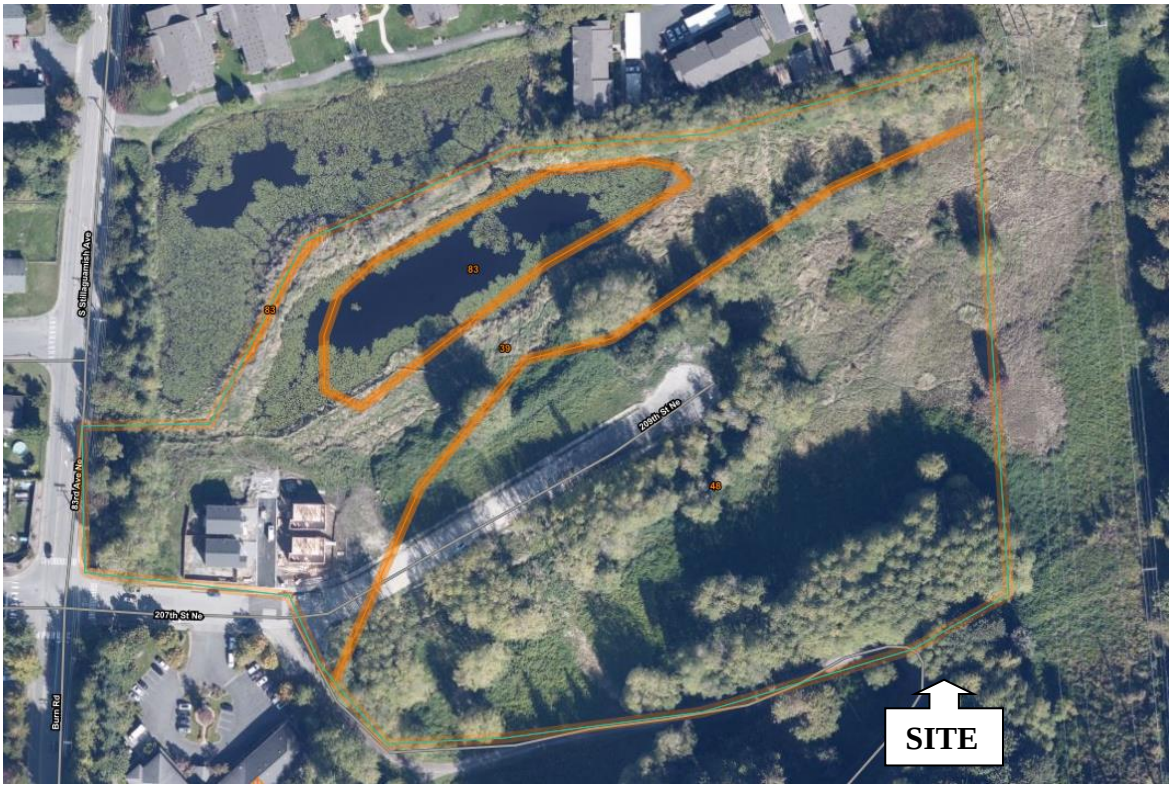
MR #9 Operations and Maintenance: An Operations and Maintenance Manual will be provided for the construction submittal.

2.0 Existing Conditions

The proposed project ***Pioneer Point*** is located at 8500 Block of 207th ST NE Arlington, Washington. More generally, the site is located in Section 12, Township 31 North, and Range 5 East of the Willamette Meridian in Snohomish County, Washington.

The project site contains approximately 16 Acres. The development area includes 3 parcels (APN# 31051200301000, APN# 31051200301400, APN#31051200301500) The property to the west of the site has been approved for construction. The existing drainage basin includes the development area and two upstream parcels located south of the property. The existing site is currently undeveloped and exists as low growing foliage with few trees and a man-made pond located on the northern portion of the site. There are two wetlands located on the northern portion of the site which will remain undisturbed. The existing site contains two drainage basins. Basin-1 that slopes to the northwest into the existing pond includes the development area. Basin-2 slopes northeast towards the Type-F stream. Basin-2 is a part of the property and will remain undisturbed. Based on the topographic survey of the site, there are upstream flows entering the site. Please refer to the upstream and downstream analysis for more details. Per SCC survey of Snohomish County, the project site contains Norma and Pastik type soils that have a hydrologic classification of Type "C". Please refer to the soils map and descriptions attached later in this report for more details.

FIGURE 3. SOIL MAP



SOILS LEGEND

39—Norma loam

48—Pastik silt loam, 8 to 25 percent slopes

83—Water

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Figure 3 - Soil Map
Pioneer Point
Arlington, Washington

SCALE: NONE	**DATE:** 10/8/21	**JOB #:** 17-0828
BY: JDM	**FILE NAME:** 17-0828 /doc/Stormwater Site Plan	

Snohomish County Area, Washington

39—Norma loam

Map Unit Setting

- *National map unit symbol:* 2hyx
- *Elevation:* 0 to 1,000 feet
- *Mean annual precipitation:* 35 to 60 inches
- *Mean annual air temperature:* 48 to 52 degrees F
- *Frost-free period:* 150 to 200 days
- *Farmland classification:* Prime farmland if drained

Map Unit Composition

- *Norma, undrained, and similar soils:* 85 percent
- *Minor components:* 15 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Norma, Undrained

Setting

- *Landform:* Depressions, drainageways
- *Parent material:* Alluvium

Typical profile

- *H1 - 0 to 10 inches:* ashy loam
- *H2 - 10 to 28 inches:* sandy loam
- *H3 - 28 to 60 inches:* sandy loam

Properties and qualities

- *Slope:* 0 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 1.98 in/hr)
- *Depth to water table:* About 0 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* Frequent
- *Available water capacity:* Moderate (about 9.0 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 5w
- *Hydrologic Soil Group:* B/D
- *Forage suitability group:* Wet Soils (G002XN102WA)
- *Other vegetative classification:* Wet Soils (G002XN102WA)
- *Hydric soil rating:* Yes

Minor Components

Norma, drained

- *Percent of map unit:* 5 percent
- *Landform:* Depressions
- *Other vegetative classification:* Seasonally Wet Soils (G002XN202WA)
- *Hydric soil rating:* Yes

Bellingham, undrained

- *Percent of map unit:* 5 percent
- *Landform:* Depressions
- *Other vegetative classification:* Wet Soils (G002XN102WA)
- *Hydric soil rating:* Yes

Terric medisaprists, undrained

- *Percent of map unit:* 5 percent
- *Landform:* Depressions
- *Other vegetative classification:* Wet Soils (G002XN102WA)
- *Hydric soil rating:* Yes

Snohomish County Area, Washington

48—Pastik silt loam, 8 to 25 percent slopes

Map Unit Setting

- *National map unit symbol:* 2hz7
- *Elevation:* 200 to 800 feet
- *Mean annual precipitation:* 45 to 70 inches
- *Mean annual air temperature:* 45 to 46 degrees F
- *Frost-free period:* 140 to 200 days
- *Farmland classification:* Farmland of statewide importance

Map Unit Composition

- *Pastik and similar soils:* 100 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Pastik

Setting

- *Landform:* Terraces
- *Parent material:* Volcanic ash and lacustrine deposits

Typical profile

- *H1 - 0 to 6 inches:* ashy silt loam
- *H2 - 6 to 29 inches:* ashy silt loam
- *H3 - 29 to 60 inches:* silt loam

Properties and qualities

- *Slope:* 8 to 25 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
- *Depth to water table:* About 18 to 30 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water capacity:* Very high (about 14.3 inches)

Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4e
- *Hydrologic Soil Group:* C
- *Forage suitability group:* Soils with Moderate Limitations (G002XN602WA)
- *Other vegetative classification:* Soils with Moderate Limitations (G002XN602WA)
- *Hydric soil rating:* No

3.0 Offsite Analysis

A site reconnaissance was performed by Brian R. Kalab of Insight engineering on June 22, 2021, to verify the downstream flow paths and observe any drainage problems downstream of the site. The sky was cloudy overcast with a temperature of 73 degrees.

The project site contains approximately 16 Acres. The development area includes 3 parcels (APN# 31051200301000, APN# 31051200301400, APN#31051200301500) The property to the west of the site has been approved for construction. The existing drainage basin includes the development area and two upstream parcels located south of the property. The existing site is currently undeveloped and exists as low growing foliage with few trees and a man-made pond located on the northern portion of the site. There are two wetlands located on the northern portion of the site which will remain undisturbed. The existing site contains two drainage basins. Basin-1 that slopes to the northwest into the existing pond includes the development area. Basin-2 slopes northeast towards the Type-F stream. Basin-2 is a part of the property and will remain undisturbed. Based on the topographic survey of the site, there are upstream flows entering the site. Please refer to the upstream and downstream analysis for more details. No visible on-site drainage problems were observed at the time of field investigations.

3.1 Upstream Analysis

Upstream flows are entering the site from southern portion of the project. Upstream parcels include APN # 31051200301600 and APN # 31051200300300.The upstream flows were included in the developed drainage basin in order to calculate the required volume for the pond. The upstream flows will be conveyed through the proposed drainage system to the existing pond to continue its natural drainage path.

3.2 Downstream Analysis

The existing site contains two drainage basins. Basin-1 that slopes to the northwest into the existing pond includes the development area. Basin-2 that slopes northeast towards stream is

outside the clearing limit. The outlet from the existing onsite pond flows into a detention pond located on the neighboring property to the northwest. The outlet from that pond drains to the west and travels underneath S Stillaguamish Ave into Kruger Creek that flows east in an unrestricted manner for about 2,900 feet and flows into Portage Creek. Portage creek flows west in an unrestricted manner. Basin-2 slopes northeast towards an unnamed watercourse. The watercourse flows north in an unrestricted manner. This is where the 1-mile downstream analysis was completed. There do not appear to be any restrictions or erosion problems within 1 mile of the site.

FIGURE 4. DOWNSTREAM ANALYSIS MAP

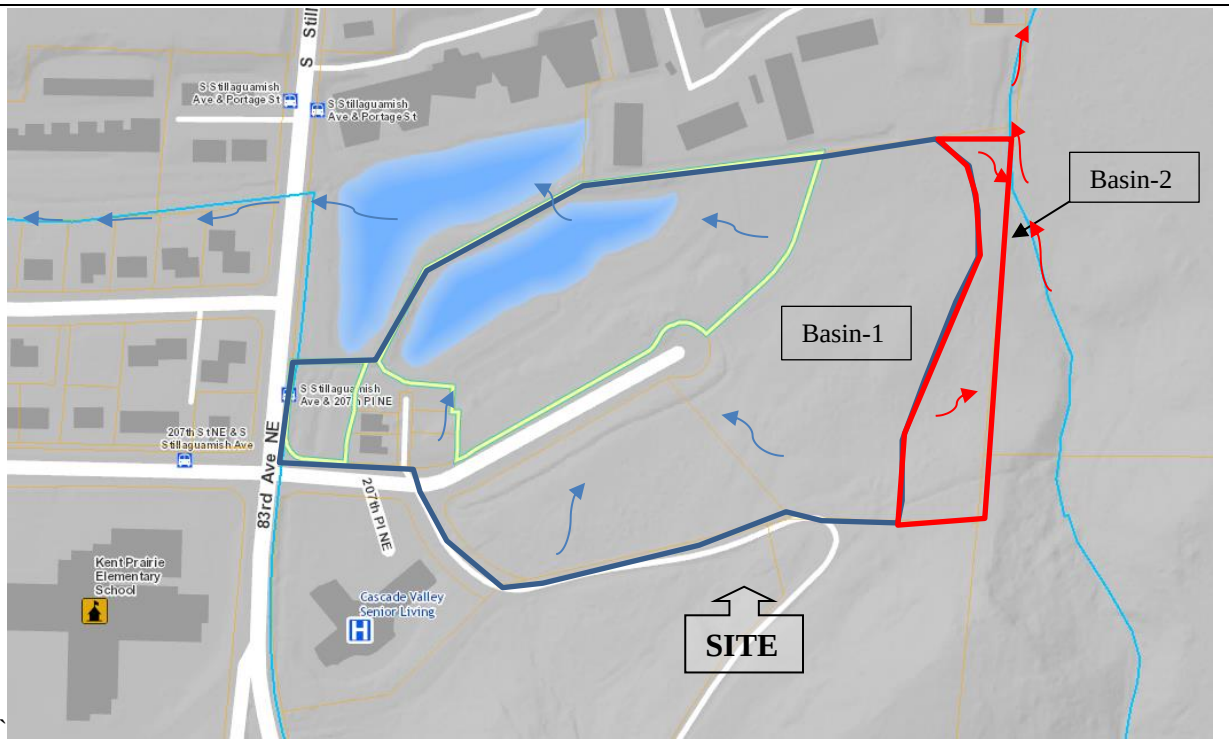

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Figure 4 - Downstream Analysis Map
Pioneer Point
Arlington, Washington

SCALE: NONE	**DATE:** 10/8/21	**JOB #:** 17-0828
BY: JDM	**FILE NAME:** 17-0828 \docs\drainage report	

4.0 Developed Conditions

The proposed project ***Pioneer Point*** is located at 8500 Block of 207th ST NE Arlington, Washington. More generally, the site is located in Section 12, Township 31 North, and Range 5 East of the Willamette Meridian in Snohomish County, Washington. Per SCC survey of Snohomish County, the project site contains Norma and Pastik type soils that have a hydrologic classification of Type "C".

The site is zoned RHD. The clearing area for the proposed development contains 8.55 Acres. The proposal is to construct 94 townhome units and access road with associated utilities. The access to the new units will be from new public local access street. The driveway entrances will be constructed per the city of Arlington standards.

Per Figure 2.2, (flow chart for new development requirements) Volume I Snohomish County Drainage Manual, Minimum requirements #1 through 9 shall apply for this project. See the Minimum Requirements Summary included later in this report. Flow control requirements will be met by the existing onsite pond on the northern portion of the site. A discharge structure in the form of weir has been designed to provide adequate flow control for the developed basin. The total existing drainage basin as well as the proposed development was included in the developed drainage basin in order to calculate the required volume for the pond. The water surface elevation for the existing pond will rise 1 foot (with sufficient freeboard) due to the proposed development based on the hydraulic calculations for the pond. The detention volume was calculated in WWHM 2012, refer to section 5.0 for the hydraulic analysis. The total required detention volume is 125,888 CF. Enhanced Water quality for the site will be provided by two MWS filters manufactured by Bioclean Environmental services Inc. located upstream of detention pond.

Per Minimum Requirement #5 (Section 2.5.5 of the SWMMWW), the following NPGIS BMPs shall be applied to provide onsite stormwater management and must be considered in the following order per List #2: Full Dispersion, Infiltration, Bioretention, Basic Dispersion, and then Perforated Stub-Out Connections. Full Dispersion is infeasible because the required native

vegetation preservation could not be achieved. Full Infiltration, Bioretention, Basic dispersion, Permeable Pavement and Perforated stub out are not feasible due to the presence of steep slopes present on the site. Refer to the geotechnical report located within the Section 6 for more information. The following BMPs shall be applied to the other hard surfaces: Full dispersion, Permeable Pavement, Bioretention, and then Sheet flow Dispersion. Full dispersion and is not feasible per explanation above. Permeable Pavement, Bioretention, and then Sheet flow Dispersion are not feasible due to the presence of steep slopes present on the site. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site.

5.1 Site Hydraulic Conditions

From the Soil Conservation Service Map of Snohomish County, the majority of the site contains Norma and Pastik type soils that have a hydrologic classification of Type "C".

5.2 Existing Drainage Basin Summary

Onsite Basin	= 16.00 Acres
Upstream Basin	= 7.08 Acres
Total Existing Basin	= 23.08 Acres

Existing Impervious:

Onsite Basin: = 16.00 Acres

Existing Pond	= 1.50 Acres
Existing Road	= 0.07 Acres
Total Site Impervious	= 1.57 Acres

Site Pervious:

Forested area = 14.43 Acres

Upstream Basin: = 7.08 Acres

Existing Roof	= 0.45 Acres
Existing Road	= 0.90 Acres
Existing Sidewalk	= 0.11 Acres
Total Upstream Impervious	= 1.46 Acres

Site Pervious:

Pervious Area (Lawn)	= 0.72 Acres
Forested Area	= 4.90 Acres
Total Pervious area	= 5.62 Acres

Refer to the Existing Basin Map and the following pages for more details.

5.3 Developed Drainage Basin Summary

Onsite Basin (+)	= 16.00 Acres
Upstream Basin (+)	= 7.08 Acres
Bypass Basin (-)	= 0.40 Acres
Total Developed Basin	= 22.68 Acres

Developed Impervious Areas:

Onsite Basin:

Site Impervious:

Existing Pond	= 1.50 Acres
Existing Road	= 0.07 Acres
Proposed Road	= 1.42 Acres
Proposed Roof	= 2.09 Acres
Proposed Driveway	= 0.50 Acres
Proposed Sidewalk	= 0.41 Acres
Total Site Impervious	= 5.99 Acres

Site Pervious:

Pervious Area (Lawn)	= 5.50 Acres
Forested Area	= 4.11 Acres
Total Pervious area	= 9.61 Acres

Upstream Basin:

Existing Roof	= 0.45 Acres
Existing Road	= 0.90 Acres
Existing Sidewalk	= 0.11 Acres
Total Upstream Impervious	= 1.46 Acres

Site Pervious:

Pervious Area (Lawn)	= 0.72 Acres
Forested Area	= 4.90 Acres
Total Pervious area	= 5.62 Acres

5.4 Bypass Basin Summary

Impervious Areas:

Proposed Road	= 0.25 Acres
Total Impervious	= 0.25 Acres

Total Pervious Areas = 0.40 Ac – 0.25 Ac = 0.15 Acres

Refer to the Developed Basin Map and the following pages for more details.

Total Pond Volume required = 125,888 CF

Total Pond Volume Provided = 125,888 CF

N

SCALE: 1" = 50'

0 25 50

EXISTING BASIN MAP

SCALE: 1" = 50'

0 25 50

DEVELOPED BASIN MAP

WWHM2012
PROJECT REPORT

Project Name: Detention Pond
Site Name: Pioneer Point
Site Address: XXX 207th Pl NE
City : Arlington
Report Date: 10/4/2021
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 : Onsite
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	3.35
C, Forest, Steep	11.08
Pervious Total	14.43

Impervious Land Use	acre
ROADS FLAT	0.07
POND	1.5
Impervious Total	1.57
Basin Total	16

Element Flows To:

Surface	Interflow	Groundwater

Name : Upstream
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Steep	2.65
C, Forest, Mod	2.25
C, Lawn, Flat	.72
Pervious Total	5.62

Impervious Land Use	acre
ROADS MOD	0.9
ROOF TOPS FLAT	0.45
SIDEWALKS FLAT	0.11
Impervious Total	1.46
Basin Total	7.08

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Developed Onsite
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	5.5
C, Forest, Mod	1.71
C, Forest, Steep	2.4
Pervious Total	9.61

Impervious Land Use	acre
ROADS MOD	1.49
ROOF TOPS FLAT	2.09
DRIVEWAYS MOD	0.5
SIDEWALKS FLAT	0.41
POND	1.5
Impervious Total	5.99
Basin Total	15.6

Element Flows To:

Surface	Interflow	Groundwater
SSD Table 1	SSD Table 1	

Name : SSD Table 1
Depth: 0.79 ft.
Discharge Structure: 1
Riser Height: 1.79 ft.
Riser Diameter: 92.4 in.
Notch Type: Rectangular
Notch Width: 1.100 ft.
Notch Height: 1.290 ft.
Orifice 1 Diameter: 7.14 in. **Elevation:** 0 ft.

Element Flows To:

Outlet 1	Outlet 2

SSD Table Hydraulic Table

Stage (feet)	Area (ac.)	Volume (ac-ft.)	Outlet Struct	NotUsed	NotUsed	NotUsed	NotUsed
0.000	1.536	0.000	0.000	0.301	0.000	0.000	0.000
0.010	1.537	0.016	0.138	0.323	0.000	0.000	0.000
0.020	1.538	0.031	0.196	0.345	0.000	0.000	0.000
0.030	1.538	0.047	0.240	0.368	0.000	0.000	0.000
0.040	1.539	0.062	0.277	0.392	0.000	0.000	0.000
0.050	1.540	0.078	0.309	0.457	0.000	0.000	0.000
0.060	1.541	0.093	0.339	0.596	0.000	0.000	0.000
0.070	1.542	0.109	0.366	0.780	0.000	0.000	0.000
0.080	1.542	0.124	0.391	0.999	0.000	0.000	0.000
0.090	1.543	0.140	0.415	1.250	0.000	0.000	0.000
0.100	1.544	0.155	0.437	1.528	0.000	0.000	0.000
0.110	1.545	0.171	0.459	1.831	0.000	0.000	0.000
0.120	1.546	0.186	0.479	2.157	0.000	0.000	0.000
0.130	1.547	0.202	0.499	2.504	0.000	0.000	0.000
0.140	1.547	0.217	0.518	2.872	0.000	0.000	0.000
0.150	1.548	0.233	0.536	3.258	0.000	0.000	0.000
0.160	1.549	0.249	0.553	3.663	0.000	0.000	0.000
0.170	1.550	0.264	0.570	4.086	0.000	0.000	0.000
0.180	1.551	0.280	0.587	4.525	0.000	0.000	0.000
0.190	1.551	0.295	0.603	4.980	0.000	0.000	0.000
0.200	1.552	0.311	0.619	5.451	0.000	0.000	0.000
0.210	1.553	0.326	0.634	5.937	0.000	0.000	0.000
0.220	1.554	0.342	0.649	6.437	0.000	0.000	0.000
0.230	1.555	0.357	0.663	6.952	0.000	0.000	0.000
0.240	1.555	0.373	0.678	7.481	0.000	0.000	0.000
0.250	1.556	0.388	0.692	8.023	0.000	0.000	0.000
0.260	1.557	0.404	0.705	8.578	0.000	0.000	0.000
0.270	1.558	0.419	0.719	9.146	0.000	0.000	0.000

0.280	1.559	0.435	0.732	9.726	0.000	0.000	0.000
0.290	1.559	0.450	0.745	10.32	0.000	0.000	0.000
0.300	1.560	0.466	0.758	10.92	0.000	0.000	0.000
0.310	1.561	0.481	0.770	11.54	0.000	0.000	0.000
0.320	1.562	0.497	0.783	12.17	0.000	0.000	0.000
0.330	1.563	0.513	0.795	12.81	0.000	0.000	0.000
0.340	1.564	0.528	0.807	13.46	0.000	0.000	0.000
0.350	1.564	0.544	0.818	14.12	0.000	0.000	0.000
0.360	1.565	0.559	0.830	14.79	0.000	0.000	0.000
0.370	1.566	0.575	0.842	15.47	0.000	0.000	0.000
0.380	1.567	0.590	0.853	16.17	0.000	0.000	0.000
0.390	1.568	0.606	0.864	16.87	0.000	0.000	0.000
0.400	1.568	0.621	0.875	17.58	0.000	0.000	0.000
0.410	1.569	0.637	0.886	18.31	0.000	0.000	0.000
0.420	1.570	0.652	0.897	19.04	0.000	0.000	0.000
0.430	1.571	0.668	0.907	19.78	0.000	0.000	0.000
0.440	1.572	0.683	0.918	20.53	0.000	0.000	0.000
0.450	1.572	0.699	0.928	21.30	0.000	0.000	0.000
0.460	1.573	0.714	0.938	22.07	0.000	0.000	0.000
0.470	1.574	0.730	0.948	22.85	0.000	0.000	0.000
0.480	1.575	0.746	0.958	23.63	0.000	0.000	0.000
0.490	1.576	0.761	0.968	24.43	0.000	0.000	0.000
0.500	1.577	0.777	0.978	25.24	0.000	0.000	0.000
0.510	1.577	0.792	0.992	26.05	0.000	0.000	0.000
0.520	1.578	0.808	1.008	26.88	0.000	0.000	0.000
0.530	1.579	0.823	1.026	27.71	0.000	0.000	0.000
0.540	1.580	0.839	1.046	28.55	0.000	0.000	0.000
0.550	1.581	0.854	1.067	29.40	0.000	0.000	0.000
0.560	1.581	0.870	1.089	30.26	0.000	0.000	0.000
0.570	1.582	0.885	1.112	31.12	0.000	0.000	0.000
0.580	1.583	0.901	1.136	31.99	0.000	0.000	0.000
0.590	1.584	0.916	1.162	32.88	0.000	0.000	0.000
0.600	1.585	0.932	1.187	33.76	0.000	0.000	0.000
0.610	1.585	0.947	1.214	34.66	0.000	0.000	0.000
0.620	1.586	0.963	1.242	35.56	0.000	0.000	0.000
0.630	1.587	0.978	1.270	36.48	0.000	0.000	0.000
0.640	1.588	0.994	1.299	37.39	0.000	0.000	0.000
0.650	1.589	1.010	1.328	38.32	0.000	0.000	0.000
0.660	1.589	1.025	1.358	39.25	0.000	0.000	0.000
0.670	1.590	1.041	1.389	40.19	0.000	0.000	0.000
0.680	1.591	1.056	1.421	41.14	0.000	0.000	0.000
0.690	1.592	1.072	1.453	42.10	0.000	0.000	0.000
0.700	1.593	1.087	1.485	43.06	0.000	0.000	0.000
0.710	1.594	1.103	1.518	44.03	0.000	0.000	0.000
0.720	1.594	1.118	1.552	45.00	0.000	0.000	0.000
0.730	1.595	1.134	1.586	45.98	0.000	0.000	0.000
0.740	1.596	1.149	1.621	46.97	0.000	0.000	0.000
0.750	1.597	1.165	1.656	47.97	0.000	0.000	0.000
0.760	1.598	1.180	1.692	48.97	0.000	0.000	0.000
0.770	1.598	1.196	1.728	49.98	0.000	0.000	0.000
0.780	1.599	1.211	1.765	50.99	0.000	0.000	0.000
0.790	1.600	1.227	1.802	52.01	0.000	0.000	0.000
1.040	1.664	1.633	2.864	0.000	0.000	0.000	0.000
1.290	1.665	2.045	4.143	0.000	0.000	0.000	0.000
1.540	1.696	2.466	5.602	0.000	0.000	0.000	0.000

1.790	1.720	2.890	7.218	0.000	0.000	0.000	0.000
2.790	1.720	4.520	88.36	0.000	0.000	0.000	0.000

Name : Upstream Basin
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Forest, Mod	**2.25**
C, Forest, Steep	**2.65**
C, Lawn, Flat	**.72**
Pervious Total	**5.62**

Impervious Land Use	**acre**
ROADS MOD	**0.9**
ROOF TOPS FLAT	**0.45**
SIDEWALKS FLAT	**0.11**
Impervious Total	**1.46**
Basin Total	**7.08**

Element Flows To:

Surface	**Interflow**	**Groundwater**
SSD Table 1	SSD Table 1	

Name : Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	**acre**
C, Lawn, Mod	**.15**
Pervious Total	**0.15**

Impervious Land Use	**acre**
ROADS FLAT	**0.25**
Impervious Total	**0.25**
Basin Total	**0.4**

Element Flows To:

Surface **Interflow** **Groundwater**

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:20.05
Total Impervious Area:3.03

Mitigated Landuse Totals for POC #1
Total Pervious Area:15.38
Total Impervious Area:7.7

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.767245
5 year	2.505003
10 year	3.040999
25 year	3.77296
50 year	4.35853
100 year	4.979161

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.042678
5 year	1.42259
10 year	1.719622
25 year	2.150843
50 year	2.515692
100 year	2.920615

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

Year	Predeveloped	Mitigated
1949	1.578	0.902
1950	3.155	1.035
1951	1.312	0.938
1952	1.557	0.839
1953	2.104	0.822
1954	2.772	0.916
1955	2.544	1.421
1956	1.445	1.107
1957	2.541	1.419
1958	3.707	1.529

1959	1.563	0.990
1960	1.576	1.162
1961	3.862	1.684
1962	2.449	1.032
1963	3.771	1.198
1964	1.508	0.980
1965	1.082	0.910
1966	1.050	0.751
1967	2.743	1.100
1968	1.813	1.570
1969	3.650	0.919
1970	1.178	0.789
1971	2.076	0.986
1972	3.142	1.281
1973	1.756	0.827
1974	1.674	0.885
1975	1.858	0.877
1976	1.298	0.979
1977	1.194	0.833
1978	1.323	0.774
1979	3.684	1.683
1980	1.264	0.926
1981	1.575	0.861
1982	1.464	1.438
1983	1.657	0.931
1984	1.464	1.080
1985	2.074	1.269
1986	3.037	2.925
1987	1.695	1.609
1988	1.319	0.907
1989	2.224	0.787
1990	1.129	0.954
1991	1.251	0.987
1992	1.592	0.839
1993	1.327	0.844
1994	0.947	0.904
1995	1.227	0.987
1996	2.236	1.661
1997	4.230	3.460
1998	1.864	0.937
1999	1.159	0.895
2000	1.796	0.882
2001	0.858	0.689
2002	1.119	0.954
2003	1.093	0.837
2004	1.947	1.419
2005	1.545	1.051
2006	2.267	1.940
2007	2.491	1.004
2008	3.027	3.244
2009	1.515	0.949

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

Rank	Predeveloped	Mitigated
1	4.2301	3.4599
2	3.8618	3.2441
3	3.7709	2.9251
4	3.7075	1.9403
5	3.6837	1.6837
6	3.6504	1.6827
7	3.1549	1.6612
8	3.1422	1.6090
9	3.0372	1.5704
10	3.0266	1.5287
11	2.7723	1.4379
12	2.7427	1.4205
13	2.5440	1.4188
14	2.5408	1.4186
15	2.4910	1.2805
16	2.4489	1.2688
17	2.2673	1.1980
18	2.2359	1.1615
19	2.2236	1.1075
20	2.1039	1.1002
21	2.0762	1.0800
22	2.0738	1.0506
23	1.9468	1.0346
24	1.8643	1.0325
25	1.8578	1.0038
26	1.8128	0.9898
27	1.7957	0.9875
28	1.7557	0.9873
29	1.6947	0.9857
30	1.6741	0.9797
31	1.6572	0.9790
32	1.5917	0.9538
33	1.5783	0.9535
34	1.5761	0.9488
35	1.5752	0.9383
36	1.5633	0.9371
37	1.5574	0.9311
38	1.5452	0.9260
39	1.5147	0.9185
40	1.5082	0.9163
41	1.4643	0.9099
42	1.4643	0.9072
43	1.4448	0.9039
44	1.3272	0.9017
45	1.3234	0.8947
46	1.3186	0.8847
47	1.3122	0.8815
48	1.2978	0.8767
49	1.2642	0.8614
50	1.2514	0.8441
51	1.2268	0.8394
52	1.1942	0.8389
53	1.1779	0.8368
54	1.1588	0.8326

55	1.1293	0.8272
56	1.1192	0.8221
57	1.0926	0.7886
58	1.0822	0.7867
59	1.0504	0.7736
60	0.9470	0.7512
61	0.8584	0.6895

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.8836	1166	1107	94	Pass
0.9187	1035	834	80	Pass
0.9538	916	652	71	Pass
0.9889	799	491	61	Pass
1.0240	698	403	57	Pass
1.0591	621	347	55	Pass
1.0942	561	306	54	Pass
1.1293	504	276	54	Pass
1.1644	460	251	54	Pass
1.1995	405	222	54	Pass
1.2346	378	201	53	Pass
1.2697	339	186	54	Pass
1.3048	303	171	56	Pass
1.3399	275	159	57	Pass
1.3750	250	146	58	Pass
1.4101	234	134	57	Pass
1.4452	215	124	57	Pass
1.4803	195	114	58	Pass
1.5154	179	109	60	Pass
1.5505	169	100	59	Pass
1.5856	154	95	61	Pass
1.6207	143	90	62	Pass
1.6558	138	82	59	Pass
1.6909	130	75	57	Pass
1.7260	127	72	56	Pass
1.7611	121	69	57	Pass
1.7962	115	67	58	Pass
1.8313	112	67	59	Pass
1.8664	105	64	60	Pass
1.9015	97	61	62	Pass
1.9366	94	59	62	Pass
1.9717	91	58	63	Pass
2.0068	88	55	62	Pass
2.0419	85	54	63	Pass
2.0770	78	54	69	Pass
2.1121	76	53	69	Pass
2.1472	71	52	73	Pass
2.1823	70	50	71	Pass
2.2174	65	49	75	Pass

2.2525	60	47	78	Pass
2.2876	55	45	81	Pass
2.3227	53	45	84	Pass
2.3578	51	44	86	Pass
2.3929	48	43	89	Pass
2.4280	45	42	93	Pass
2.4631	40	37	92	Pass
2.4982	38	34	89	Pass
2.5333	35	33	94	Pass
2.5684	31	32	103	Pass
2.6035	30	30	100	Pass
2.6386	28	27	96	Pass
2.6737	26	26	100	Pass
2.7088	26	26	100	Pass
2.7439	24	24	100	Pass
2.7790	21	22	104	Pass
2.8141	20	20	100	Pass
2.8492	19	19	100	Pass
2.8843	18	17	94	Pass
2.9194	18	15	83	Pass
2.9545	16	13	81	Pass
2.9896	16	13	81	Pass
3.0247	15	11	73	Pass
3.0598	12	9	75	Pass
3.0949	12	9	75	Pass
3.1300	10	7	70	Pass
3.1651	8	5	62	Pass
3.2002	7	3	42	Pass
3.2353	7	3	42	Pass
3.2704	7	2	28	Pass
3.3055	7	2	28	Pass
3.3406	7	2	28	Pass
3.3757	6	2	33	Pass
3.4108	6	1	16	Pass
3.4459	6	1	16	Pass
3.4810	6	0	0	Pass
3.5161	6	0	0	Pass
3.5512	6	0	0	Pass
3.5863	6	0	0	Pass
3.6214	6	0	0	Pass
3.6565	5	0	0	Pass
3.6916	4	0	0	Pass
3.7267	3	0	0	Pass
3.7618	3	0	0	Pass
3.7969	2	0	0	Pass
3.8320	2	0	0	Pass
3.8671	1	0	0	Pass
3.9022	1	0	0	Pass
3.9373	1	0	0	Pass
3.9724	1	0	0	Pass
4.0075	1	0	0	Pass
4.0426	1	0	0	Pass
4.0777	1	0	0	Pass
4.1128	1	0	0	Pass
4.1479	1	0	0	Pass

4.1830	1	0	0	Pass
4.2181	1	0	0	Pass
4.2532	0	0	0	Pass
4.2883	0	0	0	Pass
4.3234	0	0	0	Pass
4.3585	0	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

LID Technique	Used for Water Quality	Total Volume Percent Treatment?	Volume Needs Treatment (ac-ft)	Infiltration Through Facility (ac-ft)	Volume (ac-ft.)	Cumulative Infiltration Volume	Percent Infiltrated	Water Quality Treated	Comment
SSD Table 1 POC	N	2340.79				N	0.00		
Total Volume Infiltrated		2340.79	0.00	0.00		0.00	0.00	0%	No Treat. Credit

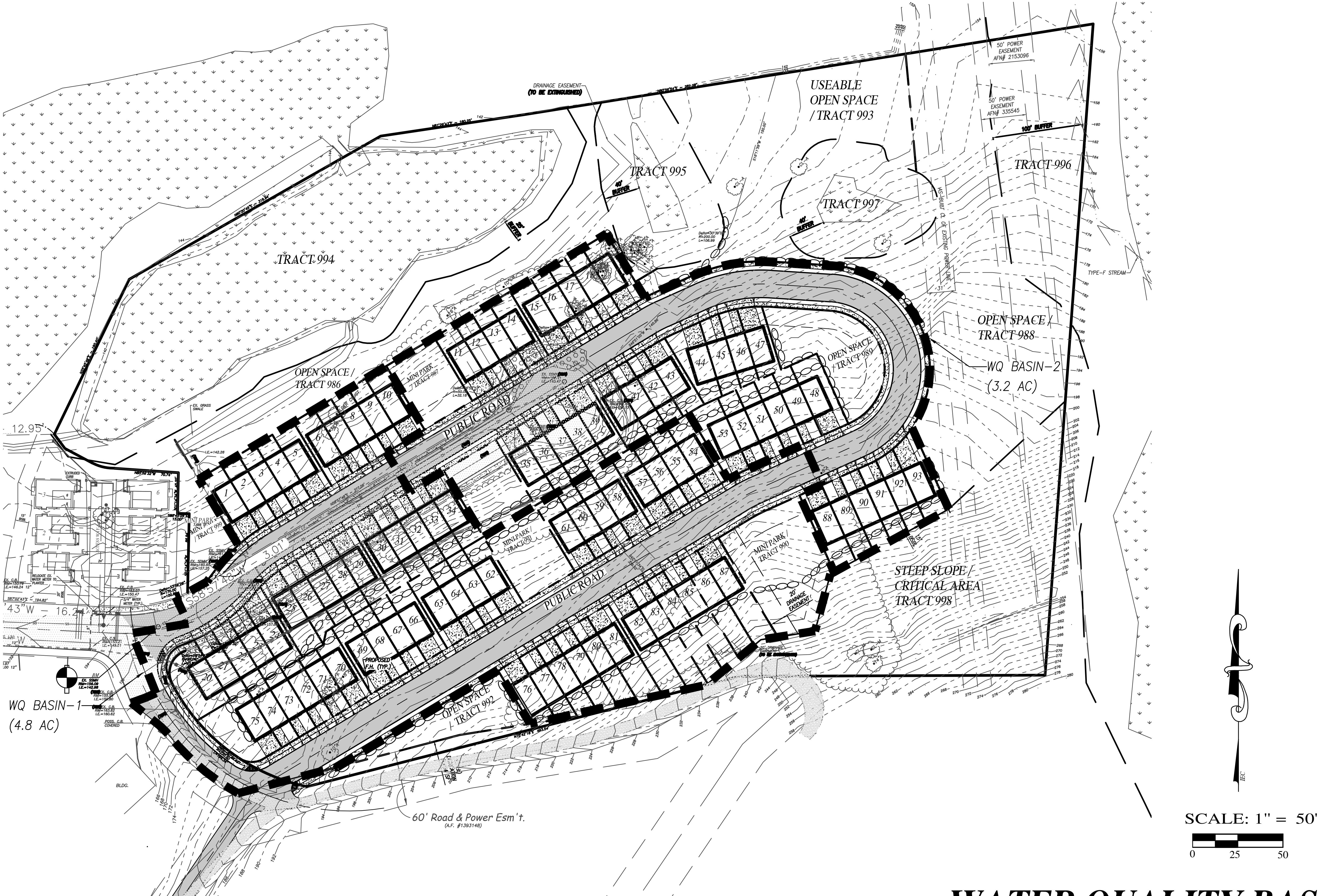
Compliance with LID Standard 8
Duration Analysis Result = Failed

Perlnd and Implnd Changes

No changes have been made.

5.4 Water Quality

Enhanced Water quality for the site will be provided by two MWS filters manufactured by Bioclean Environmental services Inc. located upstream of detention pond.



WATER QUALITY BASIN MAP

5.5 Conveyance Analysis and Design

A detailed conveyance analysis and design will be provided for the construction submittal.

6.0 Appendix

A. Stormwater Pollution Prevention Plan

B. Geotechnical Engineering Report

A. STORMWATER POLLUTION PREVENTION PLAN

Construction Stormwater General Permit

Stormwater Pollution Prevention Plan (SWPPP)

for

Pioneer Point

Prepared for:

The Washington State Department of Ecology
Northwest Regional Office
3190 – 160th Avenue SE
Bellevue, WA 98008

Permittee / Owner	Developer	Operator / Contractor
Randy Brockway	TBD	To be determined
11014 19th Ave SE,Suite #8-315		
Everett, WA 98208		

Project Site Location

8500 Block of 207th Pl NE
Arlington, WA 98223

Certified Erosion and Sediment Control Lead (CESCL)

Name	Organization	Contact Phone Number
Brian R. Kalab, P. E.	Insight Engineering	425-303-9363

SWPPP Prepared By

Name	Organization	Contact Phone Number
Sithara George, BSCE.	Insight Engineering	425-303-9363

SWPPP Preparation Date

August 19, 2021

Project Construction Dates

Activity / Phase	Start Date	End Date
Construction Duration	May 1, 2022	April 10, 2023

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F. 303(d) List Waterbodies / TMDL Waterbodies Information

G. Contaminated Site Information

H. Engineering Calculations

List of Acronyms and Abbreviations

Acronym / Abbreviation	Explanation
303(d)	Section of the Clean Water Act pertaining to Impaired Waterbodies
BFO	Bellingham Field Office of the Department of Ecology
BMP(s)	Best Management Practice(s)
CESCL	Certified Erosion and Sediment Control Lead
CO_2	Carbon Dioxide
CRO	Central Regional Office of the Department of Ecology
CSWGP	Construction Stormwater General Permit
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERO	Eastern Regional Office of the Department of Ecology
ERTS	Environmental Report Tracking System
ESC	Erosion and Sediment Control
GULD	General Use Level Designation
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
NWRO	Northwest Regional Office of the Department of Ecology
pH	Power of Hydrogen
RCW	Revised Code of Washington
SPCC	Spill Prevention, Control, and Countermeasure
su	Standard Units
SWMMEW	Stormwater Management Manual for Eastern Washington
SWMMWW	Stormwater Management Manual for Western Washington
SWPPP	Stormwater Pollution Prevention Plan
TESC	Temporary Erosion and Sediment Control
SWRO	Southwest Regional Office of the Department of Ecology
TMDL	Total Maximum Daily Load
VFO	Vancouver Field Office of the Department of Ecology
WAC	Washington Administrative Code
WSDOT	Washington Department of Transportation
WWHM	Western Washington Hydrology Model

1 Project Information

Project/Site Name: Pioneer Point
Street/Location: 8500 Block of 207th Pl NE

City: Arlington State: WA Zip code: 98223
Subdivision:
Receiving waterbody: Portage Creek

1.1 Existing Conditions

Total acreage (including support activities such as off-site equipment staging yards, material storage areas, borrow areas).

Total acreage: 16.00 acres
Disturbed acreage: 8.55 acres
Existing structures: 1.57 acres
Landscape 4.85 acres
topography:
Drainage patterns: Sheet Flow
Existing Vegetation: landscape with several trees.
Critical Areas (wetlands, streams, high erosion risk, steep or difficult to stabilize slopes): Buffer area provided from wetland

List of known impairments for 303(d) listed or Total Maximum Daily Load (TMDL) for the receiving waterbody: N/A

1.2 Proposed Construction Activities

Description of site development (example: subdivision):
The proposal is to construct 94-unit townhome units and access road with associated utilities. The access to the new units will be from new public local access street.Description of construction activities (example: site preparation, demolition, excavation):
Prepare the site for construction by the installation of the indicated BMP's. Excavate the site for the new single-family homes.

Description of site drainage including flow from and onto adjacent properties. Must be consistent with Site Map in Appendix A:

Flow control requirements will be met by the existing onsite pond on the northern portion of the site. A discharge structure in the form of weir has been designed to provide adequate flow control for the developed basin. The total existing drainage basin as well as the proposed development was included in the developed drainage basin in order to calculate the required volume for the pond. The water surface elevation for the existing pond will rise 1 foot (with sufficient freeboard) due to the proposed development based on the hydraulic calculations for the

pond. The detention volume was calculated in WWHM 2012, refer to section 5.0 for the hydraulic analysis. The total required detention volume is 125,888 CF. Enhanced Water quality for the site will be provided by two MWS filters manufactured by Bioclean Environmental services Inc. located upstream of detention pond.
The pond's outlet will continue to its natural drainage path.

Description of final stabilization (example: extent of revegetation, paving, landscaping):
The access to the new homes will be from new public local access street.. Typical residential landscaping will be around the homes and the driveway to provide final stabilization.

Contaminated Site Information:
Proposed activities regarding contaminated soils or groundwater (example: on-site treatment system, authorized sanitary sewer discharge):
Enhanced Water quality for the site will be provided by two MWS filters manufactured by Bioclean Environmental services Inc. located upstream of detention pond.

2 Construction Stormwater Best Management Practices (BMPs)

The SWPPP is a living document reflecting current conditions and changes throughout the life of the project. These changes may be informal (i.e., hand-written notes and deletions). Update the SWPPP when the CESCL or local agency has noted a deficiency in BMPs or deviation from original design.

2.1 The 13 Elements

2.1.1 Element 1: Preserve Vegetation / Mark Clearing Limits

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin. Trees that are to be preserved, as well as all sensitive areas and their buffers, shall be clearly delineated, both in the field and on the plans. In general, natural vegetation and native topsoil shall be retained in an undisturbed state to the maximum extent possible.

A protective barrier shall be placed around the protected trees prior to land preparation or construction activities, and shall remain in place until all construction activity is terminated. No equipment, chemicals, soil deposits or construction materials shall be placed within the protective barriers. Any landscaping activities subsequent to the removal of the barriers shall be accomplished with light machinery or hand labor. (LMC 17.15.160 B1)

List and describe BMPs:

- Preserving Natural Vegetation (BMP C101)
- High Visibility Plastic or Metal Fence (BMP C103)
- Buffer Zones (BMP C102)

Install orange barrier fencing along the clearing limits, according to the approved construction plans, prior to any construction activities. Maintain until all construction activities are completed.

Alternate BMPs for marking clearing limits are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

Installation Schedules: The limits of construction will be clearly marked before land-disturbing activities begin.
Inspection and Maintenance plan: Site inspections will be conducted at least once a week and within 24 hours following any rainfall event which causes a discharge of stormwater from the site. For sites with temporary stabilization measures, the site inspection frequency can be reduced to once every month.

Responsible Staff: Permittee shall take immediate action(s) to: stop, contain, and clean up the unauthorized discharges, or otherwise stop the noncompliance; correct the problem(s); implement appropriate Best Management Practices (BMPs), and/or conduct maintenance of existing BMPs; and achieve compliance with all applicable standards and permit conditions. In addition, if the noncompliance causes a threat to human health or the environment, the Permittee shall comply with the Noncompliance Notification requirements in Special Condition S5.F of the permit.

2.1.2 Element 2: Establish Construction Access

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters.

List and describe BMPs: Stabilized Construction Entrance (BMP C105)
Alternate construction access BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

Installation Schedules: Install the temporary construction entrance, according to the approved construction plans, prior to any clearing or grading activities

Inspection and Maintenance plan: Maintain until the access road is paved.

Responsible Staff: Contractor.

2.1.3 Element 3: Control Flow Rates

In order to protect the properties and waterways downstream of the project site, stormwater discharges from the site will be controlled. In general, discharge rates of stormwater from the site will be controlled where increases in impervious area or soil compaction during construction could lead to downstream erosion, or where necessary to meet local agency stormwater discharge requirements (e.g. discharge to combined sewer systems).

Will you construct stormwater retention and/or detention facilities?

☒ Yes ☐ No

Will you use permanent infiltration ponds or other low impact development (example: rain gardens, bio-retention, porous pavement) to control flow during construction?

☐ Yes ☒ No

List and describe BMPs: High Visibility Plastic or Metal Fence (BMP C103)
Temporary Sediment Pond (C241)

Alternate flow control BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

Installation Schedules: Install orange high rise fencing along the clearing limits, according to the approved construction plans, prior to any construction activities.

Inspection and Maintenance plan: Maintain until all construction activities are completed.

Responsible Staff: Contractor

2.1.4 Element 4: Install Sediment Controls

Whenever possible, sediment laden water shall be discharged into onsite, relatively level, vegetated areas (BMP C240 paragraph 5, page 4-102).

In some cases, sediment discharge in concentrated runoff can be controlled using permanent stormwater BMPs (e.g., infiltration swales, ponds, trenches). Sediment loads can limit the effectiveness of some permanent stormwater BMPs, such as those used for infiltration or bio-filtration; however, those BMPs designed to remove solids by settling (wet ponds or detention ponds) can be used during the construction phase. When permanent stormwater BMPs will be used to control sediment discharge during construction, the structure will be protected from excessive sedimentation with adequate erosion and sediment control BMPs. Any accumulated sediment shall be removed after construction is complete and the permanent stormwater BMP will be re-stabilized with vegetation per applicable design requirements once the remainder of the site has been stabilized.

The following BMP will be implemented as end-of-pipe sediment controls as required to meet permitted turbidity limits in the site discharge(s). Prior to the implementation of these technologies, sediment sources and erosion control and soil stabilization BMP efforts will be maximized to reduce the need for end-of-pipe sedimentation controls. In addition, sediment will be removed from paved areas in and adjacent to construction work areas manually or using mechanical sweepers, as needed, to minimize tracking of sediments on vehicle tires away from the site and to minimize wash-off of sediments from adjacent streets in runoff.

List and describe BMPs:

- Silt Fence (BMP C233)
- Storm Drain Inlet Protection (BMP C220)

Alternate sediment control BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

Installation Schedules: Install silt fencing, according to the approved plans, prior to any clearing or grading activities. Install catch basin filters, according to the approved construction plans, as catch basins are installed and become operable.

Inspection and Maintenance plan: Maintain Silt Fence and Storm Drain Inlet Protection until all construction activities are completed.

Responsible Staff: Contractor.

2.1.5 Element 5: Stabilize Soils

The project site is located west of the Cascade Mountain Crest. As such, no soils shall remain exposed and unworked for more than 7 days during the dry season (May 1 to September 30) and 2 days during the wet season (October 1 to April 30). Regardless of the time of year, all soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on weather forecasts.

In general, cut and fill slopes will be stabilized as soon as possible and soil stockpiles will be temporarily covered with plastic sheeting. All stockpiled soils shall be stabilized from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels.

West of the Cascade Mountains Crest

Season	Dates	Number of Days Soils Can be Left Exposed
During the Dry Season	May 1 – September 30	7 days
During the Wet Season	October 1 – April 30	2 days

Soils must be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.

Anticipated project dates: Start date: May1, 2022 End date: April 10, 2023

Will you construct during the wet season?
☒ Yes ☐ No

List and describe BMPs:

Exposed and un-worked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project. The specific BMPs for soil stabilization that shall be used on this project include:

- Temporary and Permanent Seeding (BMP C120)

Installation Schedules:

Apply temporary hydro-seed to exposed and un-worked soils, according to the approved construction plans, as needed to prevent erosion during site grading.

Inspection and Maintenance plan:

Apply permanent hydro-seed to areas at final grade as site grading is completed.

- Mulching (BMP C121)

Installation Schedules:

Apply mulching to exposed and un-worked soils, according to the approved construction plans, as needed to prevent erosion during site grading.

Inspection and Maintenance plan:

Maintain until site grading is completed and permanent hydro-seed is applied.

- Plastic Covering (BMP C123)

Installation Schedules:

Cover stockpiles with plastic sheeting, according to the approved construction plans, as needed to prevent erosion during site grading.

Inspection and Maintenance plan:
Maintain until stockpiles are removed from site.

- Dust Control (BMP C140)

Installation Schedules and Inspection and Maintenance plan:

 Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
 Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
 Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
 Sprinkle the site with water until surface is wet. Repeat as needed. To prevent carryout of mud onto street, refer to Stabilized Construction Entrance (BMP C105).
 Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
 Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
 PAM (BMP C126) added to water at a rate of 0.5 lbs. per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may actually reduce the quantity of water needed for dust control. Use of PAM could be a cost-effective dust control method.

Techniques that can be used for unpaved roads and lots include:

 Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
 Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
 Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
 Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
 Encourage the use of alternate, paved routes, if available.
 Restrict use of paved roadways by tracked vehicles and heavy trucks to prevent damage to road surface and base.
 Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
 Pave unpaved permanent roads and other trafficked areas.
 Use vacuum street sweepers.
 Remove mud and other dirt promptly so it does not dry and then turn into dust.
 Limit dust-causing work on windy days.

 Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP.

- Early application of gravel base on areas to be paved

Place gravel base on roadways, according to the approved construction plans, after roadways are graded to sub-grade. Maintain until roads are paved.

Alternate soil stabilization BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

Responsible Staff: Contractor.

2.1.6 Element 6: Protect Slopes

All cut and fill slopes will be designed, constructed, and protected in a manner than minimizes erosion. The following specific BMPs will be used to protect slopes for this project:

Will steep slopes be present at the site during construction?
☒ Yes ☐ No

List and describe BMPs:

- Temporary and Permanent Seeding (BMP C120)
- Plastic Covering (BMP C123)

Alternate slope protection BMPs are included in Appendix C as a quick reference tool for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix D), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix C after the first sign that existing BMPs are ineffective or failing.

Installation Schedules: Apply temporary hydro-seed to cut and fill slopes, according to the approved construction plans, as needed to minimize erosion during site grading.
Inspection and Maintenance plan: Apply permanent hydro-seed to cut and fill slopes at final grade as site grading is completed.
Responsible Staff: Contractor

2.1.7 Element 7: Protect Drain Inlets

All storm drain inlets and culverts made operable during construction shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. However, the first priority is to keep all access roads clean of sediment and keep street wash water separate from entering storm drains until treatment can be provided. Storm Drain Inlet Protection (BMP C220) will be implemented for all drainage inlets and culverts that could potentially be impacted by sediment-laden runoff on and near the project site.

List and describe BMPs:

Drop Inlet Protection

- Storm Drain Inet Protection (C220)

If the BMP options listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix D), or if no BMPs are listed above but deemed necessary during construction, the Certified Erosion and Sediment Control Lead shall implement one or more of the alternative BMP inlet protection options listed in Appendix C.

Installation Schedules: Install catch basin filters, according to the approved construction plans, as catch basins become operable.

Inspection and Maintenance plan: Maintain until all construction activities are completed.

Responsible Staff: Contractor

2.1.8 Element 8: Stabilize Channels and Outlets

No site runoff is to be conveyed into channels, or discharged to a stream or some other natural drainage point.— The onsite flowrates will be minimal therefore no BMP's are proposed Stabilize Channels and Outlets.

If any BMP's are provideded, the project site is located west of the Cascade Mountain Crest. As such, all temporary on-site conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected peak 10 minute velocity of flow from a Type 1A, 10-year, 24-hour recurrence interval storm for the developed condition. Alternatively, the 10-year, 1-hour peak flow rate indicated by an approved continuous runoff simulation model, increased by a factor of 1.6, shall be used. Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems.

List and describe BMPs:

- Outlet Protection (BMP C209)

Installation Schedules: Install rip-raps, according to the approved construction plans.

Inspection and Maintenance plan: Maintain until all construction activities are completed.

Responsible Staff: Contractor

Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches, will be installed at the outlets of all conveyance systems.

2.1.9 Element 9: Control Pollutants

The following pollutants are anticipated to be present on-site:

Table 2 – Pollutants

Pollutant (List pollutants and source, if applicable)
petroleum products
chemicals stored in the construction areas
Dust released from demolished sidewalks
Solid waste

All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants are discussed below.

Vehicles, construction equipment, and/or petroleum product storage/dispensing:

- All vehicles, equipment, and petroleum product storage/dispensing areas will be inspected regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills.
- On-site permanent fueling tanks and petroleum product storage containers shall include secondary containment.
- Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment.
- In order to perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle.
- Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

Chemical storage:

- Any chemicals stored in the construction areas will conform to the appropriate source control BMPs listed in Volume IV of the Ecology stormwater manual. In Western WA, all chemicals shall have cover, containment, and protection provided on site, per BMP C153 for Material Delivery, Storage and Containment in SWMMWW 2005

Excavation and tunneling spoils dewatering waste:

- Dewatering BMPs and BMPs specific to the excavation and tunneling (including handling of contaminated soils) are discussed under Element 10.

Demolition:

- Dust released from demolished sidewalks, buildings, or structures will be controlled using Dust Control measures (BMP C140).
- Storm drain inlets vulnerable to stormwater discharge carrying dust, soil, or debris will be protected using Storm Drain Inlet Protection (BMP C220 as described above for Element 7).

 Process water and slurry resulting from saw-cutting and surfacing operations will be prevented from entering the waters of the State by implementing Saw-cutting and Surfacing Pollution Prevention measures (BMP C152).

Concrete and grout:

 Process water and slurry resulting from concrete work will be prevented from entering the waters of the State by implementing Concrete Handling measures (BMP C151).

Sanitary wastewater:

 Portable sanitation facilities will be firmly secured, regularly maintained, and emptied when necessary.

Solid Waste:

 Solid waste will be stored in secure, clearly marked containers.

Other:

 Other BMPs will be administered as necessary to address any additional pollutant sources on site.

A SPCC plan is required for this site.

As per the Federal regulations of the Clean Water Act (CWA) and according to Final Rule 40 CFR Part 112, as stated in the National Register, a Spill Prevention, Control, and Countermeasure (SPCC) Plan is required for construction activities. A SPCC Plan has been prepared to address an approach to prevent, respond to, and report spills or releases to the environment that could result from construction activities. This Plan must:

 Be well thought out in accordance with good engineering;

List and describe BMPs: BMP C151, BMP C152, BMP C153, BMP C140 and BMP C220.

Installation Schedules:

Inspection and Maintenance plan: All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris.

Achieve three objectives - prevent spills, contain a spill that occurs, and clean up the spill;

 Identify the name, location, owner, and type of facility;
 Include the date of initial operation and oil spill history;
 Name the designated person responsible;
 Show evidence of approval and certification by the person in authority; and
 Contain a facility analysis.

Responsible Staff: Contractor.

Will maintenance, fueling, and/or repair of heavy equipment and vehicles occur on-site?

☐ Yes ☒ No

Will wheel wash or tire bath system BMPs be used during construction?

☒ Yes ☐ No

Will pH-modifying sources be present on-site?

☒ Yes ☐ No

Table 3 – pH-Modifying Sources

☐	None
☒	Bulk cement
☒	Cement kiln dust
☒	Fly ash
☒	Other cementitious materials
☒	New concrete washing or curing waters
☒	Waste streams generated from concrete grinding and sawing
☒	Exposed aggregate processes
☒	Dewatering concrete vaults
☐	Concrete pumping and mixer washout waters
☐	Recycled concrete
☐	Recycled concrete stockpiles
☐	Other (i.e., calcium lignosulfate) [please describe:]

Stormwater runoff will be monitored for pH starting on the first day of any activity that includes more than 40 yards of poured or recycled concrete, or after the application of "Engineered Soils" such as, Portland cement treated base, cement kiln dust, or fly ash. This does not include fertilizers. For concrete work, pH monitoring will start the first day concrete is poured and continue until 3 weeks after the last pour. For engineered soils, the pH monitoring period begins when engineered soils are first exposed to precipitation and continue until the area is fully stabilized.

Stormwater samples will be collected daily from all points of discharge from the site and measured for pH using a calibrated pH meter, pH test kit, or wide range pH indicator paper. If the measured pH is 8.5 or greater, the following steps will be conducted:

1. Prevent the high pH water from entering storm drains or surface water.

2. Adjust or neutralize the high pH water if necessary using appropriate technology such as CO_2 sparging (liquid or dry ice).

3. Contact Ecology if chemical treatment other than CO_2 sparging is planned.

Concrete trucks must not be washed out onto the ground, or into storm drains, open ditches, streets, or streams. Excess concrete must not be dumped on-site, except in designated concrete washout areas with appropriate BMPs installed. Excess concrete must be returned to the plant for recycling if there are no concrete washout areas with appropriate BMPs installed.

Will uncontaminated water from water-only based shaft drilling for construction of building, road, and bridge foundations be infiltrated provided the wastewater is managed in a way that prohibits discharge to surface waters?

☒ Yes ☐ No

2.1.10 Element 10: Control Dewatering

No dewatering is proposed for the development. If dewatering is needed, Transport. off-site in a vehicle (vacuum truck for legal disposal).

Table 4 – Dewatering BMPs

☐	Infiltration
☒	Transport off-site in a vehicle (vacuum truck for legal disposal)
☐	Ecology-approved on-site chemical treatment or other suitable treatment technologies
☐	Sanitary or combined sewer discharge with local sewer district approval (last resort)
☐	Use of sedimentation bag with discharge to ditch or swale (small volumes of localized dewatering)

2.1.11 Element 11: Maintain BMPs

All temporary and permanent Erosion and Sediment Control (ESC) BMPs shall be maintained and repaired as needed to ensure continued performance of their intended function.
Maintenance and repair shall be conducted in accordance with each particular BMP specification (see *Volume II of the SWMMWW or Chapter 7 of the SWMMEW*).
Visual monitoring of all BMPs installed at the site will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive and is temporarily stabilized, the inspection frequency may be reduced to once every calendar month.
All temporary ESC BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed.
Trapped sediment shall be stabilized on-site or removed. Disturbed soil resulting from removal of either BMPs or vegetation shall be permanently stabilized.
Additionally, protection must be provided for all BMPs installed for the permanent control of stormwater from sediment and compaction. BMPs that are to remain in place following completion of construction shall be examined and restored to full operating condition. If sediment enters these BMPs during construction, the sediment shall be removed and the facility shall be returned to conditions specified in the construction documents.

List and describe BMPs :

- Scheduling BMP (C162)

2.1.12 Element 12: Manage the Project

The project will be managed based on the following principles:

- Projects will be phased to the maximum extent practicable and seasonal work limitations will be taken into account.
- Inspection and monitoring:
    - Inspection, maintenance and repair of all BMPs will occur as needed to ensure performance of their intended function.
    - Site inspections and monitoring will be conducted in accordance with Special Condition S4 of the CSWGP. Sampling locations are indicated on the Site Map. Sampling station(s) are located in accordance with applicable requirements of the CSWGP.
- Maintain an updated SWPPP.
    - The SWPPP will be updated, maintained, and implemented in accordance with Special Conditions S3, S4, and S9 of the CSWGP.

As site work progresses the SWPPP will be modified routinely to reflect changing site conditions. The SWPPP will be reviewed monthly to ensure the content is current.

Table 5 – Management

☒	Design the project to fit the existing topography, soils, and drainage patterns
☒	Emphasize erosion control rather than sediment control
☒	Minimize the extent and duration of the area exposed
☒	Keep runoff velocities low
☒	Retain sediment on-site
☒	Thoroughly monitor site and maintain all ESC measures
☒	Schedule major earthwork during the dry season
☐	Other (please describe)

Table 6 – BMP Implementation Schedule

Phase of Construction Project	Stormwater BMPs	Date	Wet/Dry Season
Mark Clearing Limits	High Visibility Plastic or Metal Fence (BMP C103)	05/01/2022	Dry
Mobilize equipment on site	Construction Road/Parking area stabilization (BMP C107)	05/01/2022	Dry
Mobilize and store all ESC and soil stabilization products	Silt Fence (BMP C233) Storm Drain Inlet Protection (BMP C220) Plastic Covering (BMP C123) Surface roughening (BMP C130)	05/01/2022	Dry
Install ESC measures	Silt Fence (BMP C233) Storm Drain Inlet Protection (BMP C220)	05/01/2022	Dry
Install stabilized construction entrance	Stabilized Construction Entrance (BMP C105)	05/01/2022	Dry
Begin clearing and grubbing	Dust Control (BMP C140)	05/15/2022	Dry
Site grading begins	Dust Control (BMP C140)	05/27/2022	Dry
Grade road and stabilize with gravel base	Dust Control (BMP C140)	05/27/2022	Dry
Begin excavation for new utilities and services		07/01/2022	Wet
Soil stabilization on excavated side slopes (in idle, no work areas)	Mulching (BMP C121) Dust Control (BMP C140) Plastic Covering (BMP C123) Nets and Blankets (BMP C122)	08/05/2022	Wet
Temporary erosion control measures (hydro-seeding)	Temporary Seeding (BMP C120)	09/01/2022	Wet
Site grading ends		09/15/2022	Wet
Begin pouring concrete curbs & sidewalks and implement	BMP C151 Concrete Handling (BMP C151) Sawcutting and Surfacing Pollution Prevention (BMP C152)	10/01/2022	Wet

Pave asphalt roads		11/05/2022	Wet
Implement Element #12 BMPs and manage site to minimize soil disturbance during the wet season	Scheduling (BMP C162) CESC Lead (BMP C160)	12/01/2022	Wet
Final landscaping and planting begins		03/1/2023	Dry
Permanent erosion control measures (hydro-seeding)	Permanent Seeding (BMP C120)	04/01/2023	Dry

2.1.13 Element 13: Protect Low Impact Development (LID) BMPs

On-site stormwater management BMPs used for runoff from roofs and other hard surfaces include: full dispersion, roof downspout full infiltration or dispersion systems, perforated stubout connections, rain gardens, bioretention systems, permeable pavement, sheetflow dispersion, and concentrated flow dispersion. The areas on the site to be used for these BMPs shall be protected from siltation and compaction during construction by sequencing the construction in a fashion to install these BMPs at the latter part of the construction grading operations, by excluding equipment from the BMPS and the associated areas, and by using the erosion and sedimentation control BMPs listed below. Additional requirements for protecting these BMPs during the construction process, testing functionality, and restoring functionality are needed at the final stage of the construction process.

Relevant BMPs

BMP C102: Buffer Zone BMP
C103: High Visibility Fence BMP
C200: Interceptor Dike and Swale BMP
C201: Grass-lined Channels BMP
C207: Check Dams BMP
C208: Triangular Silt Dike BMP
C231: Brush Barrier BMP
C233: Silt Fence BMP
C234: Vegetated Strip

3 Pollution Prevention Team

Table 7 – Team Information

Title	Name(s)	Phone Number
Certified Erosion and Sediment Control Lead (CESCL)	Brian Kalab	425-303-9363
Resident Engineer	Brian Kalab / Insight Engineering	425-303-9363
Emergency Ecology Contact	Tracy Walters	425-649-7000
Emergency Permittee/ Owner Contact	Randy Brockway	206-992-5051
Non-Emergency Owner Contact	Randy Brockway	206-992-5051
Monitoring Personnel	TBD	
Ecology Regional Office	Northwest Regional Office	425-649-7000

4 Monitoring and Sampling Requirements

Monitoring includes visual inspection, sampling for water quality parameters of concern, and documentation of the inspection and sampling findings in a site log book. A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Stormwater sampling data

The site log book must be maintained on-site within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

Numeric effluent limits may be required for certain discharges to 303(d) listed waterbodies. See CSWGP Special Condition S8 and Section 5 of this template.

The receiving waterbody, Swamp Creek, is impaired for: Bacteria, Bioassessment, DO. pH and Temp. All stormwater and dewatering discharges from the site are subject to an **effluent limit** of 8.5 su for pH and/or 25 NTU for turbidity.

4.1 Site Inspection

Site inspections will be conducted at least once every calendar week and within 24 hours following any discharge from the site. For sites that are temporarily stabilized and inactive, the required frequency is reduced to once per calendar month.
The discharge point(s) are indicated on the Site Map (see Appendix A) and in accordance with the applicable requirements of the CSWGP.

4.2 Stormwater Quality Sampling

4.2.1 Turbidity Sampling

Requirements include calibrated turbidity meter or transparency tube to sample site discharges for compliance with the CSWGP. Sampling will be conducted at all discharge points at least once per calendar week.
Method for sampling turbidity:

Table 8 – Turbidity Sampling Method

☒	Turbidity Meter/Turbidimeter (required for disturbances 5 acres or greater in size)
☐	Transparency Tube (option for disturbances less than 1 acre and up to 5 acres in size)

The limit for turbidity value is 25 nephelometric turbidity units (NTU) and a transparency less than 33 centimeters.
If the discharge's turbidity is 26 to 249 NTU **or** the transparency is less than 33 cm but equal to or greater than 6 cm, the following steps will be conducted:

1. Stop effluent discharge to receiving waterbody immediately. If discharge continues, this will be a direct violation of the SWPPP and CSWGP. Implement baker tanks to prevent discharge from entering reciving water body. Replace/repair BMP's if not functioning properly. Do not discharge runoff until the turbidity value is 25 nephelometric turbidity units (NTU) or less and a transparency less than 33 centimeters.

2. Review the SWPPP for compliance with Special Condition S9. Make appropriate revisions within 7 days of the date the discharge exceeded the limit.
3. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the limit. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
4. Document BMP implementation and maintenance in the site log book.

If the turbidity exceeds 250 NTU **or** the transparency is 6 cm or less at any time, the following steps will be conducted:

1. Telephone or submit an electronic report to the applicable Ecology Region's Environmental Report Tracking System (ERTS) within 24 hours.
    - **Central Region** (Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima): (509) 575-2490 or http://www.ecy.wa.gov/programs/spills/forms/nerts_online/CRO_nerts_online.html
    - **Eastern Region** (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400 or http://www.ecy.wa.gov/programs/spills/forms/nerts_online/ERO_nerts_online.html
    - **Northwest Region** (King, Kitsap, Island, San Juan, Skagit, Snohomish, Whatcom): (425) 649-7000 or http://www.ecy.wa.gov/programs/spills/forms/nerts_online/NWRO_nerts_online.html
    - **Southwest Region** (Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, Wahkiakum,): (360) 407-6300 or http://www.ecy.wa.gov/programs/spills/forms/nerts_online/SWRO_nerts_online.html
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the limit. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period
3. Document BMP implementation and maintenance in the site log book.
4. Continue to sample discharges daily until one of the following is true:
    - Turbidity is 25 NTU (or lower).
    - Transparency is 33 cm (or greater).
    - Compliance with the water quality limit for turbidity is achieved.
        - 1 - 5 NTU over background turbidity, if background is less than 50 NTU
        - 1% - 10% over background turbidity, if background is 50 NTU or greater
    - The discharge stops or is eliminated.

4.2.2 pH Sampling

pH monitoring is required for "Significant concrete work" (i.e., greater than 1000 cubic yards poured concrete over the life of the project). The use of recycled concrete or engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD] or fly ash) also requires pH monitoring.

For significant concrete work, pH sampling will start the first day concrete is poured and continue until it is cured, typically three (3) weeks after the last pour.

For engineered soils and recycled concrete, pH sampling begins when engineered soils or recycled concrete are first exposed to precipitation and continues until the area is fully stabilized.

If the measured pH is 8.5 or greater, the following measures will be taken:

1. Prevent high pH water from entering storm sewer systems or surface water.
2. Adjust or neutralize the high pH water to the range of 6.5 to 8.5 su using appropriate technology such as carbon dioxide (CO_2) sparging (liquid or dry ice).
3. Written approval will be obtained from Ecology prior to the use of chemical treatment other than CO_2 sparging or dry ice.

Method for sampling pH:

Table 9 – pH Sampling Method

☒	pH meter
☐	pH test kit
☐	Wide range pH indicator paper

5 Discharges to 303(d) or Total Maximum Daily Load (TMDL) Waterbodies

5.1 303(d) Listed Waterbodies

Is the receiving water 303(d) (Category 5) listed for turbidity, fine sediment, phosphorus, or pH?
☐ Yes ☒ No
Describe the method(s) for 303(d) compliance:N/A

List and describe BMPs:
Concrete Handling (BMP C151)

Sawcutting and Surfacing Pollution Prevention (BMP C152)

Outlet Protection (BMP C209)

Mulching (BMP C121)
Temporary and Permanent Seeding (BMP C120)
Dust Control (BMP C140)
Polyacrylamide (PAM) for Soil Erosion Protection (BMP C126)

5.2 TMDL Waterbodies

Waste Load Allocation for CWSGP discharges:
List and describe BMPs:
List and describe BMPs:
Concrete Handling (BMP C151)

Sawcutting and Surfacing Pollution Prevention (BMP C152)

Outlet Protection (BMP C209)

Mulching (BMP C121)
Temporary and Permanent Seeding (BMP C120)
Dust Control (BMP C140)

Discharges to TMDL receiving waterbodies will meet in-stream water quality criteria at the point of discharge.

The Construction Stormwater General Permit Proposed New Discharge to an Impaired Water Body form is included in Appendix F.

6 Reporting and Record Keeping

6.1 Record Keeping

6.1.1 Site Log Book

A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Sample logs

6.1.2 Records Retention

Records will be retained during the life of the project and for a minimum of three (3) years following the termination of permit coverage in accordance with Special Condition S5.C of the CSWGP.

Permit documentation to be retained on-site:

- CSWGP
- Permit Coverage Letter
- SWPPP
- Site Log Book

Permit documentation will be provided within 14 days of receipt of a written request from Ecology. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with Special Condition S5.G.2.b of the CSWGP.

6.1.3 Updating the SWPPP

The SWPPP will be modified if:

- Found ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site.
- There is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

The SWPPP will be modified within seven (7) days if inspection(s) or investigation(s) determine additional or modified BMPs are necessary for compliance. An updated timeline for BMP implementation will be prepared.

6.2 Reporting

6.2.1 Discharge Monitoring Reports

Cumulative soil disturbance is one (1) acre or larger; therefore, Discharge Monitoring Reports (DMRs) will be submitted to Ecology monthly. If there was no discharge during a given

monitoring period the DMR will be submitted as required, reporting "No Discharge". The DMR due date is fifteen (15) days following the end of each calendar month.
DMRs will be reported online through Ecology's WQWebDMR System.

6.2.2 Notification of Noncompliance

If any of the terms and conditions of the permit is not met, and the resulting noncompliance may cause a threat to human health or the environment, the following actions will be taken:

1. Ecology will be notified within 24-hours of the failure to comply by calling the applicable Regional office ERTS phone number (Regional office numbers listed below).
2. Immediate action will be taken to prevent the discharge/pollution or otherwise stop or correct the noncompliance. If applicable, sampling and analysis of any noncompliance will be repeated immediately and the results submitted to Ecology within five (5) days of becoming aware of the violation.
3. A detailed written report describing the noncompliance will be submitted to Ecology within five (5) days, unless requested earlier by Ecology.

Anytime turbidity sampling indicates turbidity is 250 NTUs or greater, or water transparency is 6 cm or less, the Ecology Regional office will be notified by phone within 24 hours of analysis as required by Special Condition S5.A of the CSWGP.

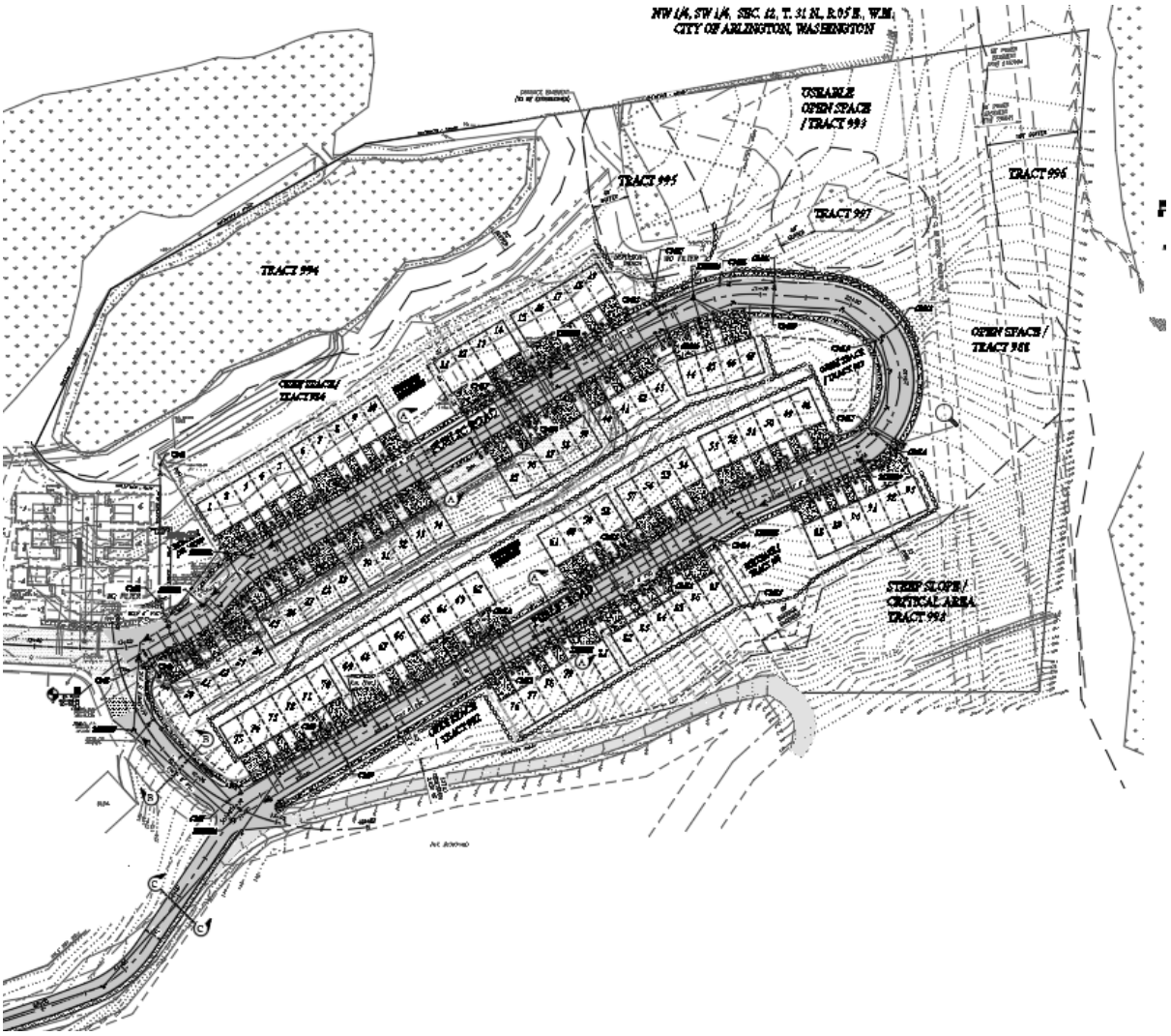
- **Central Region** at (509) 575-2490 for Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, or Yakima County
- **Eastern Region** at (509) 329-3400 for Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, or Whitman County
- **Northwest Region** at (425) 649-7000 for Island, King, Kitsap, San Juan, Skagit, Snohomish, or Whatcom County
- **Southwest Region** at (360) 407-6300 for Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, or Wahkiakum

Include the following information:

1. Your name and / Phone number
2. Permit number
3. City / County of project
4. Sample results
5. Date / Time of call
6. Date / Time of sample
7. Project name

In accordance with Special Condition S4.D.5.b of the CSWGP, the Ecology Regional office will be notified if chemical treatment other than CO_2 sparging is planned for adjustment of high pH water.

A. Site Map


NW 1/4, SW 1/4, SEC. 12, T. 31 N., R.05 E., W.M.
CITY OF ARLINGTON, WASHINGTON
USEABLE OPEN SPACE / TRACT 993
TRACT 995
TRACT 997
TRACT 996
TRACT 994
OPEN SPACE / TRACT 991
OPEN SPACE / TRACT 994
PARLAC ROAD
TRAILS ROAD
STEEP SLOPE / CRITICAL AREA TRACT 992

BMP Detail

Element #1 - Mark Clearing Limits

- High Visibility Plastic or Metal Fence (BMP C103)
- Preserving Natural Vegetation (BMP C101)
- Buffer Zones (BMP C102)

Element #2 - Establish Construction Access

- Stabilized Construction Entrance (BMP C105)

Element #3 - Control Flow Rates

- Temporary Sediment Pond (BMP C 241)

Element #4 - Install Sediment Controls

- Silt Fence (BMP C233)
- Storm Drain Inlet Protection (BMP C220)
- Interceptor Dike and Swale (BMP C200)

Element #5 - Stabilize Soils

- Mulching (BMP C121)
- Temporary and Permanent Seeding (BMP C120)
- Plastic Covering (BMP C123)
- Dust Control (BMP C140)

Element #6 - Protect Slopes

- Plastic Covering (BMP C123)
- Temporary and Permanent Seeding (BMP C120)

Element #7 - Protect Drain Inlets

- Storm Drain Inlet Protection (BMP C220)

Element #8 - Stabilize Channels and Outlets

- Outlet Protection (BMP C209)

Element #10 - Control Dewatering

- Additional Advanced BMPs to Control Dewatering:

Element #11 – Maintain BMP's

- Scheduling (BMP C162)

Element #12 – Manage the Project

- CESC Lead (BMP C160)

Element #13 – Protect On-site Stormwater Management BMPs for Runoff from Roofs and Other Hard Surfaces

- BMP C102: Buffer Zone BMP
- C200: Interceptor Dike and Swale
- C207: Check Dams BMP
- C233: Silt Fence BMP

B. Correspondence

Ecology
EPA
Local Government

C. Site Inspection Form

Construction Stormwater Site Inspection Form

Project Name _____ Permit # _____ Inspection Date _____ Time _____

Name of Certified Erosion Sediment Control Lead (CESCL) or qualified inspector if *less than one acre*
Print Name: _____

Approximate rainfall amount since the last inspection (in inches): _____

Approximate rainfall amount in the last 24 hours (in inches): _____

Current Weather Clear ☐ Cloudy ☐ Mist ☐ Rain ☐ Wind ☐ Fog ☐

A. Type of inspection: Weekly ☐ Post Storm Event ☐ Other ☐

B. Phase of Active Construction (*check all that apply*):

Pre Construction/installation of erosion/sediment controls	☐	Clearing/Demo/Grading	☐	Infrastructure/storm/roads	☐
Concrete pours	☐	Vertical Construction/buildings	☐	Utilities	☐
Offsite improvements	☐	Site temporary stabilized	☐	Final stabilization	☐

C. Questions:

1. Were all areas of construction and discharge points inspected? Yes ___ No ___
2. Did you observe the presence of suspended sediment, turbidity, discoloration, or oil sheen Yes ___ No ___
3. Was a water quality sample taken during inspection? (*refer to permit conditions S4 & S5*) Yes ___ No ___
4. Was there a turbid discharge 250 NTU or greater, or Transparency 6 cm or less?* Yes ___ No ___
5. If yes to #4 was it reported to Ecology? Yes ___ No ___
6. Is pH sampling required? pH range required is 6.5 to 8.5. Yes ___ No ___

If answering yes to a discharge, describe the event. Include when, where, and why it happened; what action was taken, and when.

_____

_____

_____

_____

*If answering yes to # 4 record NTU/Transparency with continual sampling daily until turbidity is 25 NTU or less/ transparency is 33 cm or greater.

Sampling Results: Date: _____

Parameter	Method (circle one)	Result			Other/Note
		NTU	cm	pH	
Turbidity	tube, meter, laboratory				
pH	Paper, kit, meter				

Construction Stormwater Site Inspection Form

D. Check the observed status of all items. Provide "Action Required "details and dates.

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
1 Clearing Limits	Before beginning land disturbing activities are all clearing limits, natural resource areas (streams, wetlands, buffers, trees) protected with barriers or similar BMPs? (high visibility recommended)						
2 Construction Access	Construction access is stabilized with quarry spalls or equivalent BMP to prevent sediment from being tracked onto roads?						
	Sediment tracked onto the road way was cleaned thoroughly at the end of the day or more frequent as necessary.						
3 Control Flow Rates	Are flow control measures installed to control stormwater volumes and velocity during construction and do they protect downstream properties and waterways from erosion?						
	If permanent infiltration ponds are used for flow control during construction, are they protected from siltation?						
4 Sediment Controls	All perimeter sediment controls (e.g. silt fence, wattles, compost socks, berms, etc.) installed, and maintained in accordance with the Stormwater Pollution Prevention Plan (SWPPP).						
	Sediment control BMPs (sediment ponds, traps, filters etc.) have been constructed and functional as the first step of grading.						
	Stormwater runoff from disturbed areas is directed to sediment removal BMP.						
5 Stabilize Soils	Have exposed un-worked soils been stabilized with effective BMP to prevent erosion and sediment deposition?						

Construction Stormwater Site Inspection Form

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
5 Stabilize Soils Cont.	Are stockpiles stabilized from erosion, protected with sediment trapping measures and located away from drain inlet, waterways, and drainage channels?						
	Have soils been stabilized at the end of the shift, before a holiday or weekend if needed based on the weather forecast?						
6 Protect Slopes	Has stormwater and ground water been diverted away from slopes and disturbed areas with interceptor dikes, pipes and or swales?						
	Is off-site storm water managed separately from stormwater generated on the site?						
	Is excavated material placed on uphill side of trenches consistent with safety and space considerations?						
	Have check dams been placed at regular intervals within constructed channels that are cut down a slope?						
7 Drain Inlets	Storm drain inlets made operable during construction are protected.						
	Are existing storm drains within the influence of the project protected?						
8 Stabilize Channel and Outlets	Have all on-site conveyance channels been designed, constructed and stabilized to prevent erosion from expected peak flows?						
	Is stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream conveyance systems?						
9 Control Pollutants	Are waste materials and demolition debris handled and disposed of to prevent contamination of stormwater?						
	Has cover been provided for all chemicals, liquid products, petroleum products, and other material?						
	Has secondary containment been provided capable of containing 110% of the volume?						
	Were contaminated surfaces cleaned immediately after a spill incident?						
	Were BMPs used to prevent contamination of stormwater by a pH modifying sources?						

Construction Stormwater Site Inspection Form

Element #	Inspection	BMPs Inspected			BMP needs maintenance	BMP failed	Action required (describe in section F)
		yes	no	n/a			
9 Cont.	Wheel wash wastewater is handled and disposed of properly.						
10 Control Dewatering	Concrete washout in designated areas. No washout or excess concrete on the ground.						
	Dewatering has been done to an approved source and in compliance with the SWPPP.						
	Were there any clean non turbid dewatering discharges?						
11 Maintain BMP	Are all temporary and permanent erosion and sediment control BMPs maintained to perform as intended?						
12 Manage the Project	Has the project been phased to the maximum degree practicable?						
	Has regular inspection, monitoring and maintenance been performed as required by the permit?						
	Has the SWPPP been updated, implemented and records maintained?						
13 Protect LID	Is all Bioretention and Rain Garden Facilities protected from sedimentation with appropriate BMPs?						
	Is the Bioretention and Rain Garden protected against over compaction of construction equipment and foot traffic to retain its infiltration capabilities?						
	Permeable pavements are clean and free of sediment and sediment laden-water runoff. Muddy construction equipment has not been on the base material or pavement.						
	Have soiled permeable pavements been cleaned of sediments and pass infiltration test as required by stormwater manual methodology?						
	Heavy equipment has been kept off existing soils under LID facilities to retain infiltration rate.						

E. Check all areas that have been inspected. ✔

All in place BMPs ☐ All disturbed soils ☐ All concrete wash out area ☐ All material storage areas ☐
All discharge locations ☐ All equipment storage areas ☐ All construction entrances/exits ☐

F. Elements checked "Action Required" (section D) describe corrective action to be taken. List the element number; be specific on location and work needed. Document, initial, and date when the corrective action has been completed and inspected.

Element #	Description and Location	Action Required	Completion Date	Initials

Attach additional page if needed

Sign the following certification:

"I certify that this report is true, accurate, and complete, to the best of my knowledge and belief"

Inspected by: (print) _____ (Signature) _____ Date: _____

Title/Qualification of Inspector: _____

D. Construction Stormwater General Permit (CSWGP)

Download the CSWGP:
http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html

E. 303(d) List Waterbodies / TMDL Waterbodies Information

F. Contaminated Site Information

The Soil profile is provided as Appendix under the Drianage Report.

G. Engineering Calculations

TESC Pond sizing calculations

The total contributing area to the proposed sediment pond is approximately 2.82 acres. The sediment pond is sized for the developed 10-year / 24-hour design storm due to the proximity to the wetlands.

1. Discharge rate

Q 10yr/24hr = 3.06 cfs

Surface Area (SA)

SA = 1.2 X Q10yr/24hr / Vsed

SA = 1.2 X 1.68 / 0.00096

Where Vsed is the settling velocity.

= 3,825 Sqft

2. Sizing the De-watering Mechanism:

Principal Spillway (Riser pipe)
The diameter shall be the minimum necessary to pass the pre-developed 10-yr/24-hr design storm. Use Figure III.2.38 Riser inflow curves (DOE) to determine this diameter (h = 1 foot)

Q (10yr/24hr predev) = 0.04 cfs
Per figure III.2.38 of the DOE manual, the minimum riser diameter is 12 inches to convey this flow rate.

Emergency Overflow Spillway
The emergency overflow spillway shall convey the 100yr/24hr developed design storm.
Q 100yr/24hr = 3.06 cfs

$$\text{Length (L)} = \frac{Q_{100yr/24hr}}{3.21\,(H)^{3/2}} - 2.4\,(H)^2$$

$$= \frac{3.06}{3.21\,(0.5)^{3/2}} - 2.4\,(0.5)^2$$

Length (L) = 2.10 feet. Use the minimum length of 6.0 feet.

De-Watering Orifice:

Size the de-watering orifice (1" minimum diameter) per the following equation:

$$Ao = \frac{As\ (2H)^{1/2}}{10.6 \times 3600\ Tg^{1/2}}$$

where Ao = Orifice area in square feet
As = Pond surface area in square feet
H = Head above the Orifice (height of riser in pipe)
T = De-watering Time (T = 24 hours)
g = Acceleration due to gravity

$$Ao = \frac{3{,}825}{10.6 \times 3600\ (24)\ (32.2)^{1/2}}$$

Ao = 0.00195 Sqft

Convert Ao to Diameter (D) in inches

$D = 24 \times (Ao / 3.14)^{1/2}$

D = 0.60 inches. (Use 1" minimum) Per the DOE design standards; the perforated pipe shall be a minimum of two inches larger than the orifice sizes. Use 3-inch diameter for the perforated pipe.

* Sediment pond shall be a minimum of 3.5-ft deep, which includes 1-ft towards free board, 1-ft towards settling depth and 1.5-ft towards sediment storage. Refer to the construction plans for more details.

B. GEOTECHNICAL ENGINEERING REPORT

- *Previous Geotechnical Reports are handed in separately.*

COBALT
GEOSCIENCES

Preliminary Geotechnical Investigation
Pioneer Point

207th Street NE East of Burn Road
Arlington, Washington

October 11, 2021

Table of Contents

Table of Contents (Continued)

LIST OF APPENDICES

October 11, 2021

1.0 Introduction

In accordance with your authorization, Cobalt Geosciences, LLC (Cobalt) has completed a preliminary geotechnical investigation and landslide evaluation for the Portage Creek Estates development (future name Pioneer Point) located east of Burn Road along 207th Street NE in Arlington, Washington (Figure 1).

The purpose of the geotechnical investigation was to identify subsurface conditions and to provide geotechnical recommendations for landslide mitigation, long term slope stability, earthwork, drainage, erosion control, and overall grading/development.

The scope of work for the geotechnical services consisted of a site investigation followed by engineering analyses to prepare this report. Preliminary recommendations presented herein pertain to landslide mitigation, foundation options, drainage, detention systems, and retaining walls. Final recommendations will be provided in a finalized geotechnical report when preliminary plans become more formalized with additional grading and building details.

2.0 Project Description

We have reviewed a site plan with grading information dated December 31, 2019 (with updated in 2021) by Insight Engineering, Inc. This plan indicates that the development will include 19 new buildings with a total of 93 residential units, a loop access road, retaining walls, and open space areas. The site plan indicates approximate building lot and roadway elevations. Specific wall types, utility locations, stormwater infrastructure, and finish floor elevations are not indicated on the plan.

The project will include landslide mitigation and drainage improvements, as determined to be necessary by the geotechnical analysis.

We should be provided with the final plans as they become available so that we may update this report as needed. This report is preliminary since it is based on preliminary building and estimated grading only.

3.0 Site Description

The site is located along 207th Street NE east of Burn Road in Arlington, Washington (Figure 1). The site consists of three adjoining parcels (No.'s 31051200301500, 31051200301000, & 310512003011400) with a total area of about 15.3 acres. Figure 2 shows the site layout and topography.

It is our understanding that the extension of 207th Street NE through the site (three parcels) was graded and paved in 1994-1995. During the winter of 1995, at least one landslide event took place upslope of the new roadway, causing bulging in the roadway and soil movement to the south and east. A subsurface drain was placed parallel to the roadway approximately 30 feet south of the roadway in about 2014. This drain is about 12 feet deep and we anticipate that the purpose was to collect and divert shallow groundwater from the steeper slope areas south of the roadway.

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The site area consists of a gentle to moderately steep slope system extending downward to the north. The site is situated near the toe of a larger slope area. Slope magnitudes range from 5 to 100 percent; however, natural slopes range from 10 to 35 percent. The slope area just south of 207th Street NE has magnitudes of 40 to 100 percent and relief of about 20 feet. This slope was created during road construction and subsequently modified during localized grading and drainage placement.

The site is vegetated with blackberry vines, ivy, ferns, grasses, Scotch Broom, along with variable diameter deciduous trees.

Historic Conditions

We reviewed historic aerial photographs of the site area from 1954 to present. From 1954 to 1966, a majority of the site was cleared of trees and appears to have been used as grazing or farm land. There were no discernable signs of hummocky terrain in the vicinity of the property. Heavy forested areas were present in the south margin of the site, extending further upslope.

Based on aerial photographs, sometime between 1966 and 1969, the two large ponds near the north margin of the property were created. Historic topographic maps prior 1966 show a stream beginning in the area of these ponds and heading westward. Topographic maps from 1969 up to present show the ponds in place, although they appear to get smaller in area as time progresses.

4.0 Field Investigation

4.1.1 Site Investigation Program

The geotechnical field investigation program was completed on August 10, August 17, and September 10, 2018 and included drilling and sampling four hollow stem auger borings within the property for subsurface analysis. Two groundwater monitoring wells and one slope inclinometer were installed in three of the four borings to provide data regarding slope movements and groundwater elevations over time. An additional five borings were drilled on November 24 and 25, 2019 with installation of local monitoring wells. Seven test pits were excavated to further evaluate shallow soil conditions in difficult to access areas.

Disturbed soil samples were obtained during drilling by using the Standard Penetration Test (SPT) as described in ASTM D-1586. The Standard Penetration Test and sampling method consists of driving a standard 2-inch outside-diameter, split barrel sampler into the subsoil with a 140-pound hammer free falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the Standard Penetration Resistance, or N-value. The blow count is presented graphically on the boring logs in this appendix. The resistance, or "N" value, provides a measure of the relative density of granular soils or of the relative consistency of cohesive soils.

The soils encountered were logged in the field and are described in accordance with the Unified Soil Classification System (USCS).

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A Cobalt Geosciences field representative conducted the explorations, collected disturbed soil samples, classified the encountered soils, kept a detailed log of the explorations, and observed and recorded pertinent site features.

The results of the boring and test pit sampling and laboratory analyses are presented in Appendix C. Boring and test pit logs from previous site investigations are also included in this appendix.

5.0 Soil and Groundwater Conditions

5.1.1 Area Geology

The site lies within the Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances/retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and non-glacial sediments consisting of interbedded gravel, sand, silt, till, and peat lenses.

The Geologic Map of the Arlington East Quadrangle, indicates that the site is located near the contacts between Vashon Advance Outwash and Transitional Beds.

Vashon Advance Outwash generally consists of medium dense to very dense, fine to coarse grained sand with variable amounts of gravel and silt deposited in front of the advancing glaciers. Interbeds of silt and clay are locally common within the outwash deposits.

Transitional Beds include bedded clay, silts, with local areas and interbeds of sand. These materials are typically dense/stiff to very dense/hard and underlie Fraser-era glacial deposits. They are typically exposed in lower elevation areas such as the base of bluffs and valleys.

Borings & Test Pits

The borings encountered loose to medium dense mixtures of silt and sand with minor clay underlain by silt, silty-sands, and local areas of clay deposits that become stiffer with depth. These deposits appear to be consistent with recessional lacustrine deposits overlying advance outwash. Below these materials, we encountered localized areas of relatively dense poorly graded sand and gravelly sands that are consistent with advance outwash.

In general, borings drilled east of the well-known landslide feature encountered mostly silty-sand and sandy silt without distinctive zones or layers of outwash sand and clay. The soils in these borings become very dense/hard at variable depths below grade. The geology in the eastern portion appears to be consistent with Transitional Beds becoming finer grained and stiff to hard with depth. The upper silty-sands to sandy-silts could be the transitional zone between the advance outwash and Transitional Beds or a type of recessional outwash.

The test pits encountered loose to medium dense layers and mixtures of silt, sand, fine organics and minor clay. These materials were relatively consistent across large areas and consistent with the upper soils encountered in most of the borings.

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Previous Investigations by Others

We reviewed various geotechnical reports and boring logs from the project site. These include the following:

- Associated Earth Sciences, Inc. (AESI), Subsurface Exploration, Geologic Hazard, and Preliminary Geotechnical Engineering Report, Portage Creek Estates, Arlington Washington, May 16, 2002
- Nelson Geotechnical Associates, Inc. (Nelson) Geotechnical Engineering Evaluation, Portage Creek Lot 3 Residential Development, Arlington Washington, January 23, 2018
- Julian Liu & Associates, Inc. (Liu), Site Plan and Test Pit Logs, Portage Creek Estates, January 19, 2017

In general, all of the previous explorations encountered materials consistent with fill, alluvium, recessional outwash and lacustrine deposits, along with localized areas of advance outwash and older underlying materials (consistent with Transitional Beds). It should be noted that the various consultants locally described their materials based on mapped geologic units and that the designations are not necessarily consistent between consultants.

Interpreted Geologic Conditions

Based on the results of our borings and previous explorations by others, we interpret the site and adjacent areas to be underlain by several geologic units with the more complex layering present in the western half of the property.

A majority of the landslide-affected area appear to be underlain by Lakebed (lacustrine) Deposits of Vashon Recessional Outwash (Qvrl). These soils include silts and clays deposited in slow moving water. Some areas appear to be underlain by Marysville Sand (Qvrm) and Arlington Gravel (Qvra) members of Vashon Recessional Outwash. Arlington Gravel appears to be confined to the northwestern portions of the site area. Landslide activity appears to be mostly present within and/or above/below the Qvrl unit which overlies the Marysville Sand and Arlington Gravel.

Lacustrine deposits that include moderate to highly plastic clays often exhibit instability when excavated at low to moderate slope magnitudes. We observed numerous areas of fractures silts and clays in the borings. The clayey deposits and slope excavations in conjunction with high groundwater table due to heavy precipitation could result in the observed landslide activity.

Below the recessional deposits, we encountered local Vashon Advance Outwash. This unit is characterized by dense to very dense fine to medium grained sand with minimal fine gravel. While we did not encounter Transitional Beds in the slide-affected areas, it appears that AESI encountered these materials in several of their borings north of 207th Street NE.

In the eastern half of the property, it appears that Lacustrine Deposits or other recessional deposits are present at shallow depths. These deposits transition to very stiff to hard silt and sandy silt, which is consistent with Transitional Beds. We did not observe areas of clayey soils in the eastern site borings.

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5.1.2 Groundwater & Inclinometer

Groundwater was encountered in most of our borings drilled at the site. Intermittent perched groundwater was encountered in B-1 between 15.5 and 20.4 feet below existing grade. The groundwater table was encountered at 24 feet below grade in B-1, which correlates to an elevation of 142.5 feet.

The groundwater table was encountered approximately 12 feet below grade in B-1 (149 feet), approximately 30 feet below grade in B-3 (158 feet) and approximately 42 feet below grade in B-4 (151 feet). There were numerous areas of mottled soils and very moist soils within the upper recessional silts and clays in all of the borings. This indicates that there may be seeps and perched groundwater seasonally in the upper strata that underlies the property.

Initial groundwater elevations from the earliest installed monitoring wells are as follows:

Boring	Date	Groundwater Elevation
B-2	8-17-18	149.15’
B-2	9-10-18	148.9’
B-3	8-17-18	158’
B-3	9-10-18	157.9’

In our more recent explorations, groundwater was present in B-5 and B-6 at 17.5 feet below grade and at 22.5 feet in B-7. Groundwater was not observed in B-8 or any of our test pits. We are collecting groundwater and inclinometer data from the monitoring wells and inclinometer casing. In general, groundwater appears to be present between 145 and 160 feet in elevation. We will prepare letter detailing groundwater elevations from periodic measrements.

Water table elevations often fluctuate over time. The groundwater level will depend on a variety of factors that may include seasonal precipitation, irrigation, land use, climatic conditions and soil permeability. Water levels at the time of the field investigation may be different from those encountered during the construction phase of the project.

We have and are continuing to collect periodic inclinometer data from the B-1 location. As of this writing, there may be local movements occurring above about 18 feet below grade; however, these movements could be within the degree of error for the equipment. Regardless, the proposed mitigation would be intended to eliminate the risk of significant lateral movements.

Former Drainage

We understand that a deep interceptor drain was placed south and upslope of 207th Street NE in approximately 2014. From our discussions, the drain is likely about 12 to 15 feet below existing site elevations.

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From our observations of groundwater in the borings, as well as the depth to groundwater in the borings, it appears that this drain was not placed deep enough to intercept and remove lower groundwater regimes in the slope but may be removing shallow seepage that occurs in late winter and spring months.

This drain can be removed as part of future site development. The new drains and other mitigation will eliminate the need for this system.

6.0 Geologic Hazards

6.1 Landslide Hazard

The western half of the property contains landslide hazards due to documented slope movements. There are steep slope areas on site; however, these slopes were created through previous grading. Most of the natural slopes have magnitudes of less than 35 percent. Most of the slopes in the eastern half of the property have not been obviously modified through prior grading. These slopes are gentle to moderate and locally consist of steep slope hazard areas based on magnitude. Additionally, clay was not observed in our borings in the eastern portion of the site.

The following are excerpts from the City of Arlington Municipal Code. Our comments or confirmation of relevant aspects present at the site are underlined.

20.93.600 - Classification.

Geologically hazardous areas include areas susceptible to erosion, sliding, earthquakes, liquefaction, or other geological events. Geologically hazardous areas shall be classified based upon the history or existence of landslides, unstable soils, steep slopes, high erosion potential or seismic hazards. In determining the significance of a geologically hazardous area the following criteria shall be used:

- Potential economic, health, safety, and environmental impact related to construction in the area;
- Soil type, slope, vegetative cover, and climate of the area;
- Available documentation of history of soil movement, the presence of mass wastage, debris flow, rapid stream incision, stream bank erosion or undercutting by wave action, or the presence of an alluvial fan which may be subject to inundation, debris flows, or deposition of stream-transported sediments.

The different types of geologically hazardous areas are defined as follows:

- Erosion hazard areas are as defined by the USDA Soil Conservation Service, United States Geologic Survey, or by the Department of Ecology Coastal Zone Atlas. The following classes are high erosion hazard areas.
- Class 3, class U (unstable) includes severe erosion hazards and rapid surface runoff areas;
- Class 4, class UOS (unstable old slides) includes areas having severe limitations due to slope; and,
- Class 5, class URS (unstable recent slides).

Landslide hazard areas shall include areas subject to severe risk of landslide based on a combination of geologic, topographic and hydrologic factors. Some of these areas may be identified in the Department of Ecology Coastal Zone Atlas, or through site-specific criteria. Landslide hazard areas include any of the following:

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- Areas characterized by slopes greater than fifteen percent and impermeable soils (typically silt and clay) frequently interbedded with permeable granular soils (predominantly sand and gravel) or impermeable soils overlain with permeable soils or springs or groundwater seepage;
- Any area that has exhibited movement during the Holocene epoch (from ten thousand years ago to present) or which is underlain by mass wastage debris of that epoch;
- Any area potentially unstable due to rapid stream incision, stream bank erosion or undercutting by wave action;
- Any area located on an alluvial fan presently subject to or potentially subject to inundation by debris flows or deposition of steam-transported sediments;
- Any area with a slope of thirty-three percent or greater and with a vertical relief of ten or more feet except areas composed of consolidated rock;
- Any area with slope defined by the United States Department of Agriculture Soil Conservation Service as having a severe limitation for building site development; and
- Any shoreline designated or mapped as class U, UOS, or URS by the Department of Ecology Coastal Zone Atlas.

Slopes.

- Moderate slopes shall include any slope greater than or equal to fifteen percent and less than thirty-three percent.
- Steep slopes shall include any slope greater than or equal to thirty-three percent.

20.93.630 - Requirements.

Landslide hazard areas. All development proposals on sites containing landslide hazard areas shall comply with the following requirements:

- Alterations. Landslide hazard areas located on slopes thirty-three percent or greater shall be altered only as allowed under standards for steep slopes set forth in this section. Landslide hazard areas and land adjacent to such a hazard area located on slopes less than thirty-three percent may be altered if:
- The proposal will not increase surface water discharge or sedimentation and will not decrease adjacent property slope stability; and
- It can be demonstrated through geotechnical analysis that there is no significant risk to the development proposal or adjacent properties or that the proposal can be designed so that the landslide hazard is significantly eliminated or mitigated such that the site and adjacent property are rendered as safe as an area without landslide hazards.
- Buffers. Unless the alteration is approved under the provisions in subsection (1) (Alterations), a minimum buffer of fifty feet shall be provided from the edges of all landslide hazard areas regardless of slope. The buffer may be extended beyond these limits to mitigate erosion hazards.

The landslide area at the site contains slopes with magnitudes mostly lower than 33 percent. There are steeper slopes; however, most of these are a result of prior (presumed legal) grading. This legal grading in conjunction with heavy precipitation events (and snowmelt) likely caused the observed historic landslide activity. The recommendations and analyses in this report indicate that slope stability within the site area can be sufficiently maintained, allowing for future and ongoing site development.

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The eastern half of the site locally contains steep slope hazard areas. We did not observe evidence of landslide activity in these areas and landslide mitigation is not required at this time. Proper drainage systems will be necessary to maintain the current level of stability.

Special Note: There is a steep slope area in the southeast corner of the property. This slope is partially developed with high tension power line systems with evidence of former grading. This slope is stable at this time with no evidence of historic landslide activity or severe erosion. That said, the slope is partially developed with low lying vegetation and could experience shallow sloughing, particularly during the wet season. We anticipate that new structures could be setback 15 feet from the toe of the slope (anticipated to be partially re-graded); however, we anticipate that some level of mitigation will be necessary. This could include a soldier pile wall with catchment capability (depending on cut depths), concrete walls, or modular block walls with geogrid reinforcement to act as a buttress. The type and height of any system will depend on the final grading plan and our specific area analysis.

In general, slope and hazard buffers may be reduced to the lowest minimum required by the City of Arlington. Most of the site has been previously graded and portions of the proposed development are within existing hazards; therefore, a buffer is not relevant. Provided proper mitigation of the hazards is performed, buffers are not useful or warranted.

6.2 Erosion Hazard

The Natural Resources Conservation Services (NRCS) maps for Snohomish County indicate that much of the site located north of 207th Street NE is underlain by Norma loam. The area south of 207th Street NE is underlain by Pastik silt loam (8 to 25 percent slopes). In general, these types of soils have a moderate to severe erosion potential in a disturbed state.

It is our opinion that soil erosion potential at this project site can be reduced through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, such as silt fences, hay bales, mulching, control ditches and diversion trenches. The typical wet weather season, with regard to site grading, is from October 31st to April 1st. Erosion control measures should be in place before the onset of wet weather.

6.3 Seismic Hazard

The overall subsurface profile corresponds to a Site Class *D* as defined by Table 1613.5.2 of the 2015 International Building Code (2015 IBC). A Site Class *D* applies to an overall profile consisting of medium dense or stiff soils within the upper 100 feet.

We referenced the U.S. Geological Survey (USGS) Earthquake Hazards Program Website to obtain values for S_S, S_1, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The site specific seismic design parameters and adjusted maximum spectral response acceleration parameters are as follows:

PGA	(Peak Ground Acceleration, in percent of g)
S_S	105.30% of g
S_1	40.90% of g

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F_A	1.079
F_V	1.591

Additional seismic considerations include liquefaction potential and amplification of ground motions by soft/loose soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. The underlying soils are generally stiff and very fine-grained. These soils have a low potential for liquefaction. The above parameters are based on ASCE 7-10. We should be notified if this project will require values from ASCE 7-16.

6.4 Slope Stability Analyses

We performed slope stability analyses through cross sections across the property and through the proposed development. These sections are within the older landslide affected area and further east in non-affected areas.

These analyses were performed in order to determine suitable options for landslide mitigation to prevent run-out or other adverse effects from the hillside south of 207th Street NE on the proposed development as well as movements above the mitigation.

The commercially available slope stability computer program Slope/W was used to evaluate the global stability of the slopes during the 1995 landslide, current conditions, and following mitigation implementation. The slope stability was analyzed under static and seismic (pseudo-static method) conditions for relevant topographic, geologic, and groundwater conditions.

The computer program calculates factors of safety for potential slope failures and generates the potential failure planes. This software calculates the slope stability under seismic conditions using pseudo-static methods. The stability of the described configuration was analyzed by comparing observed factors of safety to minimum values as set by standard geotechnical practice.

A factor of safety of 1.0 is considered equilibrium and less than 1.0 is considered failure. The required factor of safety for global stability is 1.5 for static conditions and 1.1 for seismic conditions. We used a horizontal peak ground acceleration of 0.21g, which is one half of the peak ground acceleration (PGA).

In order to confirm our estimated soil parameters, we conducted back-analyses with a factor of safety slightly below 1.0 for static conditions for the 1995 landslide event. We then analyzed slope stability utilizing various mitigation techniques, including pile wall reinforcement, buttressing, and other grading modifications.

Soil parameters were determined through N-value data, soil classification, laboratory data, nearby geotechnical report information, and from Geotechnical Properties for Landslide-Prone Seattle – Area Glacial Deposits (2000) by Savage, Morrissey, and Baum.

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The following estimated soil parameters were used in our analyses:

Soil Parameters at Failure	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Colluvium/Slide Material	135	50	10
Advance Outwash	120	0	38
Recessional Lacustrine Deposits	135	50	22
Transitional Beds	125	250	34

Current Soil Parameters	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Colluvium/Slide Material	125	150	10
Advance Outwash	120	0	38
Recessional Lacustrine Deposits	125	100	22
Transitional Beds	125	250	34

Slope Stability Results

Cross Section A to A'	Static Factor of Safety	0.21g Seismic Factor of Safety
Existing Conditions	1.552	0.772
Conditions During 1995 Landslide	0.982	-
Post Mitigation Conditions	1.978	1.204

Cross Section B to B'	Static Factor of Safety	0.21g Seismic Factor of Safety
Existing Conditions	1.765	0.799
Conditions During 1995 Landslide	1.003	-
Post Mitigation Conditions	4.225	1.141

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The analyses indicate that a combination of high groundwater and removal of soil mass near the toe of the slope likely caused the landslide event in 1995. It is possible that excavation of the two large ponds in the late 1960's may have led to global instability prior to the 1995 construction.

Since cohesive soils often remain weak following landslide activity, it will be necessary to construct a soldier pile or drilled shaft/secant pile wall with drainage systems to reduce the likelihood of future instability in the site area. Our analyses indicate that a pile wall with 200 kips of restraining force per 6-foot pile spacing results in adequate factors of safety.

Please note that our analyses utilized multiple groundwater levels at failure and groundwater along the top/within the silt/clay interbeds. We anticipate that Y-shaped finger drains extending into these soils will help further drain these soils. The post-mitigation analyses utilized a lower groundwater level but not a fully eliminated groundwater zone in the clay/silt. If the drainage systems adequately drain this zone of soil, the factors of safety would be expected to be slightly higher than indicated.

7.0 DISCUSSION

7.1.1 General

It is our opinion that the likelihood of future landslide activity at the site is low to moderate at this time. Construction of 207th Street NE (mass excavations) coupled with very high groundwater elevations and precipitation in late 1995 was the likely cause of the landslide activity. Landslide activity was particularly high in 1995 due to heavy precipitation throughout the Puget Sound region. The combination of very heavy precipitation, denuded slope areas above the failure, and mass excavation of the toe of a slope underlain by local clay, resulted in the failure at the site.

The primary causes of any future landslide activity would be increases in groundwater/surface water in upland areas, surcharge loading, and seismic activity.

Construction of a cantilever or tieback reinforced soldier pile wall and drainage systems to lower groundwater elevations can increase stability to required levels. A drilled shaft or drained secant pile wall with grade beam system could also be considered.

Preliminarily, new residential structures may be supported on shallow foundation systems bearing on properly compacted structural fill placed on medium dense/stiff native soils, or on existing medium dense/stiff native soils. Due to the presence of locally loose/soft soils, some overexcavation and replacement may be required. Additional foundation support options may include near surface soil mitigation with dry cement to create a more stable sub-base. If building loads are anticipated to be moderate to high, pipe piles, auger-cast piles, or helical anchors may be considered. We have included several options for estimating.

The existing interceptor drain may be removed as part of site development with the new deep wall system and deeper drains.

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8.0 Recommendations

8.1.1 Site Preparation and Structural Fill

It will be necessary to remove topsoil and loose colluvium as part of mass grading and site development. Based on observations from the site investigation program, it is anticipated that the stripping depth will range from 8 to 24 inches. The highly organic and other poor quality materials may be used in non-structural landscaped areas elsewhere on site. These soils are not suitable for use as wall backfill or in other structural areas.

The near-surface soils consist of silty-sand, sandy-silt, and various mixtures of silt, sand, and clay. In general, non-plastic soils (mixtures of silt and sand) may be considered suitable for use as structural fill. All soils used as structural fill should be within 3 percent of the optimum moisture content during compaction. Soils that are moderately to highly plastic, such as clayey silts, clays, and other very fine grained soils, will not be suitable for use as structural fill without amendment. We can provide specific amendment recommendations upon request. Note that all near surface soils have higher than optimum moisture content, even in the summer. Significant drying or amendment with cement will likely be required to allow any and all of the site soils to be used as fill.

Imported structural fill should consist of a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve).

Structural fill should be placed in maximum lift thicknesses of 12 inches and should be compacted to a minimum of 95 percent of the modified proctor maximum dry density, as determined by the ASTM D 1557 test method.

8.1.2 Temporary Excavations

The backfill zone behind any retaining wall should be benched prior to fill placement. Benches should be excavated into firm native soils with a maximum height of 4 feet and minimum length of 6 feet. This results in a maximum temporary excavation slope of 1.5H:1V (horizontal to vertical). The benching and fill placement work should be periodically monitored by the geotechnical engineer. There should be no surcharges, such as soil stockpiles, located above any temporary excavation unless work is taking place.

Temporary cuts should be in accordance with the Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. Temporary slopes should be visually inspected daily by a qualified person during construction activities and the inspections should be documented in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and reducing slope erosion during construction.

Temporary cut slopes should be covered with visqueen to help reduce erosion during wet weather, and the slopes should be closely monitored until the permanent retaining systems or slope configurations are complete. Materials should not be stored or equipment operated within 10 feet of the top of any temporary cut slope.

Soil conditions may not be completely known from the geotechnical investigation. In the case of temporary cuts, the existing soil conditions may not be completely revealed until the excavation work

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exposes the soil. Typically, as excavation work progresses the maximum inclination of temporary slopes will need to be re-evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed and required deadlines can be met.

If any variations or undesirable conditions are encountered during construction, we should be notified so that supplemental recommendations can be made. If room constraints or groundwater conditions do not permit temporary slopes to be cut to the maximum angles allowed by the WAC, temporary shoring systems may be required. The contractor should be responsible for developing temporary shoring systems, if needed. We recommend that Cobalt Geosciences and the project structural engineer review temporary shoring designs prior to installation, to verify the suitability of the proposed systems.

8.1.3 Erosion and Sediment Control

Erosion and sediment control (ESC) is used to reduce the transportation of eroded sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented and these measures should be in general accordance with local regulations. At a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features for the site:

- Schedule the soil, foundation, utility, and other work requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be completed during the wet season (generally October through April).
- All site work should be completed and stabilized as quickly as possible.
- Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.
- Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited other filtration methods will need to be incorporated.

8.1.4 Foundation Design

Preliminarily, new residential structures may be supported on shallow foundation systems bearing on properly compacted structural fill placed on medium dense/stiff native soils, or on existing medium dense/stiff native soils. Due to the presence of locally loose/soft soils, some overexcavation and replacement may be required. Note that during the wet season (October through April with possible issues through June), the near surface soils are more apt to be wet and require removal and replacement or modification with dry cement.

Additional foundation support options may be considered, particularly if building loads are expected to be moderate to high. We can provide additional input upon request.

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Foundation Options

Shallow Foundations

The proposed residential structures may be supported on shallow spread footing foundation systems bearing on undisturbed stiff/medium dense or firmer native soils or on properly compacted structural fill placed on the suitable native soils. Any undocumented fill or loose soils should be removed and replaced with structural fill below foundation elements. Structural fill below footings should consist of clean angular rock 5/8 to 2 inches in size.

We anticipate that local overexcavation and replacement will be necessary in some areas. The depth of overexcavation and replacement will vary from about 1 to 3 feet. We can provide additional and alternative foundation support recommendations upon request. These may include installation of foundations with interconnecting grade beams, geotextile fabric placement, cement treatment of near surface soils, and the use of angular rock over the geogrid.

For shallow foundation support, we recommend widths of at least 16 and 24 inches, respectively, for continuous wall and isolated column footings supporting the proposed structures. Provided that the footings are supported as recommended above, a net allowable bearing pressure of 1,500 pounds per square foot (psf) may be used for design.

A 1/3 increase in the above value may be used for short duration loads, such as those imposed by wind and seismic events. Structural fill placed on bearing, native subgrade should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Footing excavations should be inspected to verify that the foundations will bear on suitable material.

Exterior footings should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Interior footings should have a minimum depth of 12 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower.

If constructed as recommended, the total foundation settlement is not expected to exceed 1 inch. Differential settlement, along a 25-foot exterior wall footing, or between adjoining column footings, should be less than ½ inch. This translates to an angular distortion of 0.002. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated. All footing excavations should be observed by a qualified geotechnical consultant.

Resistance to lateral footing displacement can be determined using an allowable friction factor of 0.30 acting between the base of foundations and the supporting subgrades. Lateral resistance for footings can also be developed using an allowable equivalent fluid passive pressure of 225 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglect the upper 12 inches below grade in exterior areas). The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance.

Care should be taken to prevent wetting or drying of the bearing materials during construction. Any extremely wet or dry materials, or any loose or disturbed materials at the bottom of the footing excavations, should be removed prior to placing concrete. The potential for wetting or drying of the bearing materials can be reduced by pouring concrete as soon as possible after completing the footing excavation and evaluating the bearing surface by the geotechnical engineer or his representative.

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Other Foundation Systems

The following sections include alternative systems if higher building loads are anticipated. We can provide additional input once building loads have been determined.

Rock Columns

Shallow perimeter and column footings for the buildings may be supported on compacted rock columns or geopiers.

We anticipate that compacted rock columns/aggregate piers will need to extend 10 to 20 feet below current site elevations to provide a higher bearing capacity for foundations. If a proprietary design system is utilized, the designer may elect to modify the required depth of the ground improvement program if deemed appropriate and suitable.

Provided that the concrete grade beam footings are supported on a system of compacted rock columns, a net allowable bearing pressure of 4,000 pounds per square foot (psf) can often be utilized for foundation design. Final structural design should be prepared by a structural engineer experienced with aggregate piers. We recommend that at least one load test be performed to verify adequate bearing capacity.

Resistance to lateral footing displacement can be determined using an allowable friction factor of 0.40 acting between the base of foundations and the supporting subgrades. Lateral resistance for footings can also be developed using an allowable equivalent fluid passive pressure of 225 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglect the upper 12 inches below grade in exterior areas). The allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance.

Mat Foundations

It is our opinion that support of the buildings on rigid or flexible mat foundation systems with interconnecting grade beams or structural slab is also suitable. Grade beams should have a maximum 10 feet spacing in any direction.

A net allowable bearing pressure of 1,500 pounds per square foot (psf) may be used for design of the mat/raft foundations. We recommend removal and replacement of the upper 12 inches of existing soil below foundation elements. Tensar TX150 should be placed over the resulting subgrade and the removed soil should be replaced with 1-1/4 inch crushed rock compacted to at least 95 percent of the modified proctor. Foundation excavations should be inspected to verify that the elements will bear on suitable material.

Exterior footings should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Once the final design plans have been determined, we should be allowed to review the plans for conformance with our recommendations.

Driven Pipe Piles

The proposed structures may be supported on shallow spread footing foundation systems bearing on driven steel pipe piles.

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Pin piles used for foundation support should consist of three or four-inch diameter, Schedule 40, galvanized, steel pipes. Allowable axial compression capacities of 6 and 10 tons may be used for these piles, respectively.

The required pile length in order to develop the recommended pile capacity is expected to vary depending on the depth of loose/soft soils across the proposed building footprints. For cost estimating purposes, a pile length of about 25 to 40 feet should be expected.

Pile caps and grade beams should be used to transmit loads to the piles. Isolated pile caps should include a minimum of two piles to reduce the potential for eccentric loads.

Three and four-inch diameter piles are typically installed using small (approximately 650 to 1,100 pound) hammers mounted to an excavator. Refusal criteria is the minimum amount of time (in seconds) required to achieve one inch of penetration, and it varies with the size of hammer used for pile driving. Penetration resistance required to achieve the capacities will be determined from the hammer size.

The following is a summary of typical driving refusal criteria for different hammer sizes that are commonly used for three and four-inch diameter piles.

Hammer	Hammer Weight (lb) / Blows per minute	3" Pile Refusal Criteria (seconds per inch)	4" Pile Refusal Criteria (seconds per inch of penetration)
Hydraulic TB 225	650 / 550 - 1100	12	20
Hydraulic TB 325	850 / 550 - 1100	10	16
Hydraulic TB 425	1,100 / 550 - 1100	6	10

Alternative hammer sizes may be used; however, the contractor should provide adequate information to verify equivalence and refusal criteria. Pile splices may be made with compression fitted sleeve pipe couplers (mechanical couplers).

A total of 3 percent of the pin piles (one pile minimum) should be load tested to verify the design capacities. All load tests shall be performed in accordance with the procedure outlined in ASTM D1143. The maximum test load shall be 2 times the design load (i.e. 2 x 10 tons = 20 tons). Passive resistance values may be determined using an equivalent fluid weight of 225 pounds per cubic foot (pcf).

A representative of the geotechnical engineer shall provide full time observation of pile installation and testing to verify the driving refusal criteria.

It is our experience that the driven pipe pile foundations should provide adequate support with total settlements on the order of $^1/_2$-inch or less.

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A structural engineer shall perform the structural design of the pile including spacing and reinforcing steel. The structural engineer also should determine the buckling load for the slender piles and make sure that is not exceeded.

Helical Piers®

Helical Piers® may be used to support new foundation systems. The Helical Piers® could be installed using portable rotary tools, truck mounted rotary tools, backhoe mounted rotary tools, caisson drills, or skid-steer loaders. It is important that the torque output, rotational speed, down pressure capability, and angle control of the installation equipment is compatible with the required foundation system. The pile installation equipment should have adequate torque capacity to prevent refusal conditions at relatively shallower depths that are well above recommended bearing depths or layers.

A Helical Pier® consists of an anchor (lead section) with 1, 2, 3 or more helical flights on a shaft. The number and diameter of the helices on the anchor are dependent on the soil characteristics of the site and the design loads to be applied to the pier. Based on these parameters the anchor helix configuration is chosen to best fit the site conditions.

As the anchor is advanced into the soil extension sections (shaft) are placed on the lead section. The shaft configuration is based on the design loads and anticipated installation torque.

The static compression load capacity of a Helical Pier® is the sum of all individual helix capacities below liquefiable soils and in bearing layer. Individual helix static compression capacity is the result of the projected area of the helix, and its bearing pressure.

It is recommended that the piers penetrate into relatively dense native soils a minimum of 7 feet, or until refusal whichever is shallower. The bearing layer will be at variable depths below the existing ground surface with an estimated range of 20 to 35 feet below grade. Increased capacity can be obtained with increased penetration, and additional helical flights on the lead section.

Helical Pier® installation should be monitored to verify installation torque, and proper embedment into the presumed bearing layer. The Helical Pier® lengths may need to be modified during construction if it is determined that the depth to the bearing layer varies. Helical Pier® anchors are well suited to field adjustments as length can be varied by merely adding or deleting extension sections (shafts) during installation.

Monitoring installation torque in the field is used to estimate the anchor compression capacity, and also as a quality control during anchor installation, provided that the anchor is bearing in dense or hard soils. Dependent on the pile size and the equipment used to install the anchors, an empirical factor is multiplied by the average torque over the final 3 feet of installation to estimate ultimate capacity.

Allowable Helical Pier Compression Capacity Pa may be estimated from the following equation provided that the pier is in the recommended bearing soils:

Pa = Kt x T/FoS,

Where T is the applied torque, Kt is the empirical ratio factor. The following industry standards apply to shafts with blades spaced along the shaft at 2.5 to 3.5 times the average blade diameter on-center and meeting the manufacturer's specifications.

1.5" and 1.75" Square Shafts - Kt = 9 ft-1

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2.875" O.D. Round Shafts - Kt = 9 ft-1

3.0" O.D. Round Shafts - Kt = 8 ft-1

3.5" O.D. Round Shafts - Kt = 7 ft-1

Proof testing of at least twenty percent of the helical piers in six (6) equal increments up to 150 percent of the design load. Each load increment up to the 150 percent of design load should be held for five (5) minutes and the vertical strain monitored. If the total strain between 1 and 5 minutes is less than 0.04 inches, the helical pier may be considered acceptable. If the recorded strain exceeds 0.04 inches, the helical pier should either be deepened and retested or abandoned and a new helical pier shall be installed and tested.

8.1.5 Concrete Retaining Walls

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls with a level backslope. Contact Cobalt if an alternate retaining wall system is used. This has been included for free standing concrete walls, basements, and detention vaults.

Wall Design Criteria	
"At-rest" Conditions (Lateral Earth Pressure – EFD+)	60 pcf (Equivalent Fluid Density)
"Active" Conditions (Lateral Earth Pressure – EFD+)	40 pcf (Equivalent Fluid Density)
Seismic Increase for "At-rest" Conditions (Lateral Earth Pressure)	21H* (Uniform Distribution) 1 in 2,500 year event
Seismic Increase for "At-rest" Conditions (Lateral Earth Pressure)	14H* (Uniform Distribution) 1 in 500 year event
Seismic Increase for "Active" Conditions (Lateral Earth Pressure)	7H* (Uniform Distribution)
Passive Earth Pressure on Low Side of Wall (Allowable, includes F.S. = 1.5)	Neglect upper 2 feet, then 225 pcf EFD+
Soil-Footing Coefficient of Sliding Friction (Allowable; includes F.S. = 1.5)	0.30

*H is the height of the wall; Increase based on one in 500 year seismic event (10 percent probability of being exceeded in 50 years),
+EFD – Equivalent Fluid Density

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls. Uniform horizontal lateral active and at-rest pressures on the retaining walls from vertical surcharges behind the wall may be calculated using active and at-rest lateral earth pressure coefficients of 0.3 and 0.5, respectively. A soil unit weight of 125 pcf may be used to calculate vertical earth surcharges.

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To reduce the potential for the buildup of water pressure against the walls, continuous footing drains (with cleanouts) should be provided at the bases of the walls. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, with perforations placed down and enveloped by a minimum 6 inches of pea gravel in all directions.

The backfill adjacent to and extending a lateral distance behind the walls at least 2 feet should consist of free-draining granular material. All free draining backfill should contain less than 3 percent fines (passing the U.S. Standard No. 200 Sieve) based upon the fraction passing the U.S. Standard No. 4 Sieve with at least 30 percent of the material being retained on the U.S. Standard No. 4 Sieve. The primary purpose of the free-draining material is the reduction of hydrostatic pressure. Some potential for the moisture to contact the back face of the wall may exist, even with treatment, which may require that more extensive waterproofing be specified for walls, which require interior moisture sensitive finishes.

We recommend that the backfill be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. In place density tests should be performed to verify adequate compaction. Soil compactors place transient surcharges on the backfill. Consequently, only light hand operated equipment is recommended within 3 feet of walls so that excessive stress is not imposed on the walls.

8.1.6 Soldier Pile Walls

Our preliminary analyses indicate that adequate factors of safety to prevent slope movements from affecting the proposed development in the western half (landslide affected areas) can be achieved through soldier pile wall construction. Our initial analyses indicate that a buried wall with a pile spacing of 6 feet on center, lateral force (restraint) of 200,000 lbf per spacing should increase stability to the required levels. We analyzed the stability using a 40-foot pile length. Figure 2 shows the possible pile wall location.

Soldier piles typically consist of steel W or H-beams inserted into oversized drilled shafts, which are backfilled with structural concrete, lean mix {Controlled Density Fill (CDF)}, or a combination of lean mix to the base of the excavation and structural concrete below the excavation to anchor the soldier piles. Permanent piles should either be coated or upsized to account for oxidation over time.

The shoring system should be monitored for movement during construction. A system of survey points should be established prior to commencing with the excavation activities. Readings should be taken periodically until the permanent wall is in place and these readings should be compared to the original baseline measurements. We also recommend installing a slope inclinometer along at least one pile during construction. The inclinometer should be the same length as the pile, be attached mechanically to minimize incidental movements, and not be located within 15 feet of either end of the wall. Monitoring should occur at least quarterly (every 3 months) for at least 3 quarters of a calendar year. If movements are ongoing, additional monitoring may be required/recommended.

Due to the potential for local caving during drilling operations for the soldier pile holes due to soft soil conditions and shallow groundwater, consideration should be given to using slurry or drilling fluid to reduce the risk of caving of the pile holes during installation. If water is present within the pile hole at the time of soldier pile concrete placement, the concrete should be placed starting at the bottom of the hole with a tremie pipe and the column of concrete should be raised slowly to displace the water.

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We recommend that soldier piles have a maximum spacing of six feet on center. Our analyses indicate that each six feet section of wall should have a minimum lateral support of 200 kips. This may require installation of one or more rows of tiebacks if a suitably strong pile wall cannot be designed.

Cantilever soldier pile walls for this site may be designed based on an active lateral earth pressure of 40 pcf (equivalent fluid pressure) for static, level conditions provided the wall is unrestrained (not fixed; permitted to move at least 0.2 percent of the wall height). The pressure will act on the soldier pile width below the base of the excavation as well. All applicable surcharge pressures should be included. Seismic coefficient of 0.21g shall be used. Lateral uniform seismic pressure of 7H is recommended for seismic conditions.

In front of the soldier piles, resistive pressure can be estimated using an allowable passive earth pressure of 300 pcf acting over 2 times the soldier pile diameter, neglecting the upper 15 feet below the existing ground surface. A factor of safety of 1.5 has been incorporated into the passive pressure value. A decreased pressure of 150 pcf may be used from 2 to 15 feet below grade. All parameters are preliminary until a final grading plan has been prepared.

We recommend that the piles be designed for an allowable end bearing pressure of 15,000 psf and an allowable skin friction value of 1,500 psf, with a pile embedment of at least 30 feet below existing grade in dense to very dense Advance Outwash or Transitional Beds. We recommend a lateral modulus of subgrade reaction value of 1,000 kips per cubic foot (kcf) for design of the soldier piles in the dense to very dense soils. A width factor of 1 times the soldier pile diameter may be used for the lateral modulus of subgrade reaction. We can provide tieback parameters once the design phases move forward.

8.1.7 Interceptor Drains

To help reduce surface water infiltration and shallow groundwater, we recommend construction of a drain upslope of the upper loop road in the western half of the property (Figure 2) along with bird foot drains locally below (north-northwest) of this area. The final location and depths of the drain will depend on the soil conditions, final grading, and observations during construction. We anticipate a likely depth of 15 feet below the proposed upper roadway elevations. Bird foot drains will likely require excavations of 10 to 25 feet after mass grading. Due to the significant depth, it may be necessary to utilize laterally drilled drains in some locations.

Drain construction will require excavations of about 15 feet below the roadway elevation to intercept shallow groundwater. The drainage excavations should be at least 1.5 feet wide and we anticipate that trench box shoring will be required as part of construction. The following elements should be incorporated into the cutoff drain:

- Bottom of trench at least 12 inches into very stiff Transitional Beds (anticipated) below the landslide debris, below groundwater, and as verified by geotechnical engineer during construction
- Minimum width of 1.5 feet and likely depth of about 15 feet below existing site elevations for upper drain and 10 to 25 feet for bird-s foot drains
- Preliminary drain location shown in Figure 2. Final location to be determined.
- Minimum 6-inch diameter perforated PVC pipe (Schedule 35 or greater) placed level within the trench and on top of a 3 to 6 inch thickness of clean rock*
- Backfill should consist of clean rock* to a depth of 6 feet below existing site elevations

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- Mirafi 140N to be placed over rock backfill with upper backfill to consist of structural fill compacted per Section 8.1.1.

*Clean rock may consist of 1.5-inch diameter washed rock, 2-inch angular ballast, or 2-4 inch angular quarry rock.

Figure 3 shows a generalized section of the interceptor drain system. The perforated PVC pipe should be connected to tightline pipes extending downslope and into the detention vault or pond.

8.1.8 Stormwater Management

We do not recommend the use of any permeable pavements or infiltration systems within the development. We recommend that all collected runoff be tightlined and routed into one or more detention vaults or ponds likely located in the northern half of the property.

The shallow soils are fine grained and generally impermeable in most areas. Additionally, the site has experienced landslide activity and since surface and groundwater is a common contributing factor in landslide activity, infiltration is not feasible or recommended. Similarly, we do not recommend using rain gardens or dispersion devices on building lots within the development. We can provide additional input on stormwater infrastructure as the design phases proceed.

8.1.9 Slab on Grade

We recommend that the upper 18 inches of the existing fill and/or native soils within slab areas be re-compacted to at least 95 percent of the modified proctor (ASTM D1557 Test Method). If the subsurface soils are loose/soft to greater depths, we recommend placement of Mirafi 5xt over the resulting subgrade prior to fill placement up to subgrade. Fill over the geogrid should be compacted per the specifications above and may consist of clean or crushed 1.5 to 2 inch sized rock. Note that a lot by lot evaluation will be necessary to determine existing soil conditions and depth of overexcavation/replacement, if required.

Often, a vapor barrier is considered below concrete slab areas. However, the usage of a vapor barrier could result in curling of the concrete slab at joints. Floor covers sensitive to moisture typically requires the usage of a vapor barrier. A materials or structural engineer should be consulted regarding the detailing of the vapor barrier below concrete slabs. Exterior slabs typically do not utilize vapor barriers.

The American Concrete Institutes ACI 360R-06 Design of Slabs on Grade and ACI 302.1R-04 Guide for Concrete Floor and Slab Construction are recommended references for vapor barrier selection and floor slab detailing.

Slabs on grade may be designed using a coefficient of subgrade reaction of 150 pounds per cubic inch (pci) assuming the slab-on-grade base course is underlain by structural fill placed and compacted as outlined in Section 8.1. A 4 to 6-inch-thick capillary break consisting of 5/8-inch clean angular rock or pea gravel should be placed over the prepared subgrade.

A perimeter drainage system is required around every building foundation system and behind any retaining walls. The perimeter drainage system should consist of a 4-inch diameter perforated drain pipe surrounded by a minimum 6 inches of drain rock wrapped in a non-woven geosynthetic filter fabric to

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reduce migration of soil particles into the drainage system. The perimeter drainage system should discharge by gravity flow to a suitable stormwater system.

Exterior grades surrounding buildings should be sloped at a minimum of one percent to facilitate surface water flow away from the building and preferably with a relatively impermeable surface cover immediately adjacent to the building.

8.1.10 Groundwater Influence on Construction

Groundwater was encountered at varying depths below existing site elevations. In general, we anticipate that perched groundwater will be present within 15 feet of the ground surface during the wet season.

There may be light volumes of shallow groundwater in shallow utility excavations that take place during the wet season. We anticipate that typical sump excavations and small pumps will be adequate to de-water these areas. If larger volumes of groundwater are encountered in deeper excavations, a series of well points may be necessary. While we do not expect this to be likely, the contractor should be prepared to provide a contingency plan for one or more types of groundwater removal systems.

8.1.11 Utilities

Utility trenches should be excavated according to accepted engineering practices following OSHA (Occupational Safety and Health Administration) standards, by a contractor experienced in such work. The contractor is responsible for the safety of open trenches. Traffic and vibration adjacent to trench walls should be reduced; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation.

In general, fine grained soils were encountered at shallow depths in the explorations at this site. These soils have low cohesion and density and will have a tendency to cave or slough in excavations. Shoring or sloping back trench sidewalls is required within these soils in excavations greater than 4 feet deep.

All utility trench backfill should consist of imported structural fill or suitable on site soils. Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. The upper 5 feet of utility trench backfill placed in pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Below 5 feet, utility trench backfill in pavement areas should be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557.Smoke3y Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

The contractor is responsible for removing all water-sensitive soils from the trenches regardless of the backfill location and compaction requirements. Depending on the depth and location of the proposed utilities, we anticipate the need to re-compact existing fill soils below the utility structures and pipes. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction procedures.

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8.1.12 Pavement Recommendations

The near surface subgrade soils include silty-sand, silt with sand, and silt trace to some sand. These soils are rated as fair for pavement subgrade material (depending on silt content and moisture conditions). We estimate that the subgrade will have a California Bearing Ratio (CBR) value of 8 and a modulus of subgrade reaction value of k = 180 pci, provided the subgrade is prepared in general accordance with our recommendations.

We recommend that at a minimum, 18 inches of the existing subgrade material be moisture conditioned (as necessary) and re-compacted to prepare for the construction of pavement sections. Deeper levels of recompaction or overexcavation and replacement may be necessary in areas where fill and/or very poor (soft/loose) soils are present. Any soils that cannot be compacted to required levels should be removed and replaced with imported structural fill. The finer grained soils (typically more than 50 percent fines) should be removed and replaced with sand and gravel. The silt may be used as fill in non-structural areas.

If subsurface soils are difficult to recompact due to fines or moisture levels, a geotextile should be placed over the soils at varying depths. The depth of stabilization will depend on the severity of the instability and depth. Mirafi 5xt may be used over the subgrade with at least 12 inches of structural fill compacted per the specifications above.

The subgrade should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. In place density tests should be performed to verify proper moisture content and adequate compaction.

The recommended flexible and rigid pavement sections are based on design CBR and modulus of subgrade reaction (k) values that are achieved, only following proper subgrade preparation. It should be noted that subgrade soils that have relatively high silt contents will likely be highly sensitive to moisture conditions. The subgrade strength and performance characteristics of a silty subgrade material may be dramatically reduced if this material becomes wet.

Based on our knowledge of the proposed project, we expect the traffic to range from light duty (passenger automobiles) to heavy duty (delivery trucks). The following tables show the recommended pavement sections for light duty and heavy duty use.

ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT

LIGHT DUTY

Asphaltic Concrete	Aggregate Base*	Compacted Subgrade* **
3.0 in.	6.0 in.	18.0 in.

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HEAVY DUTY

Asphaltic Concrete	Aggregate Base*	Compacted Subgrade* **
4.5 in.	6.0 in.	18.0 in.

PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT

Min. PCC Depth	Aggregate Base*	Compacted Subgrade* **
6.0 in.	10.0 in.	18.0 in.

** 95% compaction based on ASTM Test Method D1557*

*** A proof roll may be performed in lieu of in place density tests*

The asphaltic concrete depth in the flexible pavement tables should be a surface course type asphalt, such as Washington Department of Transportation (WSDOT) ½ inch HMA. The rigid pavement design is based on a Portland Cement Concrete (PCC) mix that has a 28 day compressive strength of 4,000 pounds per square inch (psi). The design is also based on a concrete flexural strength or modulus of rupture of 550 psi.

9.0 Construction Field Reviews

Cobalt Geosciences should be retained to provide part time field review during construction in order to verify that the soil conditions encountered are consistent with our design assumptions and that the intent of our recommendations is being met. This will require field and engineering review to:

- Monitor pile or other mitigation system installation
- Monitor inclinometers and survey data
- Observe drainage placement
- Verify foundation bearing and/or installation of support systems
- Monitor backfill and compaction
- Proofroll verification
- Observe excavation stability

Geotechnical design services should also be anticipated during the subsequent final design phase to support the structural design and address specific issues arising during this phase. Field and engineering review services will also be required during the construction phase in order to provide a Final Letter for the project. Note that these items are preliminary and based on our experience with similar projects.

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10.0 Closure

This report was prepared for the exclusive use of Lavoy, Inc. and their appointed consultants. Any use of this report or the material contained herein by third parties, or for other than the intended purpose, should first be approved in writing by Cobalt Geosciences, LLC.

The recommendations contained in this report are based on assumed continuity of soils with those of our test holes and assumed structural loads. Cobalt Geosciences should be provided with final architectural and civil drawings when they become available in order that we may review our design recommendations and advise of any revisions, if necessary. We anticipate that there will be a report update following any updates to plans and as mitigation layouts and designs are determined.

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Lavoy, Inc. who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Cobalt Geosciences should any of these not be satisfied.

Respectfully submitted,

Cobalt Geosciences, LLC

Original signed by:

10/11/2021

Phil Haberman, PE, LG, LEG
Principal

PH/sc

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APPENDIX A
Statement of General Conditions

Statement of General Conditions

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Cobalt Geosciences and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Cobalt Geosciences present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Cobalt Geosciences is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Cobalt Geosciences at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Cobalt Geosciences must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Cobalt Geosciences will not be responsible to any party for damages incurred as a result of failing to notify Cobalt Geosciences that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Cobalt Geosciences, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Cobalt Geosciences cannot be responsible for site work carried out without being present.

APPENDIX B
Figures: Vicinity Map, Site Plan, Cross Sections

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Unified Soil Classification System (USCS)

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS (more than 50% retained on No. 200 sieve)	Gravels (more than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with Fines (more than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (50% or more of coarse fraction passes the No. 4 sieve)	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sand, gravelly sands, little or no fines
		Sands with Fines (more than 12% fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (50% or more passes the No. 200 sieve)	Silts and Clays (liquid limit less than 50)	Inorganic	ML	Inorganic silts of low to medium plasticity, sandy silts, gravelly silts, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
		Organic	OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays (liquid limit 50 or more)	Inorganic	MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt
			CH	Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay
		Organic	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat, humus, swamp soils with high organic content (ASTM D4427)

Classification of Soil Constituents

MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).

Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).

Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).

Grain Size Definitions

Description	Sieve Number and/or Size
Fines	<#200 (0.08 mm)
Sand	
-Fine	#200 to #40 (0.08 to 0.4 mm)
-Medium	#40 to #10 (0.4 to 2 mm)
-Coarse	#10 to #4 (2 to 5 mm)
Gravel	
-Fine	#4 to 3/4 inch (5 to 19 mm)
-Coarse	3/4 to 3 inches (19 to 76 mm)
Cobbles	3 to 12 inches (75 to 305 mm)
Boulders	>12 inches (305 mm)

Relative Density (Coarse Grained Soils)

N, SPT, Blows/FT	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
Over 50	Very dense

Consistency (Fine Grained Soils)

N, SPT, Blows/FT	Relative Consistency
Under 2	Very soft
2 - 4	Soft
4 - 8	Medium stiff
8 - 15	Stiff
15 - 30	Very stiff
Over 30	Hard

Moisture Content Definitions

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

COBALT GEOSCIENCES

Soil Classification Chart

Appendix C
Figure C.1

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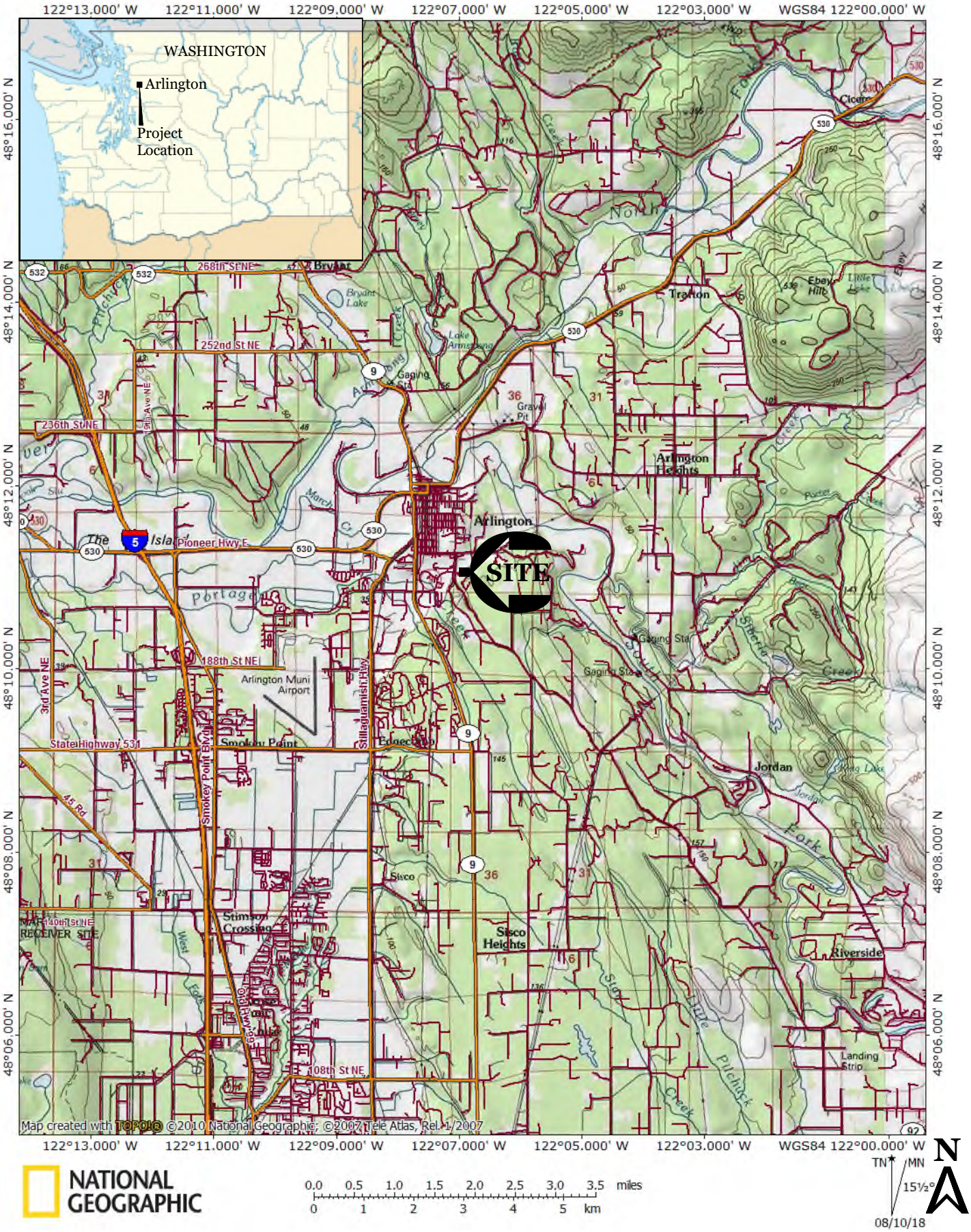

NATIONAL GEOGRAPHIC

COBALT GEOSCIENCES

Geotechnical Investigation
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Arlington, Washington

VICINITY MAP
FIGURE 1

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LEGEND

- **B-1** — Approximate Boring & Test Pit Location (Cobalt)
- **TP-1** — Approximate Test Pit Location (Terra, 11/2017)
- **TP-1** — Approximate Test Pit Location (Liu, 1/2017)
- **EB-1** — Approximate Boring Location (AESI, 4/2002)
- **EP-1** — Approximate Test Pit Location (AESI, 3/2002)
- **A** — Approximate Cross Section Location

Approximate Graphic Scale

50 0 50 100

(In Feet)

1 inch = 100 feet

N

COBALT GEOSCIENCES

Geotechnical Investigation
Arlington, Washington

SITE PLAN

FIGURE 2

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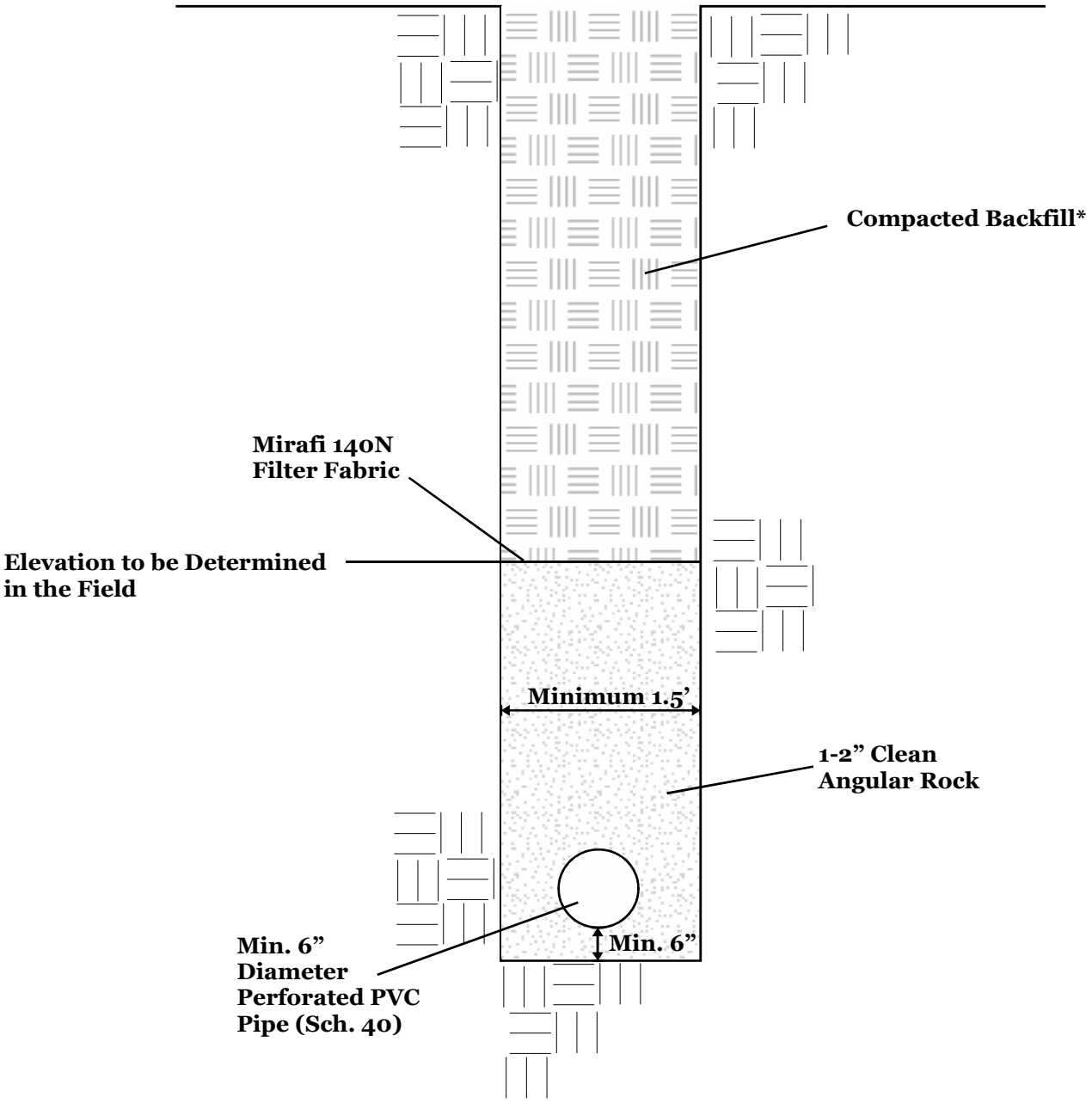

*Compacted backfill to consist of on-site soils compacted to at least 90 percent of the modified proctor (ASTM D1557 Test Method) in landscaping areas or suitable structural fill compacted to at least 95 percent of the modified proctor below pavements, walkways or other structural features. All structural fill to be compacted in 12-inch thick loose lifts. Clean angular rock should not be compacted.

COBALT GEOSCIENCES	Geotechnical Investigation 207th Place NE Arlington, Washington	**CUTOFF DRAIN FIGURE 3**	Cobalt Geosciences, LLC P.O. Box 82243 Kenmore, WA 98028 (206) 331-1097 www.cobaltgeo.com cobaltgeo@gmail.com

APPENDIX C
Exploration Logs & Laboratory Analyses

Unified Soil Classification System (USCS)

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS (more than 50% retained on No. 200 sieve)	Gravels (more than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with Fines (more than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (50% or more of coarse fraction passes the No. 4 sieve)	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sand, gravelly sands, little or no fines
		Sands with Fines (more than 12% fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (50% or more passes the No. 200 sieve)	Silts and Clays (liquid limit less than 50)	Inorganic	ML	Inorganic silts of low to medium plasticity, sandy silts, gravelly silts, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
		Organic	OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays (liquid limit 50 or more)	Inorganic	MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt
			CH	Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay
		Organic	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat, humus, swamp soils with high organic content (ASTM D4427)

Classification of Soil Constituents

MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).

Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).

Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).

Grain Size Definitions

Description	Sieve Number and/or Size
Fines	<#200 (0.08 mm)
Sand	
-Fine	#200 to #40 (0.08 to 0.4 mm)
-Medium	#40 to #10 (0.4 to 2 mm)
-Coarse	#10 to #4 (2 to 5 mm)
Gravel	
-Fine	#4 to 3/4 inch (5 to 19 mm)
-Coarse	3/4 to 3 inches (19 to 76 mm)
Cobbles	3 to 12 inches (75 to 305 mm)
Boulders	>12 inches (305 mm)

Relative Density (Coarse Grained Soils)

N, SPT, Blows/FT	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
Over 50	Very dense

Consistency (Fine Grained Soils)

N, SPT, Blows/FT	Relative Consistency
Under 2	Very soft
2 - 4	Soft
4 - 8	Medium stiff
8 - 15	Stiff
15 - 30	Very stiff
Over 30	Hard

Moisture Content Definitions

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

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Soil Classification Chart

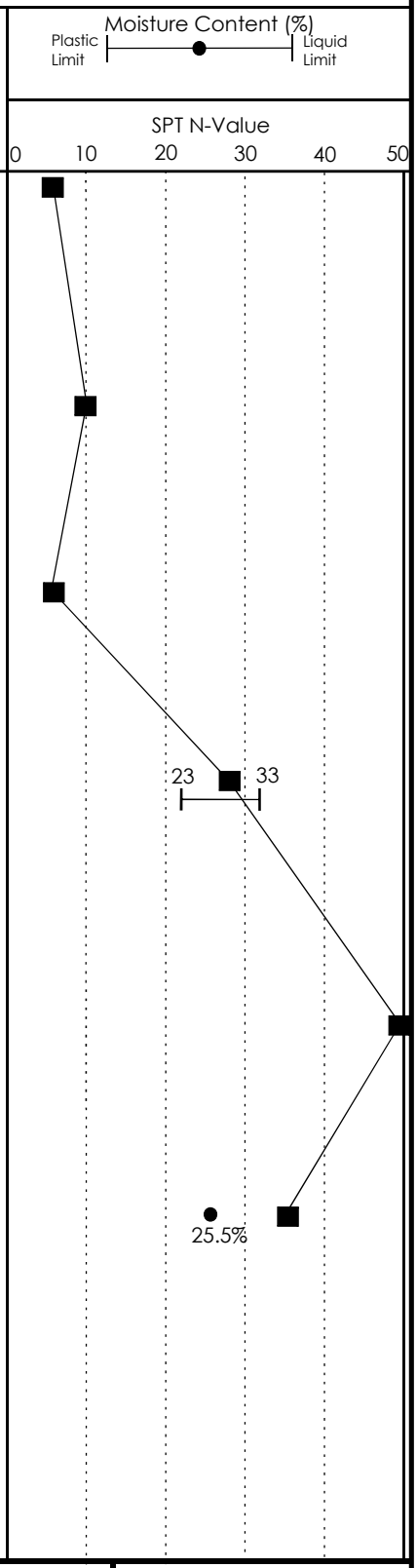
Figure C1

Log of Boring B-1

Date: August 10, 2018	Depth: 26.5'	Initial Groundwater: 15.5' & 24'
Contractor: CN	Elevation: ~166.5'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
0			3			Vegetation/Topsoil
2			2 4		ML	Medium stiff to stiff, silt with fine grained sand, mottled reddish brown to grayish brown, moist.
4						
6			3 4 6			
8						
10			1 2 4		ML	Medium stiff, silt with clay trace to some fine grained sand, mottled reddish brown to grayish brown, moist. Unit Weight - 100 pcf
12						
14					ML/ CL	Stiff, clayey silt with fine grained sand, mottled reddish brown to grayish brown, moist to very moist.
16			6 8 9		SP	Medium dense, fine to medium grained sand with gravel, grayish brown, wet. -Local interbeds of silty-sand with gravel
18						
20			5			
			36 50/4		SM/ML	Very stiff to hard, silt with sand, reddish brown to grayish brown, moist.
22					ML	Very stiff to hard, sandy silt to clayey silt with fine grained sand, grayish brown to olive gray, moist to wet. -Wet below 24'
24						
26			6 11 24			-85.2% fines
						End of Boring 26.5'
28						
30						
32						
34						

Groundwater



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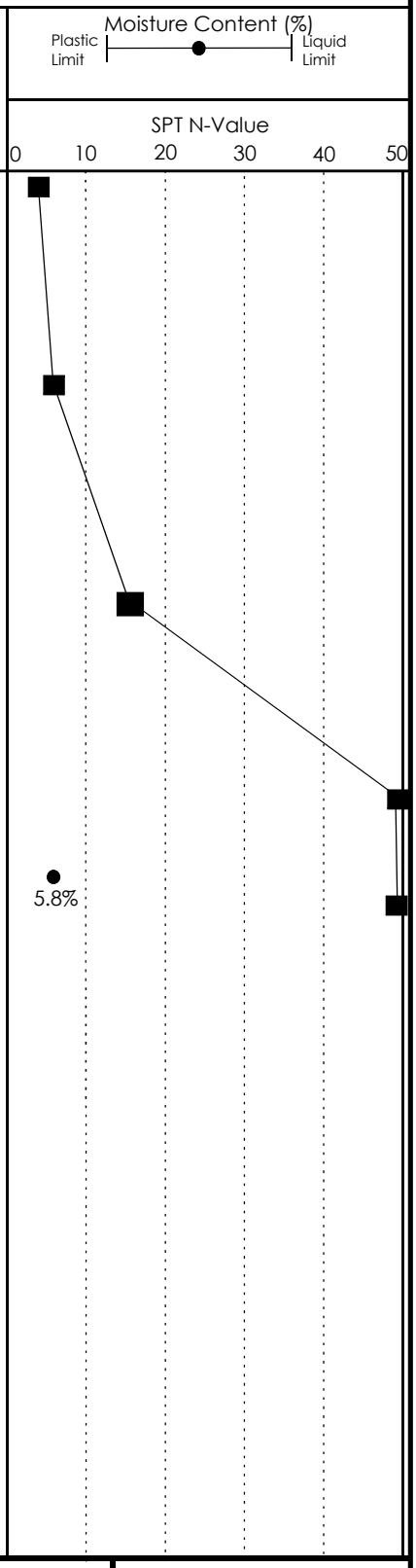
Boring Log

Log of Boring B-2

Date: August 10, 2018	Depth: 19'	Initial Groundwater: 11.5'
Contractor: CN	Elevation: ~161'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
0			1			Vegetation/Topsoil
2			2 2		ML	Medium stiff to stiff, silt with fine grained sand trace fine organics trace clay, moist.
4						
6			2 3 3			
8						
10			4 7 8			
12					SP	Medium dense to very dense, fine to medium grained sand with gravel, yellowish brown to grayish brown, wet. -Interbeds of silty-sand with gravel
14						
16			24 45 50/5		GP	Very dense, fine to medium grained gravel with sand, yellowish brown to grayish brown, wet.
18			31 40 50/3			
20						End of Boring 19'
22						
24						
26						
28						
30						
32						
34						

Groundwater



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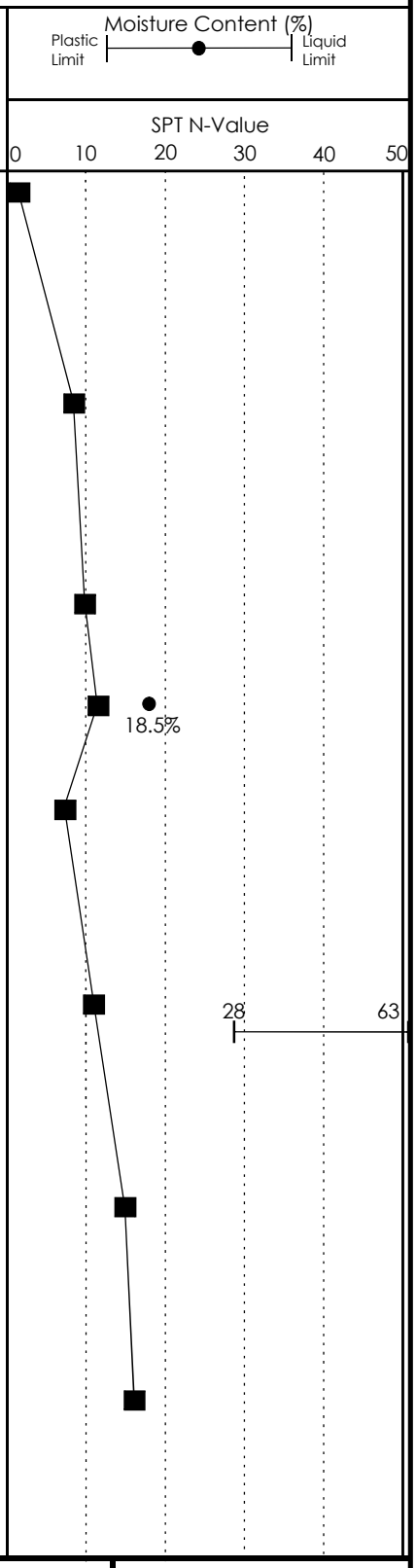
Boring Log

Log of Boring B-3

Date: August 17, 2018	Depth: 31.5'	Initial Groundwater: N/A
Contractor: CN	Elevation: ~188'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: 30'

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
0			1 1			Vegetation/Topsoil
2			1		ML	Soft/loose to medium dense/stiff, silt with fine grained sand to silty sand, mottled dark yellowish brown to reddish brown, moist.
4			3 4 5			-Gradational ML to SM along with interbedded SM and ML Unit Weight - 114 pcf
6						
8						
10			1 4 6			
12			3 5 6		SM	Medium dense, silty-fine to fine grained sand, yellowish brown to grayish brown, moist to very moist.
14						
			4		SM/ML	Stiff, silt with sand, mottled reddish brown to grayish brown, moist.
16			3 4		ML/ CL	Stiff, clayey silt trace to some fine grained sand, olive gray to grayish brown, moist. -Fractured from 15.75 to 16.25'
18						
20			2 5 6		CH	Stiff, clay with sand and silt, highly plastic, olive gray to grayish brown, moist.
22						-Mottled from 19' to 23'
24					ML	Stiff to very stiff, silt trace to some fine grained sand, grayish brown to olive gray, moist to wet.
26			3 5 8			-Wet below 30'
28						
30			6 9 7			
32						End of Boring 31.5'
34						

Groundwater



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Boring Log

Log of Boring B-4

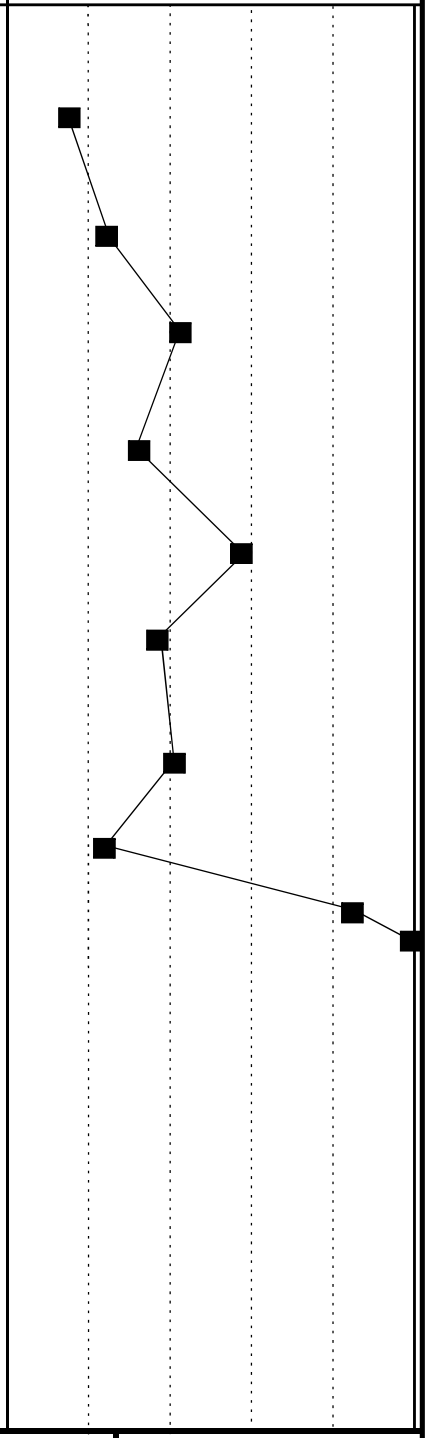
Date: September 10, 2018	Depth: 46.5'	Initial Groundwater: 42'
Contractor: EDI	Elevation: ~193'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: 42'

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
						Vegetation/Topsoil
4			2 3 5		SM/ ML	Soft/loose to medium dense/stiff, silt with fine grained sand to silty sand, mottled dark yellowish brown to reddish brown, dry to moist.
8			4 6 6			-Gradational ML to SM along with interbedded SM and ML
12						Unit Weight - 112 pcf
16			17 7 14		ML/ CL	Stiff to very stiff, silt with clay trace to some fine grained sand, mottled grayish brown to olive gray, moist. -Local CH and fine organics
20			5 6 10		CH	Stiff to very stiff, clay with sand and silt, highly plastic, grayish brown to olive gray, moist. -Local fractures
24			8 13 16		ML	Stiff, sandy silt trace to some clay, yellowish brown to grayish brown, moist to very moist.
28			8 6 13			-Fractured locally
32			8 7 13			
36			3 5 7			
40			8 12 30		SP	Dense to very dense, fine to medium grained sand trace gravel, yellowish brown to olive gray, moist to wet. (Advance Outwash)
44			12 24 35			End of Boring 46.5'

Groundwater

Moisture Content (%)
Plastic Limit — Liquid Limit

SPT N-Value
0 10 20 30 40 50



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Boring Log

Log of Boring B-5

Date: November 24, 2019	Depth: 31'	Initial Groundwater: N/A
Contractor: EDI	Elevation: ~159'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: 17.5'

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
			2 2 2			Vegetation/Topsoil
2					SM/ ML	Medium stiff/loose, silty-fine to fine grained sand trace fine organics, yellowish brown to brown, moist.
4			4 3 4			
6						
8						
10			6		ML	Stiff, silt with fine grained sand, yellowish to grayish brown, moist.
			6 4		SM	Medium dense, silty-fine to medium grained sand with fine organics, brown to dark brown, moist.
12						
14					SM	Medium dense, silty-fine to medium grained sand with areas of silt trace to some clay, mottled yellowish brown to grayish brown, moist.
16			3 5 5			
18						-Local CM scale organics and CL interbeds at 21 and 20.75 feet
20			4 5 8			
22						
24					SM	Medium dense, silty-fine to medium grained sand, mottled yellowish brown to grayish brown, moist to wet.
			5 8			
26			9		SM	Medium dense to very dense, silty-fine to medium grained sand with gravel, yellowish brown to olive gray, moist to wet.
28						-Local GP at 30.5' and ML at 30'
30			10 50/6			
32						End of Boring 31'
34						

Groundwater

Moisture Content (%)
Plastic Limit — Liquid Limit

SPT N-Value
0 10 20 30 40 50

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Boring Log

Log of Boring B-6

Date: November 24, 2019	Depth: 31.5'	Initial Groundwater: N/A
Contractor: EDI	Elevation: ~188'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: 17.5'

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
0			1 3			Vegetation/Topsoil
2			2		SM	Loose to medium dense, silty-fine to fine grained sand with trace to cm scale fine organics, mottled yellowish brown to grayish brown, moist to very moist.
4			4 5 5			
6						
8						
10			5 7 5			
12						
14					SM	Medium dense, silty-fine to fine grained sand yellowish brown to grayish brown, moist to wet.
16			5 10 12			
18						
20			6		SM/ML	Medium dense/stiff, silt with fine grained sand mottled yellowish brown to grayish brown, moist to wet.
22			6 6		ML	Stiff to very stiff, silt with fine grained sand, grayish brown, moist.
24					ML	Very stiff to hard, silt with fine grained sand, olive gray to grayish brown, moist.
26			10 34 50/6		ML	Very dense/hard, silty-fine to fine grained sand, olive gray to grayish brown, moist.
28						
30			18 40 50/4			
32						End of Boring 31.5'
34						

Groundwater

Moisture Content (%)
Plastic Limit — Liquid Limit

SPT N-Value
0 10 20 30 40 50

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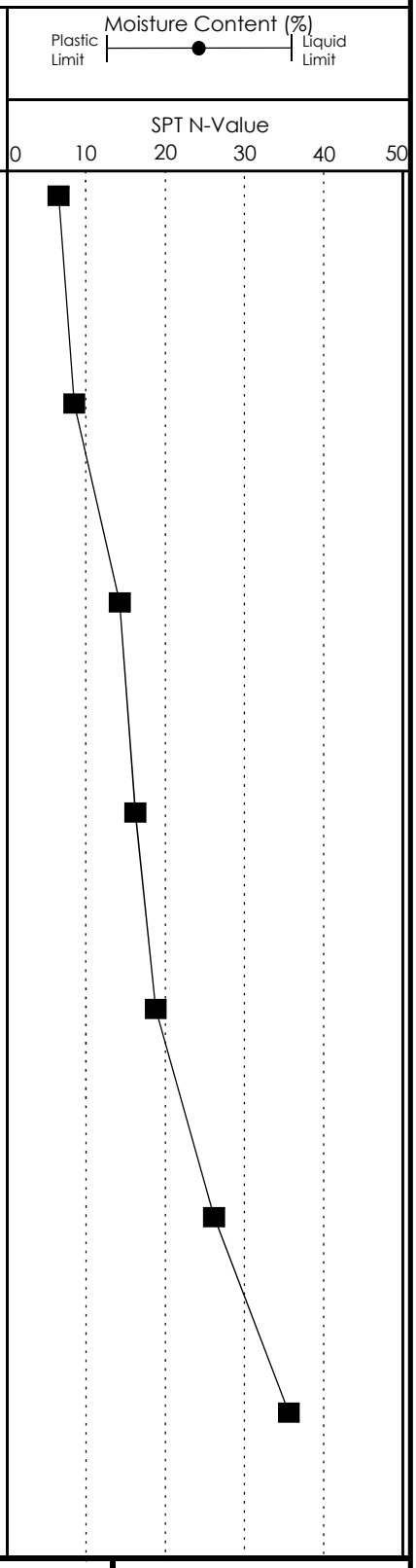
Boring Log

Log of Boring B-7

Date: November 25, 2019	Depth: 31.5'	Initial Groundwater: N/A
Contractor: EDI	Elevation: ~190'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: 22.5'

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
			1 4			Vegetation/Topsoil
2			3		SM /ML	Medium stiff/loose, silty-fine to fine grained sand trace organics, yellowish brown to grayish brown, moist.
4						
6			6 4 4			
8					SM	Medium dense, silty-fine to fine grained sand, mottled yellowish brown to grayish brown, moist.
10			5 6 7			
12						
14						
			5			
16			6 10		ML	Stiff, silt trace to with fine grained sand, grayish brown to olive gray, moist to wet.
18						
20			6 9 10			
22						
24					ML	Very stiff to hard, silt with fine grained sand, locally mottled olive gray to olive brown, moist.
26			6 11 15			
28						
30			10 15 20			
32						End of Boring 31.5'
34						

Groundwater



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Boring Log

Log of Boring B-8

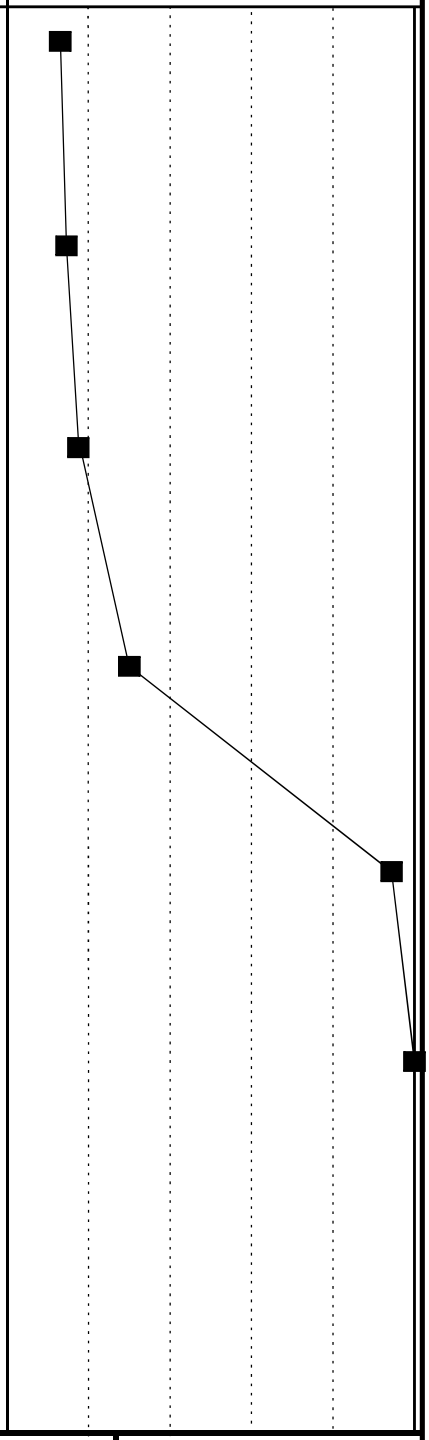
Date: November 25, 2019	Depth: 26'	Initial Groundwater: N/A
Contractor: EDI	Elevation: ~187'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: None

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
			3 3			Vegetation/Topsoil
2			3		SM /ML	Medium stiff/loose, silty-fine to fine grained sand, mottled yellowish brown to grayish brown, moist.
4			4 4			
6			4		ML	Stiff, silty-fine to fine grained sand, mottled yellowish brown to grayish brown, moist.
8						
10			5 4			
12			5		ML	Stiff to hard, silt trace to with fine grained sand, grayish brown to olive gray, moist.
14						
16			5 6 8			
18						
20			15 25 22			
22						
24						
26			25 50/6			
						End of Boring 26'
28						
30						
32						
34						

Groundwater

Moisture Content (%)
Plastic Limit — Liquid Limit

SPT N-Value
0 10 20 30 40 50



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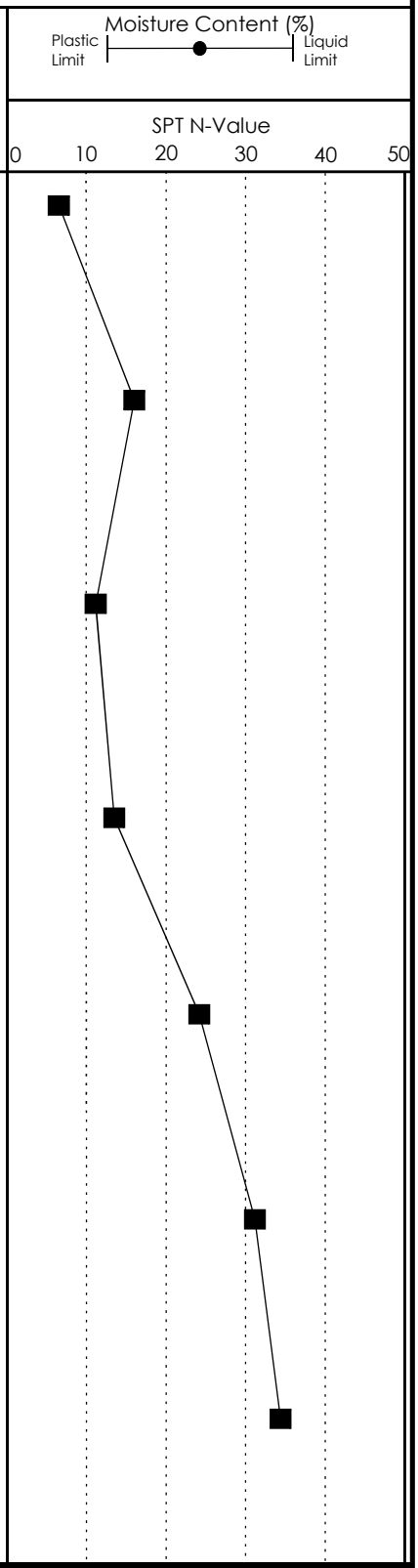
Boring Log

Log of Boring B-9

Date: November 25, 2019	Depth: 31.5'	Initial Groundwater: N/A
Contractor: EDI	Elevation: ~212'	Sample Type: Split Spoon
Method: Hollow Stem Auger	Logged By: PH Checked By: SC	Final Groundwater: 18'

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
			2 3			Vegetation/Topsoil
2			3		SM /ML	Medium stiff/loose to stiff/medium dense, silty-fine to fine grained sand, yellowish brown to grayish brown, moist.
4			5 8 8			
6						
8					ML	Stiff, silt trace to with fine grained sand, grayish brown to olive gray, moist to wet.
10			4 4 7			-Mottled below 15'
12						
14						
16			6 7 6			
18						
20			8 10 14		ML	Very stiff to hard, silt with fine grained sand, locally mottled olive gray to olive brown, moist.
22						
24						
26			12 12 19			
28						
30			15 16 18			
32						End of Boring 31.5'
34						

Groundwater



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Geotechnical Investigation
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Arlington, Washington

Boring Log

KRAZAN & ASSOCIATES, INC. TESTING REPORT

Job Name: 2018 Control Samples (Arlington - Portage Creek)
Job # : 096-18402

Client: Cobalt Geosciences
Sample Date: 8/20/2018

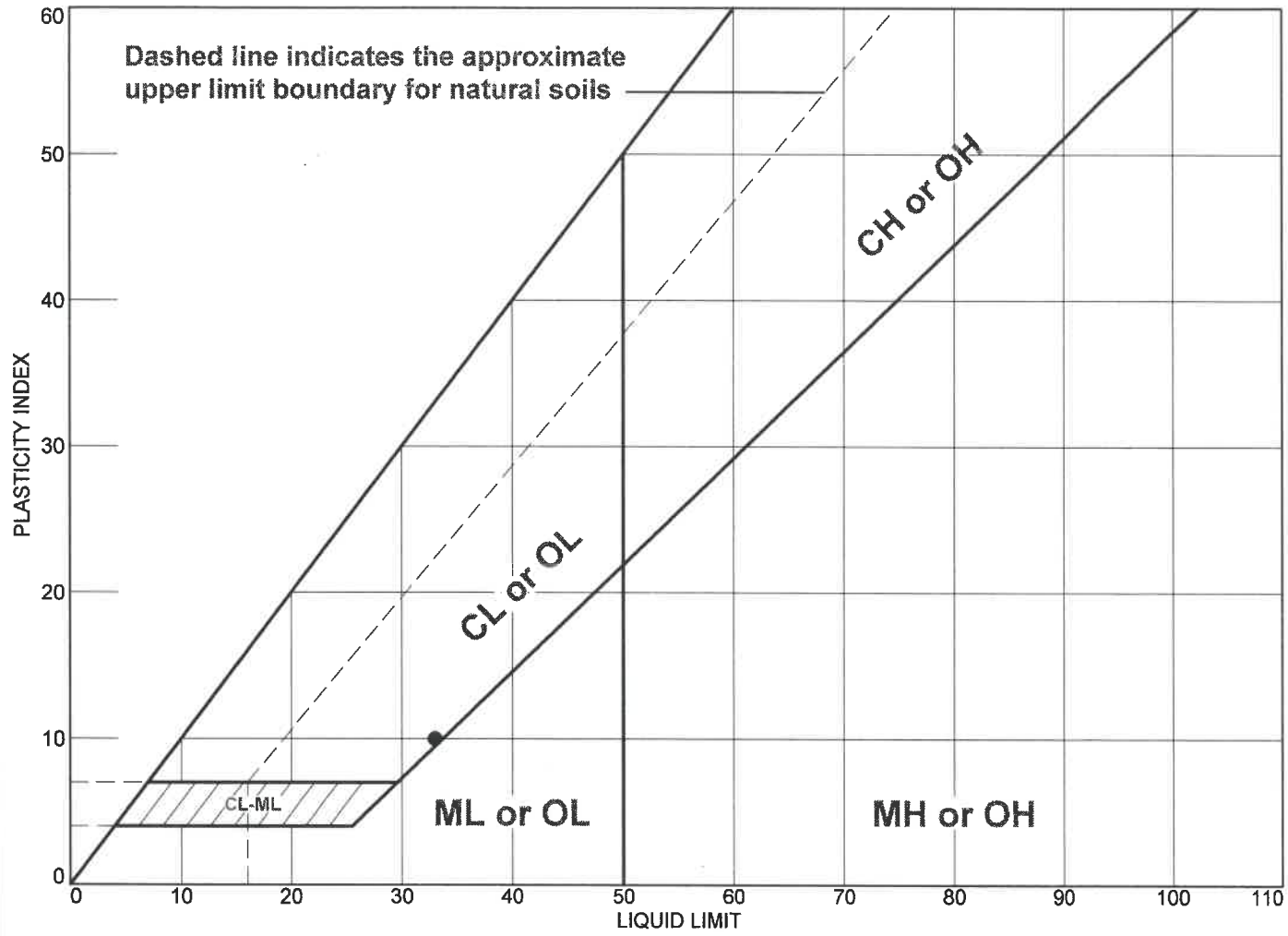
Amount of Material in Soils Finer Than the No. 200 Sieve (ASTM D-1140)

Sample ID	Sample Description	Boring #	Natural Moisture Content	Depth	Before Wash + Tare	After Wash + Tare	Tare	% Passing #200
64022-A	Gray clayey silt with sand	**B-1**	**25.5%**	**25'**	634.3	350.8	301.5	**85.2%**

Tested By: Corbett Mercer

Checked Corbett Mercer (Lab Manager)

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive-brown clayey silt with sand.	33	23	10	100	N/A	CL-ML

Project No. 09618402 **Client:** Cobalt Geosciences

Project: 2018 Control Samples

● **Location:** Client Supplied: Arlington - Portage Creek (B-1) **Depth:** 15' **Sample Number:** 64022-B

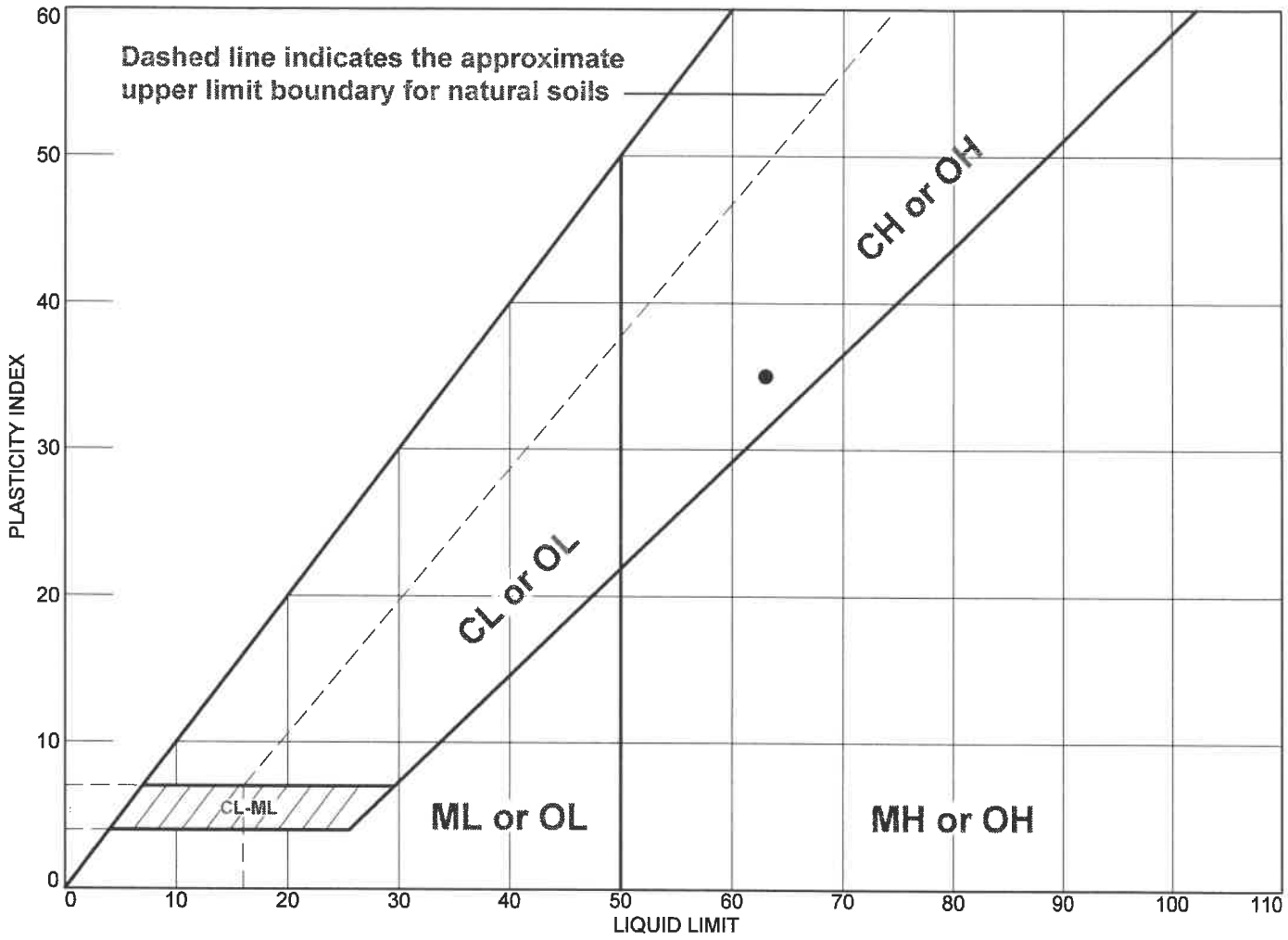
Remarks:

● Sample ID: 64022-B.
Sample Date: 8/20/18.

Krazan

Tested By: Corbett Mercer **Checked By:** Corbett Mercer

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray clay with sand and silt.	63	28	35	100	N/A	CH

Project No. 09618402 **Client:** Cobalt Geosciences

Project: 2018 Control Samples

● **Location:** Client Supplied: Arlington - Portage Creek (B-3) **Depth:** 20' **Sample Number:** 64022-C

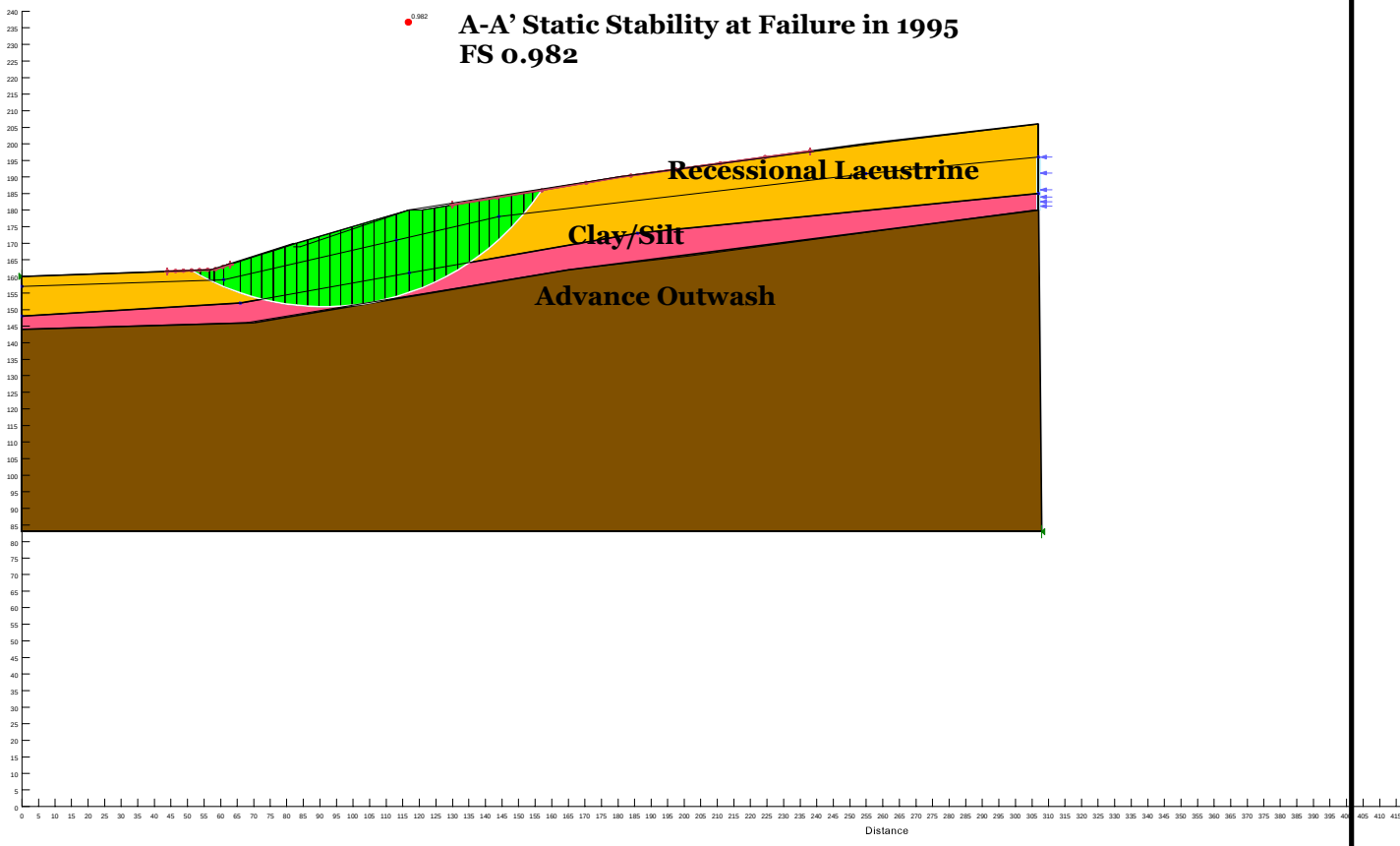
Remarks:

● Sample ID: 64022-C.
Sample Date: 8/20/18.

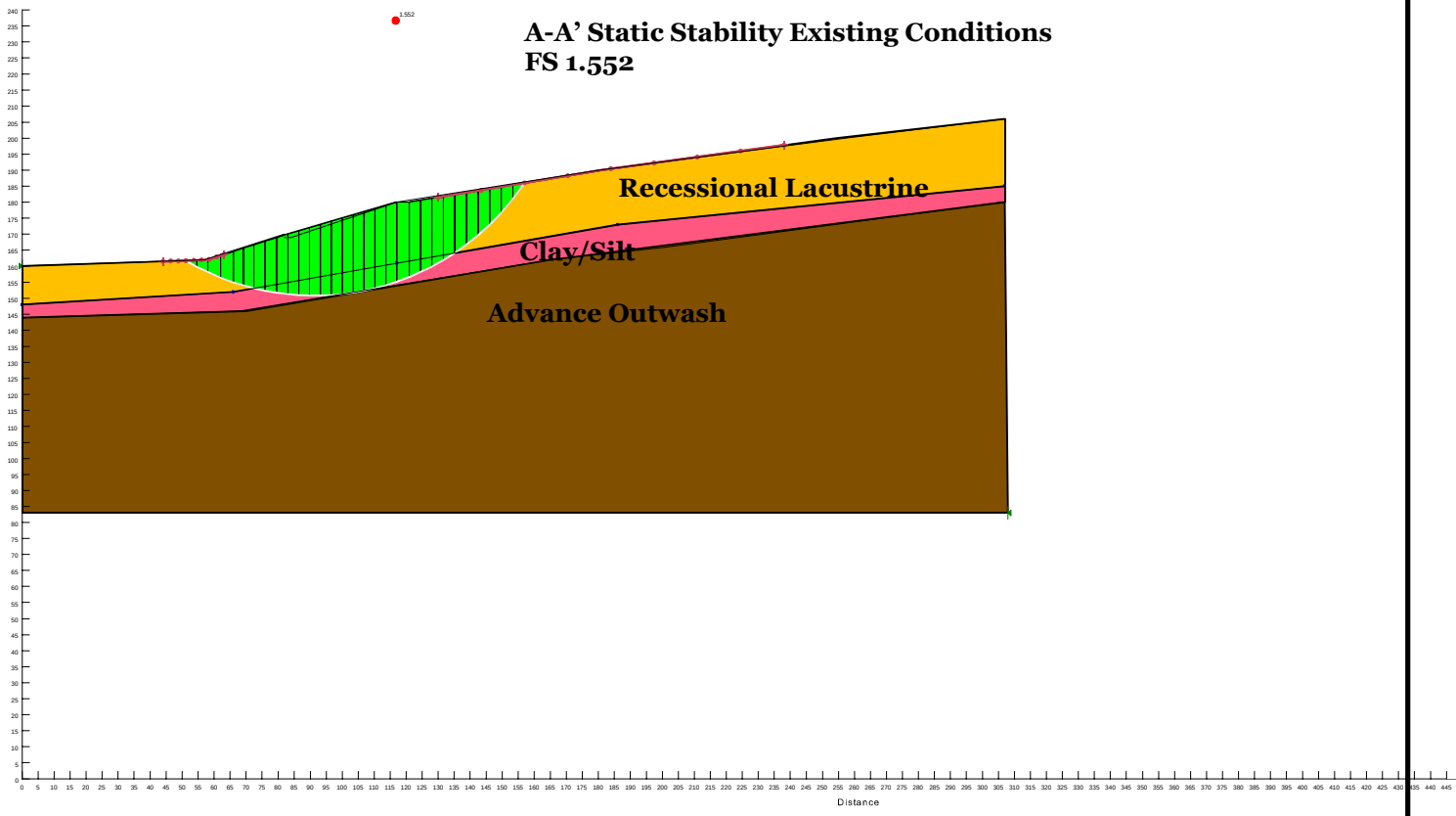
Krazan

Tested By: Corbett Mercer **Checked By:** Corbett Mercer

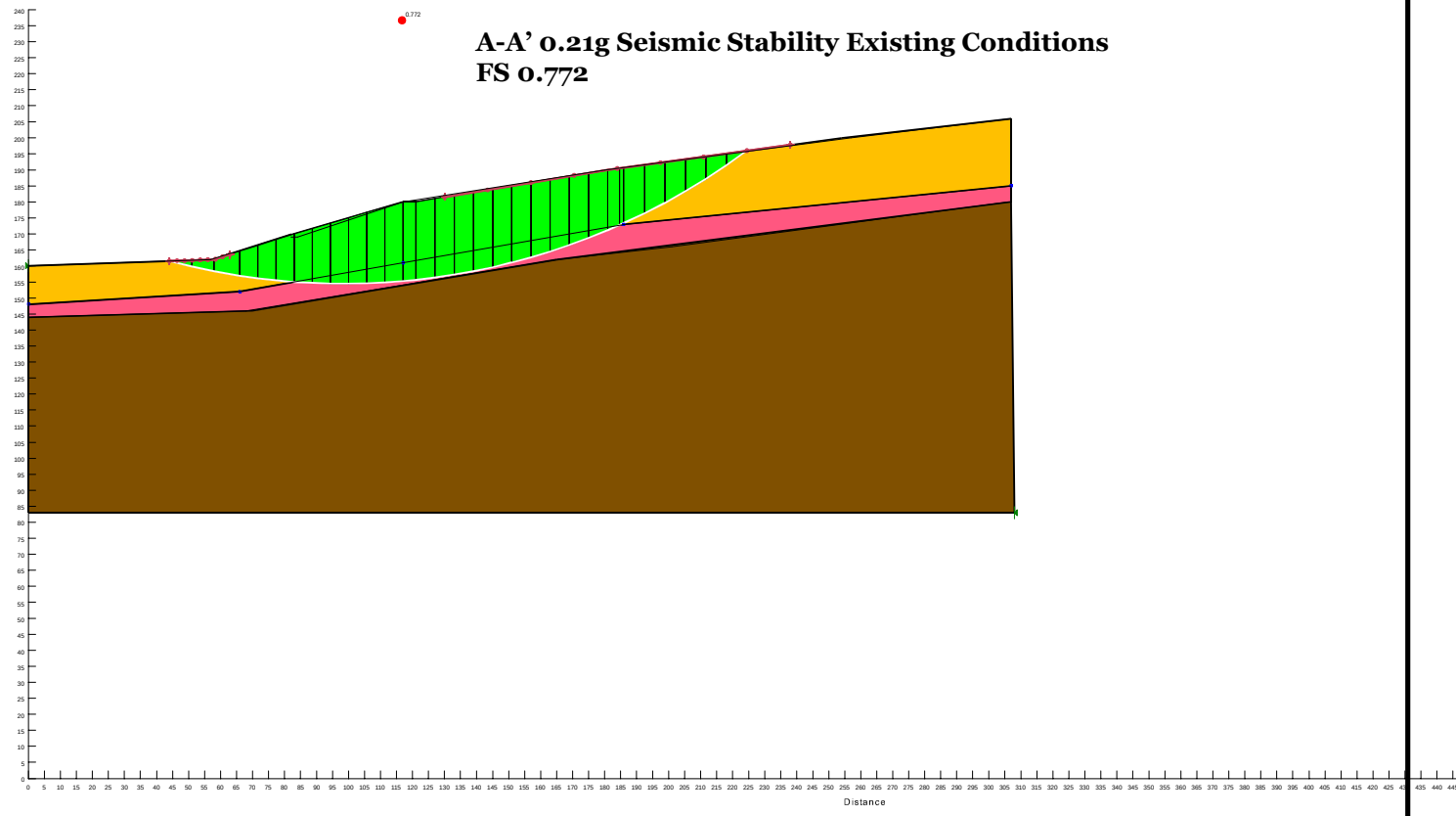
APPENDIX D
Slope Stability Analyses



COBALT GEOSCIENCES	Geotechnical Investigation 207th Place NE Arlington, Washington	**SLOPE STABILITY ANALYSES FIGURE D1**	Cobalt Geosciences, LLC P.O. Box 82243 Kenmore, WA 98028 (206) 331-1097 www.cobaltgeo.com cobaltgeo@gmail.com



A-A' Static Stability Existing Conditions
FS 1.552



A-A' 0.21g Seismic Stability Existing Conditions
FS 0.772

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SLOPE STABILITY ANALYSES FIGURE D2

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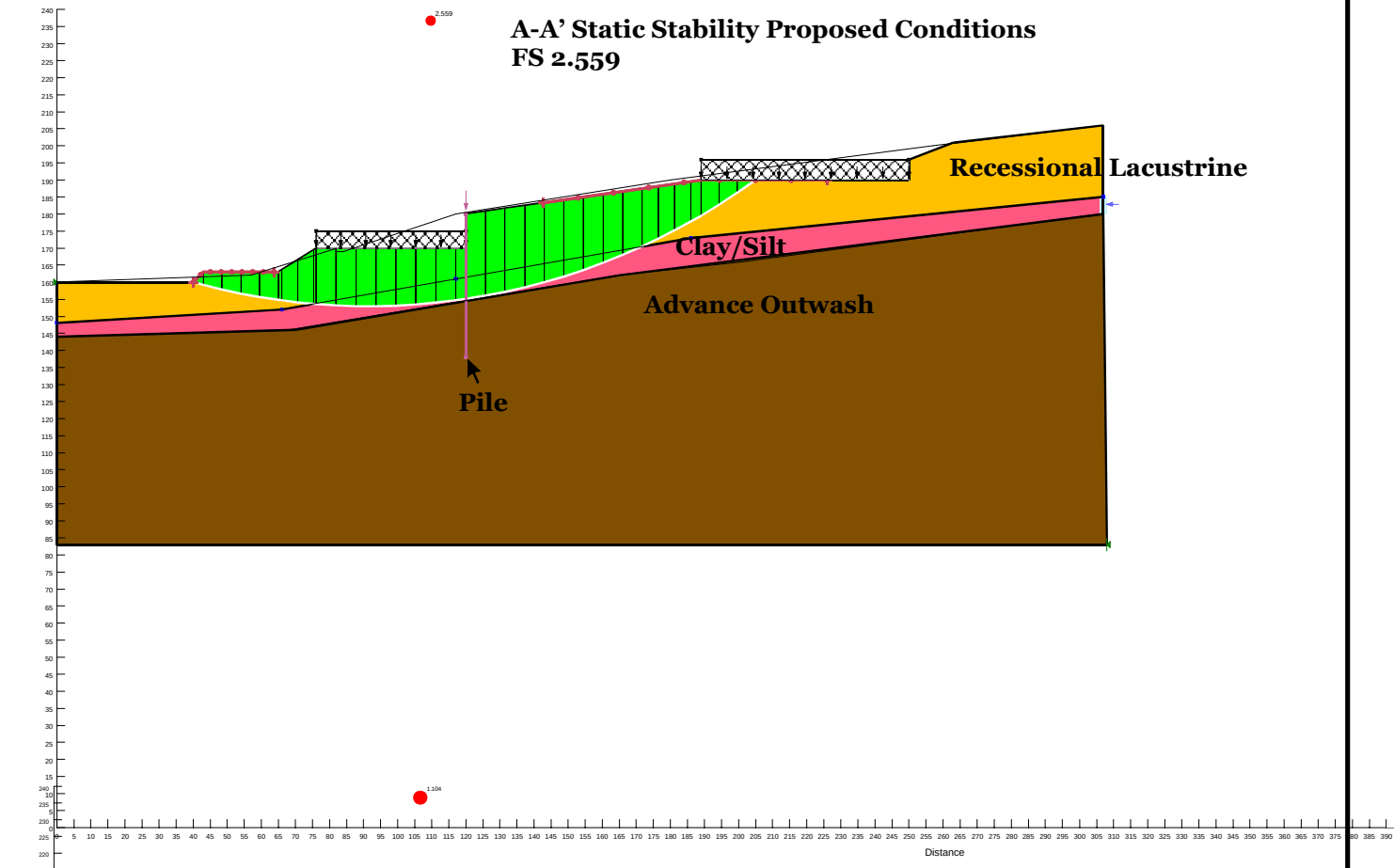

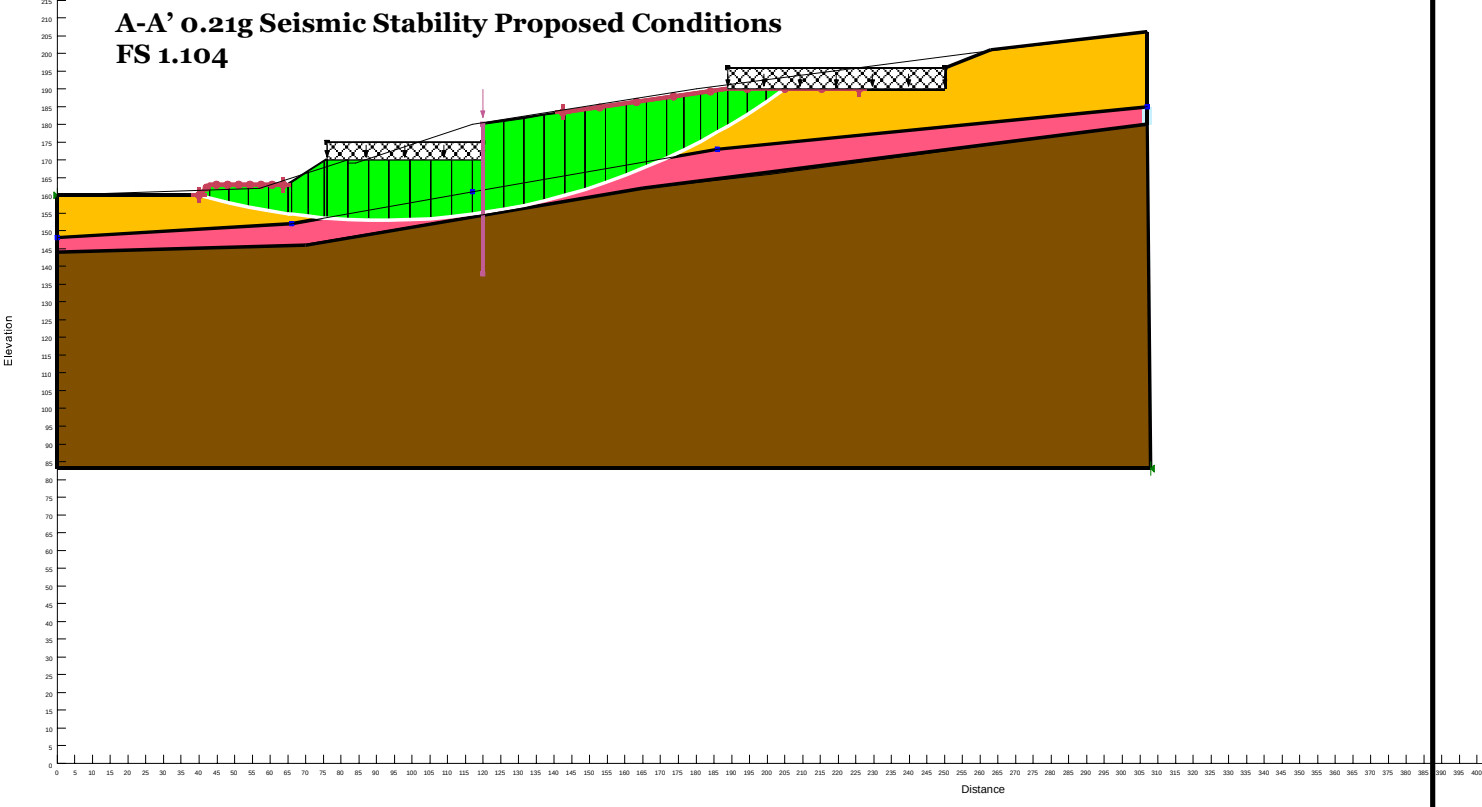

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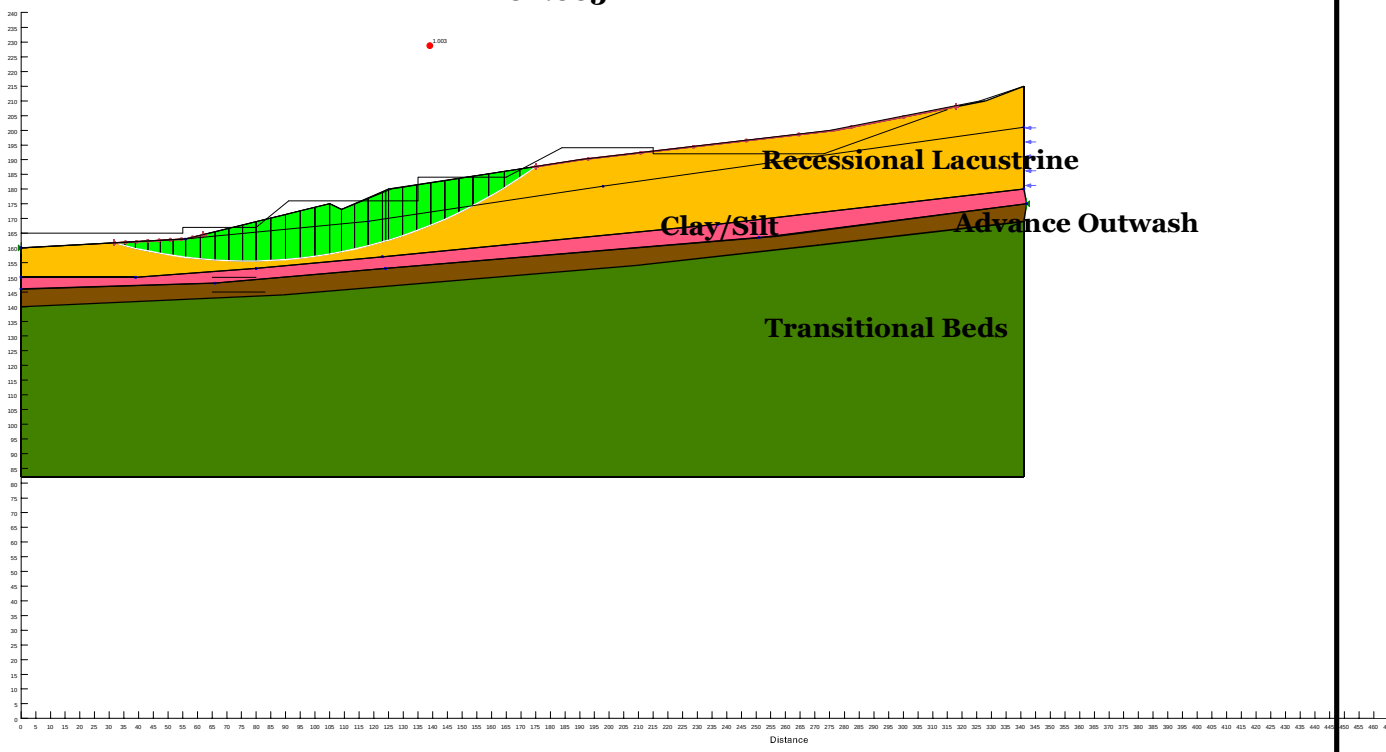
B-B' Static Stability at Failure in 1995
FS 1.003



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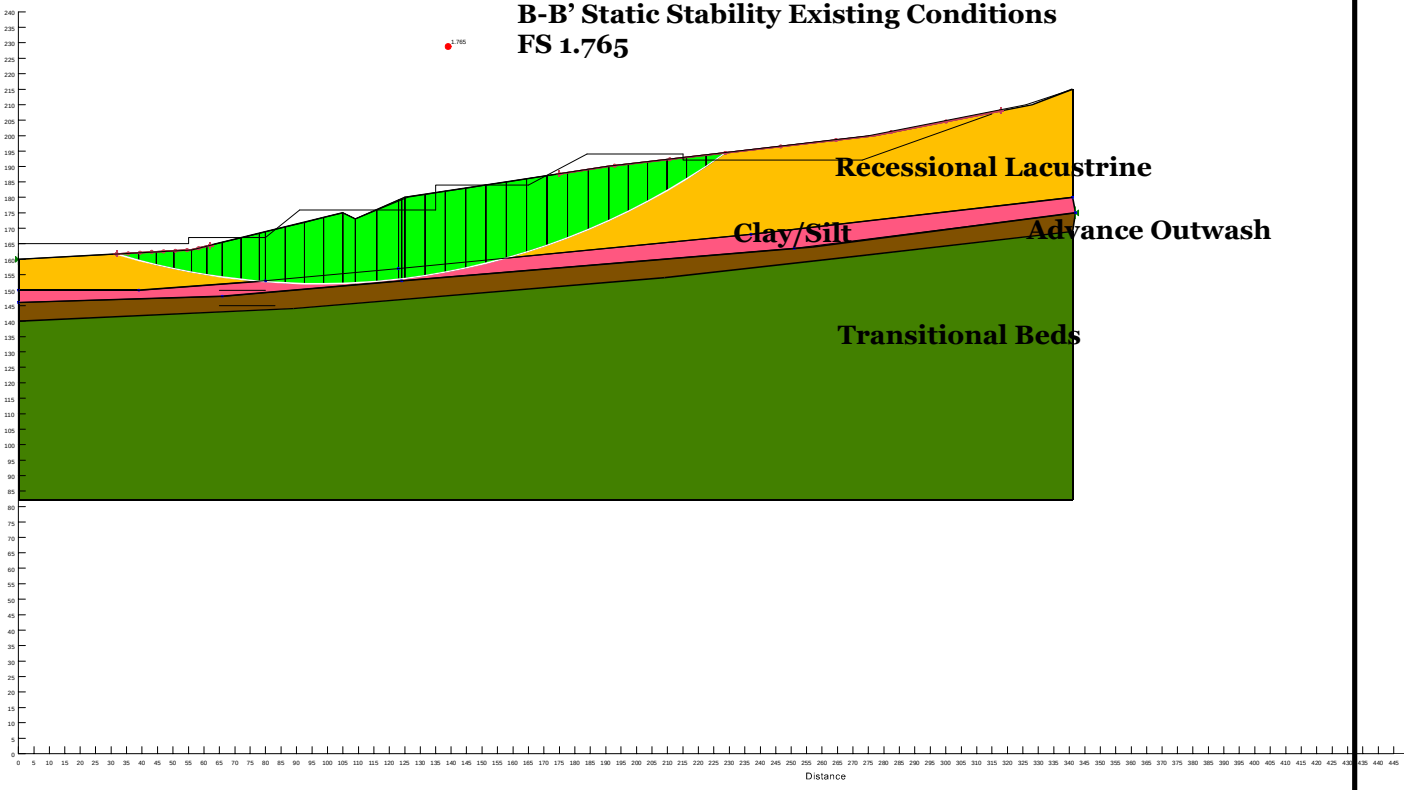
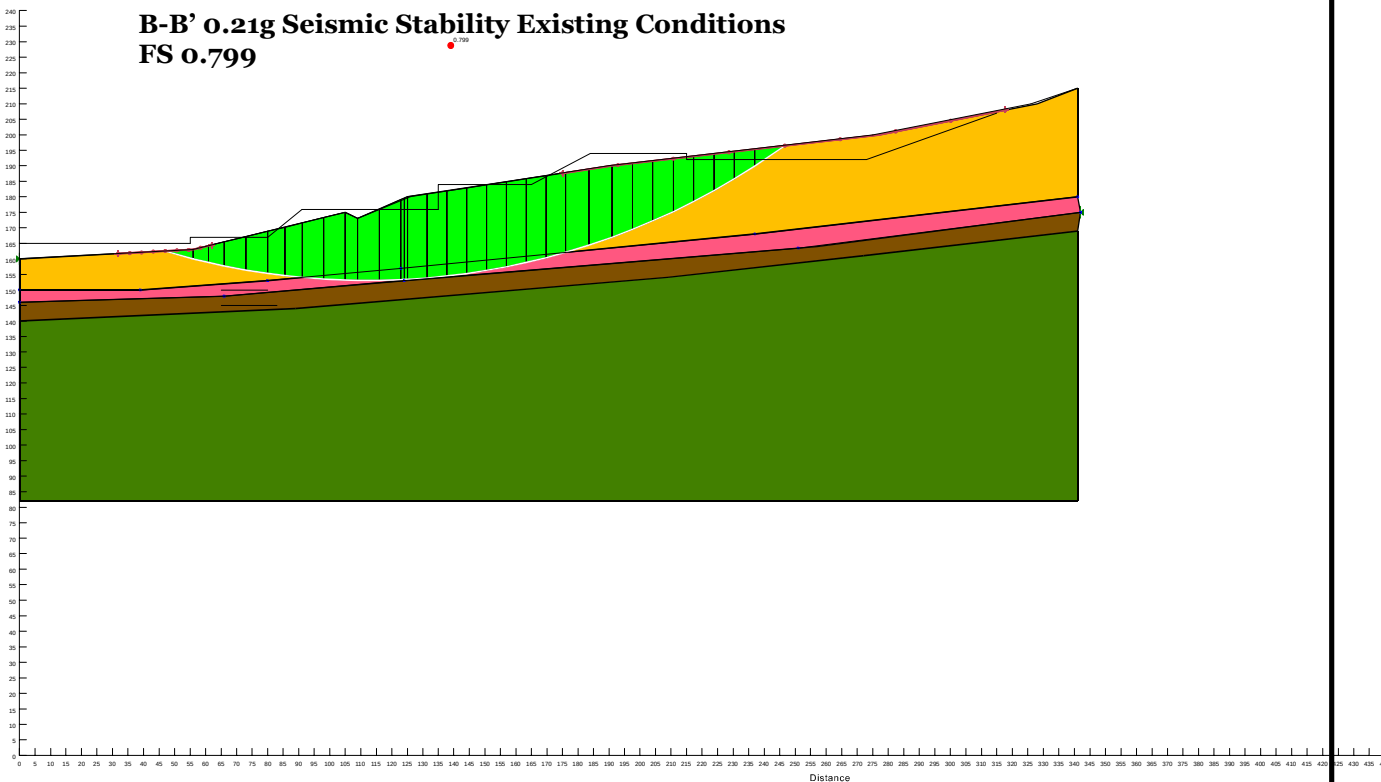
B-B' Static Stability Existing Conditions
FS 1.765



B-B' 0.21g Seismic Stability Existing Conditions
FS 0.799



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SLOPE STABILITY ANALYSES FIGURE D5

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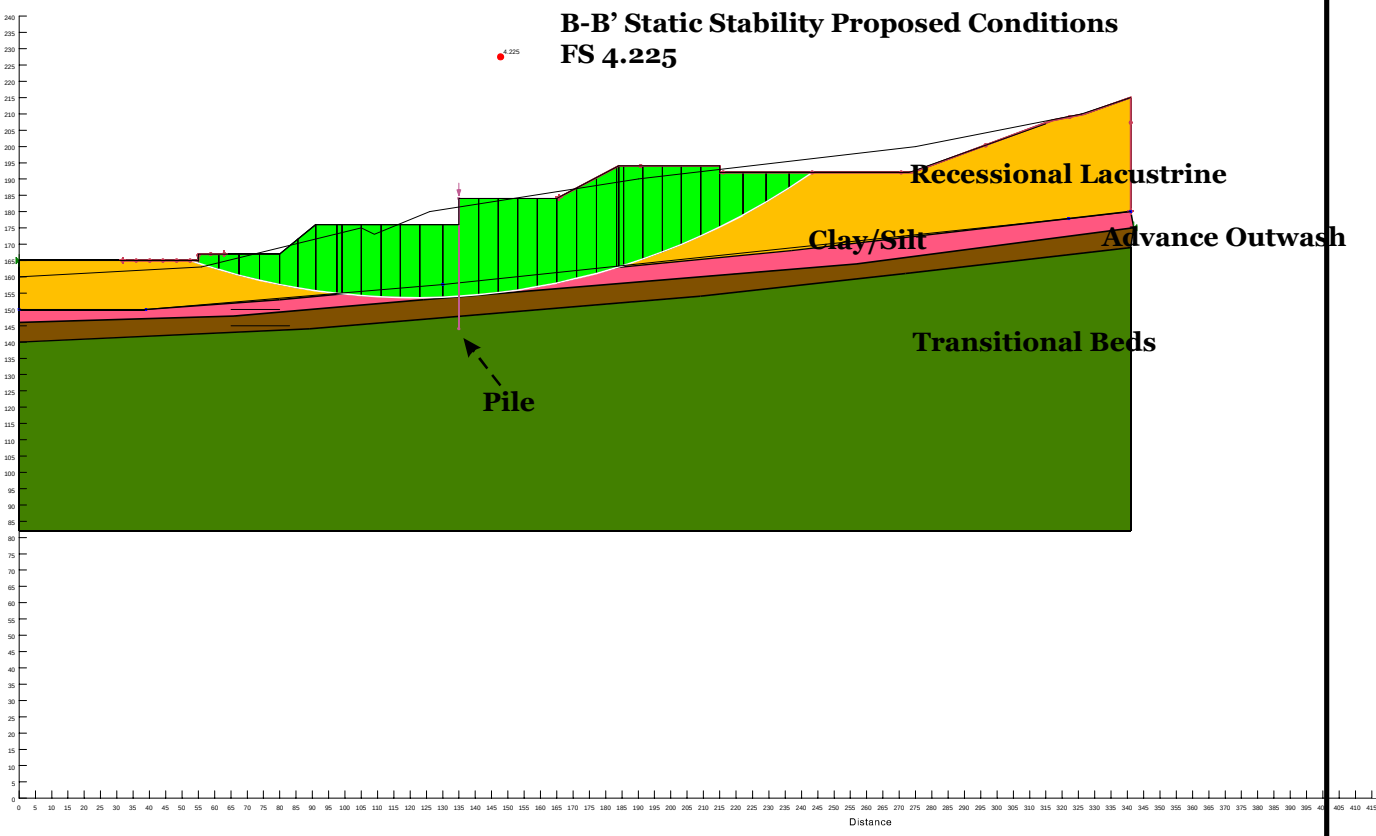

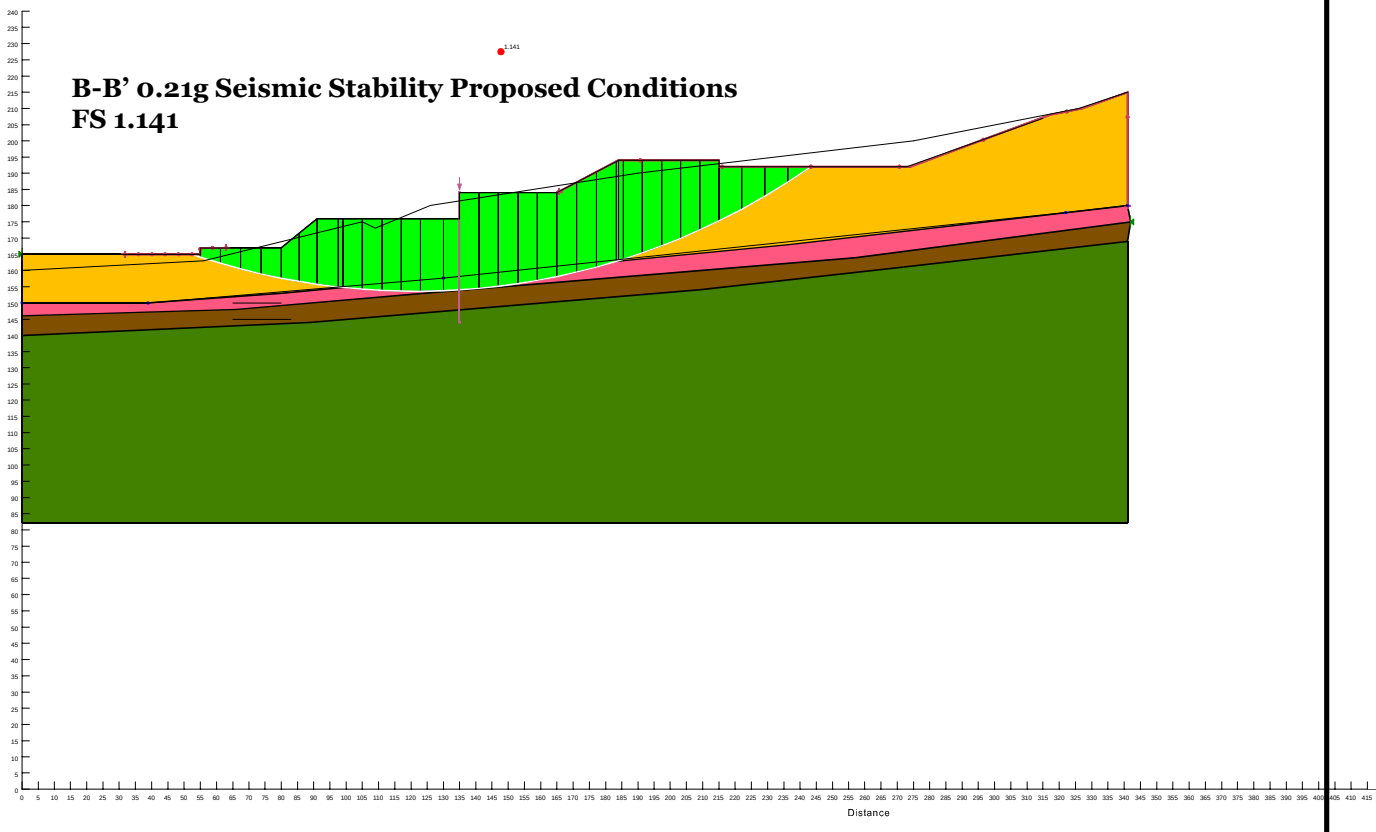

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SLOPE STABILITY ANALYSES FIGURE D6

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