Buttenweiser – Wiley Residence
6838 96th Avenue SE (Mercer Island)

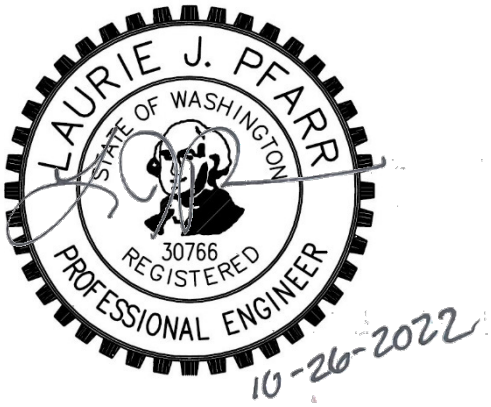
6838 96th Avenue SE

Mercer Island, WA 98040

Revised Stormwater Site Plan

October 26, 2022

The information contained in this report was prepared by and under the direct supervision of the undersigned:



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LPD engineering pllc

BUTTENWEISER – WILEY RESIDENCE
6838 96TH AVENUE SE (MERCER ISLAND)
STORMWATER SITE PLAN

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BUTTENWEISER – WILEY RESIDENCE
6838 96TH AVENUE SE (MERCER ISLAND)
REVISED STORMWATER SITE PLAN
OCTOBER 26, 2022

PROJECT OVERVIEW

The following Stormwater Drainage Report is for parcel #3024059010 located at 6838 96th Avenue SE in Mercer Island, Washington. See **Figure 1 – Vicinity Map.** The existing parcel total approximately 41,214 SF square feet (0.95 acres) and consists of a single-family residence with a residential structure with a detached garage, concrete driveway and asphalt parking, concrete walkways, and concrete patios. The project proposes reconstruction of a single-family residential building and exterior on-site improvements. The new single-family residential property will reside in the east side facing the Lake Washington waterfront, including reconstruction of a detached garage west of the proposed residential building. Site improvements will consist of the removal and replacement of the asphalt parking with a new asphalt parking area, removal and replacement of the existing concrete patio and walkways with pervious deck areas and exterior concrete stairs, landscape improvements including site grading, and various drainage features for outdoor entertaining and access to the waterfront.

Based upon the City of Mercer Island Municipal Code (MIMC) Section 15.09.050, the drainage analysis will be assessed using the Department of Ecology (DOE) 2014 Stormwater Manual of Western Washington (SWMWW). Additionally, projects that replace, modify, or construct a new driveway prior to discharge from the site shall provide passive spill control.

EXISTING CONDITIONS

The site is bounded by single-family residences to the north, south, and west, and Lake Washington to the East. According to the City of Mercer Island Zoning Map, the project site is within the R-8.4 zone. Based upon the USDA Natural Resources Conservation Service Web Soil Survey, the site soils consist of Kitsap silt loam, 15-30% slopes, on the approximate western third of the property and Arents/Alderwood Material, 6-15% slopes on the eastern two-thirds of the property. Refer to **Figure 3 – Soils Map**. A geotechnical report has been prepared by Aspect Consulting, dated September 2, 2021. Subsurface exploration found fill, consisting of soft to medium stiff silt with proportions of sand from 7-15 feet below ground surface. Beneath the fill layer, weathered pre-Olympia nonglacial deposits were encountered, consisting of loose to dense, very moist to wet, silty sand with proportions of gravel. Groundwater was observed in one of the borings. The geotechnical report is attached in Appendix D of this report.

According to the City of Mercer Island, the property is within a Seismic Hazard area along the eastern side of the property. Additionally, the entire site is within an Erosion Hazard area and the middle portion of the site includes a Steep Slope Hazard area.

The existing site consists of a single-family residence with a residential structure with a detached garage, concrete driveway and asphalt parking, concrete walkways, and concrete patios. Topographically, the site slopes from the west to the east towards Lake Washington with a grade difference of approximately 80 feet and an average slope of 21 percent.

Downstream Analysis

The project site was mapped by topographical field survey provided by Terrance, dated February 4th, 2021. This field survey was provided to LPD Engineering and was supplemented by record information and aerial mapping data obtained from the City of Mercer Island.

Per existing site plans, there is an existing 6-inch storm drain mainline along the south side of the property. The 6-inch polyvinyl chloride (PVC) drainage pipe discharges from the site to Lake Washington. The discharge point is located in the southeast corner of the property. Stormwater runoff from the driveway is collected by an area drain and conveyed south via a 4-inch PVC to the 6-inch PVC mainline along the south side. Runoff from the existing roofs is collected using downspouts, and also convey east via the 6-inch PVC which outlets at the southeast corner of the property through a concrete bulk head into Lake Washington. Refer to **Figure 4 – Downstream Drainage Map**.

PROPOSED CONDITIONS

The total new plus replaced hard surface (as defined by the 2014 DOE manual) is approximately 10,585 square feet. See **Figure 5 – Proposed Conditions**. The asphalt and concrete driveway and concrete pathways have been included in both the existing and proposed hard surface area calculations for this drainage analysis. Please note that the "hard surface" calculations used in the drainage analysis are not necessarily the same as the impervious surface calculations used for the lot coverage analysis. Table 1 below shows an area summary of proposed improvements.

Table 1 – New Plus Replaced Hard Surfaces

Surface Area	Square Feet	Acres
PGHS Asphalt Driveway	202	0.004
PGHS Concrete Driveway	4,427	0.102
NPGHS Concrete Walk/ Stairs	1,137	0.026
NPGIS Gravel Pavement	997	0.023
NPGHS Roof (Existing foundation and floor slab to be removed and replaced)	3,822	0.089
Total New Plus Replaced Hard Surface	10,585	0.244

Drainage from the proposed single-family residence will be collected by a combination of trench drains, area drains, and Type 1 catch basins. A drainage runnel is located along the northern side of the proposed residential property which will discharge runoff into a non-infiltrating bioretention area located along the eastern side of the property. Drainage from southern side of the property will directly discharge to Lake Washington. Roof runoff will be collected in gutters and downspouts connected to a below-grade tight lined drainage system. The proposed site drainage system and outfall locations are shown on the Grading and Drainage plans included in the Project Documents (Appendix A).

MINIMUM REQUIREMENTS

Per Volume I of the DOE Manual, if the existing lot coverage is 35% impervious or more, the project is classified as a redevelopment. If less than 35% existing lot coverage, the project is a new development. The site is currently has approximately 22.4% impervious coverage and is therefore classified as a new development. See **Figure 2 – Existing Impervious Coverage**.

This project's minimum requirements were determined based on the redevelopment flow chart (Figure 2.4.1) referred to in Volume I of the 2014 SWMMWW. The project proposes more than 5,000 SF of new plus replaced hard surface and therefore, will require Minimum Requirements (MR) #1-#9 for all *new and replaced hard surfaces and converted vegetation areas.*

The project creates greater than 5,000 SF of new hard surface. Comparing the total hard surface area in the pre-developed and post-developed conditions, the amount of hard surface area tributary to the downstream storm system has increased by 1,350 SF. See Table 2 for a net calculation of existing and proposed surfaces:

Table 2 – Net Area Summary

Pre-Developed Hard/Impervious Surfaces discharged to Lake Washington [SF]	Post-Developed Hard/Impervious Surfaces discharged to Lake Washington [SF]	Delta (SF)
9,235	10,585	1,350

Therefore, no additional requirements are applied to this project. No flow control or water quality treatment is required.

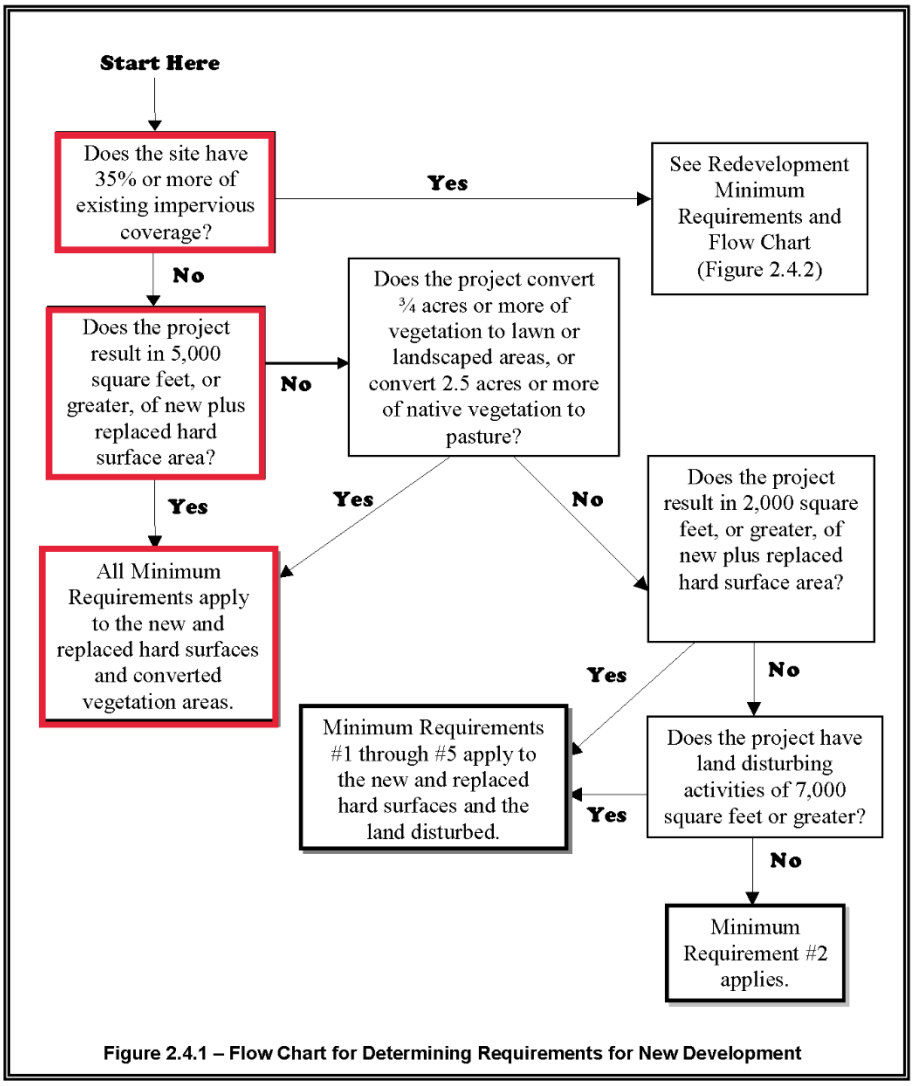


Figure 2.4.1 – Flow Chart for Determining Requirements for New Development

As indicated in the flow chart above, the minimum requirements (MR1-MR9) will apply to the new plus replaced hard surfaces. The project does not propose any converted vegetation areas since the site's existing pervious areas are landscape and lawn areas. Below is description of each of the minimum requirements for the project and how this project addresses them:

Minimum Requirement #1 – Preparation of Stormwater Site Plans (MR1): This document is the Stormwater Site Plan. It outlines the existing and proposed site and drainage conditions, describes the flow control systems, and presents the stormwater analysis.

Minimum Requirement #2 – Construction Stormwater Pollution Prevention Plan (SWPPP) (MR2): The construction SWPPP is included in this report, under Appendix C.

Minimum Requirement #3 – Source Control of Pollution (MR3): In the proposed conditions, there are no applicable activities matching those listed within Volume IV of the 2014 DOE Manual that will require the use of source control measures.

Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls (MR4): The proposed conditions will not alter the general drainage path. Stormwater will continue to runoff from west to east with discharge into Lake Washington, as it does in the existing condition.

Minimum Requirement #5 – On-Site Stormwater Management (MR5): On this project, the proposed on-site stormwater management BMPs include preservation and retention of native vegetation, permeable pavement, bioretention, and amended soils. Refer to the Stormwater Management section below for a detailed description of the onsite stormwater management.

Minimum Requirement #6 – Runoff Treatment (MR6): On this project, the proposed pollution generating hard surface (PGHS) is less than 5,000 square feet. Therefore, water quality treatment is not required.

Minimum Requirement #7 – Flow Control (MR7): Table I-E.1 Exempt Surface Waters List, identifies Lake Washington as a Flow Control-Exempt Surface water. Stormwater runoff from the project site directly discharges to Lake Washington. Therefore, flow control is not required.

Minimum Requirements #8 – Wetlands Protection (MR8): The proposed project does not directly or indirectly discharge stormwater into a wetland.

Minimum Requirements #9 – Operations and Maintenance (MR9): The maintenance and operations guidelines for the associated proposed stormwater facilities will be attached in Appendix E of this report.

Stormwater Management

Flow Control

As mentioned, the proposed project will result in more than 5,000 SF of new plus replaced hard surface, and therefore MR7 is applicable to this project. However, per MIMC Section 15.09.050.A.2, hard surfaces that are infeasible to mitigate with On-Site Stormwater Management BMPs (MR5) are also exempt from flow control requirements as the site has a direct discharge to Lake Washington and the proposed downstream system will have adequate conveyance capacity. Refer to the On-Site Stormwater Management and Conveyance sections of this report for further details.

Water Quality Treatment

The proposed project will have a total of 4,629 SF PGIS, which is less than 5,000 SF threshold (Section 2.5.6 of DOE SWMMWW). Therefore, this project is not required to provide water quality treatment.

On-Site Stormwater Management

Based upon the City of Mercer Island Municipal Code (MIMC) Section 15.09.050.A, the new plus replaced hard surface area will require mitigation by on-site stormwater management BMPs to the maximum extent feasible. However, per 2014 DOE Manual Section 2.5.5, projects that are required to meet on-site stormwater management (MR5), but do not trigger flow control (MR7) do not have to achieve LID performance standards nor consider bioretention, rain gardens, permeable pavement, and full dispersion if using List #1 or List #2. A number of other BMPs, as required by Section 2.5.5, were evaluated for the project and are discussed below.

BMP T5.13 Post-Construction Soil Quality and Depth: Post-Construction Soil Quality and Depth will be applied to existing lawn areas requiring replacement due to being disturbed by construction.

BMP T5.10A Downspout Full Infiltration Systems, BMP T5.10B Downspout Dispersion Systems or BMP T5.10C Perforated stub-out Connections: Downspout infiltration systems and perforated stub out connections were determined to be infeasible for this site. The geotechnical report for the site, prepared by Aspect Consulting, LLC., observed that the soils underlying the site consisted of fill materials with varying proportions of silty soils. Groundwater was encountered in site explorations and mottling was also observed, indicating shallow groundwater. Refer to the geotechnical report which is supplemental to this report.

Downspout dispersion systems were also found to be infeasible for this site. Per Section 3.1.2 of Volume III. a vegetative flow path of 25-feet or more was not feasible downstream of the hard surfaces.

BMPT5.11 Concentrated Flow Dispersion or BMP T5.12 Sheet Flow Dispersion: Concentrated flow or sheet flow dispersion for the proposed driveway and concrete walkways was not feasible due to limited site and vegetative flow path downstream of the proposed surfaces.

BMPT5.15 Permeable Pavements: Permeable pavement is not feasible on this project because the site slopes exceed those allowable by Volume V of the DOE SWMMWW.

BMPT5.30 Full Dispersion: Full dispersion is infeasible because it would require at least 65% of the site to be in a forested or native condition, which cannot be accomplished.

BMPT7.30 Bioretention: Although not required to be evaluated for this project, a bioretention area will be implemented at the east end of the project. The project is proposing to route 7,729 SF of impervious surface to the bioretention. Per Volume V of the DOE SWMMWW, the bioretention area shall have horizontally projected surface below the overflow which is at least 5% of the total impervious draining to it. Thus, the minimum area of the cell would be 386 SF. The proposed bioretention bottom surface area is 369 SF, but the horizontally projected area (6-inches ponding) is approximately 391 SF, which meets the requirement listed previously.

Conveyance

An analysis of the onsite conveyance systems was performed for the inlet pipe to the bioretention and the south discharge pipe. Refer to the Conveyance Analysis Spreadsheet and MGS Flood output included in Appendix B. At a minimum, the new pipe systems must be able to convey the 25-year peak runoff event per DOE standards, which was determined using MGS Flood with 15-minute time steps. The conveyance systems were also sized for the 100-year peak flow, as a conservative measure. These values were compared to the full flow capacity of the conveyance pipes, which was determined using Manning's equation.

A conservative conveyance analysis was completed for the 6-inch bioretention inlet pipe that collects the north side roofs of the proposed residential property and the soldier pile footing drain. This area totals 0.067 acres of impervious and 0.172 acres of landscaping. The 6-inch HDPE pipe (n=0.012) will be at a 9.3% slope for a full flow capacity of 1.86 CFS (cubic feet per second). The 25-year and 100-year peak storm event were determined to be 0.117 CFS and 0.219 CFS, respectively; therefore, the storm system has adequate capacity.

Additionally, a conveyance analysis was completed for the 6-inch conveyance pipe running along the south side of the site, collecting a portion of the proposed roof and existing car park surface, this totals 0.068 acres of impervious and 0.224 acres of landscaping. The pipe was sized to convey the 100-year storm event. The 6-inch HDPE pipe (n=0.012) will be at a 14.6% slope for a full flow capacity of 2.33 CFS (cubic feet per second). From MGS Flood, the 25-year and 100-year peak storm flows were determined to be 0.137 CFS and 0.254 CFS, respectively. Thus, this pipe system will have adequate conveyance capacity for the proposed conditions.

The proposed runnel conveyance was also reviewed. Flows to the runnel includes the driveway and parking court. Also tributary to the runnel is the onsite wetland. Per coordination with the project Geotechnical Engineer, maximum flow from the wetland area was approximated by assuming that the areas were effectively impervious during high flows. Based on the side slopes and longitudinal slope, and Manning's n of 0.013 (smooth cast iron), it was determined that minimum depth to convey the 100-year storm is 4.56 inches. The runnel has depth of 6-inches, so it would be adequate for conveyance purposes. See runnel calculations in Appendix B.

CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

A construction SWPPP narrative for the project has been included in Appendix C and is based on Volume II of the 2014 DOE Surface Water Management Manual requirements. An NPDES permit from the Washington State Department of Ecology is not required for the project because it will disturb less than one (1) acre of land area.

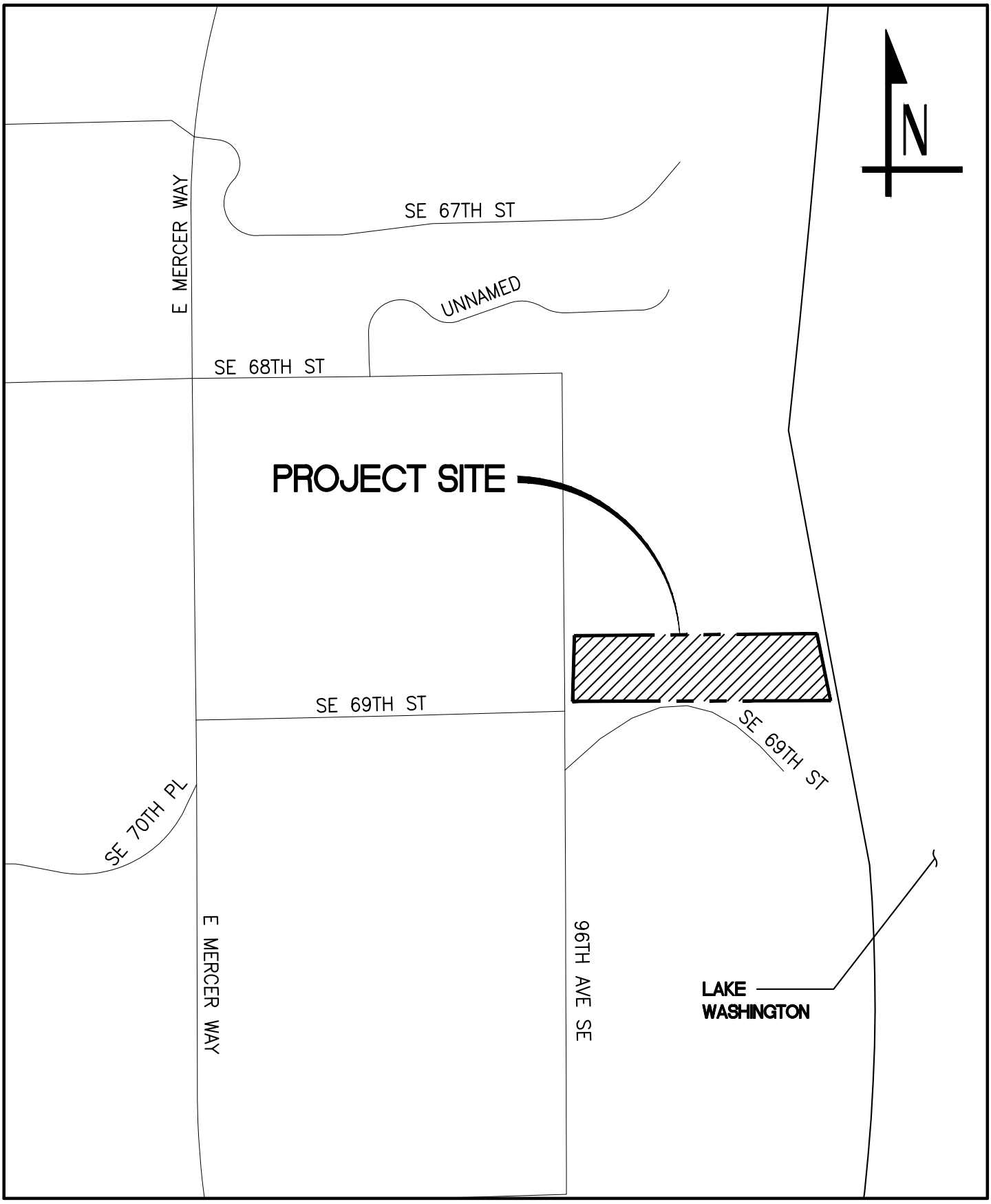
The TESC plan includes a temporary sediment settling tank. A minimum volume was calculated using the methodology from the 2014 DOE manual, with the 2-year developed flow rate from MGS Flood. A volume of an equivalent sediment trap was calculated to find the necessary volume for a sediment tank for this project. A copy of the Sediment Facility Sizing Calculations worksheet and associated MGS Flood output used for this exercise is attached in Appendix B. Stormwater runoff from the project work area will be directed toward temporary sumps installed as necessary. Stormwater will then be pumped to the temporary sediment settling tank.

In addition to the sediment settling tanks, TESC elements in the project include the following:

- Storm Drain Inlet Protection, per BMP C220
- Silt Fence, per BMP C233
- Tree Protection Fencing

The TESC elements shown are intended to be the minimum allowable. The NPDES permit will require periodic inspection of the TESC elements to confirm they are holding up and continuing to function as intended. During construction, the contractor is responsible for upgrading these facilities as necessary. The implementation of the TESC plan and construction maintenance, replacement and upgrading of the TESC facilities are the responsibility of the contractor, per the contract documents. The TESC facilities will be constructed prior to and in conjunction with all clearing and grading activity and in a manner in which sediment or sediment laden water does not leave the project site, enter the drainage system, or violate applicable water quality standards. The SWPPP must be present on-site at all times.

FIGURES



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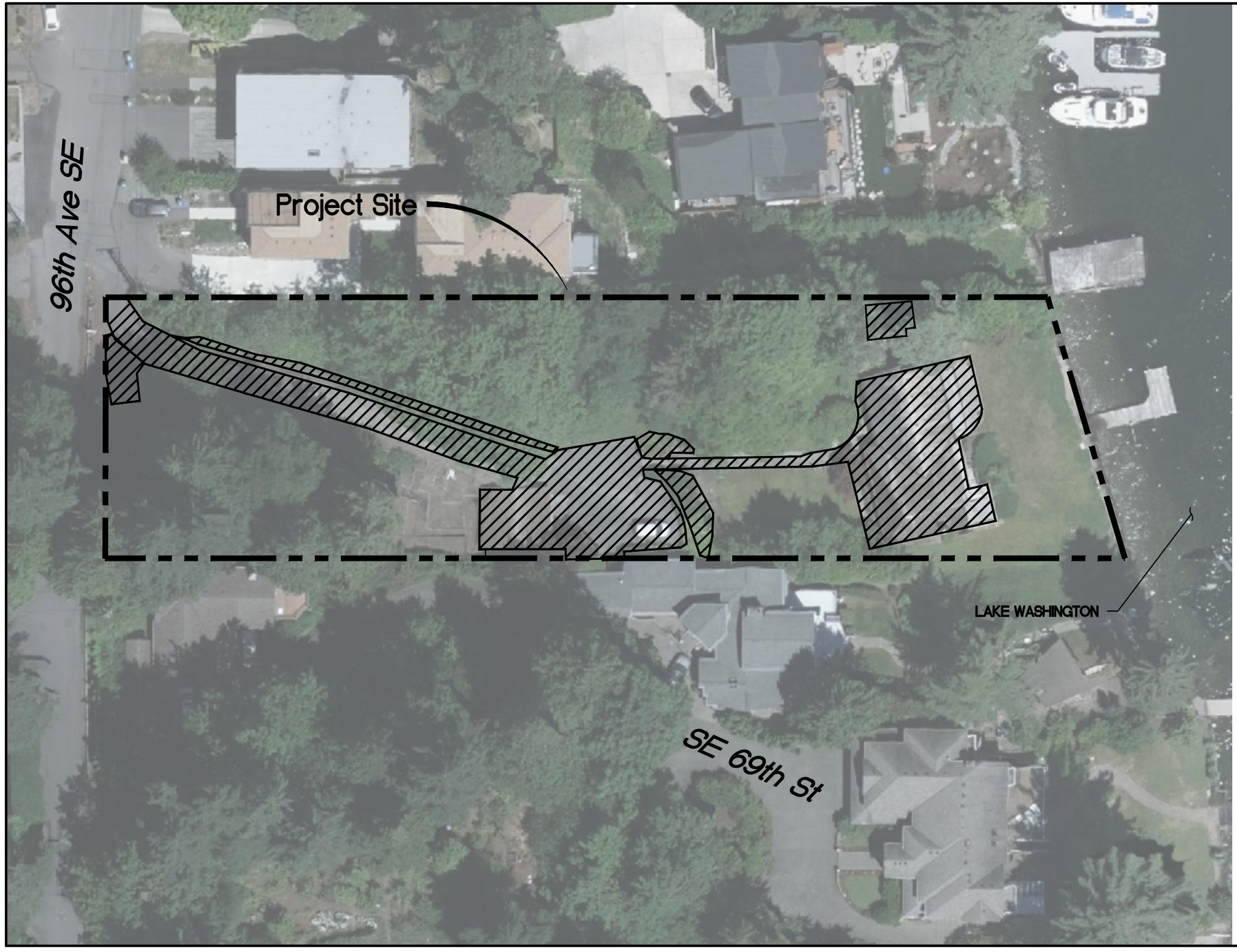
DESCRIPTION

VICINITY MAP

OCTOBER 26, 2022

FIGURE

1



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0 20 40

Scale 1"=40'

EXISTING IMPERVIOUS AREA	
Ex Impervious	0.212 AC
Total Site Area	0.946 AC
Percentage of Site Impervious	22.4%

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DESCRIPTION

EXISTING IMPERVIOUS COVERAGE

OCTOBER 26, 2022

FIGURE

2

KING COUNTY AREA, WASHINGTON (WA633)

MAP UNIT SYMBOL	MAP UNIT NAME
KpD	Kitsap silt loam, 15% to 30% slopes
KpC	Arents, Alderwood Material, 6% to 15% slopes

N

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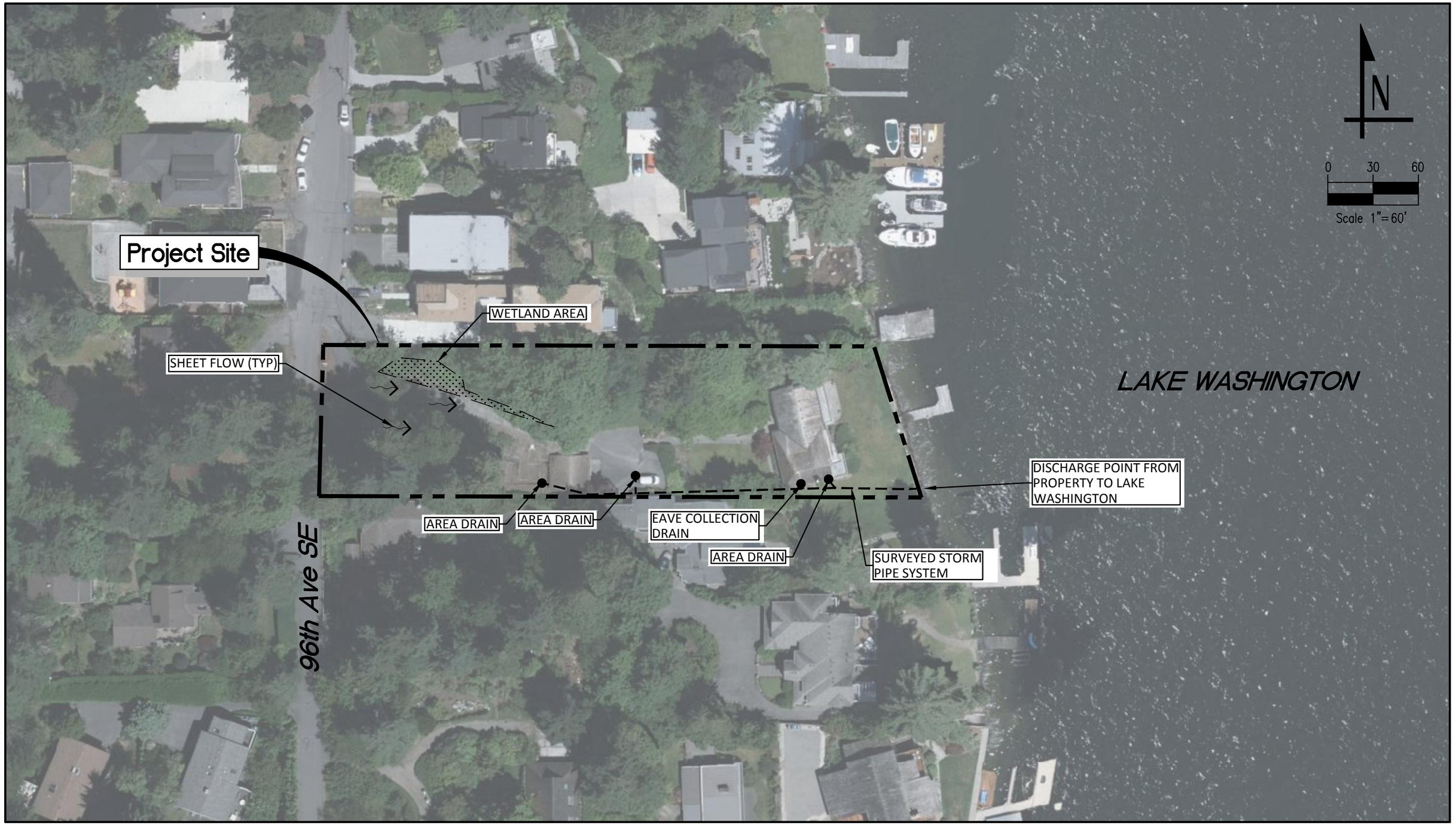
DESCRIPTION

SOILS MAP

OCTOBER 26, 2022

FIGURE

3



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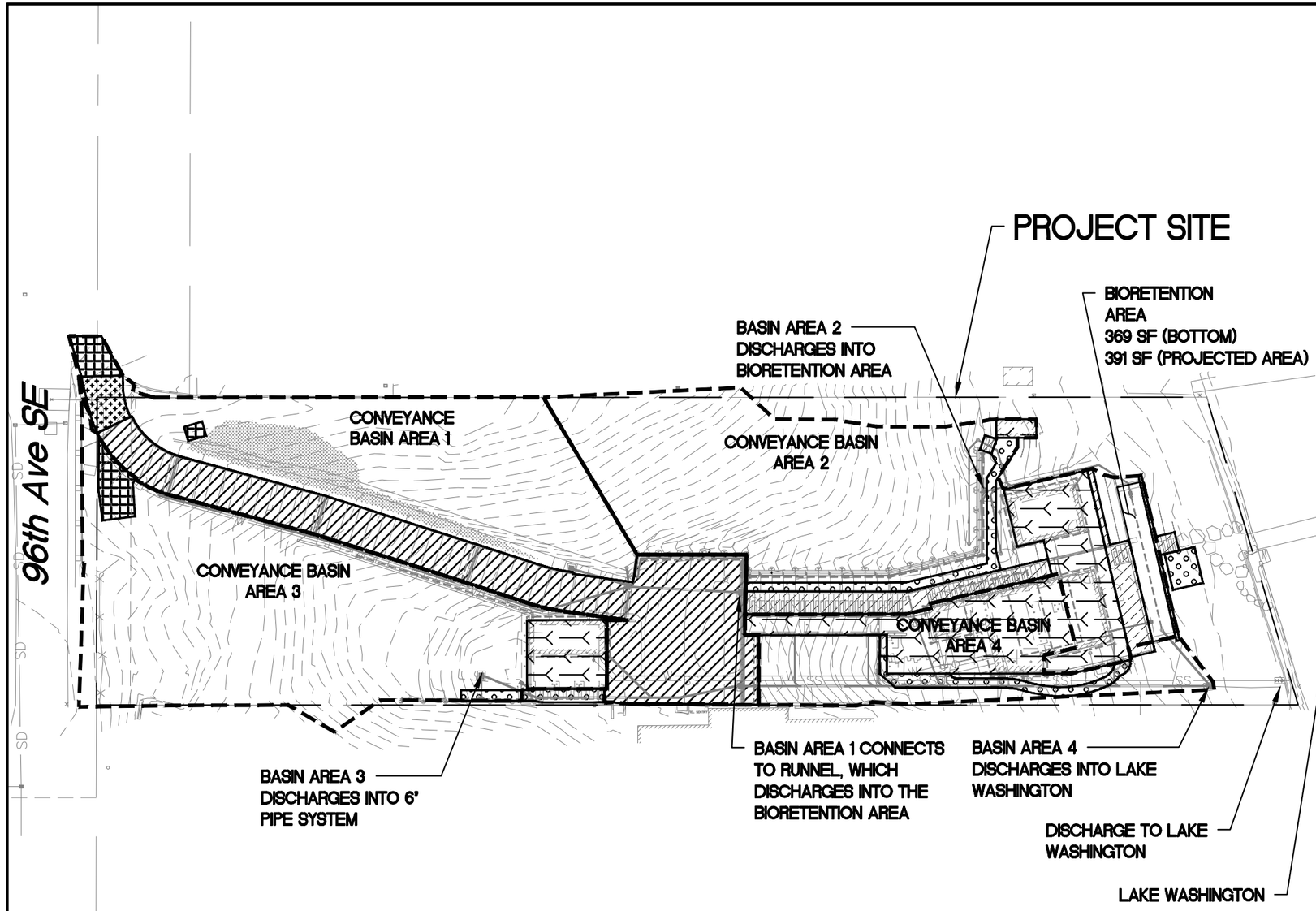
DESCRIPTION

DOWNSTREAM DRAINAGE MAP

OCTOBER 26, 2022

FIGURE

4



0 20 40

Scale 1"=40'

Hard Surface Summary

	BUILDING ROOF	3,822 SF (0.088 AC)
	CONCRETE WALK/STAIRS (NPGHS)	1,137 SF (0.026 AC)
	CONCRETE PAVEMENT (PGHS)	4,427 SF (0.102 AC)
	GRAVEL PAVEMENT (NPGHS)	997 SF (0.023 AC)
	ASPHALT PAVEMENT (PGHS)	202 SF (0.004 AC)
	TOTAL NEW PLUS REPLACED HARD SURFACE	10,585 SF (0.243 AC)
	EX IMPERVIOUS TO REMAIN	397 SF (0.009 AC)

\\lpd.local\shares\data\lpd engineering pllc\projects\miller hull\6838 96th ave se_mercer island\drainage\tir exhibits\figure 5 - proposed conditions.dwg andreww 10/25/2022 11:47 AM

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DESCRIPTION

PROPOSED CONDITIONS

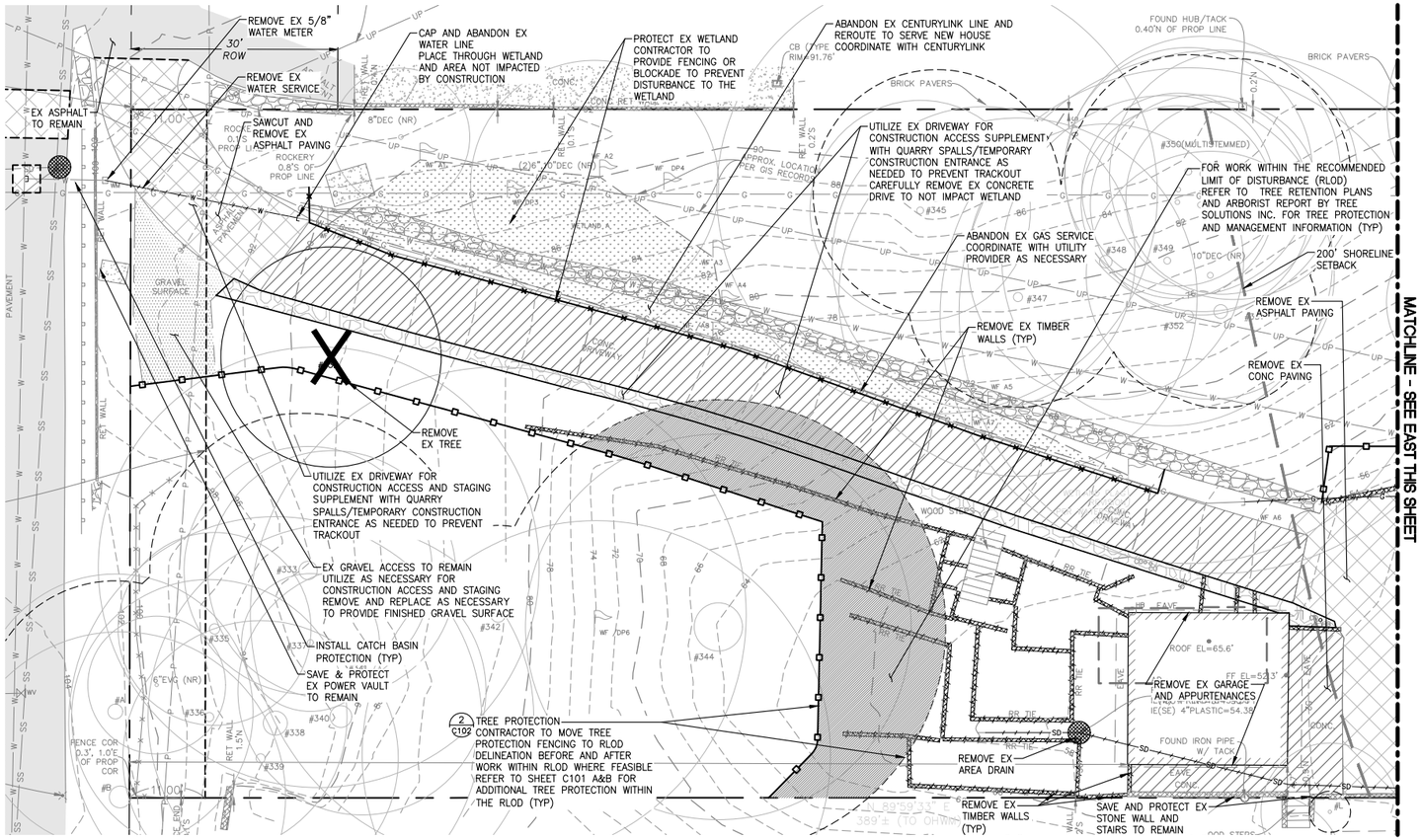
OCTOBER 26, 2022

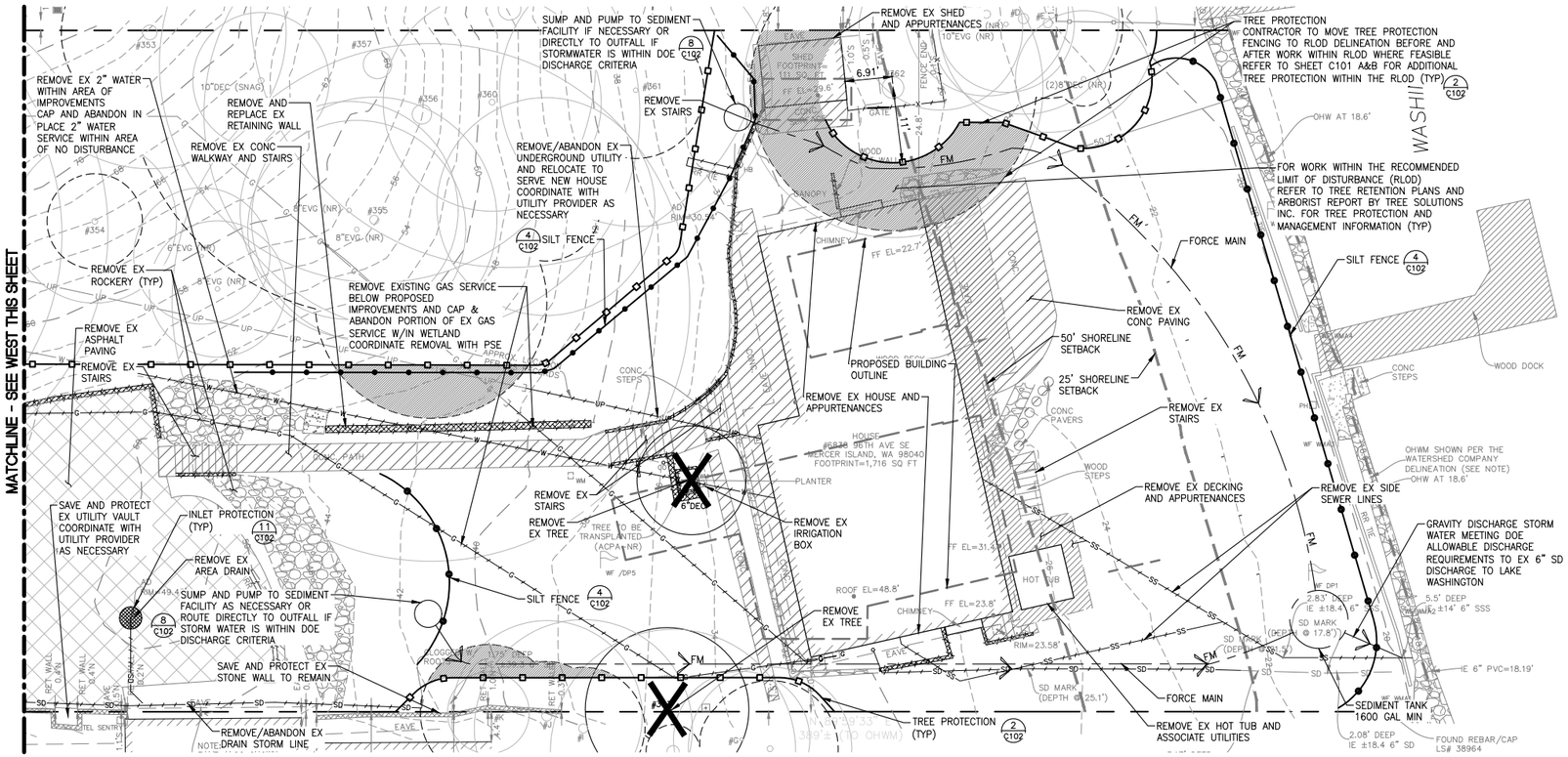
FIGURE

5

APPENDIX A

Design Drawings





TESC NOTES

1. CONTRACTOR TO VIDEO INVESTIGATE EX SD DRAIN AND EX SS LINE TO VERIFY CONDITION, LOCATION AND INVERT ELEVATION. CONTRACTOR TO PROVIDE VIDEO TO ENGINEER FOR REVIEW OF EXISTING CONDITION PRIOR TO CONSTRUCTION.
2. PROVIDE SEDIMENT TANK AS NECESSARY FOR STORMWATER SEDIMENT CONTROL PRIOR TO DISCHARGE FROM THE SITE.
3. CONTRACTOR TO PROVIDE CONSTRUCTION FENCING AS NECESSARY TO SECURE MATERIALS, EQUIPMENT AND ALL AREAS BEING DISTURBED.

ADDITIONAL NOTES

1. REFER TO ARCHITECT PLANS FOR LOT COVERAGE AND HARDSCAPE CALCULATIONS AT SHORELINE SETBACKS
2. REFER TO ARCHITECT PLANS FOR LOT COVERAGE AND HARDSCAPE CALCULATIONS AT THE SITE PROPERTY
3. REFER TO TREE RETENTION PLANS AND ARBORIST REPORT BY TREE SOLUTIONS INC. FOR TREE PROTECTION AND MANAGEMENT INFORMATION.
4. EXISTING WETLAND SHALL NOT BE DISTURBED FOR ANY REASON. REFER TO WETLAND AND SHORELINE MITIGATION PLAN FOR LIMITS OF PROJECT IMPACTS.
5. THE PROJECT INCLUDES REPLACEMENT OF EXISTING TIMBER RETAINING WALLS WITH NEW CAST-IN-PLACE CANTILEVERED CONCRETE WALLS AND/OR CANTILEVERED SOLDIER PILE AND LAGGING WALLS. IN SOME CASES, THE EXISTING RETAINING WALLS ARE SUPPORTING SLOPES THAT MAY BECOME UNSTABLE IF THE EXISTING WALLS ARE REMOVED WITHOUT MAINTAINING CONTINUOUS LATERAL SUPPORT THROUGHOUT CONSTRUCTION. THE CONTRACTOR IS FULLY RESPONSIBLE FOR SITE SAFETY, INCLUDING THE STABILITY OF TEMPORARY EXCAVATIONS AND SLOPES. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE MEANS, METHODS, TECHNIQUES, SEQUENCES, AND OPERATIONS OF CONSTRUCTION OPERATIONS. SLOPE HEIGHTS, INCLINATIONS, AND EXCAVATION DEPTHS SHOULD IN NO CASE EXCEED THOSE SPECIFIED IN LOCAL, STATE, OR FEDERAL SAFETY REGULATIONS. THE FOLLOWING ARE GEOTECHNICAL RECOMMENDATIONS TO REDUCE THE POTENTIAL FOR SLOPE INSTABILITY DURING CONSTRUCTION:
   a. PROPOSED SOLDIER PILE WALL ALIGNMENTS SHOULD BE LOCATED, TO THE MAXIMUM EXTENT PRACTICAL, IMMEDIATELY UPSLOPE OF THE EXISTING TIMBER WALL ALIGNMENTS TO ALLOW FOR DRILLING OF SHAFTS AND PLACEMENT OF STEEL PRIOR TO DEMOLITION OF THE EXISTING TIMBER WALLS. EXCAVATION IN FRONT OF THE PROPOSED SOLDIER PILE WALLS AND LAGGING INSTALLATION SHOULD TAKE PLACE FROM THE TOP DOWN, CONCURRENT WITH PIECE-WISE DEMOLITION OF THE EXISTING TIMBER WALL ELEMENTS SUCH THAT LATERAL SUPPORT OF THE SLOPE IS MAINTAINED AT ALL TIMES.
   b. ALTERNATIVELY, SOLDIER PILE WALLS CAN BE LOCATED DIRECTLY IN FRONT OF THE EXISTING WALLS, AND THE EXISTING WALLS CAN BE LEFT IN-PLACE DURING BACKFILL PLACEMENT.
   c. WALL DEMOLITION AND CONSTRUCTION SHOULD TAKE PLACE DURING THE DRY SEASON (APRIL THROUGH SEPTEMBER) WHEN PRECIPITATION AND GROUNDWATER ARE TYPICALLY AT A MINIMUM AND THERE IS A REDUCED RISK OF SATURATION OF THE SITE SOILS AND ASSOCIATED SLOPE INSTABILITY.
   d. IT MAY BECOME NECESSARY FOR THE CONTRACTOR TO UTILIZE TEMPORARY SHORING SYSTEMS TO PROVIDE TEMPORARY SUPPORT OF SLOPES. THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND SUCCESSFUL INSTALLATION OF TEMPORARY SHORING SYSTEMS. TEMPORARY SHORING SYSTEMS SHOULD BE DESIGNED AND CONSTRUCTED TO SUPPORT LATERAL LOADS EXERTED BY THE RETAINED SOIL MASS AND ANY PRESSURES APPLIED DURING CONSTRUCTION, SUCH AS HEAVY EQUIPMENT AND STOCKPILES NEXT TO THE EXCAVATION.

811 Know what's **below**. **Call** before you dig. Dial 811

N

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Scale 1"=10'

LEGEND

- PROPERTY LINE
- EX CONTOUR (INDEX)
- EX CONTOUR
- EX BUILDING
- SAWCUT LINE
- ASPHALT REMOVAL
- CONCRETE REMOVAL
- STABILIZED CONSTRUCTION ENTRANCE
- SILT FENCE
- WETLAND PROTECTION
- WORK WITHIN THE RECOMMENDED LIMIT OF DISTURBANCE (RLOD) SEE TREE RETENTION PLAN
- EX TREE TO REMAIN
- EX TREE TO BE REMOVED
- TREE PROTECTION
- CATCH BASIN INSERT PROTECTION
- WETLAND BUFFER DELINEATION
- REMOVE EX TIMBER WALL

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STAMP

LAURIE J. PFARR — STATE OF WASHINGTON — 30706 — REGISTERED PROFESSIONAL ENGINEER — 10-26-2022

MERCER ISLAND HOUSE: CASCADE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

BUILDING PERMIT RESUBMITTAL

OCTOBER 27, 2022

REVISIONS

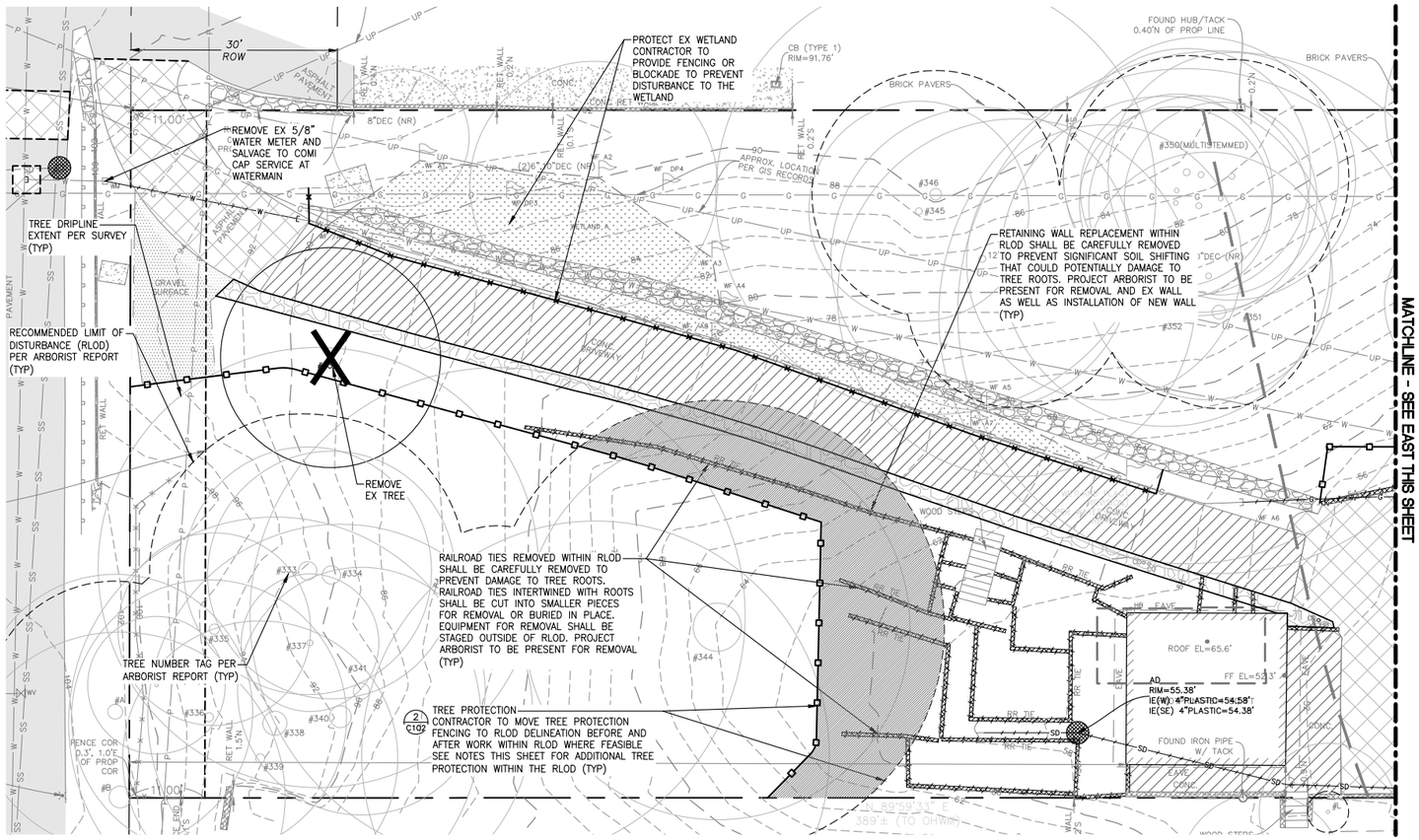
No.	Description	Date
1	BUILDING PERMIT RESUBMITTAL	10/27/22

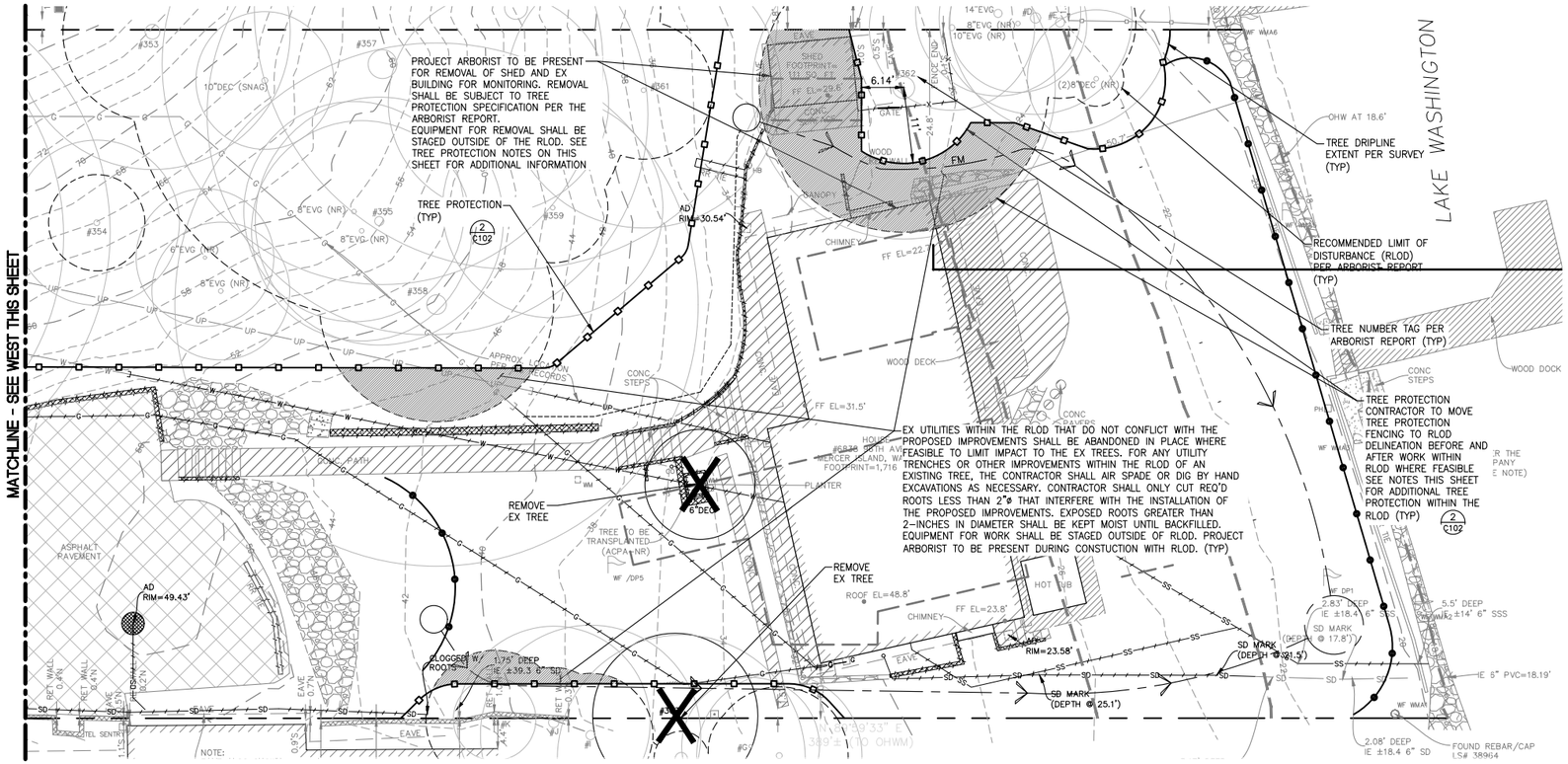
Drawn: EVW
Checked: ACW
MJH Proj No.: A20.0085.00
Issue Date: OCTOBER 27, 2022

SHEET

TESC AND DEMOLITION PLAN

C100





TREE PROTECTION MEASURES AND SPECIAL INSTRUCTIONS AROUND RETAINED TREES

1. REFER TO ARBORIST REPORT BY TREE SOLUTIONS INC. FOR TREE PROTECTION AND MANAGEMENT INFORMATION.
2. ANY WORK, ACTIVITY OR SOIL DISTURBANCE WITHIN THE PROTECTION FENCING, OR LIMIT OF DISTURBANCE, SHALL BE REVIEWED, APPROVED AND MONITORED BY THE PROJECT ARBORIST.
3. PRIOR TO ANY SITE WORK OR DEMOLITION, TREE PROTECTION FENCING (TPF) SHALL BE ERECTED AROUND RETAINED TREES AS SHOWN. TPF SHALL BE SIX (6) FOOT TEMPORARY CHAIN-LINK FENCE AND SHALL BE INSTALLED COMPLETELY ENCIRCLING THE RETAINED TREES.
4. A CITY PLANNER MUST APPROVE ANY MODIFICATIONS TO THE FENCING MATERIAL AND LOCATION.
5. THE AREA PROTECTED BY THE TPF IS OFF LIMITS TO ALL CONSTRUCTION RELATED ACTIVITY.
6. FENCING SHALL NOT BE MOVED OR REMOVED UNLESS APPROVED BY A CITY PLANNER.
7. NO STOCKPILING OF MATERIALS, VEHICULAR OR PEDESTRIAN TRAFFIC, MATERIAL STORAGE OR USE OF EQUIPMENT OR MACHINERY SHALL BE ALLOWED WITHIN RECOMMENDED LIMIT OF DISTURBANCE (RLOD) TO THE EXTENT FEASIBLE. SOIL PROTECTION IS REQUIRED FOR CONSTRUCTION DISTURBANCE WITHIN THE RLOD. THIS INCLUDES BUT IS NOT LIMITED TO 6-INCHES OF WOOD CHIPS COVERED WITH ¾" PLYWOOD OR COMPOSITE MATS.
8. ALL GROUNDWORK WITHIN RLOD SHALL BE MONITORED BY PROJECT ARBORIST TO ASSESS ROOT IMPACTS AND GUIDE ROOT CUTTING AS NECESSARY. FOR ANY UTILITY TRENCHES OR OTHER IMPROVEMENTS WITHIN THE RLOD OF AN EXISTING TREE, THE CONTRACTOR SHALL AIR SPADE OR DIG BY HAND EXCAVATIONS. CONTRACTOR SHALL ONLY CUT REQ'D ROOTS LESS THAN 2"ø THAT INTERFERE WITH THE INSTALLATION OF THE PROPOSED IMPROVEMENTS. EXPOSED ROOTS GREATER THAN 2-INCHES IN DIAMETER SHALL BE KEPT MOIST UNTIL BACKFILLED.
9. BRANCH PRUNING SHALL BE PERFORMED, BY AN APPROVED ISA CERTIFIED ARBORIST, WHERE LIMBS OVERHANG THE TPF TO REDUCE INJURY FROM EQUIPMENT. SEE ARBORIST REPORT FOR SPECIFIC TREE PRUNING RECOMMENDATIONS.

811 Know what's **below**. **Call** before you dig. Dial 811

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Scale 1"=10'

LEGEND

- PROPERTY LINE
- EX CONTOUR (INDEX)
- EX CONTOUR
- EX BUILDING
- SAWCUT LINE
- ASPHALT REMOVAL
- CONCRETE REMOVAL
- STABILIZED CONSTRUCTION ENTRANCE
- SILT FENCE
- WETLAND PROTECTION
- WORK WITHIN THE RECOMMENDED LIMIT OF DISTURBANCE (RLOD) SEE TREE RETENTION PLAN
- EX TREE TO REMAIN
- EX TREE TO BE REMOVED
- TREE PROTECTION
- CATCH BASIN INSERT PROTECTION
- WETLAND BUFFER DELINEATION
- REMOVE EX TIMBER WALL

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Phone: 206.682.6837
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JAURIE J. PFARR — STATE OF WASHINGTON — 30706 — REGISTERED PROFESSIONAL ENGINEER — 10-26-2022

MERCER ISLAND HOUSE: CASCADE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

BUILDING PERMIT RESUBMITTAL

OCTOBER 27, 2022

REVISIONS

No.	Description	Date
1	BUILDING PERMIT RESUBMITTAL	10/27/22

Drawn: EVW
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MJH Proj No.: A20.0085.00

Issue Date: OCTOBER 27, 2022

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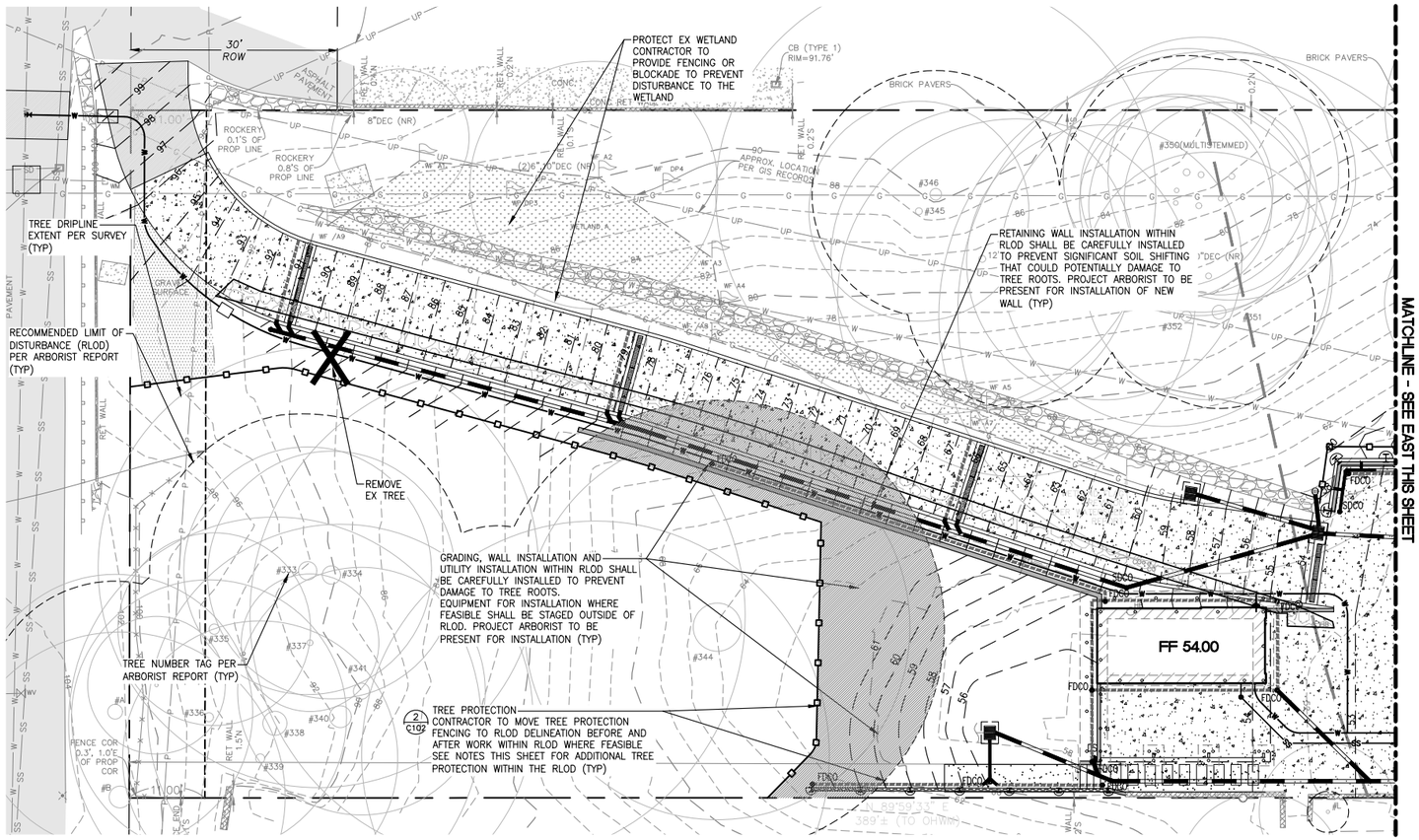
TREE RETENTION PLAN A- REMOVAL

C101A



LEGEND

- PROPERTY LINE
- EX CONTOUR (INDEX)
- EX CONTOUR
- PROPOSED CONTOUR (INDEX)
- PROPOSED CONTOUR
- FF 78.0 FINISHED FLOOR ELEVATION
- EX BUILDING
- PROPOSED BUILDING
- CONCRETE PAVEMENT
- ASPHALT (AC) PAVEMENT
- GRAVEL SURFACING PER LA
- PAVERS PER LA
- GRASSPAVE PER LA
- SITE WALL
- TRENCH/CHANNEL DRAIN
- BIORETENTION POND
- QUARRY SPALL DISCHARGE PAD
- AREA/YARD DRAIN
- CATCH BASIN TYPE 1
- STORM DRAINAGE PIPE
- FOOTING/SUBSURFACE DRAIN
- SDCO STORM DRAIN CLEANOUT
- FDCO FOOTING DRAIN CLEANOUT
- DS DOWNSPOUTS
- SSCO SIDE SEWER PIPE
- SEWER CLEANOUT
- SIDE SEWER CONNECTION
- WORK WITHIN THE RECOMMENDED LIMIT OF DISTURBANCE (RLOD) SEE TREE RETENTION PLAN
- EX TREE TO REMAIN
- TREE PROTECTION
- WETLAND BUFFER DELINEATION

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Scale 1"=10'

TREE PROTECTION MEASURES AND SPECIAL INSTRUCTIONS AROUND RETAINED TREES

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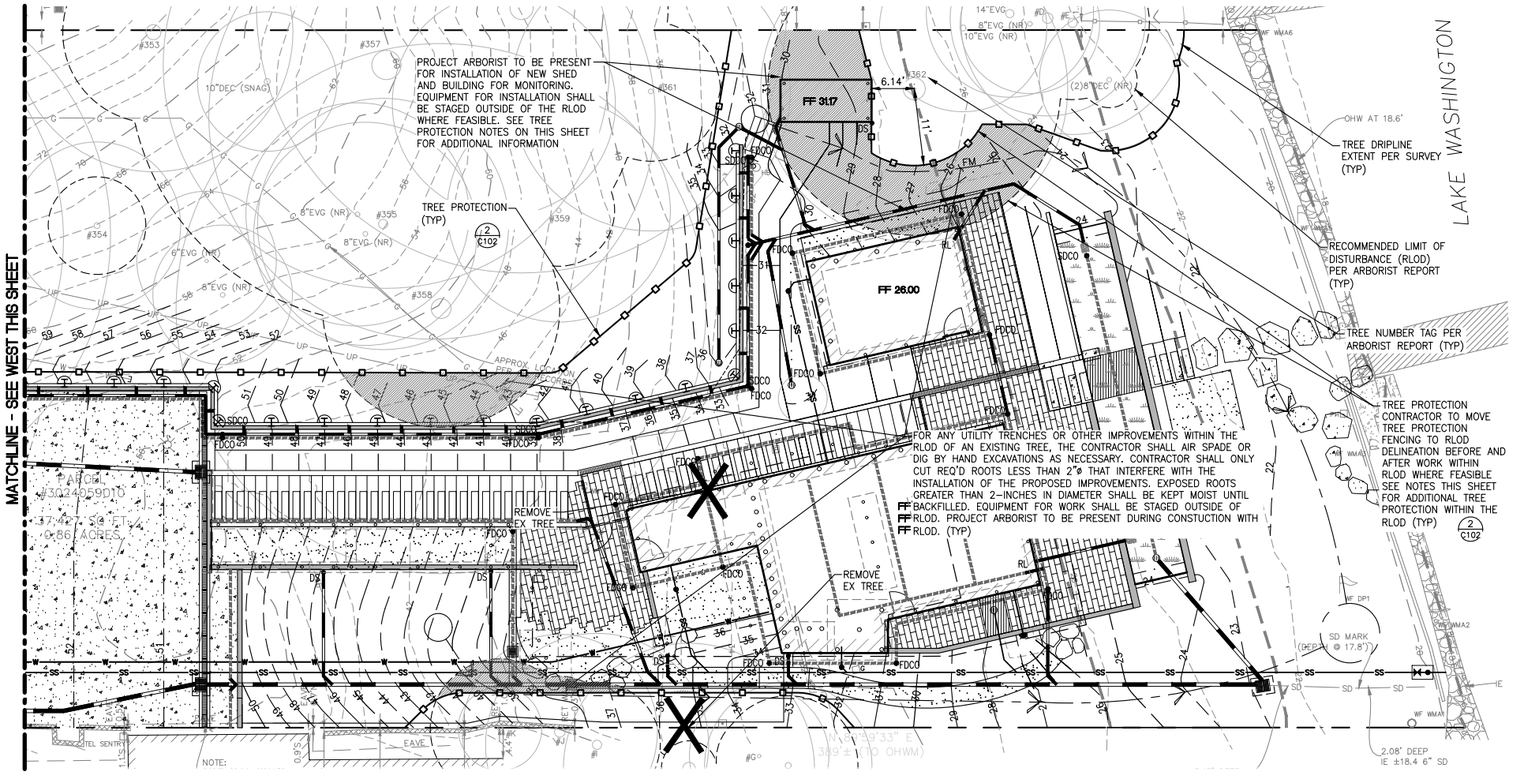

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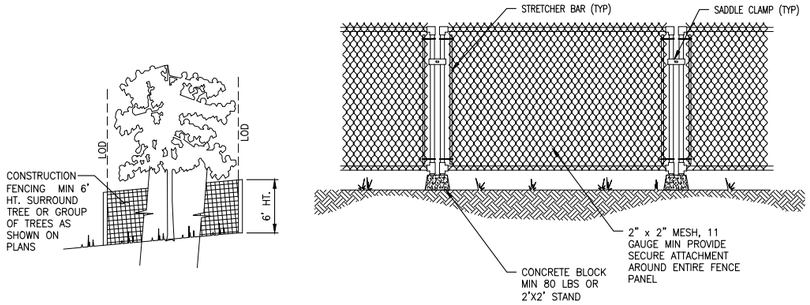
TREE RETENTION PLAN B- PROPOSED

C101B

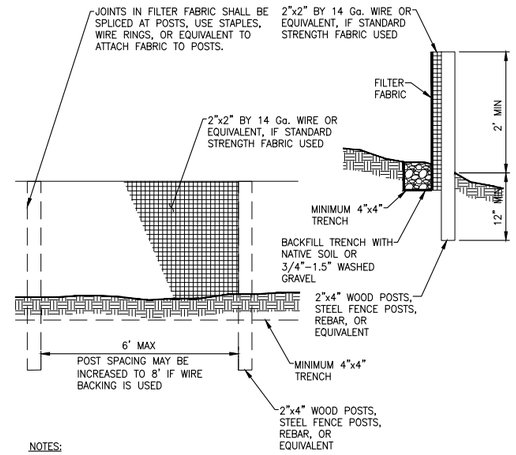


NOTES:

1. A 6 FOOT HIGH TEMPORARY FENCE MUST BE PLACED PRIOR TO THE COMMENCEMENT OF CLEARING OR EARTHWORK. NOTIFY THE CLEARING AND GRADING INSPECTOR TO GET BOTH THE INSPECTION AND WRITTEN APPROVAL OF FLAGGED TREES AND TEMPORARY PROTECTION FENCING AROUND TREES TO BE SAVED PER THE APPROVED CLEARING AND GRADING PLAN.
2. NO STOCKPILING OF MATERIAL AND NO VEHICULAR TRAFFIC ARE ALLOWED WITHIN THE LIMITS OF THE DISTURBANCE (LOD), THE TEMPORARY FENCING, UNLESS APPROVED BY THE ARBORIST. FILLING, EXCAVATION, AND CLEARING MUST BE ACCOMPLISHED BY HAND METHODS ONLY UNLESS APPROVED BY ARBORIST.
3. ROOTS OF TREES TO BE SAVED WHICH ARE DAMAGED DURING CONSTRUCTION MUST BE TREATED IN THE FOLLOWING WAY: FOR DAMAGED ROOTS OVER 2" IN DIAMETER, MAKE A CLEAN, STRAIGHT CUT TO REMOVE THE DAMAGED PORTION OF THE ROOT ALL EXPOSED ROOTS WILL BE TEMPORARILY COVERED WITH DAMP BURLAP OR WOOD SHAVINGS TO PREVENT DRYING AND COVERED WITH EARTH AS SOON AS POSSIBLE.

NTS TREE PROTECTION FENCING 2

NTS NOT USED 3



NOTES:

1. SILT FENCING WITHIN THE TREE PROTECTION ZONE OF RETAINED TREES SHALL BE INSTALLED IN A MANNER THAT DOES NOT SEVER ROOTS. INSTALL SO THAT SILT FENCING SITS ON THE GROUND AND IS WEIGHED IN PLACE BY SANDBAGS OR GRAVEL. DO NOT TRENCH TO INSERT SILT FENCING INTO THE GROUND.

NTS SILT FENCE 4

EROSION AND SEDIMENTATION CONTROL NOTES

1. THE IMPLEMENTATION OF THESE EROSION SEDIMENTATION CONTROL (ESC) PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE ESC FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL ALL CONSTRUCTION IS APPROVED.
2. THE ESC FACILITIES SHOWN ON THIS PLAN MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES IN SUCH A MANNER AS TO INSURE THAT SEDIMENT-LADEN WATER DOES NOT ENTER THE DRAINAGE SYSTEM OR VIOLATE APPLICABLE WATER STANDARDS, AND MUST BE COMPLETED PRIOR TO ALL OTHER CONSTRUCTION.
3. THE ESC FACILITIES SHOWN ON THIS PLAN ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE ESC FACILITIES SHALL BE UPGRADED (E.G. ADDITIONAL SUMPS, RELOCATION OF DITCHES AND SILT FENCES), AS NEEDED FOR UNEXPECTED STORM EVENTS. ADDITIONALLY MORE ESC FACILITIES MAY BE REQUIRED TO ENSURE COMPLETE SILTATION CONTROL. THEREFORE, DURING THE COURSE OF CONSTRUCTION IT SHALL BE THE OBLIGATION AND RESPONSIBILITY OF THE CONTRACTOR TO ADDRESS ANY NEW CONDITIONS THAT MAY BE CREATED BY THEIR ACTIVITIES AND TO PROVIDE ADDITIONAL FACILITIES OVER AND ABOVE THE MINIMUM REQUIREMENTS AS MAY BE NEEDED.
4. THE ESC FACILITIES SHALL BE INSPECTED DAILY DURING NON-RAINFALL PERIODS, EVERY HOUR (DAYLIGHT) DURING A RAINFALL EVENT AND AT THE END OF EVERY RAINFALL BY THE PERMIT HOLDER/CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING. IN ADDITION, TEMP. SILTATION PONDS AND ALL TEMP. SILTATION CONTROLS SHALL BE MAINTAINED IN A SATISFACTORY CONDITION UNTIL SUCH TIME THAT CLEARING AND OR CONSTRUCTION IS COMPLETED, PERMANENT DRAINAGE FACILITIES ARE OPERATIONAL, AND THE POTENTIAL FOR EROSION HAS PASSED.
5. ANY AREA STRIPPED OF VEGETATION, INCLUDING ROADWAY EMBANKMENTS WHERE NO FURTHER WORK IS ANTICIPATED FOR A PERIOD OF SEVEN (7) DAYS, SHALL BE IMMEDIATELY STABILIZED WITH THE APPROVED ESC METHODS (E.G. SEEDING, MULCHING, NETTING, EROSION, BLANKETS, ETC.)
6. ANY AREAS NEEDING ESC MEASURES, NOT REQUIRING IMMEDIATE ATTENTION, SHALL BE ADDRESSED WITHIN SEVEN (7) DAYS.
7. THE ESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH OR WITHIN THE 48 HOURS FOLLOWING A STORM EVENT.
8. AT NO TIME SHALL MORE THAN ONE FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A CATCH BASIN. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO DOWNSTREAM SYSTEM.
9. WHERE SEEDING FOR TEMPORARY EROSION CONTROL IS REQUIRED, FAST GERMINATING GRASSES SHALL BE APPLIED AT AN APPROPRIATE RATE (E.G. ANNUAL OR PERENNIAL RYE APPLIED AT APPROXIMATELY 80 POUNDS PER ACRE).
10. WHERE STRAW MULCH FOR TEMPORARY EROSION CONTROL IS REQUIRED, IT SHALL BE APPLIED AT A MINIMUM THICKNESS OF THREE INCHES.
11. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH THE CITY OF MERCER ISLAND STANDARDS AND SPECIFICATIONS.
12. EROSION/SEDIMENTATION CONTROL FACILITIES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE DETAILS IN DEPARTMENT OF ECOLOGY STORMWATER MANAGEMENT MANUAL, UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
13. A COPY OF THE APPROVED EROSION CONTROL PLANS MUST BE ON THE JOB SITE WHENEVER CONSTRUCTION IS IN PROGRESS.
14. TEMPORARY EROSION/SEDIMENTATION CONTROLS SHALL BE INSTALLED & OPERATING PRIOR TO ANY GRADING OR LAND CLEARING.
15. WHEREVER POSSIBLE, MAINTAIN NATURAL VEGETATION FOR SILT CONTROL.
16. ALL CUT AND FILL SLOPES 5:1 (5 FEET HORIZONTAL TO 1 FOOT VERTICAL) OR STEEPER THAT WILL BE LEFT EXPOSED FOR MORE THAN 7 DAYS SHALL BE PROTECTED BY JUTE MATTING, PLASTIC SHEETING, MULCH, OR OTHER APPROVED STABILIZATION METHOD AND PROVIDED WITH ADEQUATE RUNOFF CONVEYANCE TO INTERCEPT RUNOFF AND CONVEY IT TO AN APPROVED STORM DRAIN.
17. OFF-SITE STREETS MUST BE KEPT CLEAN AT ALL TIMES. IF DIRT IS DEPOSITED ON THE PUBLIC STREET, THE STREET SHALL BE CLEANED. ALL VEHICLES SHALL LEAVE THE SITE BY WAY OF THE CONSTRUCTION VEHICLE ENTRANCE AND SHALL BE CLEANED OF MUD PRIOR TO EXITING ONTO THE STREET. SILT SHALL BE CLEANED FROM ALL CATCH BASINS WHEN THE BOTTOM HALF BECOMES FILLED WITH SILT.
18. ANY CATCH BASIN COLLECTING WATER FROM THE SITE, WHETHER THEY ARE ON OR OFF OF THE SITE, SHALL HAVE THEIR GRATES COVERED WITH FILTER FABRIC DURING CONSTRUCTION.
19. IF ANY PORTION OF THE EROSION/SEDIMENTATION CONTROL ELEMENTS ARE DAMAGED OR NOT FUNCTIONING, OR IF THE CLEARING LIMIT BOUNDARY BECOMES NON-DEFINED, IT SHALL BE REPAIRED IMMEDIATELY.

NTS EROSION AND SEDIMENTATION CONTROL NOTES 9

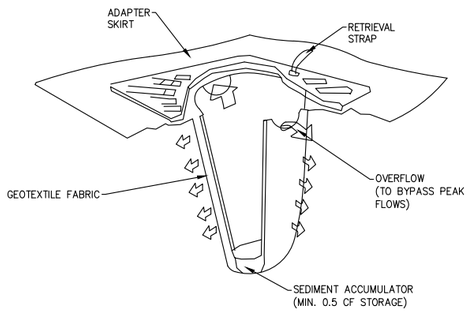
CITY OF MERCER ISLAND NOTES

1. ANY CHANGES TO THE APPROVED PLANS REQUIRES CITY APPROVAL THROUGH A REVISION.
2. APPLICANT IS RESPONSIBLE FOR ANY DAMAGES TO UNDERGROUND UTILITIES CAUSED FROM THIS CONSTRUCTION.
3. CATCH BASIN FILTERS SHOULD BE PROVIDED FOR ALL STORM DRAIN CATCH BASIN/INLETS DOWNSLOPE AND WITHIN 500 FEET OF THE CONSTRUCTION AREA. CATCH BASIN FILTERS SHOULD BE DESIGNED BY THE MANUFACTURER FOR USE AT CONSTRUCTION SITES AND APPROVED BY THE CITY INSPECTOR. CATCH BASIN FILTERS SHOULD BE INSPECTED FREQUENTLY, ESPECIALLY AFTER STORM EVENTS. IF THE FILTER BECOMES CLOGGED, IT SHOULD BE CLEANED OR REPLACED.
4. CONTRACTORS SHALL VERIFY LOCATIONS AND DEPTHS OF UTILITIES.
5. AT LEAST 48 HOURS PRIOR TO CONSTRUCTION, CALL "ONE CALL" AT 1.800.425.5555.
6. DO NOT BACKFILL WITH NATIVE MATERIAL ON PUBLIC RIGHT-OF-WAY. ALL MATERIAL MUST BE IMPORTED.
7. EROSION CONTROL: ALL "LAND DISTURBING ACTIVITY" IS SUBJECT TO PROVISIONS OF MERCER ISLAND ORDINANCE 95C-118 "STORM WATER MANAGEMENT." SPECIFIC ITEMS TO BE FOLLOWED AT YOUR SITE.
8. PROTECT ADJACENT PROPERTIES FROM ANY INCREASED RUNOFF OR SEDIMENTATION DUE TO THE CONSTRUCTION PROJECT THROUGH THE USE OF APPROPRIATE "BEST MANAGEMENT PRACTICES" (BMP) EXAMPLES INCLUDE, BUT ARE NOT LIMITED TO, SEDIMENT TRAPS, SEDIMENT PONDS, FILTER FABRIC FENCES, VEGETATIVE BUFFER STRIPS OR BIOENGINEERED SWALES.
9. CONSTRUCTION ACCESS TO SITE SHOULD BE LIMITED TO ONE ROUTE. STABILIZE ENTRANCE WITH QUARRY SPALLS TO PREVENT SEDIMENT FROM LEAVING THE SITE OR ENTERING THE STORM DRAINS.
10. PREVENT SEDIMENT, CONSTRUCTION DEBRIS, PAINTS, SOLVENTS, ETC., OR OTHER TYPES OF POLLUTION FROM ENTERING PUBLIC STORM DRAINS. KEEP ALL POLLUTION ON YOUR SITE.
11. ALL EXPOSED SOILS SHALL REMAIN DENUDED FOR NO LONGER THAN SEVEN (7) DAYS AND SHALL BE BE STABILIZED WITH MULCH, HAY, OR THE APPROPRIATE GROUND COVER. ALL EXPOSED SOILS SHALL BE COVERED IMMEDIATELY DURING ANY RAIN EVENT.
12. INSTALLATION OF CONCRETE DRIVEWAYS, TREES, SHRUBS, IRRIGATION, BOULDERS, BERMS, WALLS, GATES, AND OTHER IMPROVEMENTS ARE NOT ALLOWED IN THE PUBLIC RIGHT-OF-WAY WITHOUT PRIOR APPROVAL, AND AN ENCROACHMENT AGREEMENT AND RIGHT OF WAY PERMIT FROM THE SENIOR DEVELOPMENT ENGINEER.
13. OWNER SHALL CONTROL DISCHARGE OF SURFACE DRAINAGE RUNOFF FROM EXISTING AND NEW IMPERVIOUS AREAS IN A RESPONSIBLE MANNER. CONSTRUCTION OF NEW GUTTERS AND DOWNSPOUTS, DRY WELLS, LEVEL SPREADERS OR DOWNSTREAM CONVEYANCE PIPE MAY BE NECESSARY TO MINIMIZE DRAINAGE IMPACT TO YOUR NEIGHBORS. CONSTRUCTION OF MINIMUM DRAINAGE IMPROVEMENTS SHOWN OR CALLED OUT ON THIS PLAN DOES NOT IMPLY RELIEF FROM CIVIL LIABILITY FOR YOUR DOWNSTREAM DRAINAGE.
14. POT HOLING THE PUBLIC UTILITIES IS REQUIRED PRIOR TO ANY GRADING ACTIVITIES LESS THAN 6" OVER THE PUBLIC MAINS (WATER, SEWER AND STORM SYSTEMS). IF THERE IS A CONFLICT, THE APPLICANT IS REQUIRED TO SUBMIT A REVISION FOR APPROVAL PRIOR TO ANY GRADING ACTIVITIES OVER THE PUBLIC MAINS.
15. REMEMBER: EROSION CONTROL IS YOUR FIRST INSPECTION.
16. ROOF DRAINS MUST BE CONNECTED TO THE STORM DRAIN SYSTEM AND INSPECTED BY THE PUBLIC WORKS DEPARTMENT PRIOR TO ANY BACKFILLING OF PIPE.
17. SILT FENCE: CLEAN AND PROVIDE REGULAR MAINTENANCE OF THE SILT FENCE. THE FENCE IS TO REMAIN VERTICAL AND IS TO FUNCTION PROPERLY THROUGHOUT THE TERM OF THE PROJECT.
18. WORK IN PUBLIC RIGHT OF WAY REQUIRES A RIGHT-OF-WAY USE PERMIT.
19. REFER TO WATER SERVICE PERMIT FOR ACTUAL LOCATION OF NEW WATER METER AND SERVICE LINE DETERMINED BY MERCER ISLAND WATER DEPARTMENT.
20. THE TV INSPECTION OF THE EXISTING SIDE SEWER TO THE CITY SEWER MAIN IS REQUIRED. IF THE RESULT OF THE TV INSPECTION IS NOT IN SATISFACTORY CONDITION, AS DETERMINED BY THE CITY OF MERCER ISLAND INSPECTOR, THE REPLACEMENT OF THE EXISTING SIDE SEWER IS REQUIRED. ALTERNATELY, A PRESSURE TEST OF THE SIDE SEWER, FROM SEWER MAIN TO POINT OF CONNECTION, MAY BE SUBSTITUTED FOR THE VIDEO INSPECTION.
21. NEWLY INSTALLED SIDE SEWER REQUIRES A 4 P.S.I. AIR TEST OR PROVIDE 10' OF HYDROSTATIC HEAD TEST.
22. THE LIMITS AND EXTENTS OF THE PAVEMENT IN THE PUBLIC RIGHT OF WAY SHALL BE DETERMINED BY THE CITY ENGINEER PRIOR TO FINALIZING THE PROJECT.
23. TREE PROTECTION INSPECTION REQUIRED BEFORE ANY WORK BEGINS, CALL 206-275-7713.

NTS CITY OF MERCER ISLAND NOTES 10

NTS NOT USED 7

NTS SUMP AND PUMP 8



SCHEMATIC DETAIL

PROVIDE "STREAMGUARD SEDIMENT CATCH BASIN INSERT" OR APPROVED EQUAL
MANUFACTURER'S NAME: BOWHEAD ENVIRONMENTAL & SAFETY
ADDRESS: P.O. BOX 375 PRESTON, WA 98050
TELEPHONE: FOR INFORMATION: (800) 909-3677
WWW.SHOPBOWHEAD.COM

NTS CATCH BASIN PROTECTION 11

NTS NOT USED 12

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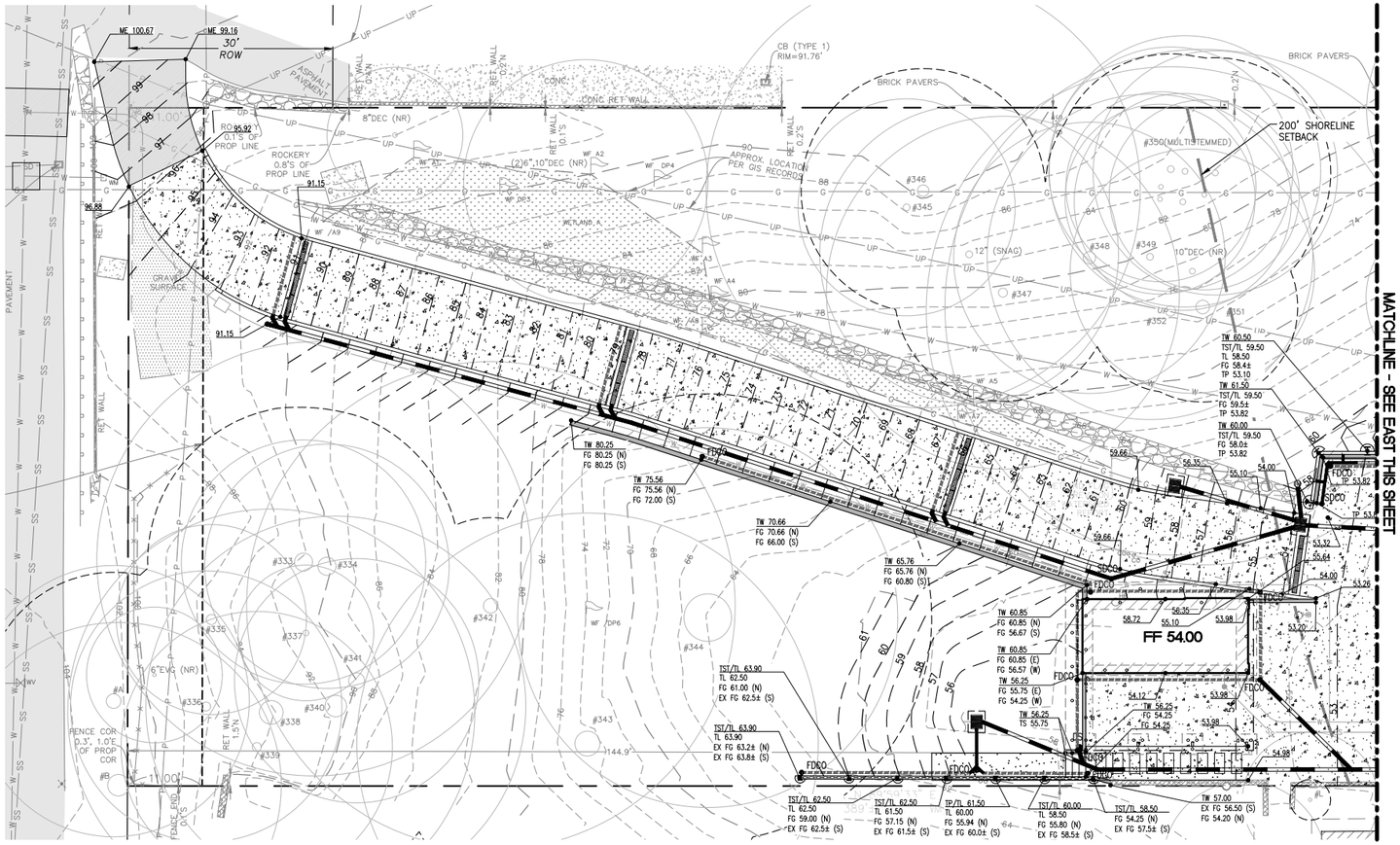
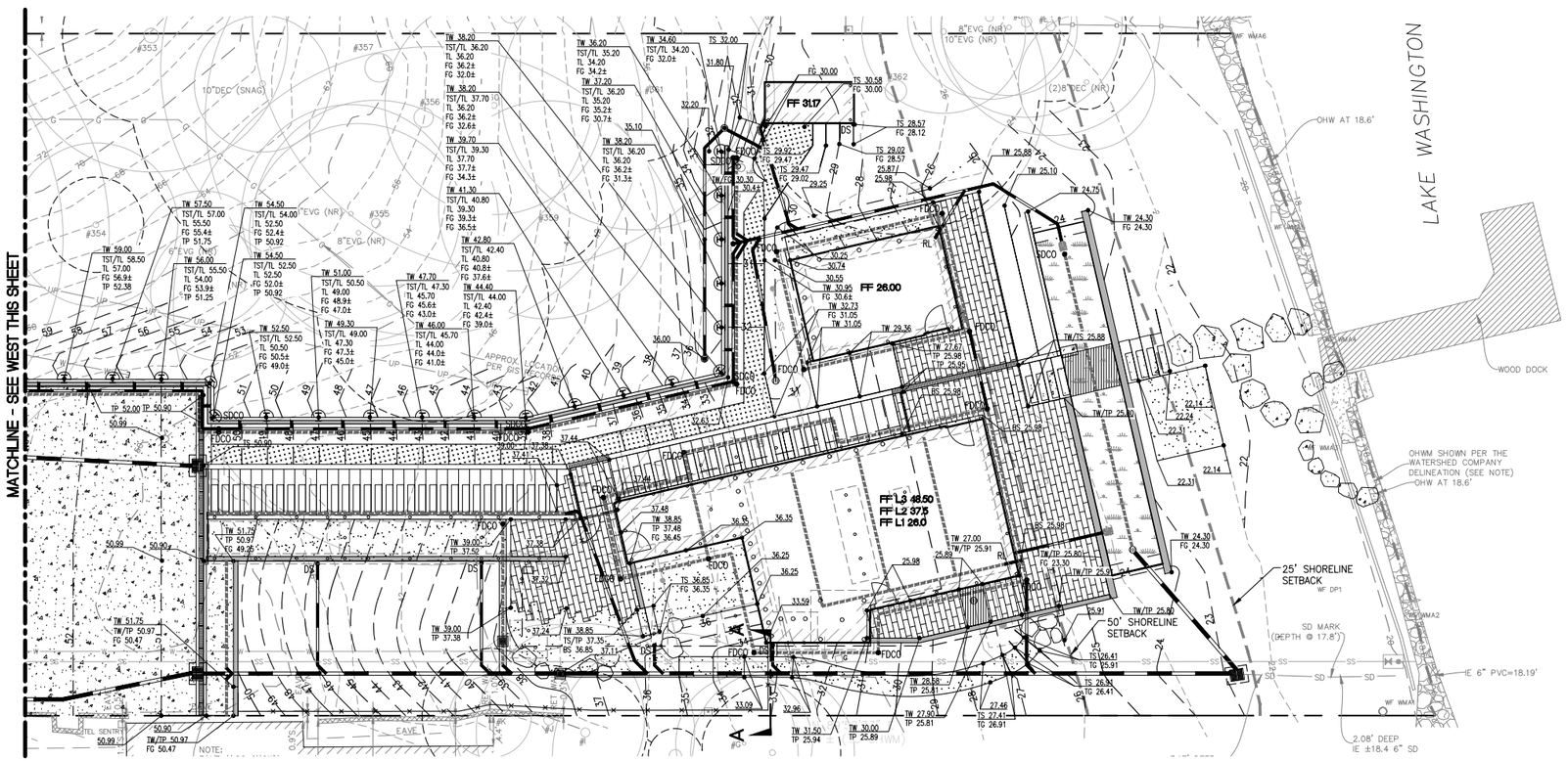
TESC DETAILS

C102





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- TOP OF STEP, BOTTOM STEP, MATCH EX
- FF 78.0 FINISHED FLOOR ELEVATION
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LAURIE J. PFARR — STATE OF WASHINGTON — 30796 — REGISTERED PROFESSIONAL ENGINEER — 10-26-2022

MERCER ISLAND HOUSE: CASCADE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

BUILDING PERMIT RESUBMITTAL

OCTOBER 27, 2022

REVISIONS

No.	Description	Date
1	BUILDING PERMIT RESUBMITTAL	10/27/22

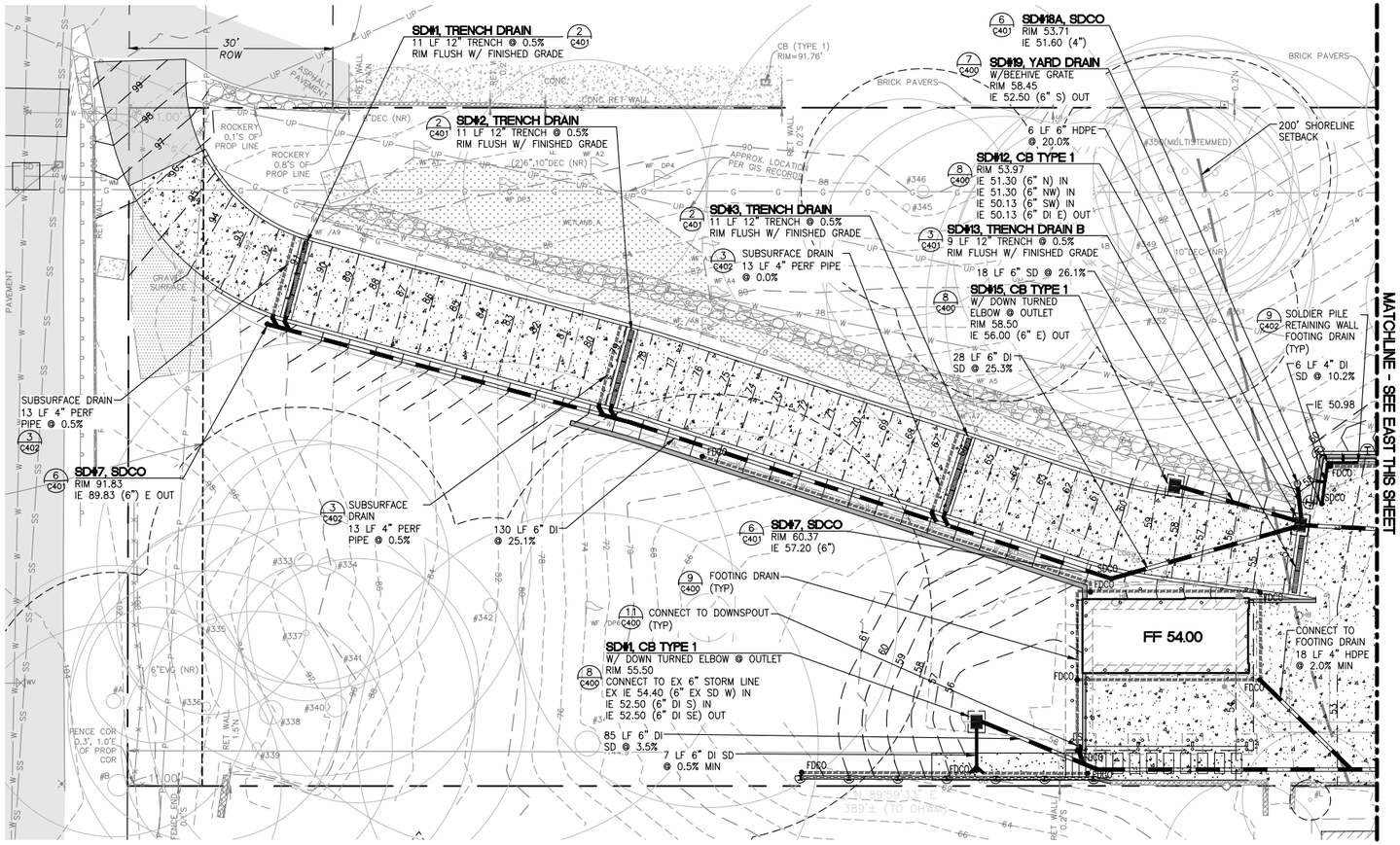
Drawn: EVW
Checked: ACW
M|H Proj No.: A20,0085,00

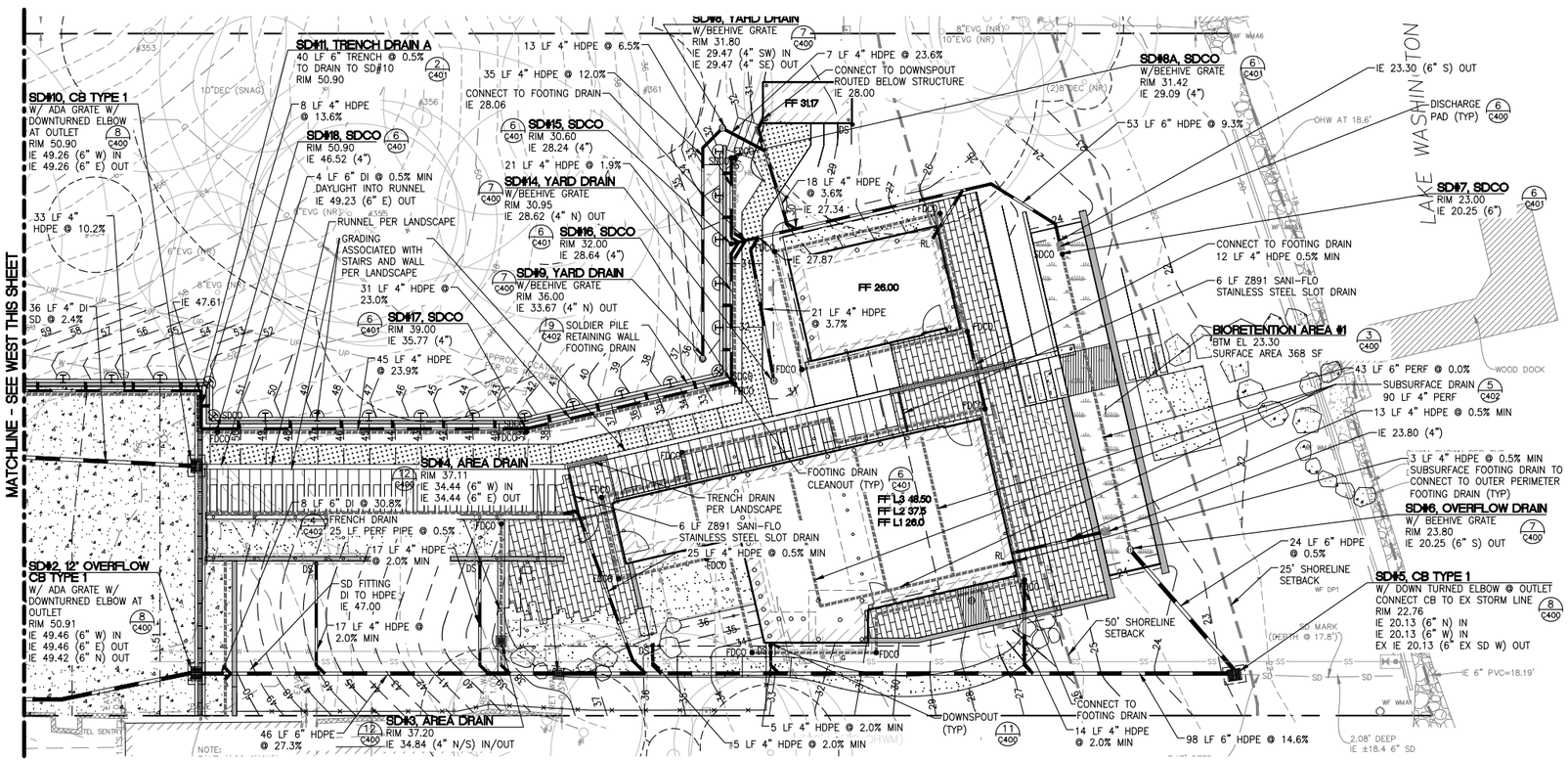
Issue Date: OCTOBER 27, 2022

SHEET

GRADING PLAN

C200A





LEGEND

- PROPERTY LINE
- EX CONTOUR (INDEX)
- EX CONTOUR
- PROPOSED CONTOUR (INDEX)
- PROPOSED CONTOUR
- SPOT ELEVATION
- TOP OF PAVE, TOP OF WALL, FINISHED GRADE
- TOP OF STEP, BOTTOM STEP, MATCH EX
- FF 78.0 — FINISHED FLOOR ELEVATION
- EX BUILDING
- PROPOSED BUILDING
- CONCRETE PAVEMENT
- ASPHALT (AC) PAVEMENT
- GRAVEL SURFACING PER LA
- PAVERS PER LA
- GRASSPAVE PER LA
- SITE WALL
- TRENCH/CHANNEL DRAIN
- BIORETENTION POND
- QUARRY SPALL DISCHARGE PAD
- AREA/YARD DRAIN
- CATCH BASIN TYPE 1
- STORM DRAINAGE PIPE
- FOOTING/SUBSURFACE DRAIN
- SDCO ● — STORM DRAIN CLEANOUT
- FDCO ● — FOOTING DRAIN CLEANOUT
- DS ● — DOWNSPOUTS
- SIDE SEWER PIPE
- SEWER CLEANOUT
- SIDE SEWER CONNECTION

N

10 0 5 10 20

Scale 1"=10'

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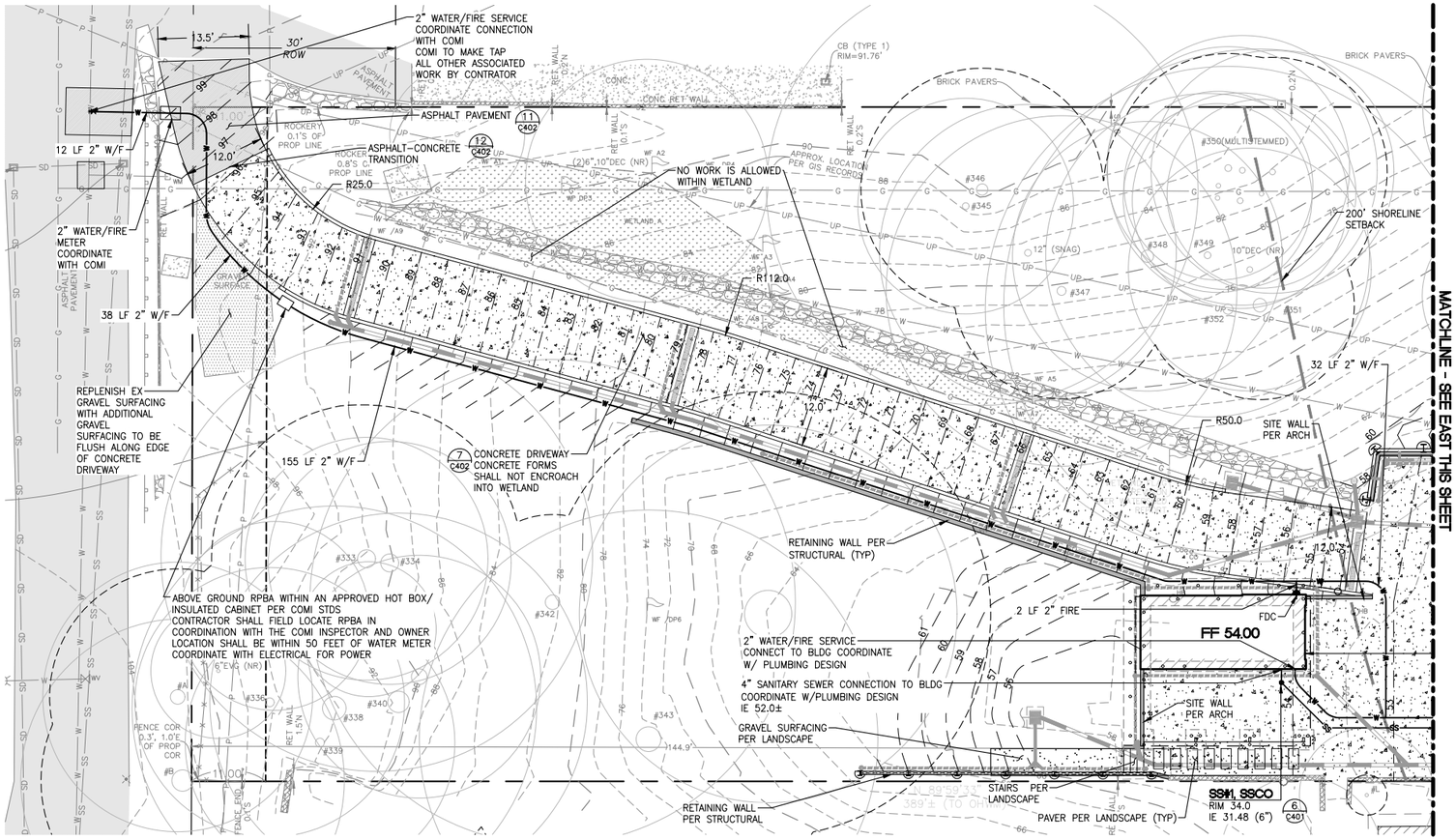
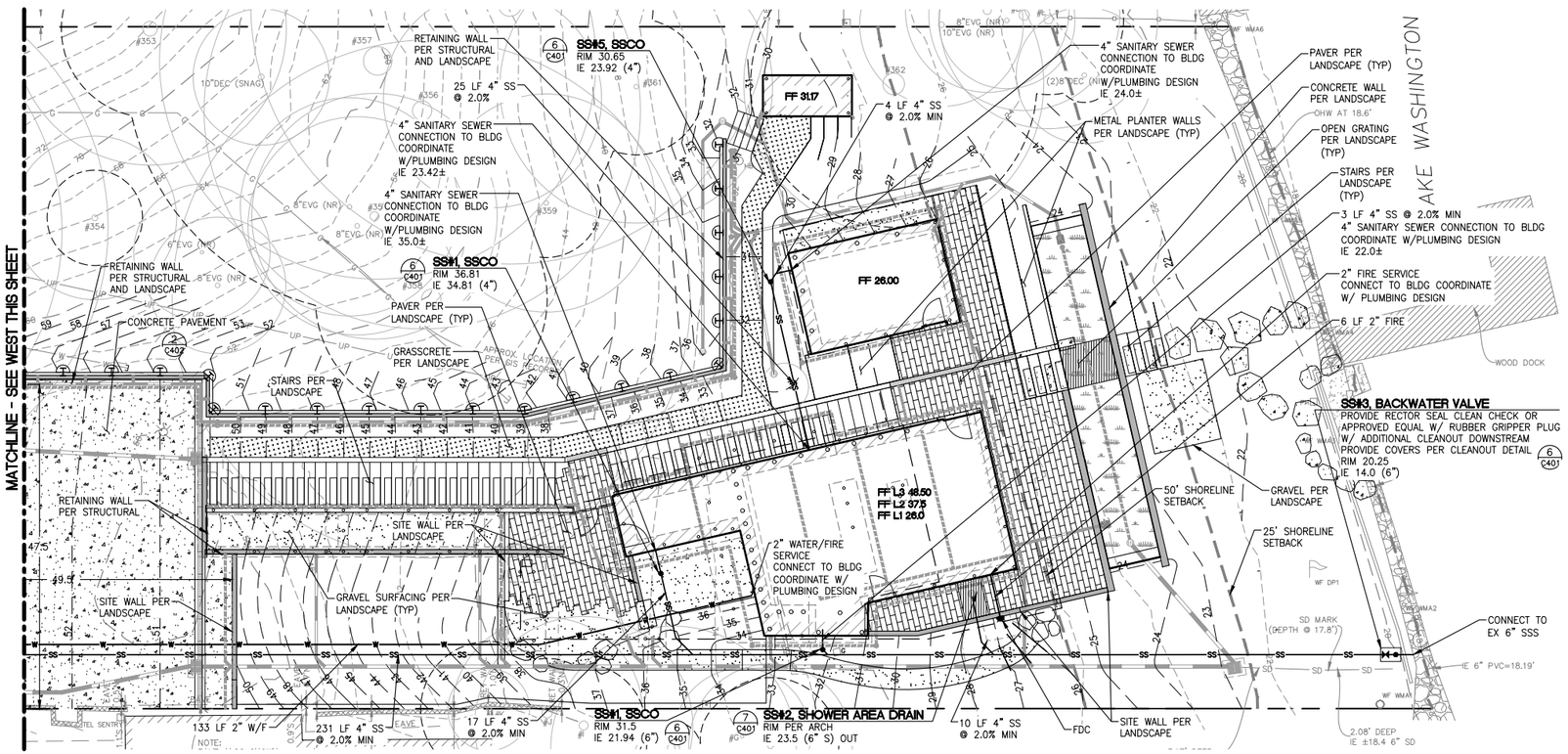
DRAINAGE PLAN

C200B





LEGEND

- PROPERTY LINE
- EX CONTOUR (INDEX)
- EX CONTOUR
- PROPOSED CONTOUR (INDEX)
- PROPOSED CONTOUR
- FF 78.0 FINISHED FLOOR ELEVATION
- EX BUILDING
- PROPOSED BUILDING
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- SSCO SS SIDE SEWER PIPE
- SEWER CLEANOUT
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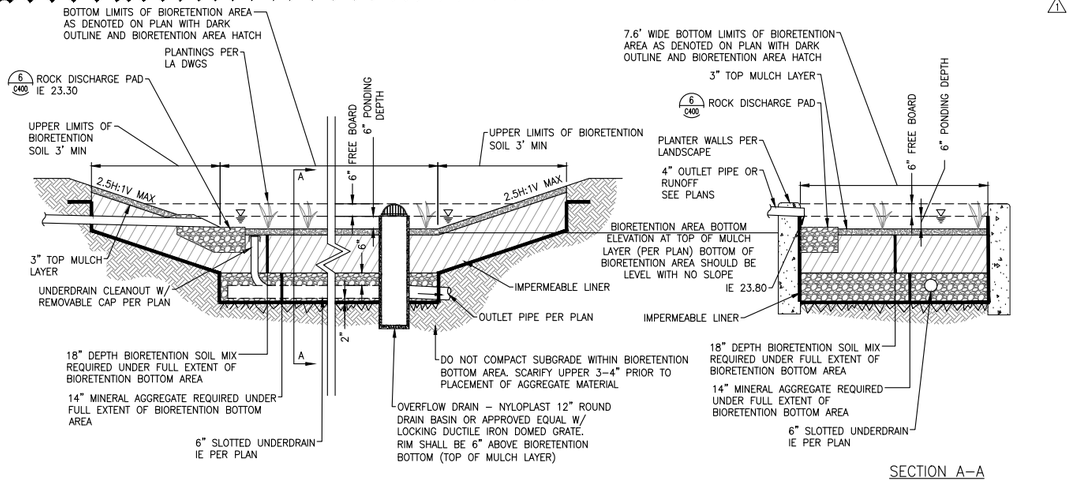
SHEET

UTILITIES & PAVING PLAN

C300

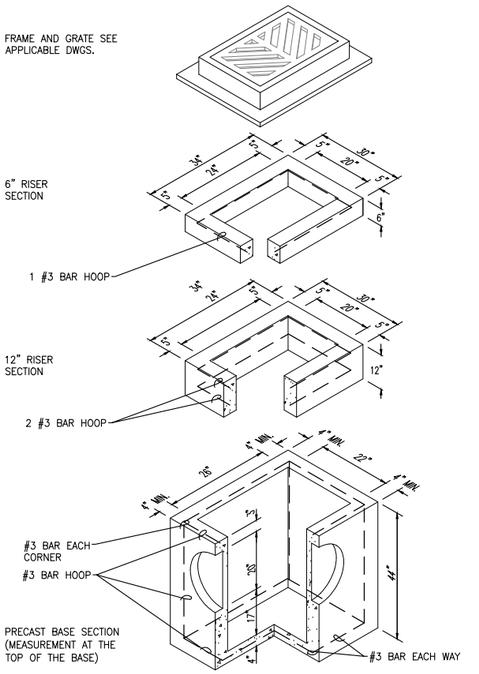
CONSTRUCTION SEQUENCE FOR BIORETENTION AREA

1. INSTALL TEMPORARY SEDIMENT CONTROL BMPS AS SHOWN ON PLAN.
2. COMPLETE SITE GRADING. PROVIDE PROTECTION SO THAT DRAINAGE IS PROHIBITED FROM ENTERING BIORETENTION CONSTRUCTION AREA.
3. SITE STABILIZATION TO BE COMPLETE PRIOR TO INSTALLATION OF BIORETENTION AREA. BIORETENTION AREAS THAT WERE USED AS TEMPORARY SEDIMENT TRAPS SHOULD BE EXCAVATED 12 INCHES BELOW THE BOTTOM OF THE SEDIMENT TRAP PRIOR TO CONSTRUCTION OF BIORETENTION AREA.
4. EXCAVATE BIORETENTION AREA TO PROPOSED DEPTH AND SCARIFY THE TOP 3"–4" OF EXISTING SOIL SURFACES.
5. INSTALL IMPERVIOUS LINER. SLIT LINER AND OVERLAP 12" OVER OUTLET PIPE.
6. INSTALL PVC SLOTTED UNDERDRAIN PIPE AND MINER AGGREGATE PER PLAN. SEE STORM DRAIN SPECS FOR SLOT DIMENSIONS.
7. BACKFILL BIORETENTION AREA WITH AGGREGATE MATERIAL AND BIORETENTION SOIL MIX, OVERFILLING IS RECOMMENDED TO ACCOUNT FOR SETTLEMENT. LIGHT HAND TAMPING IS ACCEPTABLE IF NECESSARY.
8. BIORETENTION SOIL MIX SHALL CONSIST OF THE FOLLOWING:
   - AGGREGATE TO COMPOST RATIO: 60% MINERAL AGGREGATE (WITH LESS THAN 5% FINES), 40% COMPOST (MEET REQUIREMENTS IN WAC 173-350-220)
   - TOTAL BIORETENTION SOIL MIX ORGANIC CONTENT SHALL BE 4–8% (BY DRY WEIGHT)
   - BIORETENTION SOIL DEPTH SHALL BE A MINIMUM OF 18–INCHES
   - BIORETENTION SOIL MIX SHALL HAVE A MINIMUM INFILTRATION RATE OF 6"/HR
9. PRESOAK THE PLANTING SOIL PRIOR TO PLANTING VEGETATION TO AID IN SETTLEMENT.
10. COMPLETE FINAL GRADING TO ACHIEVE PROPOSED DESIGN ELEVATIONS. LEAVE SPACE FOR UPPER LAYER OF MULCH AS SPECIFIED ON PLANS.
11. PLANT VEGETATION ACCORDING TO PLANTING PLAN.
12. MULCH AND INSTALL EROSION PROTECTION AT SURFACE FLOW ENTRANCES WHERE NECESSARY UNTIL ENTIRE SITE IS STABILIZED. MULCH MUST BE WOOD CHIPS CONSISTING OF SHREDDED OR CHIPPED HARDWOOD. MULCH SHOULD NOT CONTAIN WEED SEEDS, GRASS CLIPPINGS, AND LARGE CHUNKS OF BARK.
13. CONTRACTOR IS RESPONSIBLE FOR KEEPING BIORETENTION SOIL SEDIMENT FREE AFTER INSTALLATION AND UPON COMPETITION OF CONSTRUCTION, AND ANY SEDIMENT CONTAMINATED BIORETENTION SOIL SHALL BE REMOVED AND REPLACED AT THE CONTRACTORS EXPENSE.



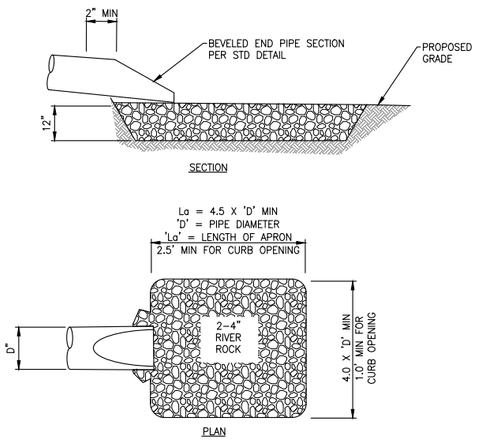
SECTION A–A

NTS **BIORETENTION AREA** 3

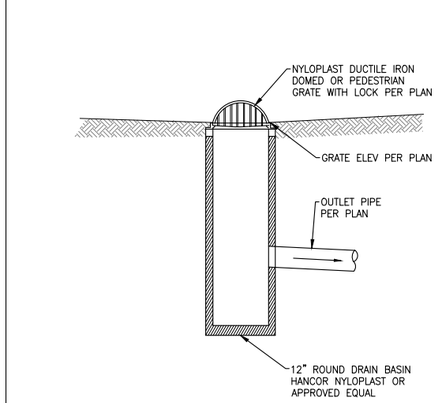


NOTES:
1. CATCH BASINS SHALL BE CONSTRUCTED IN ACCORDANCE WITH ASTM C478 (AASHTO M 199) & C890 UNLESS OTHERWISE SHOWN ON PLANS OR NOTED IN THE WSDOT/APWA STANDARD SPECIFICATIONS.
2. AS AN ACCEPTABLE ALTERNATIVE TO REBAR, WELDED WIRE FABRIC HAVING A MIN. AREA OF 0.12 SQUARE INCHES PER FOOT MAY BE USED. WELDED WIRE FABRIC SHALL COMPLY TO ASTM A497 (AASHTO M 221). WIRE FABRIC SHALL NOT BE PLACED IN KNOCKOUTS.
3. ALL REINFORCED CAST–IN–PLACE CONCRETE SHALL BE CLASS 4000.
4. PRECAST BASES SHALL BE FURNISHED WITH CUTOUTS OR KNOCKOUTS. KNOCKOUTS SHALL HAVE A WALL THICKNESS OF 2" MIN. ALL PIPE SHALL BE INSTALLED IN FACTORY PROVIDED KNOCKOUTS. UNUSED KNOCKOUTS NEED NOT BE GROUTED IF WALL IS LEFT INTACT.
5. ROUND KNOCKOUTS MAY BE ON ALL 4 SIDES, WITH MAX. DIA. OF 20". KNOCKOUTS MAY BE EITHER ROUND OR "D" SHAPE.
6. KNOCKOUT OR CUTOUT HOLE SIZE IS EQUAL TO PIPE OUTER DIA. PLUS CATCH BASIN WALL THICKNESS.
7. THE MAX. DEPTH FROM THE FINISHED GRADE TO THE PIPE INVERT IS 5'–0".
8. THE TAPER ON THE SIDES OF THE PRECAST BASE SECTION AND RISER SECTION SHALL NOT EXCEED 1/2"/FT.
9. CATCH BASIN FRAME AND GRATE SHALL BE IN ACCORDANCE WITH STANDARD SPECIFICATIONS AND MEET THE STRENGTH REQUIREMENTS OF FEDERAL SPECIFICATION RR–F–621D. MATING SURFACES SHALL BE FINISHED TO ASSURE NON–ROCKING FIT WITH ANY COVER POSITION.
10. FRAME AND GRATE MAY BE INSTALLED WITH FLANGE DOWN OR CAST INTO RISER.
11. FOR CATCH BASINS IN PARKING LOTS REFER TO WSDOT STD PLAN B–5.60–01.
12. EDGE OF RISER OR BRICK SHALL NOT BE MORE THAN 2" FROM VERTICAL EDGE OF CATCH BASIN WALL.
13. CATCH BASIN INSTALLATION SHALL BE PER CONTRACT DOCUMENTS AND DETAILS.

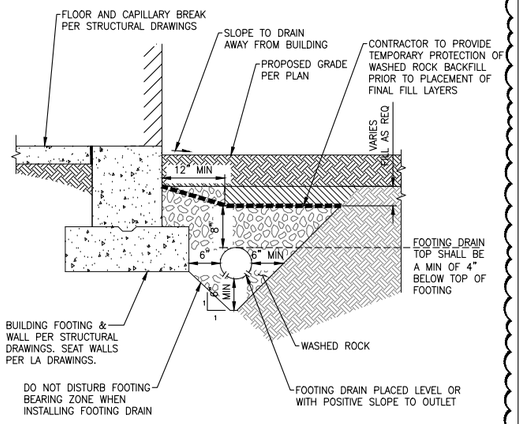
NTS **CATCH BASIN TYPE 1** 8



NTS **DISCHARGE PAD** 6

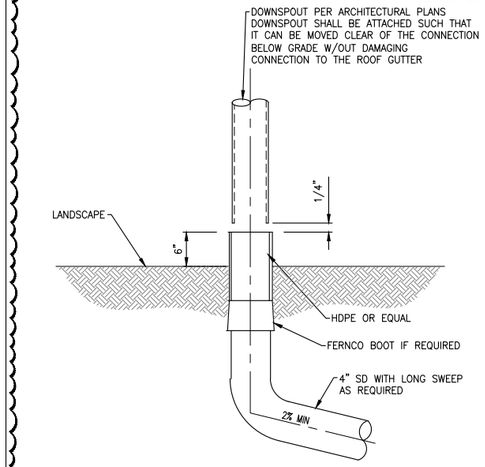


NTS **YARD/ OVERFLOW DRAIN** 7

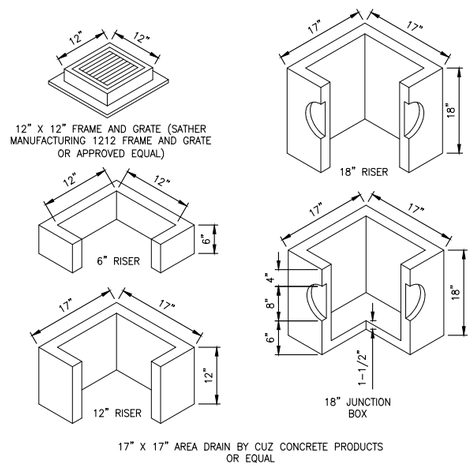


NTS **FOOTING DRAIN** 9

NTS **NOT USED** 10



NTS **ROOF DOWNSPOUT CONNECTION** 11



NTS **AREA DRAIN** 12

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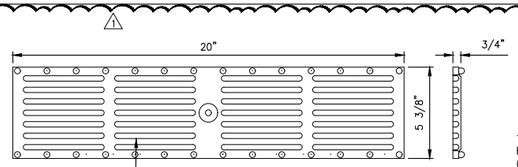
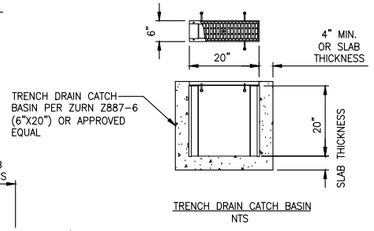
DETAILS

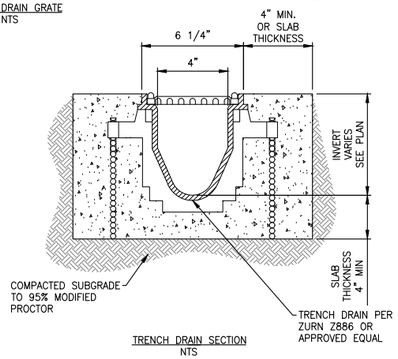
C400



TRENCH DRAIN GRATE
NTS

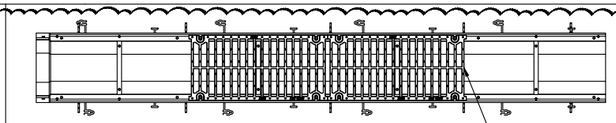


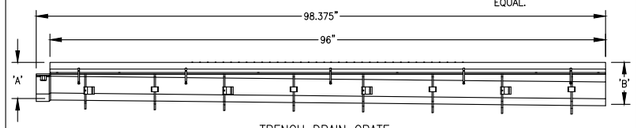
TRENCH DRAIN CATCH BASIN
NTS



TRENCH DRAIN SECTION
NTS

NTS
TRENCH DRAIN A 2





TRENCH DRAIN GRATE
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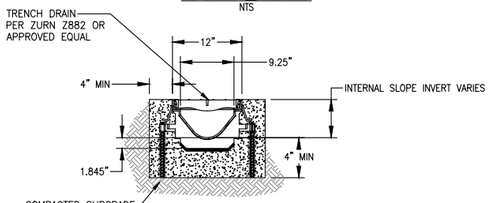


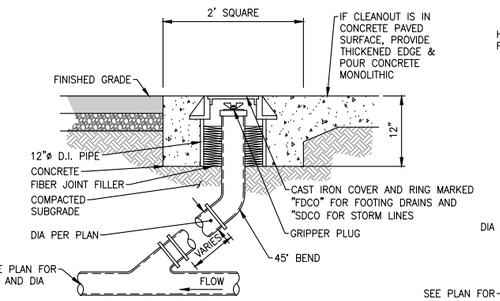
TRENCH DRAIN SECTION
NTS

NTS
TRENCH DRAIN B 3

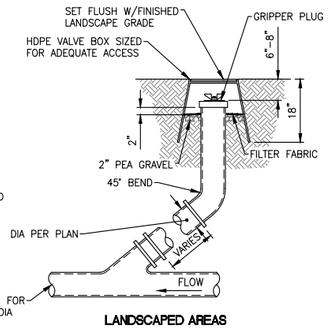
MERCER ISLAND UTILITY NOTES

1. ALL STAGING AND STORAGE SHALL OCCUR ON SITE.
2. A REDUCED PRESSURE BACKFLOW ASSEMBLY (RPBA) INSTALLATION SHALL BE REQUIRED AND INSTALLED 12 INCHES ABOVE GRADE BEHIND THE WATER MATER FOR ALL NEW AND DEMO REBUILD SINGLE FAMILY, LAKEFRONT PROJECTS. THE RPBA SHALL BE INSPECTED AT TIME OF INSTALLATION AND AT BUILDING FINAL. (A HOT BOX TO PROTECT THE RPBA ASSEMBLY IS OPTIONAL. A DOUBLE CHECK VALVE ASSEMBLY (DCVA) IS REQUIRED ON ALL FIRE SPRINKLER SYSTEMS.
3. POT HOLING THE PUBLIC UTILITIES IS REQUIRED PRIOR TO ANY GRADING ACTIVITIES LESS THAN 6" OVER THE PUBLIC MAINS (WATER, SEWER AND STORM SYSTEMS). IF THERE IS A CONFLICT, THE APPLICANT IS REQUIRED TO SUBMIT A REVISION FOR APPROVAL PRIOR TO ANY GRADING ACTIVITIES OVER THE PUBLIC MAINS.
4. DO NOT BACKFILL WITH NATIVE MATERIAL ON PUBLIC RIGHT OF WAY. ALL MATERIAL MUST BE IMPORTED.
5. REFER TO WATER SERVICE PERMIT FOR ACTUAL LOCATION OF NEW WATER METER AND SERVICE LINE DETERMINED BY MERCER ISLAND WATER DEPARTMENT.
6. THE EXISTING WATER SERVICE MUST BE ABANDONED AT THE CITY WATER MAIN WHEN A NEW SERVICE IS INSTALLED. THE HOMEOWNER IS RESPONSIBLE FOR ALL COST ASSOCIATED WITH THE ABANDONMENT OF THE EXISTING WATER SERVICE.
7. NO ADS FLEXIBLE PIPE SHALL BE ALLOWED.
8. SAND COLLARS ARE REQUIRED FOR GROUTING PVC PIPE TO CONCRETE STRUCTURES. THIS ALSO APPLIES TO ADS N-12 PIPES AND HDPE PIPES.
9. OWNER SHALL CONTROL DISCHARGE OF SURFACE DRAINAGE RUNOFF FROM EXISTING AND NEW IMPERVIOUS AREAS IN A RESPONSIBLE MANNER. CONSTRUCTION OF NEW GUTTERS AND DOWNSPOUTS, DRY WELLS, LEVEL SPREADERS OR DOWNSTREAM CONVEYANCE PIPE MAY BE NECESSARY TO MINIMIZE DRAINAGE IMPACT TO YOUR NEIGHBORS. CONSTRUCTION OF MINIMUM DRAINAGE IMPROVEMENTS SHOWN OR CALLED OUT ON THE PLAN DOES NOT IMPLY RELIEF FROM CIVIL LIABILITY FOR YOUR DOWNSTREAM DRAINAGE.
10. THE CONTRACTOR MUST POT HOLE ALL UTILITIES PRIOR TO MAKING CONNECTIONS TO VERIFY MATERIAL, DIAMETER, ALIGNMENTS, ETC. PRIOR TO MAKING CONNECTIONS, CONTRACTOR SHALL HAVE ALL NECESSARY PARTS, MATERIALS AND EQUIPMENT ON SITE. CONTACT SITE & UTILITIES INSPECTOR TO VERIFY.
11. CATCH BASIN FILTERS SHOULD BE PROVIDED FOR ALL STORM DRAIN CATCH BASINS/INLETS DOWNSLOPE AND WITHIN 500 FEET OF THE CONSTRUCTION AREA. CATCH BASIN FILTERS SHOULD BE DESIGNED BY THE MANUFACTURER FOR USE AT CONSTRUCTION SITES AND APPROVED BY THE CITY INSPECTOR. CATCH BASIN FILTERS SHOULD BE INSPECTED FREQUENTLY, ESPECIALLY AFTER STORM EVENTS. IF THE FILTER BECOMES CLOGGED, IT SHOULD BE CLEANED OR REPLACED.
12. THE TV INSPECTION OF THE EXISTING SIDE SEWER TO THE CITY SEWER MAIN IS REQUIRED. IF THE RESULT OF THE TV INSPECTION IS NOT IN SATISFACTORY CONDITION BY THE CITY OF MERCER ISLAND INSPECTOR, THE REPLACEMENT OF THE EXISTING SIDE SEWER IS REQUIRED.
13. INFORM THE MERCER ISLAND CITY SITE/UTILITY INSPECTOR AT 206.275-7714 OF THE ANTICIPATED START DATE OF IN-WATER WORK PRIOR TO COMMENCEMENT OF CONSTRUCTION.
14. FIELD LOCATE THE SEWER MAIN (LAKELINE) UNDERLYING THE LAKEBED AND MARK CLEARLY PRIOR TO THE START OF CONSTRUCTION. CONTACT THE MERCER ISLAND SITE/UTILITY INSPECTOR AT 206.275-7714 FOR AVAILABLE INFORMATION ABOUT THE LAKELINE AND ASSISTANCE WHERE POSSIBLE WITH IDENTIFYING THE GENERAL LOCATION OF THE LAKELINE PRIOR TO CONSTRUCTION. GIS MAPPING MAY BE AVAILABLE BY CALLING 206.236-3471. THE APPLICANT SHALL BE RESPONSIBLE OF ANY DAMAGE TO SAID SEWER MAIN RESULTING FROM CONSTRUCTION.

NTS
UTILITY NOTES 8

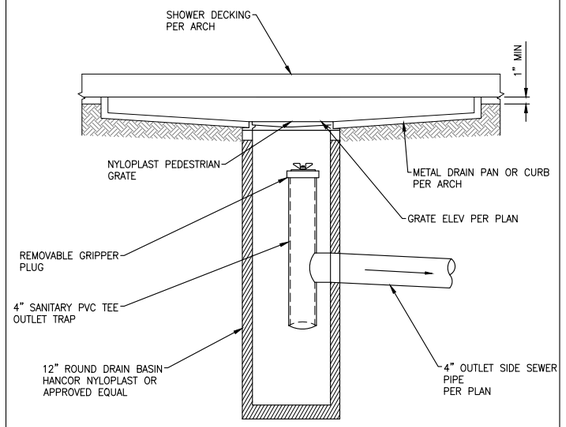


PAVED AREAS

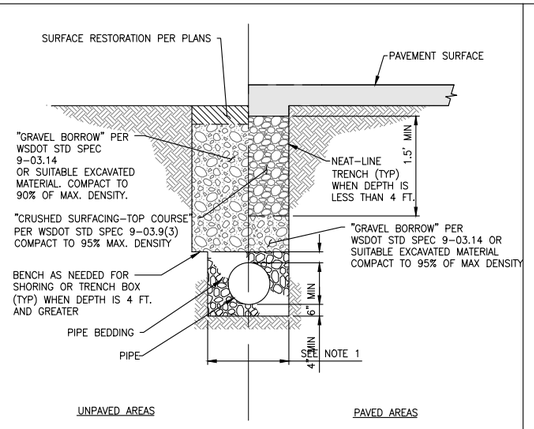


LANDSCAPED AREAS

NTS
CLEANOUT 6



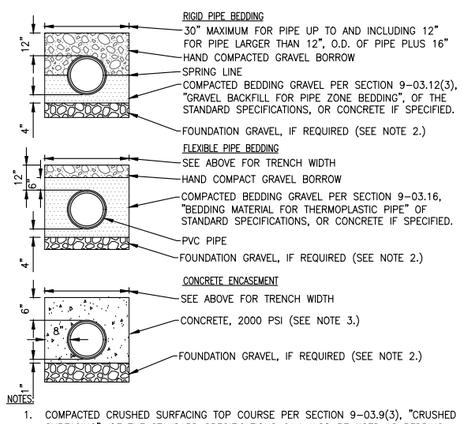
NTS
SHOWER AREA DRAIN 7



NOTE:

1. MAXIMUM WIDTH OF TRENCH AT TOP OF PIPE
   * 30" FOR PIPE UP TO AND INCLUDING 12" NOMINAL DIAMETER.

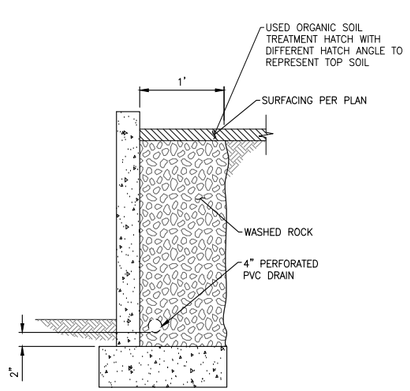
NTS
PIPE BEDDING 9



NOTES:

1. COMPACTED CRUSHED SURFACING TOP COURSE PER SECTION 9-03.9(3), "CRUSHED SURFACING", OF THE STANDARD SPECIFICATIONS CAN ALSO BE USED AS BEDDING GRAVEL.
2. EXCAVATE UNSTABLE MATERIAL DOWN TO FIRM SOIL AND REPLACE WITH FOUNDATION GRAVEL PER SECTION 9-03.9(1), "BALLAST", OF THE STANDARD SPECIFICATIONS
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANCHORING PIPE TO PREVENT FLOTATION DURING CONCRETE PLACEMENT.

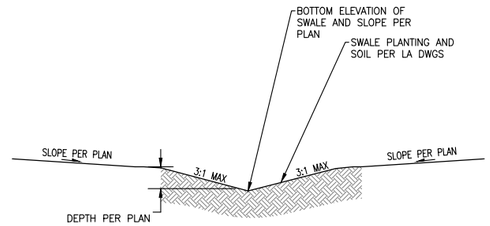
NTS
PIPE TRENCH 10



NOTES:

1. SEE STRUCTURAL PLANS FOR RETAINING WALL DESIGN.
2. SEE LANDSCAPE PLANS FOR SEAT/PLANTER WALLS.

NTS
TYPICAL WALL DRAIN 11



NTS
LANDSCAPE DRAINAGE SWALE 12

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LAURIE J. PFARR — STATE OF WASHINGTON — 30706 — REGISTERED PROFESSIONAL ENGINEER — 10-26-2022

MERCER ISLAND HOUSE: CASCADE

6838 96TH AVE SE
MERCER ISLAND, WA 98040

SUBMITTAL

BUILDING PERMIT RESUBMITTAL

OCTOBER 27, 2022

REVISIONS

No.	Description	Date
1	BUILDING PERMIT RESUBMITTAL	10/27/22

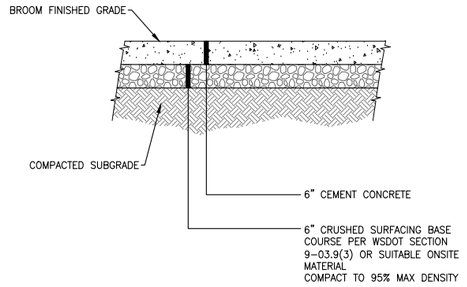
Drawn: EVW
Checked: ACW
M|H Proj No.: A20.0085.00
Issue Date: OCTOBER 27, 2022

SHEET

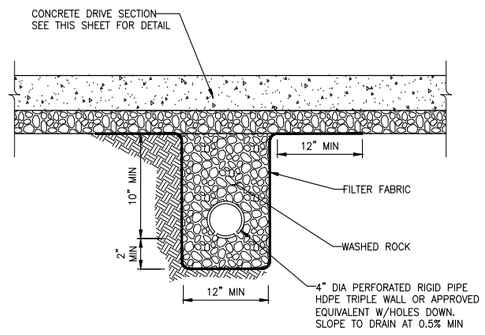
DETAILS

C401

NTS
NOT USED 1



NTS
CONCRETE PAVEMENT 2



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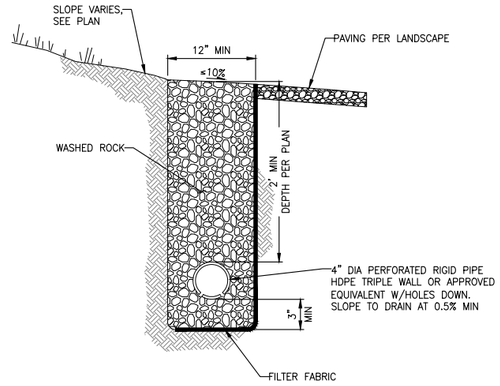
SUBSURFACE DRAIN 3



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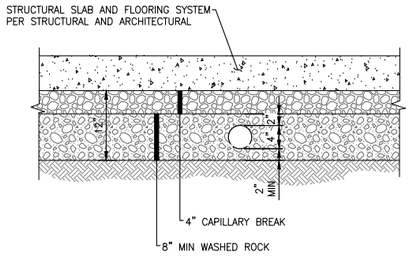
FRENCH DRAIN 4



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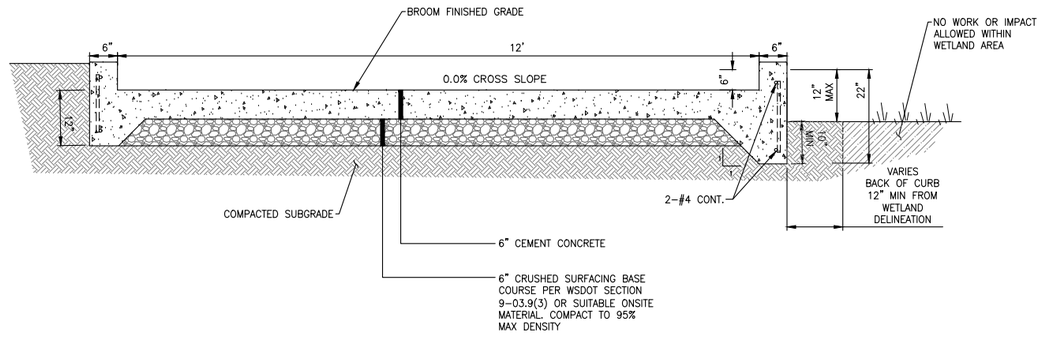
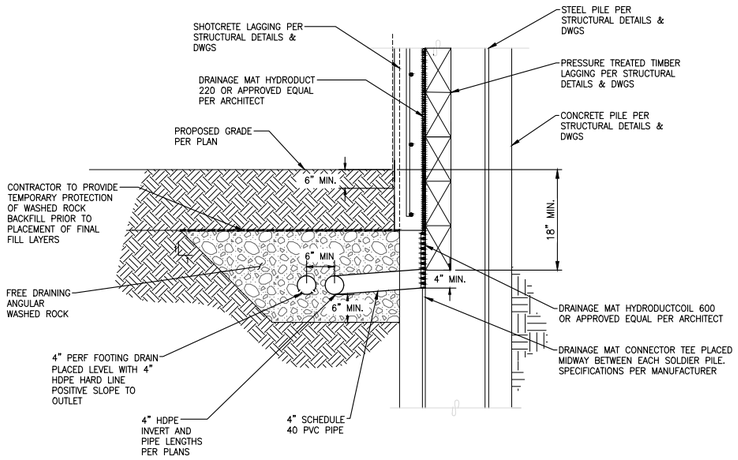
SUB-SLAB DRAINAGE 5

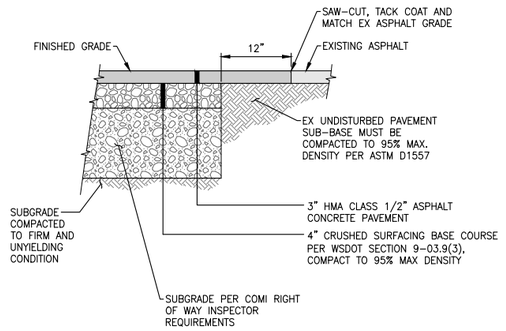


NTS
CONCRETE DRIVE 7

NTS
NOT USED 8



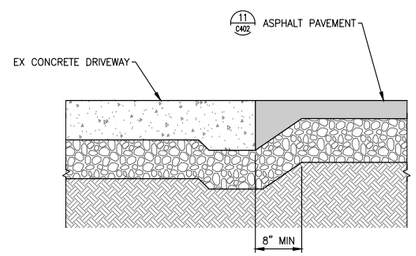
NTS
SOLDIER PILE RETAINING WALL FOOTING DRAIN 9



NOTES:

1. IF EX PAVEMENT SECTION IS THICKER, MATCH EX SECTION. OTHERWISE CONSTRUCT SECTION SHOWN.
2. SAW-CUT FULL DEPTH WHERE NEW PAVEMENT ABUTS EXISTING AND APPLY TACK COAT.
3. PLACE ASPHALT IN ACCORDANCE WITH WSDOT APWA SECTION 5-04.
4. PROOF ROLL AND REMOVE ANY SOFT SPOTS. REPLACE REMOVED MATERIAL WITH GRAVEL BORROW. CONTRACTOR SHALL TEST AND VERIFY SUBGRADE MEETS COMPACTION REQUIREMENTS PRIOR TO PAVING.

NTS
ASPHALT PAVEMENT 11



NTS
ASPHALT-CONCRETE TRANSITION 12

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C402

LPD engineering pllc

APPENDIX B

Design Calculations and Supporting Information

6838 96th Ave SE Mercer Island Residence - Areas

10/26/2022

Impervious Areas summary

	sf	*ac*
Total Parcel	41,214	0.946

New Plus Replaced Hard Surface	*sf*	*ac*
Building Roof Area	3,822	0.088
Asphalt Pavement (PGHS)	202	0.005
Concrete Pavement (PGHS)	4,427	0.102
Concrete Stairs/Walkway (NPGHS)	1,137	0.026
Gravel Pavement (NPGHS)	997	0.023
New Plus Replaced Hard Surface Total	**10,585**	**0.243**

Existing Impervious to Remain

Driveway Pavement	156	0.004
Miscellaneous Impervious	241	0.006
Existing Impervious to Remain Total	**397**	**0.009**
Landscape	30,232	0.694

6838 96th Ave SE Mercer Island Residence - Basin Areas

10/26/2022

Modeled Areas

Conveyance Analysis (Pervious as LAWN STEEP)

			25-year *cfs*	100-year *cfs*
BASIN 1 - To Bioretention Area	*sf*	*ac*		
Pervious	5,518	0.127		
Impervious	4,814	0.111		
Total Basin Area	***10,332***	***0.237***	0.139	0.258
BASIN 2 - To Bioretention Area	*sf*	*ac*		
Pervious	7,497	0.172		
Impervious	2,915	0.067		
Total Basin Area	***10,412***	***0.239***	0.117	0.219
Basin 3 - link to Direct outfall to Lake Washington	*sf*	*ac*		
Pervious	8,094	0.186		
Impervious	860	0.020		
Total Basin Area	***8,954***	***0.206***	0.083	0.154
Basin 4 - Direct outfall to Lake Washington	*sf*	*ac*		
Pervious	1,684	0.039		
Impervious	2,120	0.049	Note: this is conveyance for basin 3 + 4	
Total Basin Area	***3,804***	***0.087***	0.137	0.254
Free flow into Lake Washington	*sf*	*ac*		
Impervious	159	0.004		
Totals	*sf*	*ac*		
Pervious	22,793	0.523		
Impervious	10,868	0.249		
Total Basin Area	***33,661***	***0.773***		

Buttenweiser-Wiley Residence
Conveyance Analysis Spreadsheet

Pipe Run	Size *(inches)*	Mannings N	Plan Slope *(ft/ft)*	Qfull *(cfs)*	Tributary Basins	Impervious Area *(acres)*	Till Lawn Area *(acres)*	Qtrib (25yr-15min) *(cfs)*	% Full (25yr)	Qtrib (100yr-15min) *(cfs)*	% Full (100yr)
Bioretention Inlet	6	0.012	0.093	**1.86**	Conveyance Basin Area #2 - north roofs & hard surfaces, north landscaping	0.067	0.172	**0.117**	**6%**	**0.219**	**12%**
South Discharge	6	0.012	0.146	**2.33**	Conveyance Basin Area #3 & #4 - south west Landscaping, south roofs & hard surfaces	0.068	0.224	**0.137**	**6%**	**0.254**	**11%**

MGS FLOOD
PROJECT REPORT – CONVEYANCE (BIORETENTION INLET)

Program Version: MGSFlood 4.57
Program License Number: 201410003
Project Simulation Performed on: 10/25/2022 10:54 AM
Report Generation Date: 10/25/2022 10:54 AM

Input File Name: Conveyance - Bioretention inlet.fld
Project Name: 96 MI Residence
Analysis Title: Bioretention Inlet Conveyance
Comments: Basin #2

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96003605 Puget East 36 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961036 Puget East 36 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : Ecology Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.239	0.239
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.239	0.239

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
C, Lawn, Steep	0.172
SIDEWALKS/STEEP	0.067
Subbasin Total	0.239

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
C, Lawn, Steep	0.172
SIDEWALKS/STEEP	0.067
Subbasin Total	0.239

**************************FLOOD FREQUENCY AND DURATION STATISTICS*********************

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	4.813E-02	2-Year	4.813E-02
5-Year	7.509E-02	5-Year	7.509E-02
10-Year	9.032E-02	10-Year	9.032E-02
25-Year	0.117	25-Year	0.117
50-Year	0.188	50-Year	0.188
100-Year	0.219	100-Year	0.219
200-Year	0.257	200-Year	0.257
500-Year	0.309	500-Year	0.309

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

MGS FLOOD
PROJECT REPORT – CONVEYANCE (SOUTH DISCHARGE)

Program Version: MGSFlood 4.57
Program License Number: 201410003
Project Simulation Performed on: 10/25/2022 11:05 AM
Report Generation Date: 10/25/2022 11:05 AM

Input File Name: Conveyance - South Discharge.fld
Project Name: 96 MI Residence
Analysis Title: South Discharge Conveyance
Comments: Basin #3 and #4

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96003605 Puget East 36 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961036 Puget East 36 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : Ecology Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.292	0.292
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.292	0.292

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
C, Lawn, Steep	0.224
SIDEWALKS/STEEP	0.068
Subbasin Total	0.292

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
C, Lawn, Steep	0.224
SIDEWALKS/STEEP	0.068
Subbasin Total	0.292

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 1

**** Point of Compliance Flow Frequency Data ****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	5.269E-02	2-Year	5.269E-02
5-Year	8.632E-02	5-Year	8.632E-02
10-Year	0.104	10-Year	0.104
25-Year	0.137	25-Year	0.137
50-Year	0.223	50-Year	0.223
100-Year	0.254	100-Year	0.254
200-Year	0.300	200-Year	0.300
500-Year	0.360	500-Year	0.360

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

Runnel Calculations

Buttenweiser-Wiley Residence 6838 96th Ave SE

Current Drainage Condition

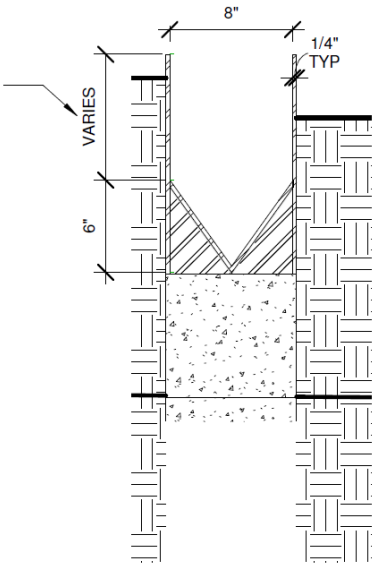
Triangular runnel cross-section

VERTICAL WALL HEIGHT VARIES:

TYPICAL / REPEATED SECTION:

4.5" (MIN)
1'-2" (MAX)
1'-2.75" (MAX where channels overlap)

LANDING / PORTAL SECTIONS:
4.5" (MIN)
1'-11.5" (MAX-ish)



Q = 0.258 cfs (100-year peak flow from MGS Flood)

n = 0.013 (Manning's n – smooth cast iron)

S = 1.2% (0.012) (longitudinal slope of runnel)

Z = 1.5 (0.67:1) (side slope – per runnel detail)

Manning's Equation (open channel)

$$Q = VA = \left(\frac{1.49}{n}\right) AR^{\frac{2}{3}} \sqrt{S}$$

Where hydraulic radius (R) for triangular cross section:

$$R_h = y^2 z / (2[y^2(1+z^2)]^{1/2})$$

Solve for y (depth):

y = 0.38 feet = 4.56 inches

4.56 inches (water depth, 100-year) < 6 inches (depth of runnel)

Sediment Tank Sizing Calculations

Per the 2014 DOE Manual

Project Name: 6838 96TH AVE SE MERCER ISLAND

Required Sediment Tank Volume (Galllons):

SA =2*Q/Vsed

Where:
Q = 2-year developed flow rate from MGS Flood
Vsed = Settling Velocity (0.00096 ft/sec)

Calculation:

multiplier =	2	
Q =	0.143	cfs
Vsed =	0.00096	fps
Required SA =	**297.9**	**square feet**

Equivalent Sediment Trap Volume:

To determine the minimum sediment trap volume, an equivalent sediment trap was sized based upon the required surface area.

Length of Top Surface Area =	26	feet
Width of Top Surface Area =	11.5	feet
Surface Area Provided =	299	square feet
Side Slope =	3	(H:1V)
Total Depth of Sediment Trap =	1	feet
Bottom Length of Sediment Trap =	20	feet
Bottom Width of Sediment Trap =	5.5	feet
Total tank Volume =	**205**	cubic feet
	1530	gallons

MGS FLOOD
PROJECT REPORT – TESC SEDIMENT SIZING

Program Version: MGSFlood 4.57
Program License Number: 201410003
Project Simulation Performed on: 05/16/2022 2:34 PM
Report Generation Date: 05/16/2022 2:35 PM

Input File Name: 2021-05-20 Prelim TESC.fld
Project Name: 6838 96th Ave SE Mercer Island Residence
Analysis Title: Preliminary TESC Sizing
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96003605 Puget East 36 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961036 Puget East 36 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 3
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.863	0.863
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.863	0.863

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Pre-Dev ----------

	-------Area (Acres) --------
Till Grass	0.863
Subbasin Total	0.863

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Post-Dev ----------

	-------Area (Acres) --------
Till Grass	0.571
Impervious	0.292
Subbasin Total	0.863

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 0

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Pre-Dev

Scenario Postdeveloped Compliance Subbasin: Post-Dev

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	6.590E-02	2-Year	0.143
5-Year	0.125	5-Year	0.208
10-Year	0.181	10-Year	0.267
25-Year	0.268	25-Year	0.347
50-Year	0.382	50-Year	0.512
100-Year	0.454	100-Year	0.595
200-Year	0.468	200-Year	0.599
500-Year	0.483	500-Year	0.602

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

APPENDIX C

Construction Stormwater Pollution Prevention Plan (SWPPP)

BUTTENWEISER – WILEY RESIDENCE
CONSTRUCTION SWPPP NARRATIVE
OCTOBER 26, 2022

The following Construction Storm Water Pollution Prevention Plan (SWPPP) narrative is for the Buttenweiser-Wiley Residence project at 6838 96th Avenue SE in Mercer Island, Washington. The narrative supplements the Temporary Erosion and Sediment Control (TESC) plan. This narrative and the drawings address the requirements of Volume II of the 2014 Department of Ecology (DOE) Stormwater Management Manual for Western Washington. Refer to the TESC plan (Sheet C100) and TESC details (Sheet C102) for more information regarding any erosion or sedimentation control measures involved in this project.

1. CONSTRUCTION STORMWATER POLLUTION PREVENTION ELEMENTS

1) **Mark Clearing Limits:** Clearing limits will be delineated on the TESC and Site Demolition plan. The actual limits of clearing will likely be smaller than the limit of work, but this identifies the maximum extent of the clearing limits. Areas impacted and not anticipated to be covered with final measures shall be stabilized using approved permanent TESC methods.

2) **Establish Construction Access:** Construction access will be provided via the existing concrete driveway from 96th Ave SE. The Contractor shall provide wheel wash if necessary.

3) **Control Flow Rates:** Stormwater flow control during construction is anticipated to be mitigated by routing runoff to a temporary sediment settling tank. Refer to the Sediment Facility Sizing calculations and the MGS Flood output included within Appendix B of the project's stormwater site plan.

4) **Install Sediment Controls:** DOE approved BMPs for sediment controls are shown on the TESC plan (Sheet C100). Sediment will be controlled using silt fence (BMP C233).

5) **Stabilize Soils:** It is possible that some of the earthwork and grading may occur in wet weather conditions. The site must be stabilized and no soils will be allowed to remain unstabilized for more than two days between October 1st and April 30th. From May 1 through September 30, install cover measures to protect disturbed areas that will remain unworked for seven days or more. By October 8, seed all areas that will remain unworked from October 1 through April 30. Mulch all seeded areas.

   Exposed slopes will be protected by DOE-approved coverage methods. BMPs including, but not limited to: C101, Preserving Natural Vegetation; C121, Mulching; C123, Plastic Covering; C130, Surface Roughening; C140, Dust Control; and T5.13 Post Construction Soil Amendment will be used to stabilize on-site soils during construction.

6) **Protect Slopes:** The DOE-approved BMPs for slope protection will be utilized during construction. Concentrated discharges shall not be allowed to flow over the top of steep slopes. BMPs including, but not limited to C101, Preserving Natural Vegetation; C208, Triangular Silt Dike; and C233, Silt Fence are to be utilized to protect slopes during construction.

7) **Protect Drain Inlets:** Drainage structures in areas where no work occurs will remain and will be protected; discharge points to the public storm drain main line will also be protected. To prevent discharge of turbid water downstream, all existing catch basins located within the disturbance area and outside of the disturbance area within approximately 300 feet downstream of the site will be protected with storm drain inlet protection (BMP C220), refer to TESC details (Sheet C101). The Contractor shall remove inlet protection at the end of the project without releasing captured sediment into the storm system.

8) **Stabilize Channels and Outlets:** Channels are not proposed as part of this project and BMPs for channel stabilization are not expected. DOE-approved BMPs for channel stabilization include, but are not limited to: C200, Interceptor Dike and Swale; and C207, Check Dams.

9) **Control Pollutants:** Temporary protection of the disturbed soils provides the first level of protection for pollution control, and perimeter measures downstream will mitigate the remaining pollutants. The temporary protection of disturbed soils may be mitigated with a temporary sump and pump facility to provide the second level of interception of pollutants. This collection system filters sediments prior to the pump system. The pump system will then route stormwater via force mains into the temporary sediment settling tank. Construction debris will be removed from the site. The Contractor will be responsible for managing their construction equipment per DOE-approved BMPs. If a truck wheel wash is required, truck wheel wash water and concrete truck washout water shall be collected and discharged to the public sanitary sewer (SS) system. To apply for and obtain a SS release, contact the local sewer purveyors (City of Mercer Island and King County Metro) for authorization.

10) **Control De-Watering:** The majority of the earthwork on the project will be constructed during the dry season, therefore it is not anticipated that groundwater will be encountered in the excavations for this project. In the event that perched groundwater is encountered during any wet season construction, the Contractor shall route it to the sediment settling facility by pumping it out of the excavation.

11) **Maintain BMPs:** DOE-approved standard BMP maintenance will be required in accordance with the DOE standard TESC plan notes and the City of Mercer Island Notes (Sheet C102)

12) **Manage the Project:** All phases of construction will be managed by the Contractor. The site must be stabilized and no soils will be allowed to remain exposed and unworked for more than two days between October 1st and April 30th and for more than seven days between May 1st and September 30th. The Contractor will provide maintenance and monitoring of TESC BMPs. Work of all contractors will be coordinated to minimize the duration of disturbance on the site. The best management practices shown on the TESC plan are minimum requirements. Failure to maintain SWPPP measures in accordance with adopted standards may result in the work being performed at the City's direction and the costs assessed as a lien against the property where such facilities are located.

13) **Protect LID BMPs:** There are no proposed LID facilities associated with this project, and therefore protection for element 13 is not required.

2. Project Description

The proposed project will include the reconstruction of a single-family residential building and exterior on-site improvements. The new single-family residential property will reside in the east side facing the Lake Washington waterfront, including reconstruction of a detached garage west of the proposed residential building. Site improvements will consist of the removal and replacement of the asphalt parking with a new asphalt parking area, removal and replacement of the existing concrete patio and walkways with pervious deck areas and exterior concrete stairs, landscape improvements including site grading, and various drainage features for outdoor entertaining and access to the waterfront

The project proposes 10,585 square feet (0.243 acres) of new plus replaced hard surface. Flow control is not required, as the site directly discharges to a flow control-exempt surface water (Lake Washington). Water quality treatment is not required because the project proposes less than 5,000 square feet of pollution-generating hard surface (PGHS) and less than ¾ acre of pollution-generating pervious surface (PGPS). On-site stormwater management will be provided with bioretention and compost-amended soils. Refer to the project's stormwater site plan for more information.

3. Existing Site Conditions

The property (parcel #3024059010) is developed and contains an existing single family residence structure with a detached garage, concrete driveway, asphalt parking, concrete walkways and concrete patios. It has a total area of approximately 41,214 square feet (0.946 acres). Topography for the site is fairly steep, falling from approximately 98 feet in the northwest corner to 18 feet at the west side of the site and an average slope of 21 percent.

Per the King County iMap, the project is within the Lake Washington drainage Basin. Runoff from the site is generally collected in catch basins and conveyed southeast to the discharge point of Lake Washington.

4. Adjacent Areas

The site is bounded by single-family residences to the north, south and west and by Lake Washington to the east. Vehicular access to the site is from 96th Ave SE with the access driveway located to the Northwest of the site.

5. Critical Areas

King County critical areas mapping indicates that the entire site is located in a designated **Erosion Hazard** area. Other environmental maps available from the City of Mercer Island indicate that the site is within an area with shallow groundwater (<10 ft belowground surface) and not feasibility for infiltration along with being located within a landslide area. The majority of the site is a protected slope area with **Steep Slope Hazards**. Other ECAs include both **Potential Slide and Seismic Hazards**.

6. Soils

Based upon the USDA Natural Resources Conservation Service Web Soil Survey, the site soils consist of Kitsap silt loam, 15-30% slopes, on the approximate western third of the property and Arents/Alderwood Material, 6-15% slopes on the eastern two-thirds of the property. A geotechnical

report has been prepared by Aspect Consulting, dated September 2, 2021. Subsurface exploration found fill, consisting of soft to medium stiff silt with proportions of sand from 7-15 feet below ground surface. Beneath the fill layer, weathered pre-Olympia nonglacial deposits were encountered, consisting of loose to dense, very moist to wet, silty sand with proportions of gravel. Groundwater was observed in one of the borings.

7. Potential Erosion Problem Areas

The site is within an erosion hazard area. Therefore, per the proposed contract documents, the contractor is to provide protection for soils to limit the exposure to erosion. The limitation of disturbance, adequate cover practices, seasonal work limitation, and runoff control are the most effective methods for reduction of turbidity in stormwater runoff. Any runoff that occurs will be directed to the temporary sump and then pumped to the sediment settling tank. Areas that have not been permanently stabilized must be addressed using DOE-approved BMPs, per the construction documents.

8. Construction Phasing

At this time, it is not expected that the project will be formally phased. The contractor is responsible for coordinating work of all subcontractors to keep the duration of site disturbance limited to the maximum extent possible.

9. Construction Schedule

Construction is expected to begin in Spring 2023 and be completed by Winter 2023.

Earthwork activities are not expected to take place in the wet season, October 1st to April 30th. Should any wet weather conditions occur during construction, the contractor shall implement the de-watering procedures outlined in this SWPPP and applicable BMPs including, but not limited to C123, Plastic Covering; C121, Mulching; C122, Nets and Blankets; C126, Polyacrylamide for Soil Erosion Protection; C130, Surface Roughening.

10. Financial/Ownership Responsibilities

This property is owned and operated by Janet Buttenweiser and Matt Wiley. The accepted low bidder on the project will be responsible for posting a performance and payment bond with the property owners, and thus will be the responsible party for any liability associated with erosion and sedimentation impact.

11. Engineering Calculations

A copy of any calculations performed during design of the project and relevant storm drainage modeling discussions is included in the project's Stormwater Site Plan.

APPENDIX D

Geotechnical Report

GEOTECHNICAL ENGINEERING REPORT

Buttenwieser/Wiley Residence
6838 96th Avenue SE
Mercer Island, Washington

Prepared for: Janet Buttenwieser

Project No. 200631 • September 2, 2021 FINAL

Aspect CONSULTING

earth + water

GEOTECHNICAL ENGINEERING REPORT

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6838 96th Avenue SE
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Project No. 200631 • September 2, 2021 FINAL

Aspect Consulting, LLC

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1 Introduction

This report presents the results of a preliminary geotechnical engineering and critical area evaluation performed by Aspect Consulting, LLC (Aspect) for the proposed new residence (Project) at 6838 96th Avenue SE on Mercer Island, Washington (King County Parcel No. 302405-9010; Site). The Site location is shown on Figure 1.

The purpose of this evaluation is to assess the geologic hazards at the Site, provide recommendations to mitigate impacts, and provide geotechnical engineering conclusions and recommendations to support design and construction of the Project.

1.1 Project Background and Description

The existing Site consists of a single-family residence and detached garage on the southeast side of Mercer Island, adjacent to Lake Washington. The Site is a 0.95-acre lot on a locally steep, east-facing slope accessed via 96th Avenue SE that descends to the Lake Washington shoreline. Our understanding of the proposed improvements is based on communications with the Project architect (Miller Hull Partnership; Miller Hull), Project structural engineer (PCS Structural Solutions; PCS), Project civil engineer (LPD Engineering, LLC; LPD) and our review of permitting-level civil and structural drawings (LPD, 2021; PCS, 2021).

The Project includes demolition of the existing buildings and replacement with a new single-family, three-story residence with a detached garage.

2 Site Conditions

This section presents the surface conditions, geologic setting, and subsurface conditions of the Site, which provides context for the types and distribution of geologic soil units and a basis for our geotechnical engineering recommendations and critical areas evaluation.

2.1 Surface Conditions

Our understanding of the surface conditions is based on a review of publicly available maps and aerial photography, observations made during a Site reconnaissance visit on December 31, 2020, and measurements obtained during our subsurface exploration program completed on February 2 and 3, 2021.

2.1.1 Topography

The Site is an approximately 0.95-acre, rectangular parcel orientated length-wise from east-west. Topography for the Site is presented in Figure 2 from a Site survey by Terrane Land Surveying (2021). The parcel is approximately 100 feet wide in the north-south direction and approximately 400 feet long in the east-west direction. The Site abuts 96th

Avenue SE to the west at approximate Elevation[1] 100 feet and descends steeply at an average slope of approximately 20- to 30-percent to the east and south over approximately 300 horizontal feet to a bench at Elevation 35 feet, which comprises the eastern side of the Site.

The bench slopes over approximately 100 horizontal feet (average approximate slope of 10- to 20-percent) down to the Lake Washington shoreline at approximate Elevation 18 feet. Locally, the Site slopes are highly variable; along the north property line they can exceed 50 percent in the steepest locations. The two existing buildings are accessed from an approximately 200-foot-long concrete driveway that slopes at approximately 5- to 20-percent from 96th Avenue SE to an asphalt parking area near the center of the Site. There is a relatively flat area behind the garage that is used as a garden.

2.1.2 Existing Structures

Existing structures including the house, driveway, garage, and rockeries (Figure 2). The existing two-story residence and detached garage were originally constructed in 1934 and appear to consist of typical wood-frame construction and cast-in-place concrete spread footings. The garage is located west of the asphalt parking area at the bottom of the driveway (at approximate Elevation 55 feet). The residence is approximately 150 feet to the east of the garage near the toe of the slope (at approximate Elevation 24 feet) and approximately 47 feet west of the shoreline. We observed no evidence of structural cracking or settlement around the exterior walls or foundations.

2.1.3 Steep Slopes and Retaining Walls

The Site has several existing retaining walls, including an approximately 5-foot-tall soldier pile wall just east of 96th Avenue SE; an approximately 4-foot-tall rockery wall along the north side of the driveway; an approximately 5- to 8-foot-tall rockery wall at the east side of the asphalt parking area; and several timber walls up to approximately 4 feet tall (along the south side of the driveway, the southern property line [southwest of the existing garage], and northwest of the existing residence). There is also an approximately a 2-foot-tall rockery bulkhead along the Lake Washington shoreline.

The steep slope north of the driveway is vegetated with mixed deciduous and coniferous trees and dense underbrush. We did not observe readily apparent evidence of instability or deformations associated with the rockery wall along the north side of the driveway, but we did observe at least one conifer tree with a slightly curved trunk located on the slope immediately northwest of the existing residence. At approximately the same location, we observed localized yielding of the existing timber retaining wall. We also observed yielding of the timber wall on the south side of the driveway behind the garage during our subsurface exploration program. The concrete driveway is deteriorated with several longitudinal cracks.

These observations are all characteristic of localized surficial slope movement that reflect the age and decay of the railroad tie timbers for the timber wall that are beyond their design life and will need to be replaced.

[1] All elevations were obtained using survey data completed by Terrane Land Surveying (Terrane; 2021) and reference the North American Vertical Datum of 1988 (NAVD88)

2.2 Subsurface Conditions

Our characterization of the subsurface conditions at the Site are based on a review of applicable geologic literature, data obtained from our subsurface explorations, and our knowledge and understanding of the regional geologic setting.

2.2.1 Geology

The most recent geologic map (Troost & Wisher, 2006) shows the Site as being underlain by nonglacial Pleistocene deposits of pre-Olympia age (Qpon), which predate the most recent glacial period (the Fraser glaciation), as well as Holocene-age lake deposits (Ql) and mass-wastage deposits (Qmw). The nonglacial pre-Olympia deposits are further subdivided into coarse-grained (Qponc) and fine-grained (Qponf) units. The mapped surficial geologic units are described as follows:

- **Fine-grained pre-Olympia nonglacial deposits (Qponf):** Silt and clay; hard, may have sandy interbeds, and peat, laminated to massive. The deposits are mapped along the central area of the Site.
- **Coarse-grained pre-Olympia nonglacial deposits (Qponc):** Sand and gravel; very dense, clean to silty, with silt layers and peat. The deposits are mapped along the west area of the Site.
- **Lake deposits (Ql):** Silt and clay; very soft to medium stiff or very loose to medium dense, with local sand layers, peat, and other organic sediments. The deposits are mapped along the east area of the Site including the shoreline.
- **Mass-wastage deposits (Qmw):** Colluvium, soil, landslide debris, and organic matter with indistinct morphology; loose to dense and soft to stiff. The deposits are mapped along the east area of the Site, including the shoreline.

Although not shown on the geologic map, we expected to encounter fill material placed or disturbed as part of the original Site development (fill observations are discussed further in Section 2.2.2 below). In general, our observations during the subsurface explorations were consistent with the geologic map and our expectations, except that we did not encounter lake deposits or clearly delineated mass-wastage deposits.

2.2.2 Stratigraphy

Aspect completed six drilled soil borings on February 2 and 3, 2021 (designated AB-01 through AB-06). We completed each of the borings to approximately 21 feet below ground surface (bgs) using hollow stem auger drilling techniques, with *in-situ* density/consistency testing and sample collection at select depth intervals. The drilling was subcontracted to Geologic Drill Partners, Inc., who completed the work with a miniature drill rig mounted on a tracked, walk-behind Bobcat. The exploration locations are shown on Figure 2. Aspect also subcontracted geotechnical laboratory testing services for moisture content, fines content, particle-size analyses, and Atterberg limits on select soil samples obtained during our field investigation.

Subsurface conditions at the Site were inferred from the completed field investigation, a review of applicable geologic literature, local geologic experience, and geotechnical laboratory testing. A more detailed description of the field exploration methods and

exploration logs are presented in Appendix A. Detailed descriptions of the tests and results are presented in Appendix B.

The primary soil units observed in our explorations, presented in stratigraphic order from top to bottom, were fill, weathered pre-Olympia nonglacial deposits, and intact pre-Olympia nonglacial deposits. Consistent with the geologic map, we encountered fine-grained pre-Olympia nonglacial deposits in the eastern portion of the Site near Lake Washington, that transitioned to coarse-grained deposits at higher elevations in the western portion of Site near 96th Avenue SE. The units are described in more detail below.

Fill

We encountered fill consisting of very soft to medium stiff, moist to wet, gray to brown silt with varying proportions of sand (ML) [2] and very loose to medium dense, moist to wet, gray to brown silty sand (SM) in all explorations from the surface to depths of between 7- to 15-feet below ground surface (bgs). At AB-02, located approximately mid-way down the concrete driveway, we also encountered a layer of medium stiff, moist, brown clay (CL) between 7 and 10 feet bgs. We encountered organics, roots, and woody debris at AB-01, AB-04, and AB-05. Based on the observed relative density and moisture content, the fill was likely placed without moisture or compaction control.

The fill can be expected to exhibit low shear strength characteristics, low to moderate permeability, moderate to high compressibility, and high moisture sensitivity.

Weathered Pre-Olympia Nonglacial Deposits

We encountered weathered pre-Olympia nonglacial deposits at AB-01, AB-02, AB-03, and AB-06 consisting of loose to dense, very moist to wet, brown to gray silty sand with varying proportions of gravel (SM) from the bottom of the fill to depths of between 10- to 15-feet bgs. The weathered pre-Olympia nonglacial deposits are similar to the underlying coarse-grained pre-Olympia nonglacial deposits, but we interpret them to be weathered due to their relatively lower density.

The weathered pre-Olympia nonglacial deposits can be expected to exhibit moderate shear strength characteristics, moderate permeability, moderate compressibility, and moderate moisture sensitivity.

Coarse-Grained Pre-Olympia Nonglacial Deposits

We encountered coarse-grained pre-Olympia nonglacial deposits in AB-01 through AB-04 from below the fill or weathered pre-Olympia nonglacial deposits to depths of between 15 to 21 feet bgs consisting of dense to very dense, slightly moist to wet, gray to brown sand with varying proportions of silt and gravel (SM, SP-SM). The coarse-grained pre-Olympia nonglacial deposits were encountered in AB-03 and AB-04 at an approximately 5-foot-thick layer overlying fine-grained pre-Olympia nonglacial deposits. At AB-01 and AB-02 the coarse-grained pre-Olympia nonglacial deposits were encountered to the bottom of the explorations at approximately 21 feet bgs.

[2] Soils are classified per the Unified Soil Classification System (USCS) in general accordance with the ASTM International (ASTM) Method D2488 Standard Practice of Description and Identification of Soils.

The coarse-grained pre-Olympia nonglacial deposits can be expected to exhibit high shear strength characteristics, low to moderate permeability, low compressibility, and moderate moisture sensitivity.

Fine-Grained Pre-Olympia Nonglacial Deposits

We encountered fine-grained pre-Olympia nonglacial deposits in AB-03 through AB-06 to depths of between 15 to 21 feet bgs consisting of medium stiff to hard, slightly moist, gray clay (CH). We interpret this clay as being highly overconsolidated and relatively intact and undisturbed (i.e., we did not observe significant evidence of fracturing, slickensides, or shearing).

The fine-grained pre-Olympia nonglacial deposits can be expected to exhibit high shear strength characteristics, low permeability, low compressibility, and moderate to high moisture sensitivity.

2.2.3 Groundwater

Groundwater was encountered in boring AB-01, where it was measured at a depth of 5.9 feet bgs at the time of drilling. The apparent moisture content of the samples in AB-06 suggest that there may have been some perched groundwater in the weathered pre-Olympia deposits at approximately 8 feet bgs above the relatively impermeable, fine-grained pre-Olympia nonglacial deposits. Red mottling and iron oxide staining was observed in several of the samples over a wide range in depths, which can indicate seasonal fluctuations in groundwater levels. We expect the groundwater on the slope is in hydraulic continuity with Lake Washington. Groundwater levels are expected to fluctuate by seasonal conditions, Site usage, variations in rainfall, irrigation, and other factors.

3 Geologic Hazard Evaluation

Erosion, sliding, and earthquake hazard areas are geologically hazardous areas as defined in Sections 19.16 of the Mercer Island City code (MICC; 2021). Development on the Site is therefore governed by the requirements of MICC 19.07. This report is intended to serve as the required critical area study to describe existing conditions, potential impacts, and risk mitigation measures consistent with MICC 19.07.110 and 19.07.160.

As part of our evaluation, we reviewed publicly available critical area maps relative to geologic hazards, as shown on Figure 2. The City of Mercer Island maps the entire parcel as a potential slide hazard area and as an erosion hazard area. The majority of the Site is also mapped as a seismic hazard area, and localized areas in the north portion of the Site are mapped as steep slope hazard areas. A historic landslide scarp is mapped on parcels immediately south of the Site (Troost and Wisher, 2006).

3.1 Landslide / Steep Slope Hazards

As part of our landslide / steep slope hazard evaluation, we reviewed the Site topography, landslide map inventories, and historic aerial photographs from 1936 and 2019 (King County, 2021). Steep slopes are defined by the City as any slope exceeding 40 percent

over a 30-foot horizontal run. Based on a recent Site survey completed by Terrane Land Surveying (Terrane, 2021), steep slopes are present on the slope north of the driveway and west of the garden behind the garage. We previously described some localized slope movement associated with decaying timber walls along steep slopes. In general, we observed no indications of global slope movement from our reconnaissance or review of aerial photographs from 1936 to 2019.

Three types of landslides hazards are common for slopes in the Puget Sound region:

- Rotational (deep-seated) landslides
- Shallow landslides
- Topping failures.

Landslides may be triggered by natural causes such as precipitation, freeze-thaw cycles, or earthquakes, or by man-made events such as broken water pipes or stormwater flow. Each of these landslide hazards is discussed in greater detail below with respect to the Site.

3.1.1 Rotational Landslides

Rotational landslides consist of deep-seated failures that are characterized by slip along a curved shear plane. Rotational landslides may transport larger masses of semi-intact soil downslope, resulting in steep head scarps along the upper portion of the failure plane, and benches and hummocks of displaced soil lower on the slope. Rotational landslides can be caused by ongoing processes, such as erosion of the toe of the slope, seeps and springs on the steep slope, and other ongoing processes. Deep-seated (below rooting depth for trees) rotational landslides can also be triggered by large earthquakes.

Deep-seated landslides can cause significant damage because of the volume of soil that they can displace. However, these landslides typically don't occur without warning signs many days in advance, such as formation of open tension cracks at the ground surface, slow downslope creep of soils, bending and tipping trees, displacement of infrastructure, etc.

Based on our reconnaissance and the dense, high-shear strength of the glacially consolidated deposits that comprise the core of the Site slopes, it is our opinion that the risk of large-scale, deep-seated rotational landslide activity is low.

3.1.2 Shallow Landslides

Shallow landslides consist of sliding of the surficial, colluvial, or weathered soil layers and overlying vegetation that typically mantle steep slopes in the Puget Sound region. Shallow landslides are commonly triggered by a significant increase in the moisture content within the upper soil layers of a slope combined with a slow increase in the thickness of weathered and loose surficial soils over geologic time. Increased moisture typically results from periods of extended, heavy precipitation, groundwater seepage, or concentrated surface water discharge onto a slope.

While shallow landslides displace a smaller volume of soil than deep-seated rotational landslides, they can be fast moving and can occur with little or no warning. Shallow slides are typically less than five to ten feet thick and several tens of feet in width. They

typically do not extensively impact the underlying denser soils or affect overall stability of a slope beyond the area that has slid.

Based on our review of the Site topography and vegetation, the presence of mapped mass wastage deposits, and our observations and experience with slopes in the Puget Sound region, we assess the potential for shallow landslides at the Site to be moderate. The potential for shallow landslides increases following extended periods of heavy precipitation or during a seismic event.

3.1.3 Toppling Failures

Toppling failures involve a mass of soil peeling off along naturally occurring tension cracks, which form in soils at the crest of steep slopes and bluffs. These tension cracks may provide conduits for surface water migration and flow, and they also promote growth of tree roots that can extend many feet downward into the cracks. As the roots grow and the face of the slope progresses through freeze-thaw cycles, or when the face of the slope at the toe of the tension crack becomes oversteepened and undermined by erosion, these cracks often become failure planes, and a slab of soil will spall or topple off the slope face. Failures of this kind are typically not more than several feet thick and occur only on very steep to near-vertical sections of slopes.

In our opinion, the potential for toppling failures at the Site is low.

3.1.4 Landslide Hazard Summary

The existing conditions include pipes, catch basins, and conveyance to an outfall at Lake Washington to manage drainage and reduce the risk for landslides. Drainage at the Site should be maintained or enhanced as part of the redevelopment to mitigate the potential for future landslide and steep slope hazards. Areas south of the driveway and west of the garage need drainage improvements to reduce the risk for instability in the vicinity of the timber walls observed during explorations and our reconnaissance.

The proposed redevelopment will occur in previously graded or developed areas of the house, garage, driveway, sod-surfaced areas between the house and driveway, and parking areas that were originally developed in 1934. The areas proposed for redevelopment are generally stable and have performed as intended. Provided Site development recommendations in this report are followed, the proposed development will, in our opinion, not pose a threat to the public health, safety, and welfare due to geologic hazards.

3.2 Erosion Hazards

We did not observe evidence of substantial erosion, scour, or rilling at the Site. Care should be taken during construction to mitigate risks of erosion. Appropriate temporary erosion and sedimentation control (TESC) best management practices (BMPs) should be implemented in accordance with City requirements.

The existing conditions include pipes, catch basins and conveyance to an outfall to Lake Washington at the Site to manage drainage and reduce the risk for erosion. Drainage at the Site should be maintained or enhanced going forward to mitigate erosion hazards. The proposed development will occur in previously graded or developed areas of the house,

garage, driveway, and parking areas that are currently managed to reduce erosion and have performed as intended. Provided Site development recommendations in this report are followed, the proposed development will, in our opinion, not pose a threat to the public health, safety and welfare due to erosion hazards.

3.3 Seismic Hazards

The Site is located within the Puget Lowland physiographic province, an area of active seismicity that is subject to earthquakes on shallow crustal faults and deeper subduction zone earthquakes. The Site lies within the Seattle Fault Zone (SFZ; Troost and Wiser, 2006), which consists of shallow crustal tectonic structures that are considered active (evidence for movement within the Holocene [since about 15,000 years ago]) and are believed to be capable of producing earthquakes of magnitude 7.3 or greater. The recurrence interval of earthquakes on this fault zone is believed to be on the order of 1,000 years or more. The most recent large earthquake on the SFZ occurred about 1,100 years ago (Pratt et al., 2015). Thrust fault traces are mapped approximately 4,700 feet north and approximately 2,300 feet south of the Site. Several other shallow crustal faults in the region are also capable of producing earthquakes and strong ground shaking.

The Site also lies within the zone of strong ground shaking from earthquakes associated with the Cascadia Subduction Zone (CSZ). Subduction zone earthquakes occur due to rupture between the subducting oceanic plate and the overlying continental plate. The CSZ can produce earthquakes up to magnitude 9.3 and the recurrence interval is thought to be on the order of about 500 years. A recent study estimates the most recent subduction zone earthquake occurred around 1700 (Atwater et al., 2015).

Deep intraslab earthquakes, which occur from tensional rupture of the sinking oceanic plate, are also associated with the CSZ. An example of this type of seismicity is the 2001 Nisqually earthquake. Deep intraslab earthquakes typically are magnitude 7.5 or less and occur approximately every 10 to 30 years.

Mitigation design to address seismic hazards will be incorporated into the development plans based on the following sections to prevent increased risk of harm to life and/or property.

3.3.1 Seismic Design Parameters

Seismic design of the improvements will be in accordance with the 2018 International Building Code (IBC), which references the American Society of Civil Engineers (ASCE) Standard ASCE/SEI 7-16, Minimum Design Loads for Buildings and Other Structures (ASCE, 2018) for seismic design. In accordance with these codes, the seismic design will consider a "Maximum Considered Earthquake" (MCE) ground motion with a 2 percent probability of exceedance in 50 years, or a return period of 2,475 years.

The effects of Site-specific subsurface conditions on the MCE ground motion at the ground surface are determined based on the "Site Class." The Site Class can be correlated to the average standard penetration resistance (N-value), average shear wave velocity, or average undrained strength (for fine-grained soils) in the upper 100 feet of the soil profile. Based on the average N-value from our explorations, we conclude the Site soil profile can be classified as Site Class D (Stiff Soil).

The design spectral response acceleration parameters adjusted for Site Class D in accordance with the 2018 IBC and ASCE/SEI 7-16 are presented in Table 5. These parameters are only valid if the exceptions outlined in Section 11.4.8 of ASCE/SEI 7-16 are met. If the exceptions are not met, then a Site Response Analysis in accordance with Section 21.1 of ASCE/SEI 7-16 is necessary. If the need for a Site Response Analysis becomes apparent as the Project design develops, Aspect can complete this upon request.

Table 1. Seismic Design Parameters

Design Parameter	Recommended Value
Site Class	D – Stiff Soil(1)
Peak Ground Acceleration (PGA)	0.620g(2)
PGA Coefficient (F_{PGA})	1.1
Site Modified PGA (PGA_M)	0.682g
Short Period Spectral Acceleration (S_s)	1.449g
1-Second Period Spectral Acceleration (S_1)	0.501g
Site Coefficient (F_a)	1.0
Site Coefficient (F_v)	1.8
Design Short Period Spectral Acceleration (S_{DS})	0.966g
Design 1-Second Period Spectral Acceleration (S_{D1})	0.601g

Notes:
1. Verify that the exceptions outlined in Section 11.4.8 of ASCE/SEI 7-16 are met. Refer to text above
2. g = gravitational force
3. Based on the latitude and longitude of the Site: 47.541180°N, -122.210110°W.
4. The risk category used was II, residential use.

3.3.2 Liquefaction

Liquefaction occurs when loose, saturated, and relatively cohesionless soil deposits temporarily lose strength from seismic shaking. The primary factors controlling the onset of liquefaction in susceptible soils include intensity and duration of strong ground motion, *in situ* stress conditions, and the depth to groundwater.

We evaluated the susceptibility of the Site soils to liquefaction based on geologic, compositional, and state criteria. The Washington Department of Natural Resources (DNR) maps the Site as generally having low to moderate liquefaction susceptibility (DNR, 2004). The loose, surficial fill deposits overlying the Site are potentially susceptible to liquefaction. This is due to their low density and because the fine-grained particles are relatively nonplastic. Liquefaction would only be expected to initiate in the fill deposits under saturated conditions, which were not observed during our subsurface

explorations. In addition, the laboratory analysis results on select samples suggest that the fines content in the fill materials is on the order of approximately 15 percent or more, which may inhibit the initiation of liquefaction.

In our opinion there is some risk of liquefaction initiating in the fill deposits during the life of the Project, if saturated conditions coexist with strong ground shaking. To mitigate this risk, we have recommended deep foundation alternatives that will bypass the fill deposits and bear the structures on pre-Olympia nonglacial deposits. It is our opinion that the pre-Olympia nonglacial deposits are not susceptible to liquefaction due to their high density. Based on the reasoning presented above, we do not expect liquefaction to be a significant hazard for the Project.

3.3.3 Surface Fault Rupture

The SFZ passes directly through Mercer Island. The U.S. Geological Survey maps east-west trending traces approximately 1 mile north and approximately 0.5 miles south of the Site (USGS, 2016). Due to the suspected long recurrence intervals and the proximity of the Site to the mapped fault traces, the potential for surficial ground rupture at the Site itself is considered low during the expected life of the Project.

4 Geotechnical Conclusions and Recommendations

Based on our evaluation, the Project is feasible from a geotechnical perspective. A summary of key Project geotechnical conclusions and recommendations are listed below and described in more detail in the following sections.

- Relatively compressible and low-strength fill deposits overlie the Site to depths of between 7- to 15-feet bgs. In order to mitigate risks to the proposed structures from differential settlement, we recommend that the structures be founded on deep foundations that bypass the fill and bear on the dense, high-strength pre-Olympia nonglacial deposits beneath the fill. Estimates of foundation capacities and design and construction recommendations for these foundation systems are included in subsequent sections.
- The Project will include new retaining walls, including cantilevered soldier pile and lagging wall systems and cast-in-place cantilevered concrete walls. Estimates of lateral earth pressures, global stability evaluations, and other wall design and construction recommendations are provided in subsequent sections.
- The existing concrete driveway has failed and will require replacement. We understand this will occur in a subsequent phase of construction. We have provided recommendations for flexible and rigid pavement sections that will mitigate risk of premature failure over the design life of the pavement due to the soft subgrade.
- The surficial fill deposits are moisture sensitive and generally not suitable for reuse as structural fill.

4.1 Soil Engineering Properties

The engineering properties of the subsurface soils were generalized for engineering analysis purposes. These parameters are shown for each observed geologic unit in Table 2. These values serve as the basis for our geotechnical recommendations and conclusions and can be used by the Project structural engineer directly to evaluate design scenarios that we have not explicitly considered in this report.

Table 2. Soil Engineering Properties

Soil Unit	USCS Classification	SPT N-Value[1]	Total Unit Weight (pcf)[2]	Effective Friction Angle (degrees)	Effective Cohesion Intercept (psf)[3]
Fill	SM, ML, CL	R: 1-14 A: 7	110	30	-
Weathered Pre-Olympia nonglacial	SM	R: 8-37 A: 25	125	35	-
Coarse-Grained Pre-Olympia nonglacial	SM, SP-SM	R: 40-90 A: 66	135	40	-
Fine-Grained Pre-Olympia nonglacial	CH	R: 6-41 A: 24	130	30	500

Notes:

1. Uncorrected. R = range, A = average
2. Pounds per cubic foot, pcf
3. Pounds per square foot, psf

4.2 Building Foundations

In our opinion, the compressible surficial fill deposits are unsuitable for conventional shallow foundations due to the risks from differential settlement. To mitigate these risks, we recommend that the new structures be founded on deep foundations that bypass the fill deposits and gain capacity from the underlying pre-Olympia nonglacial deposits. The use of deep foundations at the Site has the secondary benefit of mitigating the more moderate risks from liquefaction or shallow slope failures in the fill deposits.

During the preliminary design phase, we evaluated both helical and pin pile foundation alternatives. We understand that the design team has elected to use pin piles, so we have included appropriate recommendations for pin pile design and construction below.

4.2.1 Pin Piles

For residential foundation support, pin piles typically consist of 2- to 6-inch-diameter steel pipe piles driven to a predetermined acceptance criterion using a pneumatic or hydraulic hammer. Acceptance criteria varies by the diameter of the pin pile but are typically defined as less than 1 inch of penetration into the ground during a specified time

period of continuous driving with the specified hammer. Specific acceptance criteria and allowable load capacity information is shown below in Table 3.

Table 3. Typical Pin Pile Capacities and Installation Acceptance Criteria

Pin Pile Diameter (in)	Hammer Weight[(1)] (lbs)	Allowable Capacity[(2)] (kips)	Acceptance Criteria[(3)] (sec)
2	90	4	60
3	550	12	12
4	850	20	16
6	2,000	30	10

Notes:
1. Minimum hammer weight recommended
2. Includes a factor of safety of 2
3. Time to drive pile less than 1 inch during continuous driving

Pin pile spacing, lateral requirements, and structural connections to other foundation elements should be designed by the Project structural engineer. We recommend schedule 80 or XS pipes for 2-inch-diameter piles and galvanized, schedule 40 pipes for 3- to 6-inch-diameter piles.

Pin piles should be utilized for axial, compressive support only. If lateral resistance is required, the pin piles may be installed on a slight batter (10 to 20 degrees from vertical) and the horizontal component of their axial capacity may be assigned as lateral resistance. This horizontal capacity will be available only in the direction of batter.

The capacities of piles greater than 2 inches in diameter should be verified through load testing in general accordance with the *Quick Load Test Method* described in ASTM D1143 (ASTM, 2018). We recommend a minimum of two piles be load tested in different areas of the proposed residence footprint prior to installing the production piles for the Project. The test piles may be incorporated as production piles at the discretion of the geotechnical engineer, provided they successfully pass the load test and are not damaged during installation or load test.

The pin piles should be required to extend to a minimum of 3 feet into the pre-Olympia nonglacial deposits (to be estimated based on observations during pile driving). Based on our explorations, we estimate that the total pile lengths to achieve the acceptance criteria shown in Table 2 will be on the order of approximately 15 feet in the vicinity of the main residence and approximately 25 feet in the vicinity of the garage. Due to buckling considerations, 2-inch-diameter pin piles shall not exceed 30 feet in length.

4.2.2 Foundation Lateral Resistance

We recommend that lateral resistance from pin piles be neglected unless they are battered. Passive and frictional resistance against pile caps/grade beams and below-grade walls can be considered for lateral resistance. Assuming the foundation elements are constructed within the existing fill deposits, we recommend using a passive equivalent fluid density of 350 pounds per cubic foot (pcf). A base friction coefficient of 0.30 may

be used to evaluate sliding resistance developed between concrete and the compacted subgrade soil. These values include a factor of safety of 1.5. Passive resistance within the top foot should be neglected unless the ground surface is protected by a concrete slab or pavement.

4.2.3 Floor Slabs

We recommend that the new structures be founded on deep foundations that bypass the surficial fill deposits. In our opinion, floor slabs that are not structurally integrated to the deep foundation system are feasible for floor loads up to 150 psf, provided the subgrade is prepared in accordance with our recommendations. Specifically, we recommend that the subgrade below floor slabs be overexcavated to a minimum depth of 18 inches and replaced with structural fill compacted to at least 95 percent of the maximum dry density determined by the modified Proctor. Additional overexcavation may be necessary if deleterious, organic, wet, or oversized material is encountered. Prior to placing the structural fill, the subgrade surface should be compacted to a firm and unyielding condition.

For floor slabs that are not structurally integrated with the deep foundation system, it should be understood that some risk of concrete distress exists due to the potential for future settlements. Future maintenance associated with this risk may be required.

For slabs-on-grade designed as a beam on elastic subgrade, we recommend using an initial vertical modulus (K_{v1}) of 120 pounds per cubic inch (pci). The K_{v1} value is appropriate for a 1-foot by 1-foot slab and needs to be adjusted based on the actual width (B) of the slab to a design vertical modulus (Ks) using the following equation below:

$$K_s = K_{v1}(B+1)^2/(4B^2),$$

where B = slab width (in feet).

Alternatively, pile-supported, structural floorslabs can be designed and constructed to mitigate risk of concrete distress from potential settlement.

For interior slabs-on-grade, we recommend the uppermost 6 inches of the subgrade consist of compacted capillary break material (in lieu of 6 inches of crushed surfacing base course [CSBC]) to provide uniform support and moisture control. The capillary break material should consist of free-draining, clean, fine gravel and coarse sand with a maximum particle size of about 1-inch and less than 3 percent material passing the U.S. No. 200 sieve by weight (fines). Angular material manufactured by crushing is preferred over rounded material such as bank run sand and gravel, to provide a subgrade surface that is not easily disturbed by workers laying steel rebar and concrete formwork. The capillary break material should be compacted to relatively firm and unyielding condition and evaluated by Aspect prior to placement of steel rebar and formwork.

For building areas where vapor intrusion mitigation would be detrimental to the interior finished space (such as air-conditioned office areas that may be covered with flooring), consideration should be given to placement of a vapor barrier over the capillary break. Detailed design and performance issues with respect to vapor intrusion and moisture control as it relates to the interior environment of the structure are beyond the expertise of

Aspect. A building envelope specialist or contractor should be consulted to address these issues, as needed.

4.2.4 Settlement

Total and differential static settlement of the structures are anticipated to be less than 0.5 inch, if founded on pin piles or helical piles installed in accordance with our recommendations provided above. Any static settlement is anticipated to occur rapidly as the structural loads are applied during construction.

4.3 Retaining Walls

Based on discussions with the design team and our review of preliminary design documents, we identified three primary retaining walls at the Site:

- **Wall 1:** cast-in-place concrete wall located along the southern property line south of the garage
- **Wall 2:** cast-in-place concrete wall located along the south side of the driveway west of the garage
- **Wall 3:** cantilevered soldier pile wall located at the bottom of the Environmentally Critical Area (ECA) steep slope north of the main residence

These walls, as well as preliminary grading information provided by the design team, are shown in Appendix C-1. The following sections contain design and construction recommendations for proposed retaining walls. All proposed retaining walls should be designed by the Project structural engineer.

4.3.1 Lateral Earth Pressures

Lateral earth pressures acting on earth retaining systems with assumed geometries for active, at-rest, and seismic conditions are shown below in Table 4. The equivalent seismic earth pressure is based on pseudo-static analysis applying a horizontal acceleration of one half of the site-modified PGA from Table 1. These values assume that new walls will primarily retain existing fill deposits at an approximately vertical interface. These values also assume that existing fill deposits will provide passive support in front of the structures. To invoke active earth pressure conditions, a wall must be capable of yielding laterally at least 0.001 to 0.002H, where H is the exposed height of the wall; otherwise, at-rest conditions should be assumed.

Table 4. Lateral Earth Pressure Parameters

Earth Pressure Condition	Foreslope Condition	Backslope Condition	Earth Pressure Coefficient	Equivalent Fluid Density[2] (pcf)[1]	Uniform Lateral Surcharge Pressure[3] (psf)[1]
Active	-	Level	0.33	40	0.33S
Active[4]	-	2H:1V	0.52	63	0.52S
Passive[5]	Level	-	3.20	350	-
Passive[4,5]	2H:1V	-	0.90	110	-
At-Rest	-	Level	0.50	60	0.50S
Seismic	-	Level	-	-	18.0H

Notes:

1. psf = pounds per square foot; pcf = pounds per cubic foot.
2. The equivalent fluid densities provided above are distributed triangularly along the exposed height of the wall. The uniform lateral surcharge pressures are distributed uniformly (rectangularly) along the exposed height of the wall.
3. S is the vertical surcharge pressure at the ground surface immediately above/behind the wall. H is the height of the wall. The resultant uniform rectangular lateral pressure should be applied to the full height of the wall.
4. These values assume a maximum backslope/foreslope of 2H:1V. Linear interpolation can be used for shallower backslope/foreslope conditions.
5. The passive value includes a factor of safety of 1.5. Passive resistance within a depth of 2 feet of the ground surface in front of the walls should be ignored.

4.3.2 Wall Global Stability

The purpose of our global stability analyses was to calculate factors of safety against global failure and determine minimum recommended embedment for the soldier piles (for the soldier pile wall) and/or wall footings (for the precast concrete walls) to ensure global stability. We performed global stability analyses for the proposed walls using topographic survey data and proposed grading information provided by the design team, as well as the results of our subsurface exploration program. We selected critical cross section locations for our analyses based on the expected locations of the maximum heights of the walls, as shown in Appendix C-1.

We conducted two-dimensional limit equilibrium slope stability analyses (SSA) using the Slide computer software program (Rocscience, 2018). We assessed stability under both static and seismic conditions. The Slide program performs slope stability computations based on the modeled slope conditions and calculates a factor of safety against slope failure, which is defined as the ratio of resisting forces to driving forces. A factor of safety of 1.0 indicates a "just-stable" condition, and a factor of safety less than 1.0 would indicate unstable conditions. Minimum factors of safety of 1.5 and 1.1 for static and seismic loading conditions, respectively, are generally considered acceptable.

We designated the soil/material units and assigned the engineering parameters shown in Table 2 and modeled a groundwater surface perched atop the fine-grained pre-Olympia nonglacial deposits and saturating the coarse-grained pre-Olympia deposits. We made the following specific assumptions regarding wall geometry at each wall location (refer to Appendix C-1 for wall locations):

Wall 1 – located along the southern property line south of the garage:

- Wall Type: Cast-in-place concrete
- Maximum Exposed Height: 5.5 feet
- Minimum Footing Embedment: 3 feet

Wall 2 – located along the south side of the driveway west of the garage:

- Wall Type: Cast-in-place concrete
- Maximum Exposed Height: 4 feet
- Minimum Footing Embedment: 3 feet

Wall 3 – located at the bottom of the ECA steep slope north of the main residence:

- Wall Type: Cantilevered soldier piles with lagging
- Maximum Exposed Height: 4 feet
- Soldier Pile Spacing: 8 feet
- Ultimate Pile Shear Strength: 160 kips
- Minimum Pile Embedment: 8 feet[3]

The model inputs, geometry, and results are presented graphically in Appendix C-2 through C-11. The calculated factors of safety for global stability are summarized in Table 5 below, which meet or exceed the recommended minimums in each case. Our analyses indicate that minor surficial sloughing should be anticipated during the design seismic event in isolated areas on some of the existing steep slopes. These locations are not anticipated to be graded or otherwise disturbed as part of the Project. In our opinion, these surficial areas should be considered maintenance issues and are not indicative of global instability for the retaining walls.

[3] We recommend that the soldier piles penetrate the minimum embedment recommended above, or a minimum of 1 foot into the fine-grained Pre-Olympia nonglacial deposits, whichever is deeper. Thus. the minimum embedment depth should be established in the field based on observations during construction.

Table 5. Summary of Factor of Safety Values for SSA Results

Wall ID	Analysis Cross Section	Static Factor of Safety for Global Stability[1]	Seismic Factor of Safety for Global Stability [2]
1	A-A'	1.1	2.0
2	B-B'	1.1	2.1
3	C-C'	1.1	2.2
3	D-D'	1.1	2.4
3	E-E'	1.1	2.2

Notes:
1. Limit equilibrium minimum factor of safety found using Spencer's method in SLIDE
2. Pseudostatic seismic analysis with a horizontal seismic coefficient of 0.341g

4.3.3 Wall Drainage

Drainage behind walls should consist of a 24-inch-thick zone of free-draining sand and gravel meeting the requirements for WSDOT Standard Specification 9-03.12(2) for Gravel Backfill for Walls. A woven geotextile separator meeting the requirements of Section 9-33.2(1), Table 3 of the WSDOT Standard Specifications should be included at the interface between the native soils and the drain rock behind the walls. Water that is carried down by this sand and gravel zone should be conveyed to a drainage system consisting of a minimum 4-inch-diameter, perforated, Schedule 40 PVC pipe surrounded by at least 6 inches of washed gravel meeting the requirements for WSDOT Standard Specification 9-03.12(4) for Gravel Backfill for Drains. The drain should be routed to discharge at an appropriate location with positive drainage away from the wall.

4.3.4 Wall Bearing Resistance

Precast concrete walls can bear on the fill deposits if the subgrade is suitably prepared and improved with a 12-inch-thick crushed rock fill pad (fill pad) composed of CSBC per WSDOT Standard Specification 9-03.9(3) (WSDOT, 2021). The compacted CSBC pad should be placed over firm and unyielding soil. We estimate that foundation widths in this application will be on the order of 1 to 5 feet wide. We recommend a maximum allowable bearing pressure of 1,500 psf be used for design to limit settlements. An increase in the allowable bearing pressure of one-third may be used for transient loading (e.g., wind, seismic). Lateral resistance along the base of wall foundations can be calculated with an allowable coefficients of friction of 0.30, which assumes a factor of safety of 1.5.

4.4 Driveway Pavements

The fill deposits are expected to provide relatively poor structural support for new pavement. Even though traffic loading is expected to be low, we recommend a robust pavement section. For flexible, hot mix asphalt (HMA) pavement surfaces, we recommend a section consisting of 3 inches of HMA overlying 8 inches of crushed surfacing. For rigid, unreinforced concrete surfaces, we recommend minimum 6 inches of

concrete overlying 6 inches of crushed surfacing. Compaction requirements are discussed in detail in Section 5.1.3

4.5 Steep Slope Management

Many of the factors that can cause landslides, such as site geology, topography, and groundwater conditions cannot be controlled. Some factors such as vegetation and stormwater runoff, however, can be controlled, and homeowners are advised to maintain the Site in a manner that maximizes slope stability.

The most likely impact to the Site from a slope stability perspective would be shallow landslides caused by saturation of the surficial fill soils on the steep slope, or from inertial forces during a seismic event. Factors that affect slope stability within the near-surface soil layer include the following (Gray and Leiser, 1982):

- **Root Reinforcement –** Roots mechanically reinforce a soil by transfer of shear stresses in the soil to tensile resistance in the roots.
- **Soil Moisture Modification –** Evapotranspiration and interception in the foliage limit buildup of soil moisture.
- **Buttressing and Arching –** Anchored and embedded stems can act as buttress piles or arch abutments in a slope, counteracting shear stresses.
- **Surcharge –** Weight of vegetation on a slope exerts both a downslope (destabilizing) stress and a stress component perpendicular to the slope, which tends to increase resistance to sliding.
- **Root Wedging –** Alleged tendency of roots to invade cracks, fissures, and channels in a soil or rock mass and thereby cause local instability by a wedging or prying action.
- **Windthrowing –** Destabilizing influences from an overturning moment exerted on a slope as a result of strong winds blowing downslope through trees.

Root reinforcement, soil moisture modification (reduction), and buttressing and arching will increase surficial slope stability at the Site. Surcharge, root wedging, and windthrowing will have a destabilizing effect on surficial slope stability.

Other sources of surficial slope instability include improperly managed storm and surface water runoff flowing near or over the top of the slope. Uncontrolled runoff or surface water should never be allowed to flow across the slope.

Care should be taken not to over-irrigate near the slope. If an irrigation system is installed near the steep slope, we recommend you install a shutoff valve well away from the slope and shut the valve during the wet season. This will reduce the risk of flooding of the hillside due to pipe damage. We recommend limiting irrigation to the dry season (between April and October).

To minimize soil erosion and reduce the risk of shallow landslides, we recommend establishing/ maintaining dense native vegetative cover that is low and has deeply-penetrating roots. We recommend consulting with a professional landscaper to determine appropriate vegetation types and to develop a planting plan for any steep slopes that are

disturbed during construction. Grading activities on the Site slopes that do not result in increased slope stability (i.e., placement of fill to flatten the slope) should be minimized to the maximum extent practical. If required, disturbance should be minor (limited to the outer 12 inches of the slope), accomplished with hand tools, and should facilitate replanting and promote vegetative growth. Grading activities should not result in a steeper inclination of the slope or the placement of new fill at the top of the slope. Landscaping debris should not be placed on the steep slope as this inhibits the growth of beneficial vegetation and adds mass to the surficial soil layers.

If soils on or near the steep slope become exposed through erosion and/or surficial landslide activity, we recommend immediately covering and aggressively revegetating the exposed areas. This may require the temporary placement of plastic sheeting replaced during the spring by a woven jute-mat (erosion control blanket) to provide temporary ground cover while vegetation takes root.

For specific vegetation recommendations, the Washington State Department of Ecology (Ecology) has several good publications on the subject including:

- Vegetation Management: A guide for Puget Sound Bluff Property Owners (Ecology, 1993a).
- Slope Stabilization and Erosion Control Using Vegetation: A Manual of Practice for Coastal Property Owners (Ecology, 1993b).

This information is also available from Ecology's website, along with a steep-slope planting guide.

5 Construction Recommendations

5.1 Soldier Pile Wall Construction

The soldier piles must be properly constructed to perform as designed. The soldier pile wall should be constructed in accordance with the applicable portions of Section 6-16 of the WSDOT Standard Specifications (WSDOT, 2021). We recommend the following:

- Groundwater and caving soil could be encountered during drilling of soldier pile shafts, and the contractor should be prepared to use a temporary casing or drilling slurry to prevent caving and soil loss. If there is standing water or drilling slurry in the shaft, concrete should be placed with a tremie pipe placed at the bottom of the hole.
- Boulders and/or cobbles could be present in the subsurface soils. The Contractor should be prepared to remove, break-up, cut through, or otherwise manage obstructions, if encountered.
- Soldier piles with center-to-center spacing of less than 3 pile-hole diameters should not be drilled in sequence. Rather, every other pile should be drilled, and

the concrete should be placed and allowed to cure at least 24 hours before adjacent piles are drilled.

- The bottom of the soldier pile shafts should be cleared of loose or slough soils that may have accumulated during drilled prior to installing the soldier pile.

Aspect should provide special inspection services during soldier pile installations, to include monitoring pile shaft drilling, acceptance of the pile shafts, and inspection of the pile and concrete installation. Acceptance of the soldier pile installation should be the responsibility of the geotechnical engineer.

5.2 General Earthwork Recommendations

Based on the materials encountered in the explorations and our understanding of the Project, we anticipate Site earthwork can be completed with standard construction equipment. Toothed buckets may be required for excavations within the coarse-grained pre-Olympia nonglacial deposits. The construction of temporary gravel access roads and working platforms may also be required to navigate the Site. Appropriate erosion and sedimentation control measures should be in accordance with local BMPs and should be implemented prior to beginning earthwork activities. Also, land clearing, grading, filling, and foundation work within the identified geologic hazard areas are not permitted between October 1 and April 1.

5.2.1 Temporary Excavations

Temporary excavation and slopes should not exceed the limits specified in the local, state, and federal regulations. Site Safety, including the stability of temporary excavations and slopes shall be the responsibility of the contractor. The soils within the anticipated excavation depths would classify as Type C soils in accordance with the Washington Administrative Code (WAC) 296-155 Part N (WAC, 2016). For planning purposes, we recommend that temporary slopes in Type C not be steeper than 1.5H:1V (horizontal to vertical). The presence of seepage may require that slopes be flattened further to remain stable.

We also recommend the following:

- Surface water should be diverted away from slopes.
- Protect slopes using plastic sheet, flash coating, or tarps to control erosion and stability, as necessary.
- Limit the duration that excavations or slopes are open to the shortest time possible.
- Traffic, equipment, and material stockpiles should not be allowed near the top of excavations or slopes.

The conditions of the excavations and slopes should be periodically observed by a competent person who is a representative of the contractor, to evaluate safety and stability.

5.2.2 Subgrade Preparation

Prior to placing structural fill or constructing foundations, subgrades should be prepared to a relatively firm and level condition that is generally free of standing water and protruding cobbles and compacted until firm and unyielding with appropriate equipment. An Aspect geotechnical engineer or geologist should evaluate foundation subgrades to verify conditions.

5.2.3 Structural Fill

Soils placed beneath or around foundations, fill embankments, walls, utilities, or below pavements should be considered structural fill. For these areas, we provide the following recommendations:

- Site-derived soils are generally unsuitable for reuse as structural fill due to their high fines (material passing the U.S. No. 200 sieve) content and moisture sensitivity.
- Structural fill below foundations and pavements should consist of crushed rock meeting the requirements for WSDOT Standard Specification 9-03.9(3) for CSBC.
- Structural fill directly behind walls should consist of sand and gravel meeting the requirements for WSDOT Standard Specification 9-03.12(2) for Gravel Backfill for Walls.
- Structural fill for utility bedding and backfill should meet the requirements for WSDOT Standard Specification 9-03.12(3) for Gravel Backfill for Pipe Zone Bedding or the material specified in the Standard Specification section applicable to the type of pipe being installed.
- Structural fill should only be placed on a relatively firm and unyielding subgrade.
- Structural fill should be compacted to a relatively firm and unyielding condition to a minimum density of 95 percent of the material maximum dry density as determined by ASTM D1557. Structural fill placed behind walls should be compacted to between 90 to 92 percent of the maximum dry density to avoid overstressing the walls.
- Structural fill should be placed in lifts with a loose thickness no greater than 12 inches when using relatively large compaction equipment, such as a vibrating plate attached to an excavator (hoe pack) or drum roller. If small, hand-operated compaction equipment is used to compact structural fill, lifts should not exceed 6 inches in loose thickness.
- Moisture content of the structural fill should be controlled to within 2 to 3 percent of the optimum moisture. Optimum moisture is the moisture content corresponding to the maximum modified proctor dry density.
- Fill placed in softscape, general grading, landscape, or common areas that are not beneath or around structures, utilities, slabs-on-grade, or below paved areas that can accommodate some settlement should be compacted to a relatively firm and unyielding condition.

5.2.4 Temporary Erosion and Sedimentation Control

Temporary erosion control measures should be implemented to prevent the migration of soil, dust, and turbid water off-Site or into stormwater systems. Such measures should include silt fences and straw wattles at the Site boundaries, silt socks in nearby catch basins, wetting exposed soil during dry periods, and quarry spalls and wheel wash stations at truck and equipment exits.

5.2.5 Wet Weather Construction

Performing Site earthwork during dry summer months is preferred, but the following considerations should be incorporated into the Project requirements in the case that work is completed during wet weather.

- Earthwork should be performed in small areas to minimize exposure to wet weather.
- Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean structural fill.
- The size and type of construction equipment used may have to be limited to prevent soil disturbance.
- The ground surface within the construction area should be graded to promote runoff of surface water and to prevent the ponding of water.
- The ground surface within the construction area should be sealed by a smooth-drum vibratory roller, or equivalent, and under no circumstances should be left uncompacted and exposed to moisture. Soils that become too wet for compaction should be removed and replaced with clean granular materials.
- Excavation and placement of fill should be observed by Aspect, the geotechnical engineer, to verify that all unsuitable materials are removed, and suitable compaction and Site drainage is achieved.
- Appropriate erosion and sedimentation BMPs should be strategically implemented in accordance with Washington State Department of Ecology and WSDOT recommendations.

6 Recommendations for Continuing Geotechnical Services

Throughout this report, we have provided recommendations where we consider it would be appropriate for Aspect to provide additional geotechnical input to the design and construction process. Additional recommendations are summarized in this section.

6.1 Additional Design and Consulting Services

Before construction begins, we recommend that Aspect:

- Continue to meet with the design team, as needed, to address geotechnical questions that may arise throughout the remainder of the design process.
- Review the design concepts as the design progresses to verify the geotechnical feasibility of site grading, retaining walls, and foundation systems and evaluate global stability as required. This may require additional explorations, depending on the design.
- Review the geotechnical elements of the project plans to see that the geotechnical engineering recommendations are properly interpreted.
- Provide an Environmentally Critical Area Impacts Statement of Risk with a final design report as required for City permitting.

6.2 Additional Construction Services

We are available to provide geotechnical engineering and monitoring services during construction. The integrity of the geotechnical elements depends on proper Site preparation and construction procedures. In addition, engineering decisions may have to be made in the field if variations in subsurface conditions become apparent.

During the construction phase of the Project, we recommend that Aspect be retained to perform the following tasks:

- Review applicable submittals
- Observe and evaluate subgrade preparation, structural fill placement, wall construction, and deep foundation installation
- Attend meetings, as needed
- Address other geotechnical engineering considerations that may arise during construction

The purpose of our observations is to verify compliance with design concepts and recommendations, and to allow design changes or evaluation of appropriate construction methods if subsurface conditions differ from those anticipated prior to the start of construction.

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Limitations

Work for this project was performed for Janet Buttenwieser (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting, LLC (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

Risks are inherent with any site involving slopes and no recommendations, geologic analysis, or engineering design can assure slope stability. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the Client.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

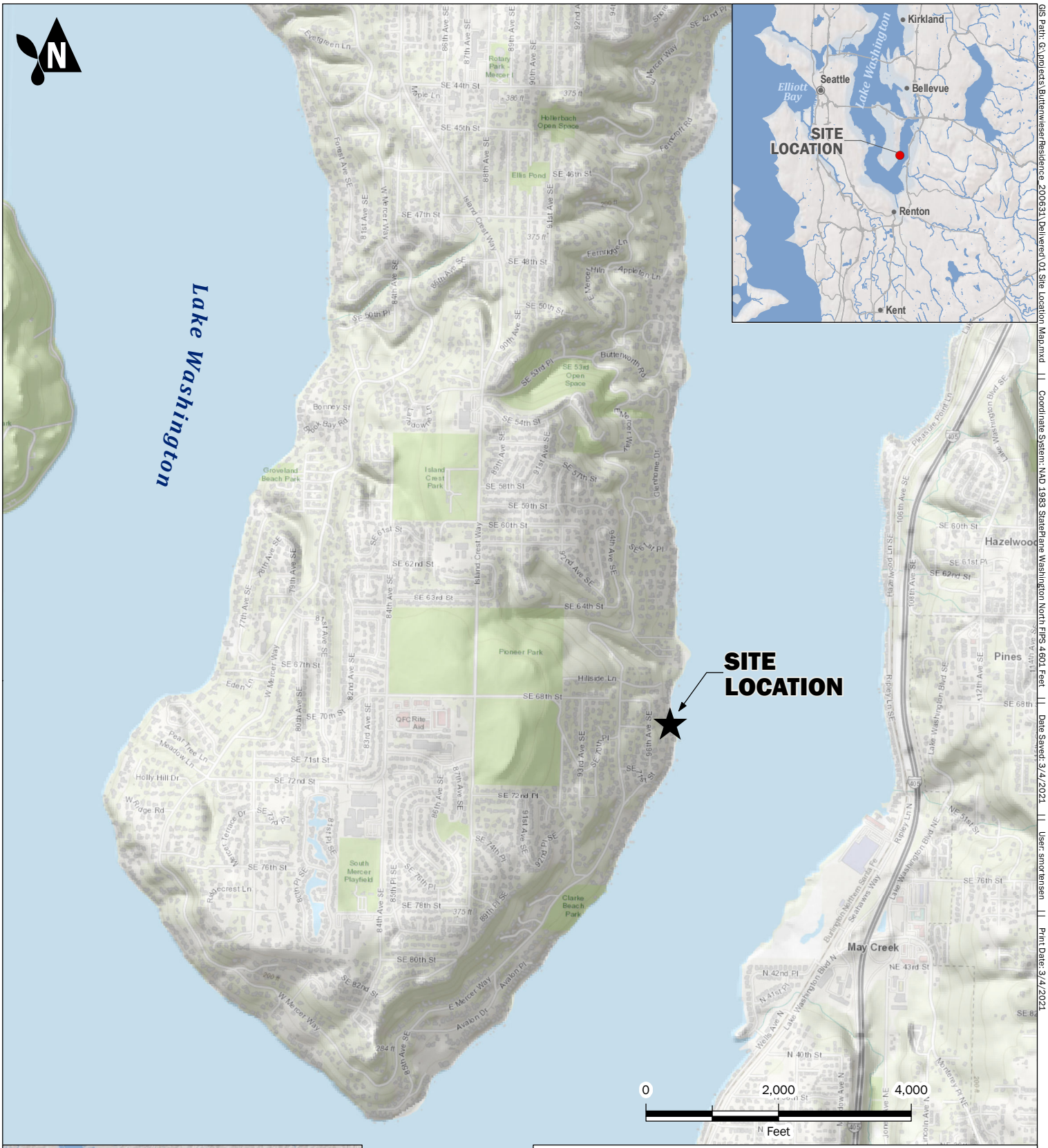
The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor’s site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect. Aspect’s original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix D titled “Report Limitations and Guidelines for Use” for additional information governing the use of this report.

We appreciate the opportunity to perform these services. If you have any questions please call Chip Barnett at 206.413.5398.

FIGURES



Site Location Map

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
6838 96th Avenue SE
Mercer Island, Washington

Aspect CONSULTING	MAR-2021	BY: MR / SBM	FIGURE NO. 1
	PROJECT NO. 200631	REVISED BY: ---	

Basemap Layer Credits || Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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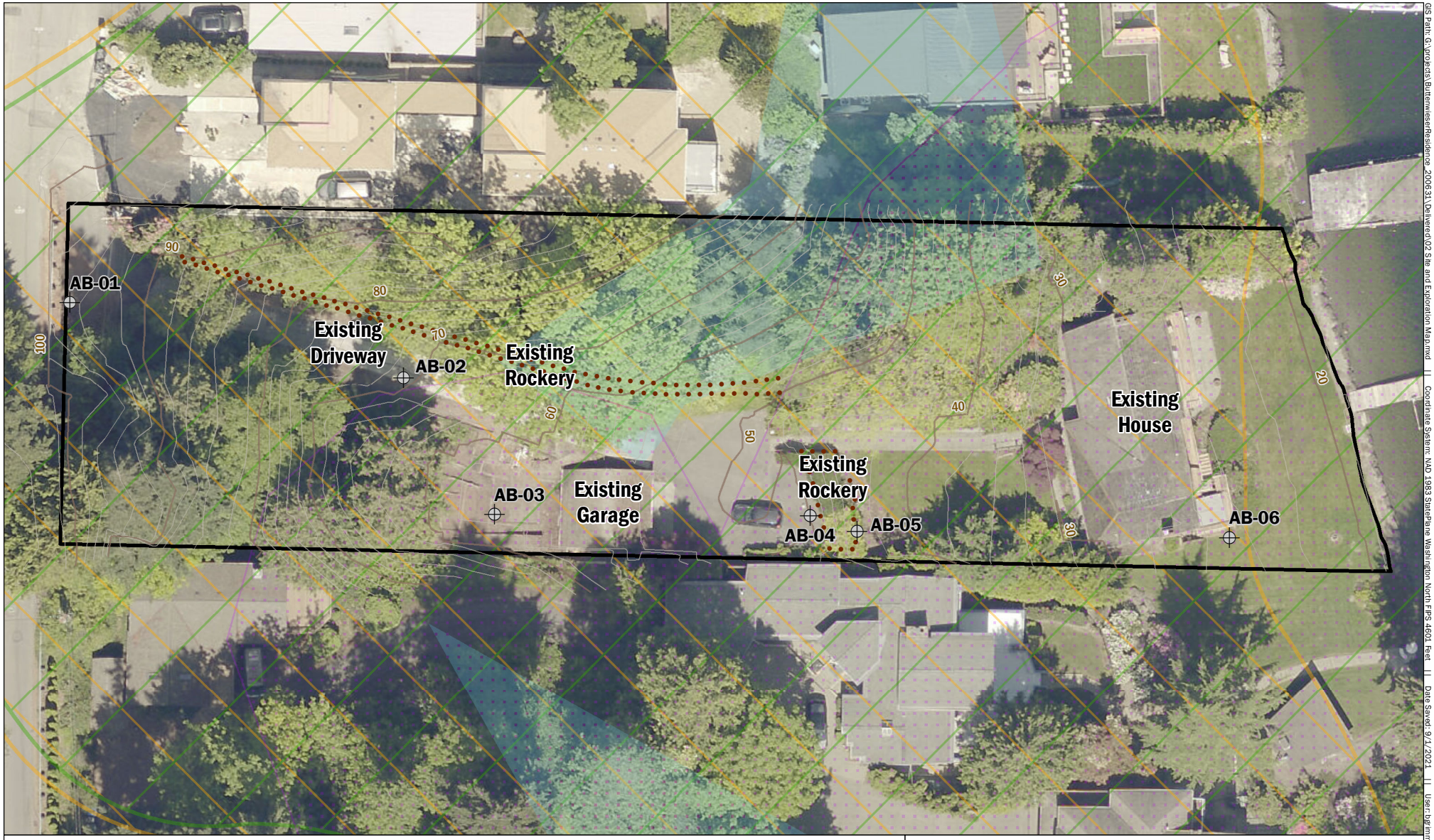


Explorations
Contour - 10' Interval
Contour - 2' Interval
Site Parcel

Mercer Island Geologic Hazard Area

Seismic
Steep Slope
Potential Slide
Erosion

N

0 40 80
Feet

Note: Topographic Contours were obtained using survey data completed by Terrane Land Surveying and reference the North American Vertical Datum of 1988.

Site and Exploration Map

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
6838 96th Avenue SE
Mercer Island, Washington

Aspect Consulting	SEP-2021	BY: MR / SBM	FIGURE NO. 2
	PROJECT NO. 200631	REVISED BY: ETB / WEG	

Basemap Layer Credits || EagleView Technologies, Inc.

GIS Path: G:\projects\ButterwieserResidence_200631\Deliverable\02 Site and Exploration Map.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 9/1/2021 || User: bgrimm || Print Date: 9/1/2021

APPENDIX A

Subsurface Exploration Logs

A. Subsurface Exploration Logs

On February 1 and 2, 2021, Aspect Consulting, LLC (Aspect) completed six machine-drilled borings (designated AB-01 through AB-06) at the Site. The machine-drilled borings were advanced with hollow-stem auger drilling methods using a portable tracked drill rig operated by Geologic Drilling Partners, Inc. under subcontract to Aspect.

Disturbed soil samples were obtained at 2.5- or 5-foot intervals using the Standard Penetration Test (SPT) in accordance with ASTM D1586, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils* (ASTM, 2018). Typically, the Standard Penetration Test involves driving a 2-inch-outside-diameter split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches (the drill rig employed on this project used rope and cathead to raise and lower the hammer). The number of blows for each 6-inch interval is recorded and the number of blows required to drive the sampler for the final two intervals (a total of 12 inches) is known as the Standard Penetration Resistance ("N-value") or blow count. The N-value provides a measure of relative density of granular soils or the relative consistency of cohesive soils. Upon completion, the machine-drilled borings were backfilled with 3/8-inch bentonite chips in accordance with requirements of the Washington State Department of Ecology.

An Aspect engineer or geologist was present throughout the exploration program to observe the drilling procedures, assist in sampling, and to prepare descriptive logs of the explorations. Soils were identified in general accordance with ASTM D2488, *Standard Practice for Description and Identification of Soils* (Visual-Manual Procedure). The summary exploration logs represent our interpretation of the contents of the field logs. The stratigraphic contacts shown on the individual summary logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The subsurface conditions depicted are only for the specific date and locations reported, and therefore, are not necessarily representative of other locations and times.

Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines	GW	Well-graded GRAVEL Well-graded GRAVEL WITH SAND
			GP	Poorly-graded GRAVEL Poorly-graded GRAVEL WITH SAND
		≥15% Fines	GM	SILTY GRAVEL SILTY GRAVEL WITH SAND
			GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines	SW	Well-graded SAND Well-graded SAND WITH GRAVEL
			SP	Poorly-graded SAND Poorly-graded SAND WITH GRAVEL
		≥15% Fines	SM	SILTY SAND SILTY SAND WITH GRAVEL
			SC	CLAYEY SAND CLAYEY SAND WITH GRAVEL
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50%		ML	SILT SANDY or GRAVELLY SILT SILT WITH SAND SILT WITH GRAVEL
			CL	LEAN CLAY SANDY or GRAVELLY LEAN CLAY LEAN CLAY WITH SAND LEAN CLAY WITH GRAVEL
			OL	ORGANIC SILT SANDY or GRAVELLY ORGANIC SILT ORGANIC SILT WITH SAND ORGANIC SILT WITH GRAVEL
	Silts and Clays Liquid Limit 50% or More		MH	ELASTIC SILT SANDY or GRAVELLY ELASTIC SILT ELASTIC SILT WITH SAND ELASTIC SILT WITH GRAVEL
			CH	FAT CLAY SANDY or GRAVELLY FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL
			OH	ORGANIC CLAY SANDY or GRAVELLY ORGANIC CLAY ORGANIC CLAY WITH SAND ORGANIC CLAY WITH GRAVEL
Highly Organic Soils			PT	PEAT and other mostly organic soils

"WITH SILT" or "WITH CLAY" means 5 to 15% silt and clay, denoted by a "-" in the group name; e.g., SP-SM • "SILTY" or "CLAYEY" means >15% silt and clay • "WITH SAND" or "WITH GRAVEL" means 15 to 30% sand and gravel. • "SANDY" or "GRAVELLY" means >30% sand and gravel. • "Well-graded" means approximately equal amounts of fine to coarse grain sizes • "Poorly graded" means unequal amounts of grain sizes • Group names separated by "/" means soil contains layers of the two soil types; e.g., SM/ML.

Soils were described and identified in the field in general accordance with the methods described in ASTM D2488. Where indicated in the log, soils were classified using ASTM D2487 or other laboratory tests as appropriate. Refer to the report accompanying these exploration logs for details.

1. Estimated or measured percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D1586)
3. Determined by SPT, DCPT (ASTM STP399) or other field methods. See report text for details.

GEOTECHNICAL LAB TESTS

MC	=	Natural Moisture Content
PS	=	Particle Size Distribution
FC	=	Fines Content (% < 0.075 mm)
GH	=	Hydrometer Test
AL	=	Atterberg Limits
C	=	Consolidation Test
Str	=	Strength Test
OC	=	Organic Content (% Loss by Ignition)
Comp	=	Proctor Test
K	=	Hydraulic Conductivity Test
SG	=	Specific Gravity Test

CHEMICAL LAB TESTS

Organic Chemicals

BTEX	=	Benzene, Toluene, Ethylbenzene, Xylenes
TPH-Dx	=	Diesel and Oil-Range Petroleum Hydrocarbons
TPH-G	=	Gasoline-Range Petroleum Hydrocarbons
VOCs	=	Volatile Organic Compounds
SVOCs	=	Semi-Volatile Organic Compounds
PAHs	=	Polycyclic Aromatic Hydrocarbon Compounds
PCBs	=	Polychlorinated Biphenyls

Metals

RCRA8	=	As, Ba, Cd, Cr, Pb, Hg, Se, Ag, (d = dissolved, t = total)
MTCA5	=	As, Cd, Cr, Hg, Pb (d = dissolved, t = total)
PP-13	=	Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn (d=dissolved, t=total)

FIELD TESTS

PID	=	Photoionization Detector
Sheen	=	Oil Sheen Test
SPT[2]	=	Standard Penetration Test
NSPT	=	Non-Standard Penetration Test
DCPT	=	Dynamic Cone Penetration Test

COMPONENT DEFINITIONS

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

ESTIMATED[1] PERCENTAGE

% by Weight		*Modifier*	*% by Weight*		*Modifier*
<1	=	Subtrace	15 to 25	=	Little
1 to <5	=	Trace	30 to 45	=	Some
5 to 10	=	Few	>50	=	Mostly

MOISTURE CONTENT

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

RELATIVE DENSITY

Non-Cohesive or Coarse-Grained Soils

Density[3]		*SPT*[2] *Blows/Foot*	*Penetration with 1/2" Diameter Rod*
Very Loose	=	0 to 4	≥ 2'
Loose	=	5 to 10	1' to 2'
Medium Dense	=	11 to 30	3" to 1'
Dense	=	31 to 50	1" to 3"
Very Dense	=	> 50	< 1"

CONSISTENCY

Cohesive or Fine-Grained Soils

Consistency[3]		*SPT*[2] *Blows/Foot*	*Manual Test*
Very Soft	=	0 to 1	Penetrated >1" easily by thumb. Extrudes between thumb & fingers.
Soft	=	2 to 4	Penetrated 1/4" to 1" easily by thumb. Easily molded.
Medium Stiff	=	5 to 8	Penetrated >1/4" with effort by thumb. Molded with strong pressure.
Stiff	=	9 to 15	Indented ~1/4" with effort by thumb.
Very Stiff	=	16 to 30	Indented easily by thumbnail.
Hard	=	> 30	Indented with difficulty by thumbnail.

GEOLOGIC CONTACTS

Observed and Distinct — Observed and Gradual — Inferred

Aspect CONSULTING

Exploration Log Key

Aspect CONSULTING	Buttenwieser/Wiley Residence - 200631		Geotechnical Exploration Log	
	Project Address & Site Specific Location 6838 96th Ave SE, Mercer Island, WA, Gravel Turnout at Top of Drive		*Coordinates (Lat,Lon WGS84)* 47.5412, -122.2110 (est)	*Exploration Number* **AB-01**
Contractor Geologic Drill Partners, Inc.	*Equipment* Mini Track Rig	*Sampling Method* Rope & cathead; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 94' (est)	
Operator Jeremy	*Exploration Method(s)* 6" OD X 2.25" ID Hollow Stem Auger	*Work Start/Completion Dates* 2/3/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* 5.9' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								Fill SANDY SILT (ML); very soft, wet, gray; nonplastic; some roots and woody debris	
		Boring backfilled with bentonite chips to 2' bgs and topped with concrete	S1		2 0 1				
5	90	▽ 2/3/2021 Approximate	S2		3 4 3			SILTY SAND (SM); loose, wet, gray to brown; fine sand	5
			S3		13 17 20			**Weathered Pre-Olympia Nonglacial Deposits** SILTY SAND (SM); dense, wet, light brown to red brown with red mottling; fine to coarse sand; trace fine to coarse, rounded gravel	
10	85		S4		7 40 43			**Coarse-Grained Pre-Olympia Nonglacial Deposits** SILTY SAND WITH GRAVEL (SM); very dense, slight moist, gray with multicolored clasts; fine to coarse sand; fine to coarse, subrounded to subangular gravel; partings of silt and clay; diamict texture	10
	80		S5		20 50/6"			Becomes increasingly sandy with fine, subrounded gravel	
15	75								15
20			S6		33 50/6"			Diamict texture becomes more pronounced	20
								Bottom of exploration at 21 ft. bgs.	

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢—⊣ Liquid Limit

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: M. Reiter
Approved by: C. Barnett

Exploration Log AB-01
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\200631 BUTTENWIESER RESIDENCE.GPJ April 6, 2021

Aspect CONSULTING	Buttenwieser/Wiley Residence - 200631		Geotechnical Exploration Log	
	Project Address & Site Specific Location 6838 96th Ave SE, Mercer Island, WA, Conc. Driveway		*Coordinates (Lat,Lon WGS84)* 47.5411, -122.2106 (est)	*Exploration Number* **AB-02**
Contractor Geologic Drill Partners, Inc.	*Equipment* Mini Track Rig	*Sampling Method* Rope & cathead; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 76' (est)	
Operator Jeremy	*Exploration Method(s)* 6" OD X 2.25" ID Hollow Stem Auger	*Work Start/Completion Dates* 2/2/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								Pavement CONCRETE; 4 inches concrete pavement with intermittent rebar	
								Fill SANDY SILT (ML); medium stiff, very moist, red brown to gray; nonplastic; fine sand	
	75	Boring backfilled with bentonite chips	S1		2 2 3	MC			
5									5
	70		S2		4 5 4	MC		Becomes stiff	
			S3		4 3 4	AL, MC LL=41% PL=23%		CLAY (CL); medium stiff, moist, light brown with red mottling; medium plasticity, medium toughness, no dilatancy, medium dry strength; trace fine, rounded gravel	
10									10
	65		S4		3 10 10			**Weathered Pre-Olympia Nonglacial Deposits** SILTY SAND (SM); medium dense, very moist, brown to gray; fine to medium sand; trace organics	
15									15
	60		S5		13 23 24			**Coarse-Grained Pre-Olympia Nonglacial Deposits** SAND WITH SILT (SP-SM); dense, moist, gray brown; fine sand	
20									20
	55		S6		19 21 26			SILTY SAND (SM); dense, wet, gray brown; fine to medium sand	
								Bottom of exploration at 21.5 ft. bgs.	

Legend

Sample Type: ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢⊣ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: M. Reiter
Approved by: C. Barnett

Exploration Log AB-02
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\200631 BUTTENWIESER RESIDENCE.GPJ April 6, 2021

Aspect CONSULTING	Buttenwieser/Wiley Residence - 200631		Geotechnical Exploration Log	
	Project Address & Site Specific Location 6838 96th Ave SE, Mercer Island, WA, Planters Behind Garage		*Coordinates (Lat,Lon WGS84)* 47.5410, -122.2105 (est)	*Exploration Number* **AB-03**
Contractor Geologic Drill Partners, Inc.	*Equipment* Mini Track Rig	*Sampling Method* Rope & cathead; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 57' (est)	
Operator Jeremy	*Exploration Method(s)* 6" OD X 2.25" ID Hollow Stem Auger	*Work Start/Completion Dates* 2/2/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	57	Boring backfilled with bentonite chips	S1		2 2 2			**Topsoil** TOPSOIL; very loose, moist, dark brown; mostly silt with sand; abundant organics **Fill** SILTY SAND (SM); very loose, very moist, gray brown; fine to coarse sand; partings of nonplastic silt	0
5	52		S2		3 1 3	PS, MC FC=41.3%		Becomes light gray to red brown	5
	50		S3		3 3 4	MC		Becomes loose, moist, gray	
10	47		S4		4 13 20			**Weathered Pre-Olympia Nonglacial Deposits** SILTY SAND WITH GRAVEL (SM); medium dense, wet, light brown to gray; fine to coarse sand; fine, subrounded to subangular gravel; trace black organics	10
15	42		S5		40 50/4"	PS, MC FC=15.3%		**Coarse-Grained Pre-Olympia Nonglacial Deposits** SILTY SAND WITH GRAVEL (SM); very dense, very moist, gray brown; fine to coarse sand; fine, subrounded to subangular gravel	15
20	37		S6		9 15 18	MC		**Fine-Grained Pre-Olympia Nonglacial Deposits** CLAY (CH); hard, slightly moist, blue gray; medium to high plasticity, medium toughness, no dilatancy, high to very high dry strength	20
								Bottom of exploration at 21.5 ft. bgs.	

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢⊣ Liquid Limit

Water Level
- No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: M. Reiter
Approved by: C. Barnett

Exploration Log AB-03
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\200631 BUTTENWIESER RESIDENCE.GPJ April 6, 2021

Aspect CONSULTING	Buttenwieser/Wiley Residence - 200631		Geotechnical Exploration Log	
	Project Address & Site Specific Location 6838 96th Ave SE, Mercer Island, WA, Top of Driveway Rockery		*Coordinates (Lat,Lon WGS84)* 47.5410, -122.2101 (est)	*Exploration Number* **AB-04**
Contractor Geologic Drill Partners, Inc.	*Equipment* Mini Track Rig	*Sampling Method* Rope & cathead; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 50' (est)	
Operator Jeremy	*Exploration Method(s)* 6" OD X 2.25" ID Hollow Stem Auger	*Work Start/Completion Dates* 2/2/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
		Boring backfilled with bentonite chips						**Pavement** ASPHALT; 3 inches hot mix asphalt GRAVEL WITH SAND (GW); 6 inches crushed aggregate surfacing	
			S1		1 2 1	AL, MC		**Fill** SILT WITH SAND (ML); soft, moist, dark gray; nonplastic; fine sand; trace woody debris	
5	45		S2		2 3 5			SILTY SAND (SM); loose, moist, gray with red mottling; fine sand; trace organics	5
			S3		5 5 6	FC, MC FC=20.9%		Becomes medium dense; fine to coarse sand	
10	40		S4		5 4 6			Becomes loose, wet; fine sand	10
15	35		S5		10 14 26			**Coarse-Grained Pre-Olympia Nonglacial Deposits** SILTY SAND WITH GRAVEL (SM); dense, slightly moist, brown; fine to coarse sand; fine, rounded gravel; diamict texture; trace charcoal	15
20	30		S6		7 15 26	MC		**Fine-Grained Pre-Olympia Nonglacial Deposits** CLAY (CH); hard, slightly moist, blue gray; medium to high plasticity, medium toughness, no dilatancy, high to very high dry strength; trace fine sand; trace fine, subrounded to subangular gravel	20

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢⊣ Liquid Limit

Water Level
- No Water Encountered

Bottom of exploration at 21.5 ft. bgs.
See Exploration Log Key for explanation of symbols

Logged by: M. Reiter
Approved by: C. Barnett

Exploration Log AB-04
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\200631 BUTTENWIESER RESIDENCE.GPJ April 6, 2021

Aspect CONSULTING	Buttenwieser/Wiley Residence - 200631		Geotechnical Exploration Log	
	Project Address & Site Specific Location 6838 96th Ave SE, Mercer Island, WA, Bot. of Driveway Rockery		*Coordinates (Lat,Lon WGS84)* 47.5410, -122.2100 (est)	*Exploration Number* **AB-05**
Contractor Geologic Drill Partners, Inc.	*Equipment* Mini Track Rig	*Sampling Method* Rope & cathead; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 42' (est)	
Operator Jeremy	*Exploration Method(s)* 6" OD X 2.25" ID Hollow Stem Auger	*Work Start/Completion Dates* 2/3/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	42	Boring backfilled with bentonite chips	S1	▲	2 1 3			**Topsoil** TOPSOIL; very loose, very moist, brown; mostly silt with fine sand; abundant roots and woody debris **Fill** SANDY SILT (ML); soft, very moist, gray; nonplastic; fine sand; some roots	0
5	37		S2	▲ ●	4 3 4	PS, MC FC=20.1%		SILTY SAND (SM); loose, very moist, gray; fine to medium sand	5
	35		S3	▲	3 3 4			Grades to brown	
10	32		S4	▲	5 7 7			Becomes medium dense, light brown; fine to medium sand; trace fine, rounded gravel	10
15	27		S5	● ▲	9 11 15	MC		**Fine-Grained Pre-Olympia Nonglacial Deposits** CLAY (CH); very stiff, slightly moist, blue gray; medium to high plasticity, medium toughness, no dilatancy, high to very high dry strength Drilling action suggests very stiff to hard soil	15
20	22		S6	▲ ●	7 9 11	MC		Bottom of exploration at 21.5 ft. bgs.	20

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢⊣ Liquid Limit

Water Level
- No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: M. Reiter
Approved by: C. Barnett

Exploration Log AB-05
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\200631 BUTTENWIESER RESIDENCE.GPJ April 6, 2021

Aspect CONSULTING	Buttenwieser/Wiley Residence - 200631		Geotechnical Exploration Log	
	Project Address & Site Specific Location 6838 96th Ave SE, Mercer Island, WA, S.E. House Corner		*Coordinates (Lat,Lon WGS84)* 47.5410, -122.2096 (est)	*Exploration Number* **AB-06**
Contractor Geologic Drill Partners, Inc.	*Equipment* Mini Track Rig	*Sampling Method* Rope & cathead; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 27' (est)	
Operator Jeremy	*Exploration Method(s)* 6" OD X 2.25" ID Hollow Stem Auger	*Work Start/Completion Dates* 2/3/2021	*Top of Casing Elev. (NAVD88)* NA	*Depth to Water (Below GS)* No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	27	Boring backfilled with bentonite chips	S1	▲ ●	4 5 4			**Topsoil** TOPSOIL; very loose, very moist, brown; mostly silt with fine sand; abundant organics and roots **Fill** SILTY SAND (SM); loose, very moist, gray; fine to medium sand	0
5	22		S2	▲ ●	3 5 7	PS, MC FC=13.9%		Becomes medium dense, dark gray; trace coarse sand; trace fine, subrounded gravel	5
			S3	▲ ●	4 5 3			**Weathered Pre-Olympia Nonglacial Deposits** SILTY SAND (SM); loose, wet, brown with red mottling; fine to coarse sand; trace fine to coarse, rounded gravel; trace black organics	
10	17		S4	▲ ●	2 3 3	MC		**Fine-Grained Pre-Olympia Nonglacial Deposits** CLAY (CH); medium stiff, slightly moist, blue gray; medium to high plasticity, medium toughness, no dilatancy, high to very high dry strength	10
15	12		S5	▲ ●	5 7 10	AL, MC LL=81% PL=34%		Becomes very stiff, slightly moist	15
20	7		S6	▲ ●	8 11 16			Bottom of exploration at 21.5 ft. bgs.	20

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ⊢ ⊣ Liquid Limit

Water Level
- No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: M. Reiter
Approved by: C. Barnett

Exploration Log AB-06
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\200631 BUTTENWIESER RESIDENCE.GPJ April 6, 2021

APPENDIX B

Laboratory Testing Results

B. Laboratory Testing Results

Laboratory tests were conducted on selected soil samples to characterize certain engineering (physical) properties of the Site soils. Laboratory testing included determination of natural moisture content, fines content, Atterberg Limits, and grain-size distribution, in general accordance with appropriate ASTM test methods.

The moisture content of selected samples was analyzed in general accordance with ASTM D2216, *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*. The fines content of selected samples was analyzed in general accordance with ASTM D1140, Standard Test Methods of Determining the Amount of Material Finer than 75-mm (No. 200) Sieve in Soils by Washing. The grain-size distribution of selected samples was analyzed in general accordance with ASTM D6913, *Standard Test Method for Particle-Size Analysis of Soils without Hydrometer Determination of Fines Content*. The Atterberg Limits were analyzed in general accordance with ASTM D4318, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*.

The results of the laboratory tests are presented in this appendix; moisture content and Atterberg Limit results are also presented graphically on the boring logs in Appendix A. The results of the grain-size distribution tests are presented as curves in this appendix, plotting percent finer by weight versus grain size.

hayremcelroy & associates, llc

9644 153rd Ave NE
Redmond, WA 98052
425-869-6750

Minus No. 200 Wash

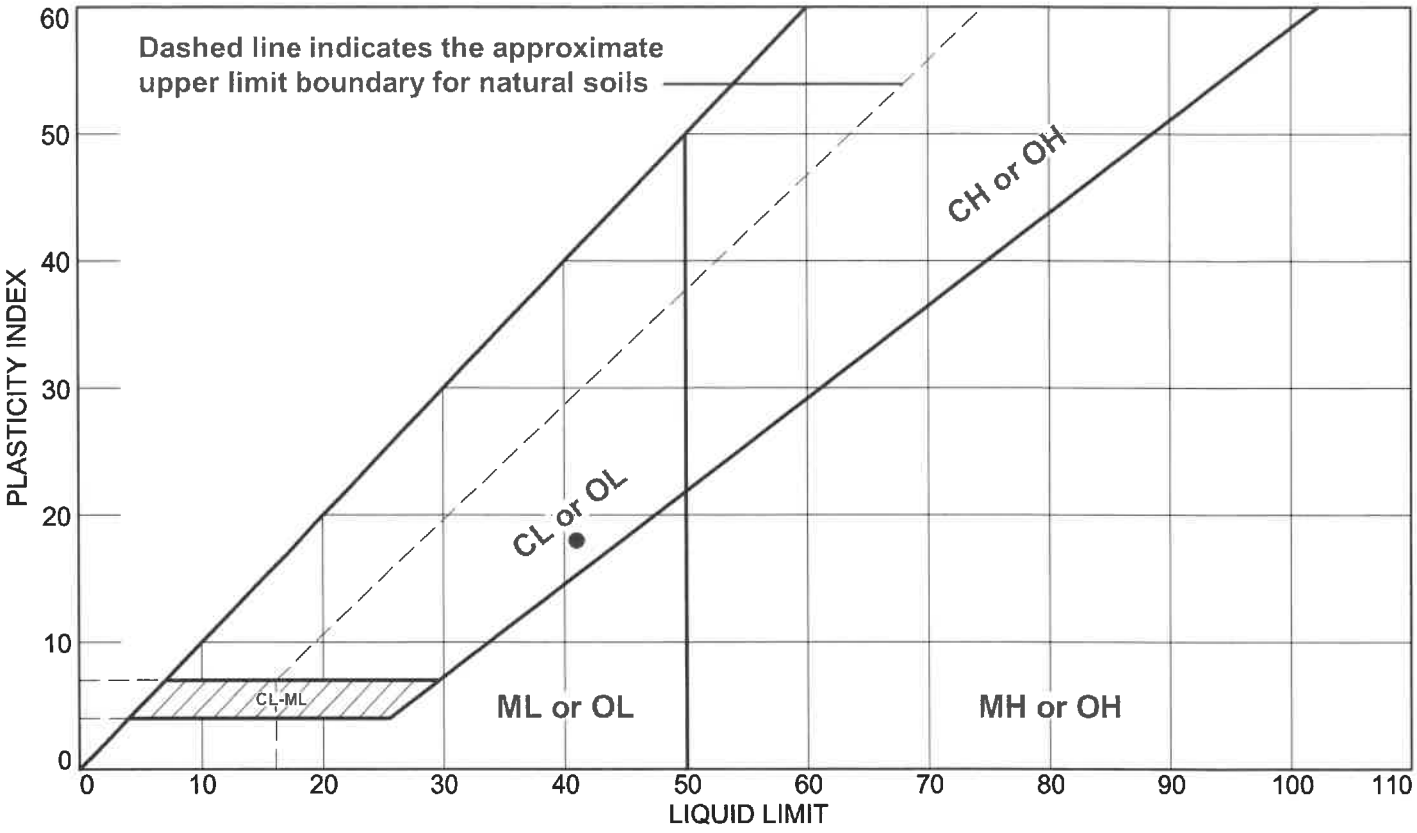
ASTM C117

Project Number: 08-175/200631
Project Name: Buttenweiser Residence
Lab Number: 8385

Technician: AD
Received: 2/5/2021
Start Date: 2/5/2021
Finish Date: 2/18/2021

HMA LAB NO	Boring No	Sample Number	Depth (ft)	Tare Weight (g)	Tare+Dry Weight Before Wash (g)	Tare+Dry Weight After Wash (g)	% Retained	% PASSING
8385-9	AB-04	S-3	7.5	15.9	358.3	286.6	79.1	20.9

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	AB-02 / S-3	8385-3	7.5	24.0	23	41	18	0.1	CL

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Buttenweiser Residence
Project No.: 08-175/200631 **Figure**

Tested By: AD **Checked By:** JAM

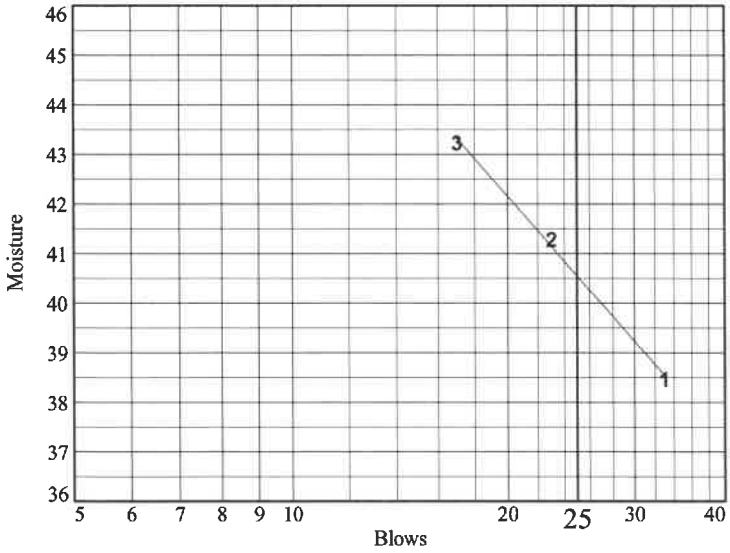
LIQUID AND PLASTIC LIMIT TEST DATA

2/18/2021

Client: Aspect Consulting
Project: Buttenweiser Residence
Project Number: 08-175/200631
Location: AB-02 / S-3
Depth: 7.5 **Sample Number:** 8385-3
Material Description: Lean CLAY with sand
USCS: CL
Tested by: AD **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	29.20	33.90	30.22			
Dry+Tare	24.86	28.02	25.26			
Tare	13.58	13.78	13.79			
# Blows	33	23	17			
Moisture	38.5	41.3	43.2			



Liquid Limit= 41
Plastic Limit= 23
Plasticity Index= 18
Natural Moisture= 24.0
Liquidity Index= 0.1

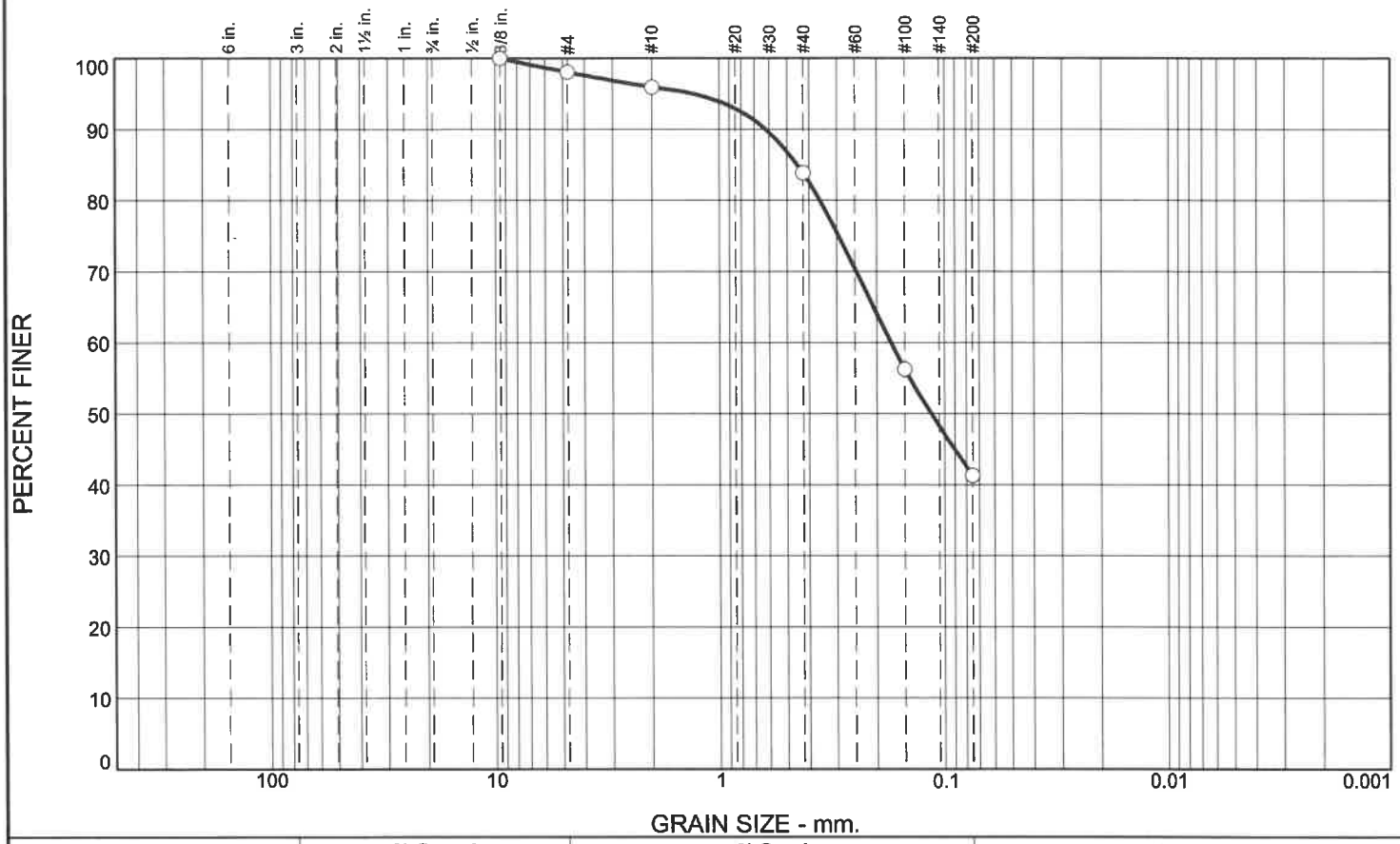
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	24.64				
Dry+Tare	22.62				
Tare	13.72				
Moisture	22.7				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
91.5	76.8	15.6	24.0

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.9	2.1	12.1	42.6	41.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100.0		
#4	98.1		
#10	96.0		
#40	83.9		
#100	56.2		
#200	41.3		

* (no specification provided)

Material Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6209 D_{85}= 0.4497 D_{60}= 0.1730
D_{50}= 0.1149 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: AB-03 / S-2 **Depth:** 5
Sample Number: 8385-4

Date: 2/18/21

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Buttenweiser Residence

Project No: 08-175/200631 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

2/18/2021

Client: Aspect Consulting
Project: Buttenweiser Residence
Project Number: 08-175/200631
Location: AB-03 / S-2
Depth: 5 **Sample Number:** 8385-4
Material Description: Silty SAND
Date: 2/18/21
USCS Classification: SM
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 130.00
Tare Wt. = 12.70
Minus #200 from wash = 40.7%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
210.60	12.70	0.00	3/8"	0.00	100.0
			#4	3.80	98.1
			#10	8.00	96.0
			#40	31.90	83.9
			#100	86.60	56.2
			#200	116.10	41.3

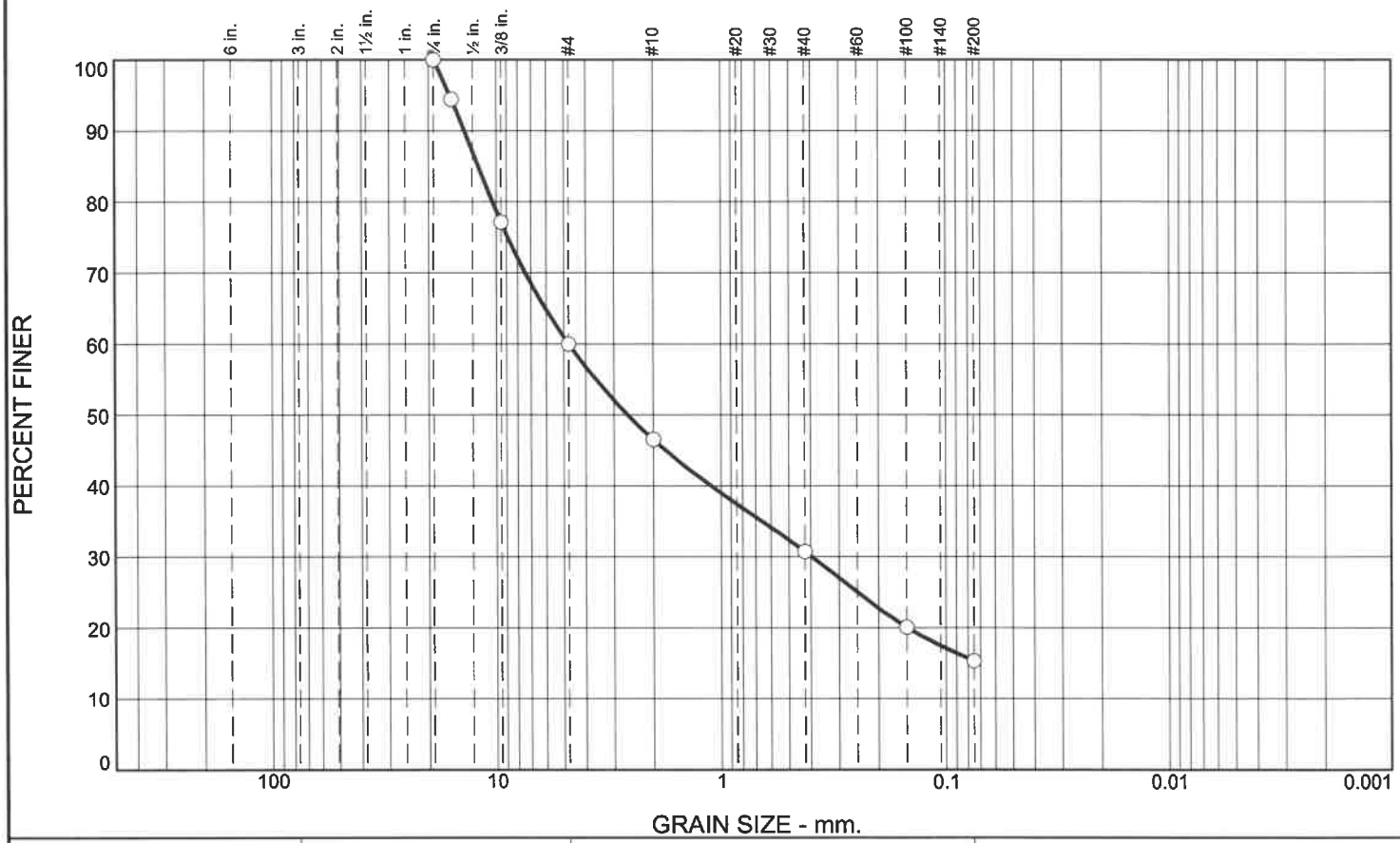
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	1.9	1.9	2.1	12.1	42.6	56.8			41.3

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.1149	0.1730	0.3578	0.4497	0.6209	1.2988

Fineness Modulus
0.90

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	40.0	13.4	15.9	15.4	15.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
5/8"	94.5		
3/8"	77.2		
#4	60.0		
#10	46.6		
#40	30.7		
#100	20.1		
#200	15.3		

* (no specification provided)

Material Description

Silty SAND with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 13.8818 D_{85}= 12.0204 D_{60}= 4.7548
D_{50}= 2.5984 D_{30}= 0.3963 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: AB-03 / S-5 **Depth:** 15
Sample Number: 8385-6

Date: 2/18/21

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Buttenweiser Residence

Project No: 08-175/200631 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

2/18/2021

Client: Aspect Consulting
Project: Buttenweiser Residence
Project Number: 08-175/200631
Location: AB-03 / S-5
Depth: 15 **Sample Number:** 8385-6
Material Description: Silty SAND with gravel
Date: 2/18/21
USCS Classification: SM
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 362.40
Tare Wt. = 16.10
Minus #200 from wash = 14.7%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
421.90	16.10	0.00	3/4"	0.00	100.0
			5/8"	22.50	94.5
			3/8"	92.70	77.2
			#4	162.40	60.0
			#10	216.90	46.6
			#40	281.10	30.7
			#100	324.30	20.1
			#200	343.70	15.3

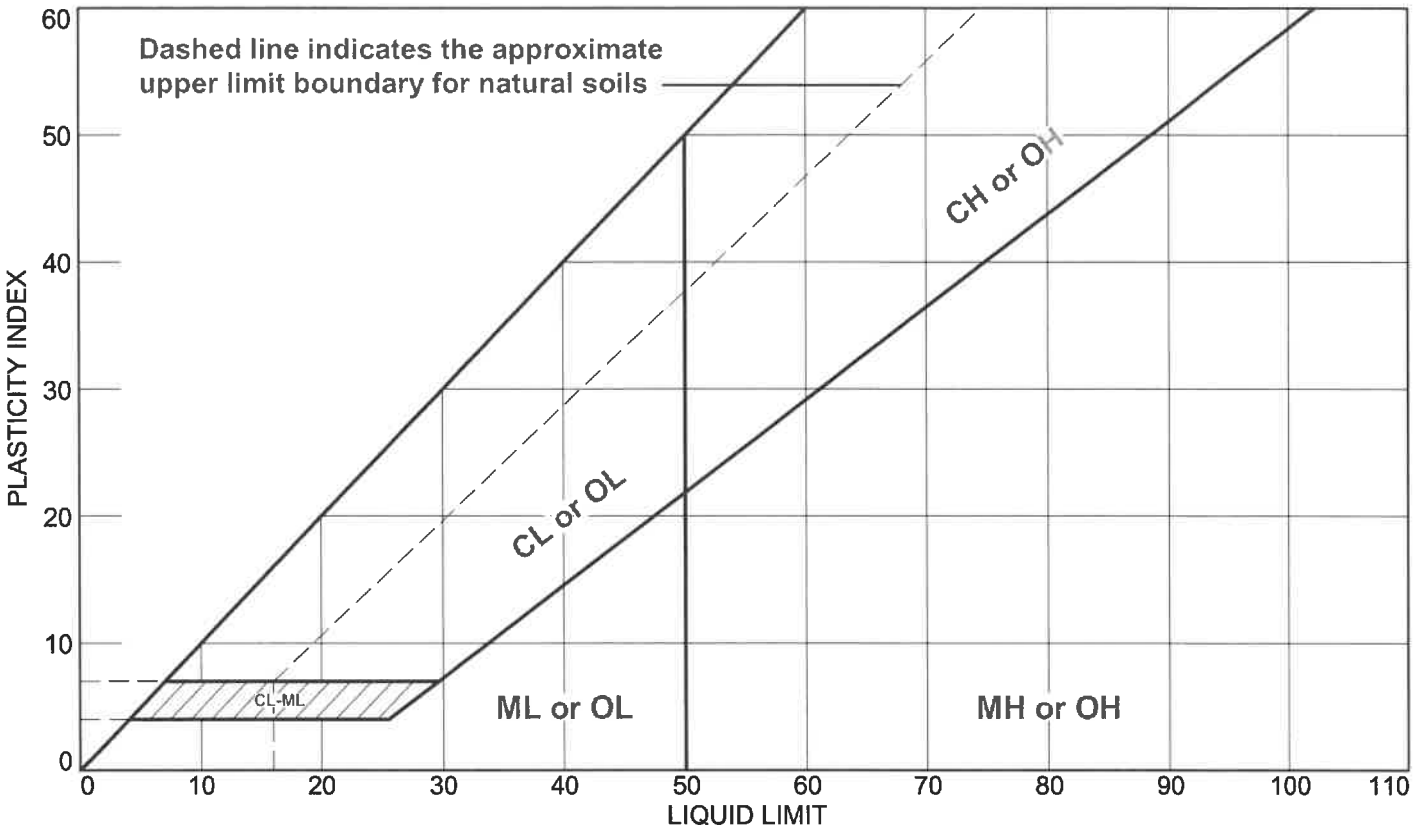
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	40.0	40.0	13.4	15.9	15.4	44.7			15.3

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1485	0.3963	1.1031	2.5984	4.7548	10.3921	12.0204	13.8818	16.1503

Fineness Modulus
3.92

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	AB-04 / S-1	8385-8	2.5	31.3	NP	NV	NP		

Hayre McElroy & Associates, LLC	**Client:** Aspect Consulting
	Project: Buttenweiser Residence
Redmond, WA	**Project No.:** 08-175/200631 **Figure**

Tested By: AD **Checked By:** JAM

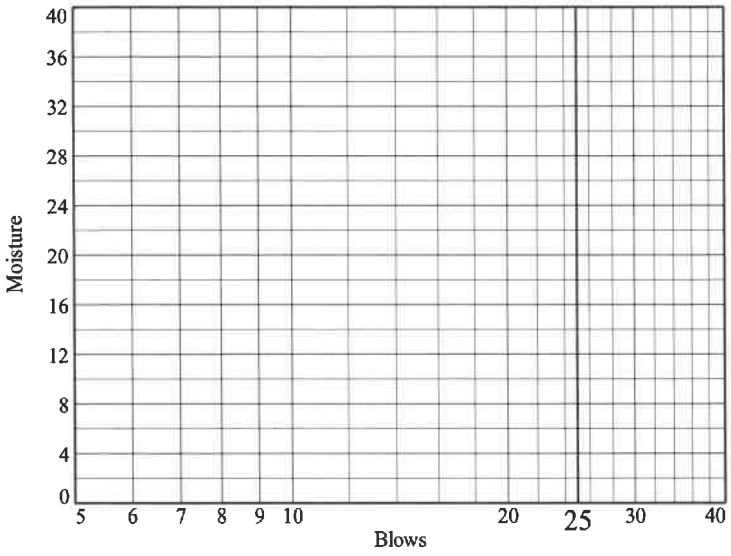
LIQUID AND PLASTIC LIMIT TEST DATA

2/18/2021

Client: Aspect Consulting
Project: Buttenweiser Residence
Project Number: 08-175/200631
Location: AB-04 / S-1
Depth: 2.5 **Sample Number:** 8385-8
Tested by: AD **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 31.3

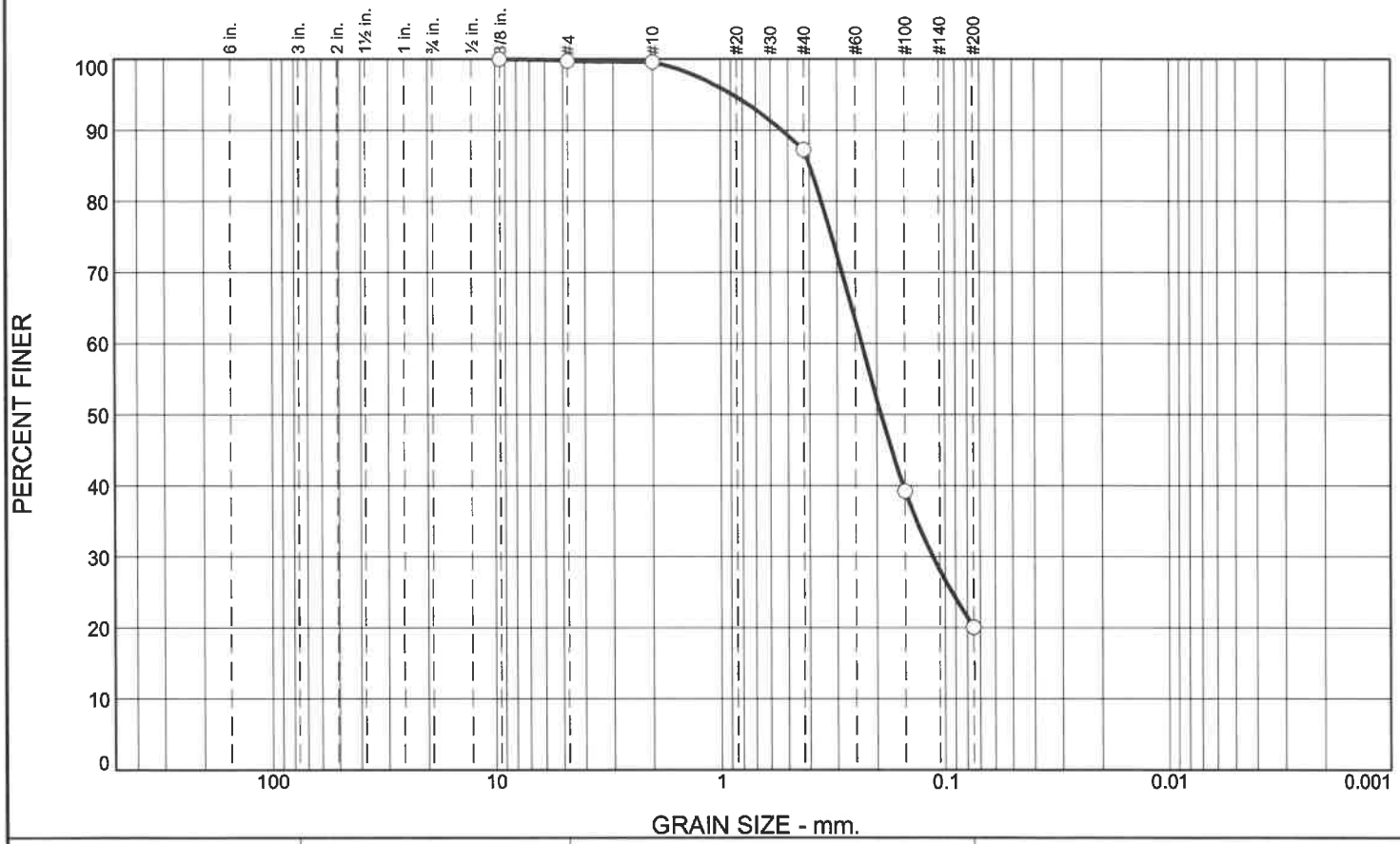
Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare					
Dry+Tare					
Tare					
Moisture					

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
35.9	30.4	12.8	31.3

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.2	12.3	67.2	20.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100.0		
#4	99.8		
#10	99.6		
#40	87.3		
#100	39.2		
#200	20.1		

* (no specification provided)

Material Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5316 D_{85}= 0.3996 D_{60}= 0.2344
D_{50}= 0.1917 D_{30}= 0.1135 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: AB-05 / S-2 **Depth:** 5
Sample Number: 8385-11 **Date:** 2/18/21

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Buttenweiser Residence

Project No: 08-175/200631 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

2/18/2021

Client: Aspect Consulting
Project: Buttenweiser Residence
Project Number: 08-175/200631
Location: AB-05 / S-2
Depth: 5 **Sample Number:** 8385-11
Material Description: Silty SAND
Date: 2/18/21
USCS Classification: SM
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 353.20
Tare Wt. = 12.70
Minus #200 from wash = 18.1%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
428.50	12.70	0.00	3/8"	0.00	100.0
			#4	1.00	99.8
			#10	1.60	99.6
			#40	53.00	87.3
			#100	252.70	39.2
			#200	332.40	20.1

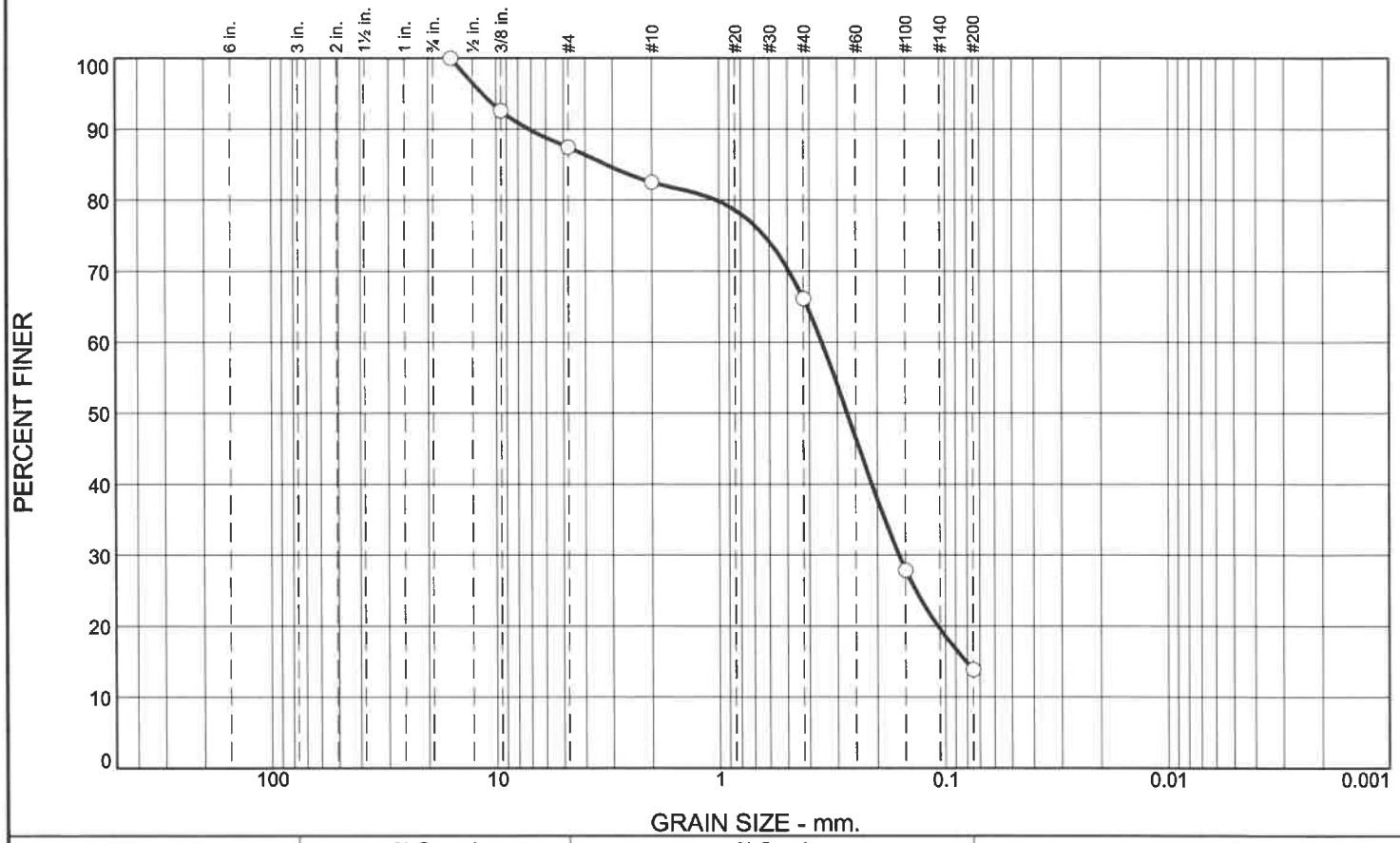
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.2	0.2	0.2	12.3	67.2	79.7			20.1

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.1135	0.1530	0.1917	0.2344	0.3538	0.3996	0.5316	0.8803

Fineness Modulus
1.01

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.5	4.9	16.5	52.2	13.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
5/8"	100.0		
3/8"	92.6		
#4	87.5		
#10	82.6		
#40	66.1		
#100	27.9		
#200	13.9		

* (no specification provided)

Material Description

Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 7.1375 D_{85}= 3.1836 D_{60}= 0.3530
D_{50}= 0.2721 D_{30}= 0.1607 D_{15}= 0.0807
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Source of Sample: AB-06 / S-2 **Depth:** 5
Sample Number: 8385-14

Date: 2/18/21

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Buttenweiser Residence

Project No: 08-175/200631 **Figure**

Tested By: AD **Checked By:** JAM

GRAIN SIZE DISTRIBUTION TEST DATA

2/18/2021

Client: Aspect Consulting
Project: Buttenweiser Residence
Project Number: 08-175/200631
Location: AB-06 / S-2
Depth: 5 **Sample Number:** 8385-14
Material Description: Silty SAND
Date: 2/18/21
USCS Classification: SM
Tested by: AD **Checked by:** JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 337.90
Tare Wt. = 12.70
Minus #200 from wash = 12.4%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
384.10	12.70	0.00	5/8"	0.00	100.0
			3/8"	27.40	92.6
			#4	46.50	87.5
			#10	64.80	82.6
			#40	125.80	66.1
			#100	267.90	27.9
			#200	319.90	13.9

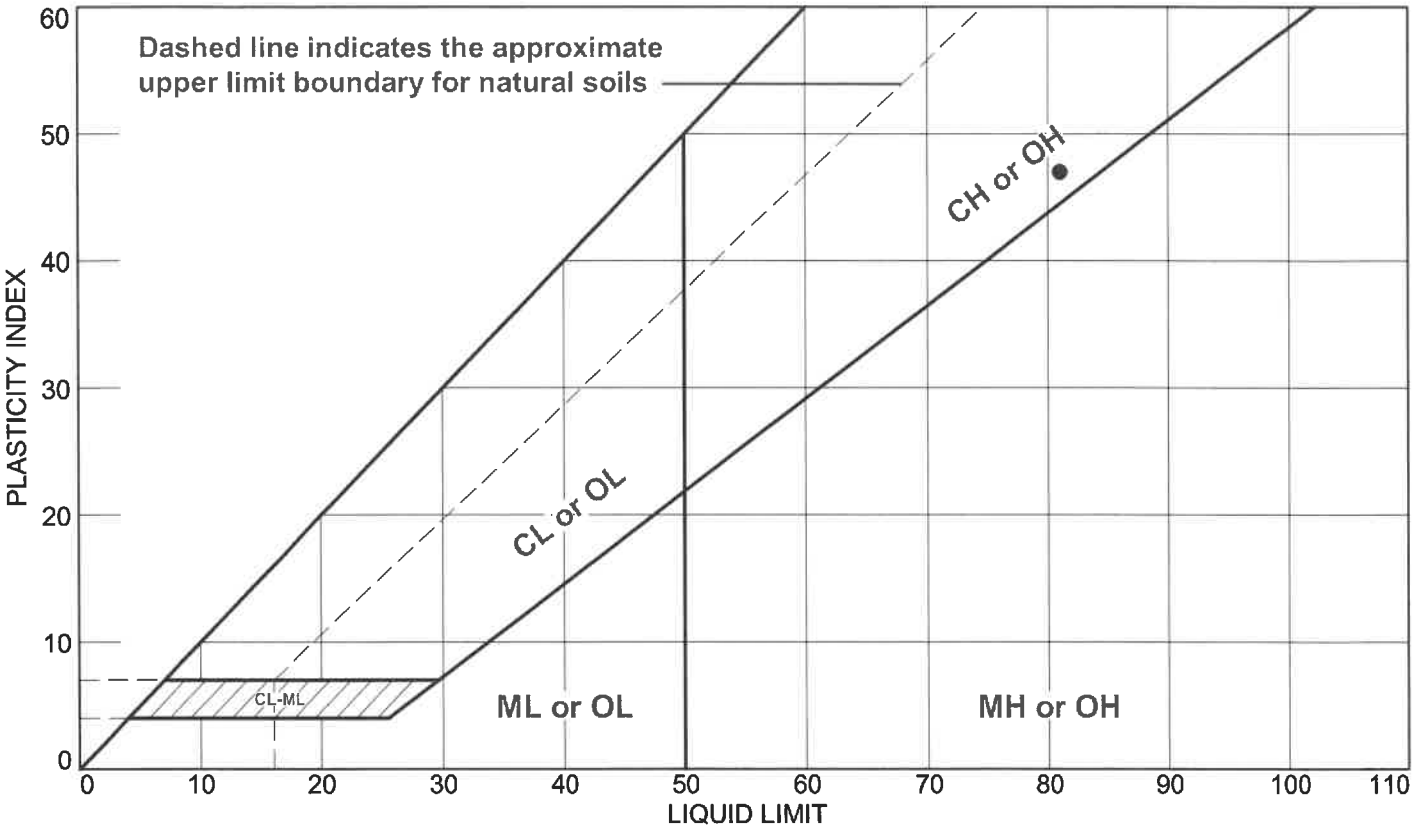
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	12.5	12.5	4.9	16.5	52.2	73.6			13.9

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0807	0.1081	0.1607	0.2119	0.2721	0.3530	1.0200	3.1836	7.1375	11.4671

Fineness Modulus
2.00

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	AB-06 / S-5	8385-16	15	37.4	34	81	47	0.1	CH

Hayre McElroy & Associates, LLC	**Client:** Aspect Consulting
	Project: Buttenweiser Residence
Redmond, WA	**Project No.:** 08-175/200631 **Figure**

Tested By: AD **Checked By:** JAM

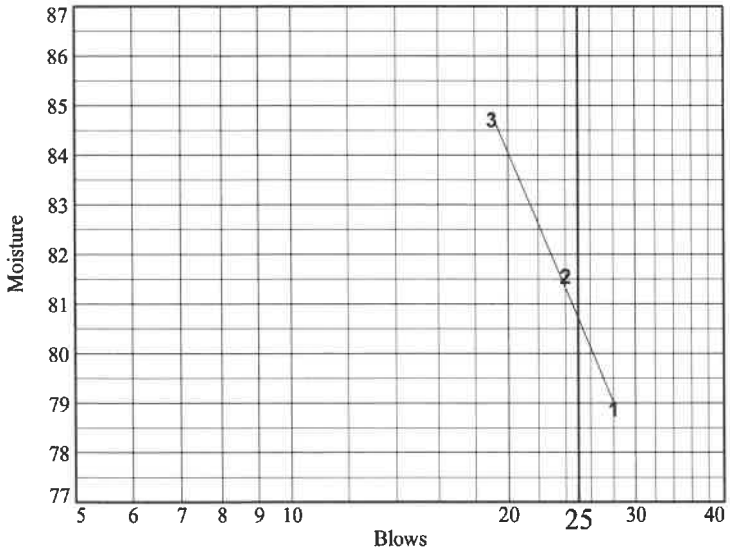
LIQUID AND PLASTIC LIMIT TEST DATA

2/18/2021

Client: Aspect Consulting
Project: Buttenweiser Residence
Project Number: 08-175/200631
Location: AB-06 / S-5
Depth: 15 **Sample Number:** 8385-16
Material Description: Fat CLAY
USCS: CH
Tested by: AD **Checked by:** JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	27.21	26.29	26.61			
Dry+Tare	21.27	20.67	20.73			
Tare	13.74	13.78	13.79			
# Blows	28	24	19			
Moisture	78.9	81.6	84.7			



Liquid Limit= 81
Plastic Limit= 34
Plasticity Index= 47
Natural Moisture= 37.4
Liquidity Index= 0.1

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	22.23				
Dry+Tare	20.05				
Tare	13.71				
Moisture	34.4				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
94.3	72.1	12.7	37.4

hayremcelroy & associates, llc

9644 153rd Ave NE
Redmond, WA 98052
425.869.6750

Moisture Content

ASTM D-2216

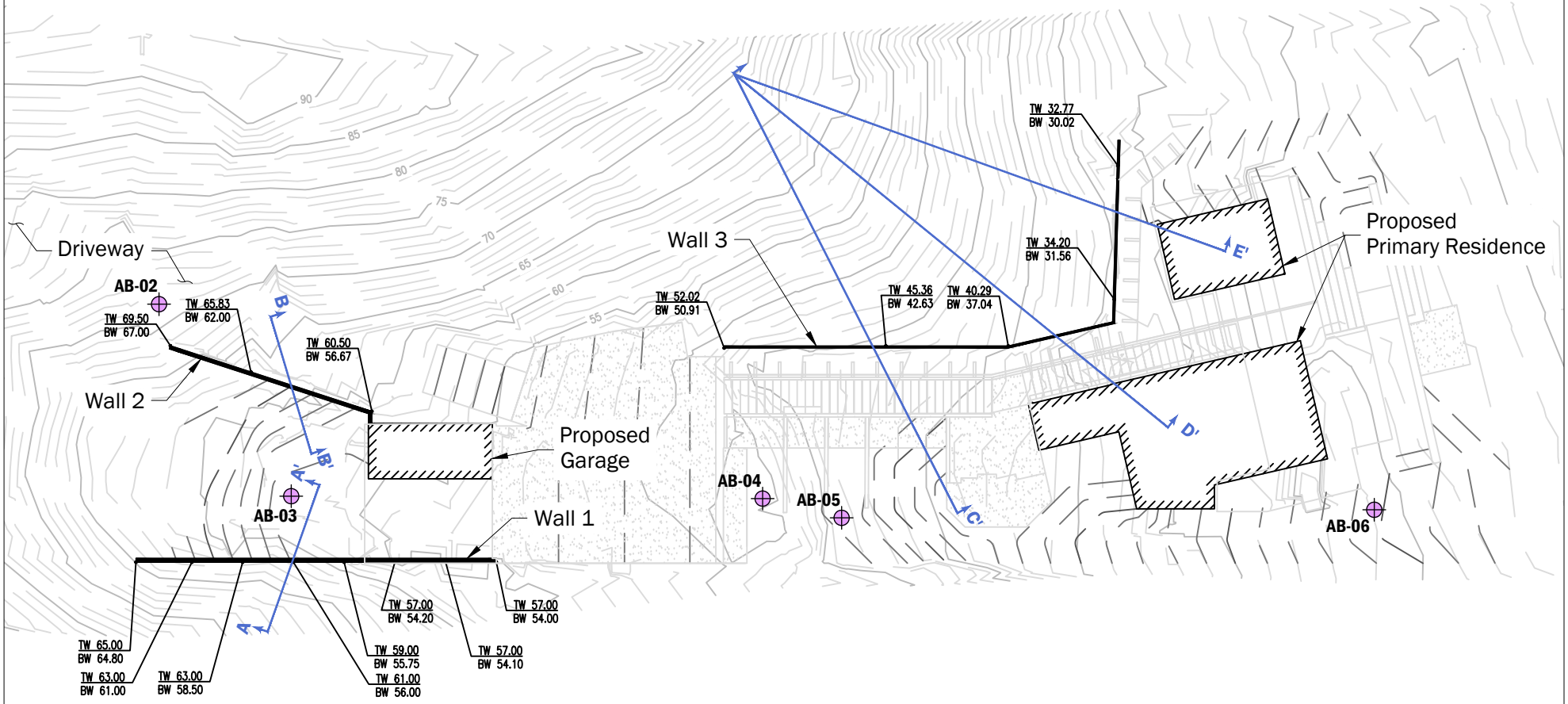
Project Number: 08-175/200631
Project Name: Buttenweiser Residence
Lab Number: 8385

Received Date: 2/5/2021
Start Date: 2/5/2021
Finish Date: 2/18/2021
Technician: AD

HMA Lab #	Boring	Sample	Depth (ft)	Weight of Moist Soil + Tare (g)	Weight of Dry Soil + Tare (g)	Tare Weight (g)	**Moisture Content (%)**
8385-1	AB-02	S-1	2.5	182.5	155.4	12.5	**19.0**
8385-2	AB-02	S-2	5	263.2	221.4	15.8	**20.3**
8385-3	AB-02	S-3	7.5	91.5	76.8	15.6	**24.0**
8385-4	AB-03	S-2	5	269.6	210.6	12.7	**29.8**
8385-5	AB-03	S-3	7.5	194.4	162.6	12.7	**21.2**
8385-6	AB-03	S-5	15	459.2	421.9	16.1	**9.2**
8385-7	AB-03	S-6	20	274.2	220.6	12.5	**25.8**
8385-8	AB-04	S-1	2.5	35.9	30.4	12.8	**31.3**
8385-9	AB-04	S-3	7.5	431.7	358.3	15.9	**21.4**
8385-10	AB-04	S-6	20	242.1	205.2	12.7	**19.2**
8385-11	AB-05	S-2	5	520.7	428.5	12.7	**22.2**
8385-12	AB-05	S-5	15	158.6	126.8	12.6	**27.8**
8385-13	AB-05	S-6	20	185.9	144.0	12.7	**31.9**
8385-14	AB-06	S-2	5	451.4	384.1	12.7	**18.1**
8385-15	AB-06	S-4	10	187.0	139.8	16.0	**38.1**
8385-16	AB-06	S-5	15	94.3	72.1	12.7	**37.4**

APPENDIX C

Wall Global Stability Analyses



Legend

- **AB-XX** Boring Location
- Existing 1' & 5' Topographic Contours
- Proposed 1' & 5' Topographic Contours
- Proposed Retaining Wall
- A A' Cross Section for Global Stability Analysis

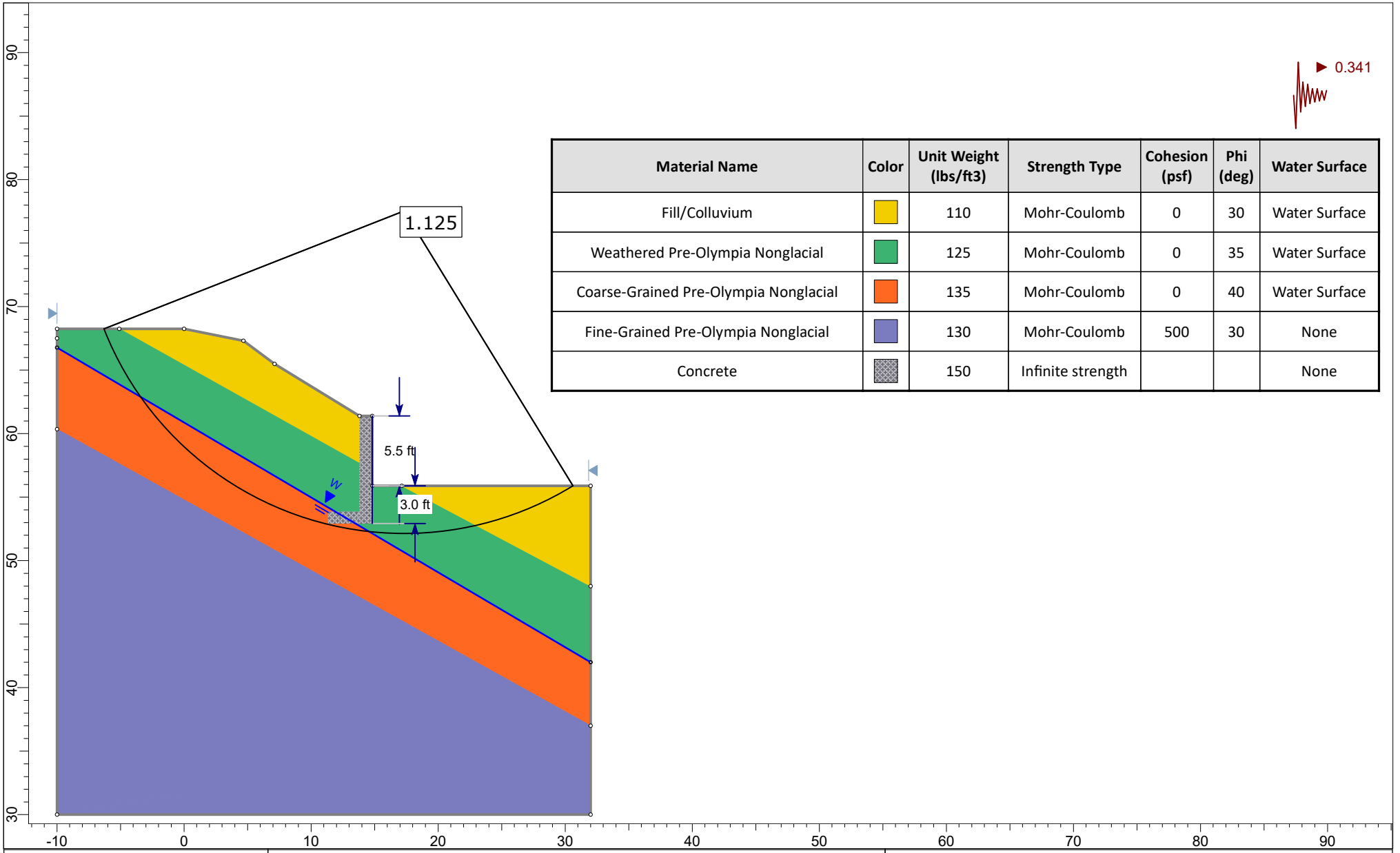
0 30 60 Feet

Global Stability Analysis Plan

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
6838 96th Avenue SE
Mercer Island, Washington

Aspect Consulting	----	BY: MBR	FIGURE NO. C-1
	PROJECT NO. 200631	REVISED BY: -	

CAD Path: Q:_GeoTech\200631 Buttenwieser\ButtenwieserGlobalStability.dwg 8.5x11 Landscape || Date Saved: Sep 01, 2021 2:09pm || User: mreiter



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	Mohr-Coulomb	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	Mohr-Coulomb	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	Mohr-Coulomb	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	Mohr-Coulomb	500	30	None
Concrete		150	Infinite strength			None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section A-A'
Seismic

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:125

S:\Buttenwieser residence Mercer Isl\Data\Analyses\Global Stability\Buttenwieser.slmd

Aspect CONSULTING

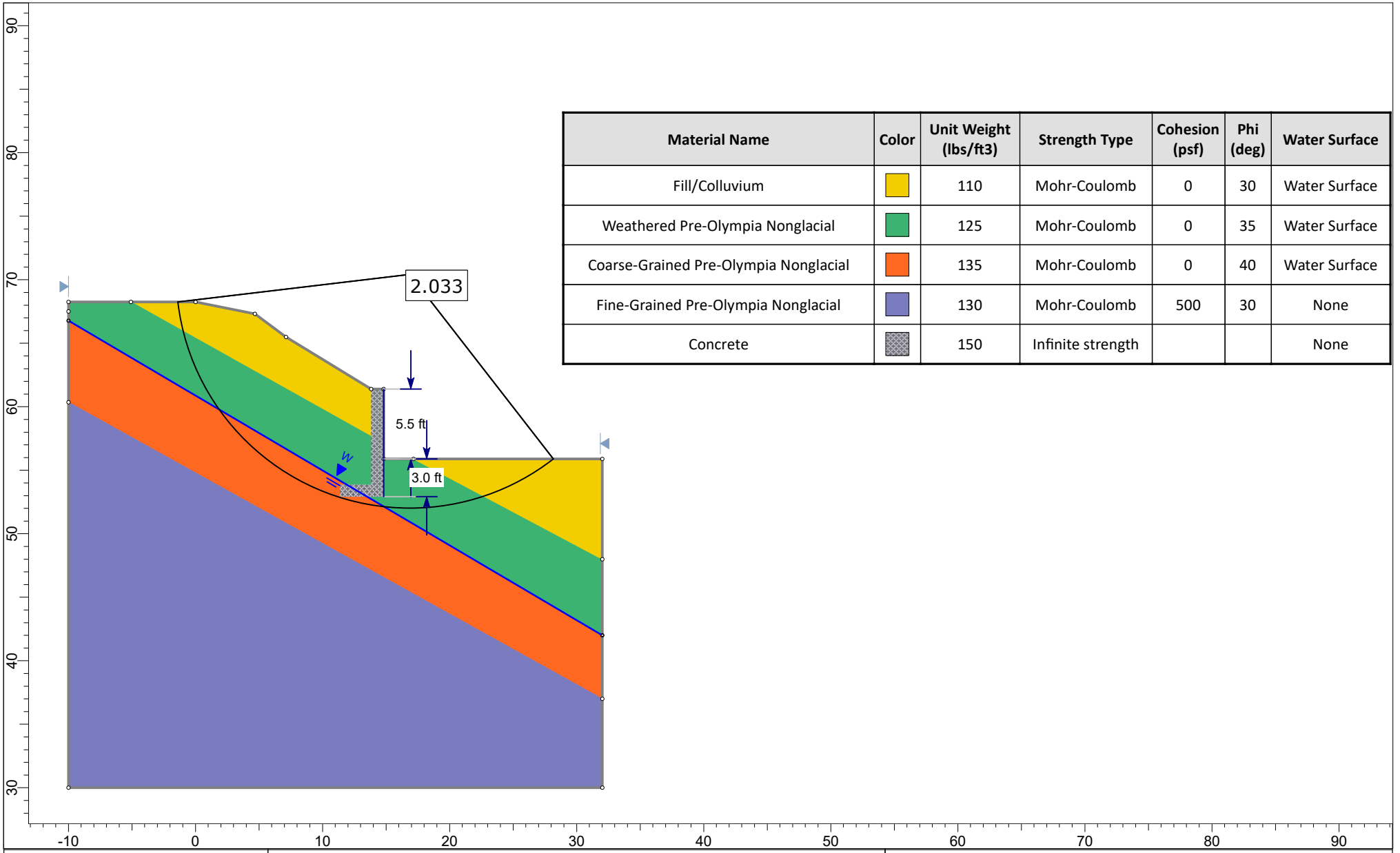
9/1/2021

PROJECT NO. 200631

BY: MBR

REVIEWED BY: ETB/HHH

APPENDIX: **C-2**



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	Mohr-Coulomb	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	Mohr-Coulomb	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	Mohr-Coulomb	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	Mohr-Coulomb	500	30	None
Concrete		150	Infinite strength			None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth (B-2)

Section A-A'
Static

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:125

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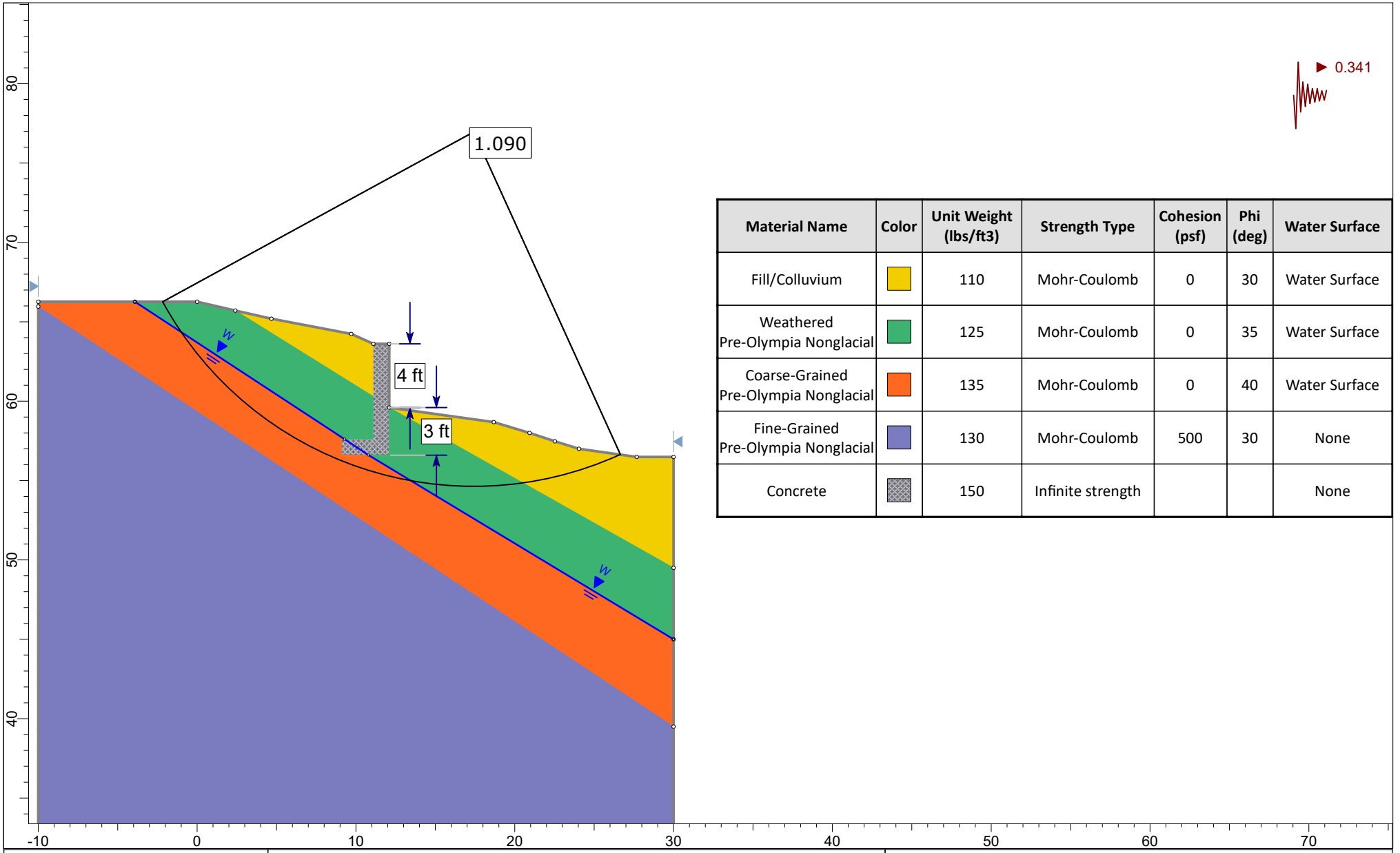
9/1/2021

PROJECT NO. 200631

BY: MBR

REVIEWED BY: ETB/HHH

APPENDIX: **C-3**



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	Mohr-Coulomb	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	Mohr-Coulomb	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	Mohr-Coulomb	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	Mohr-Coulomb	500	30	None
Concrete		150	Infinite strength			None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section B-B'
Seismic

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:100

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PROJECT NO. 200631

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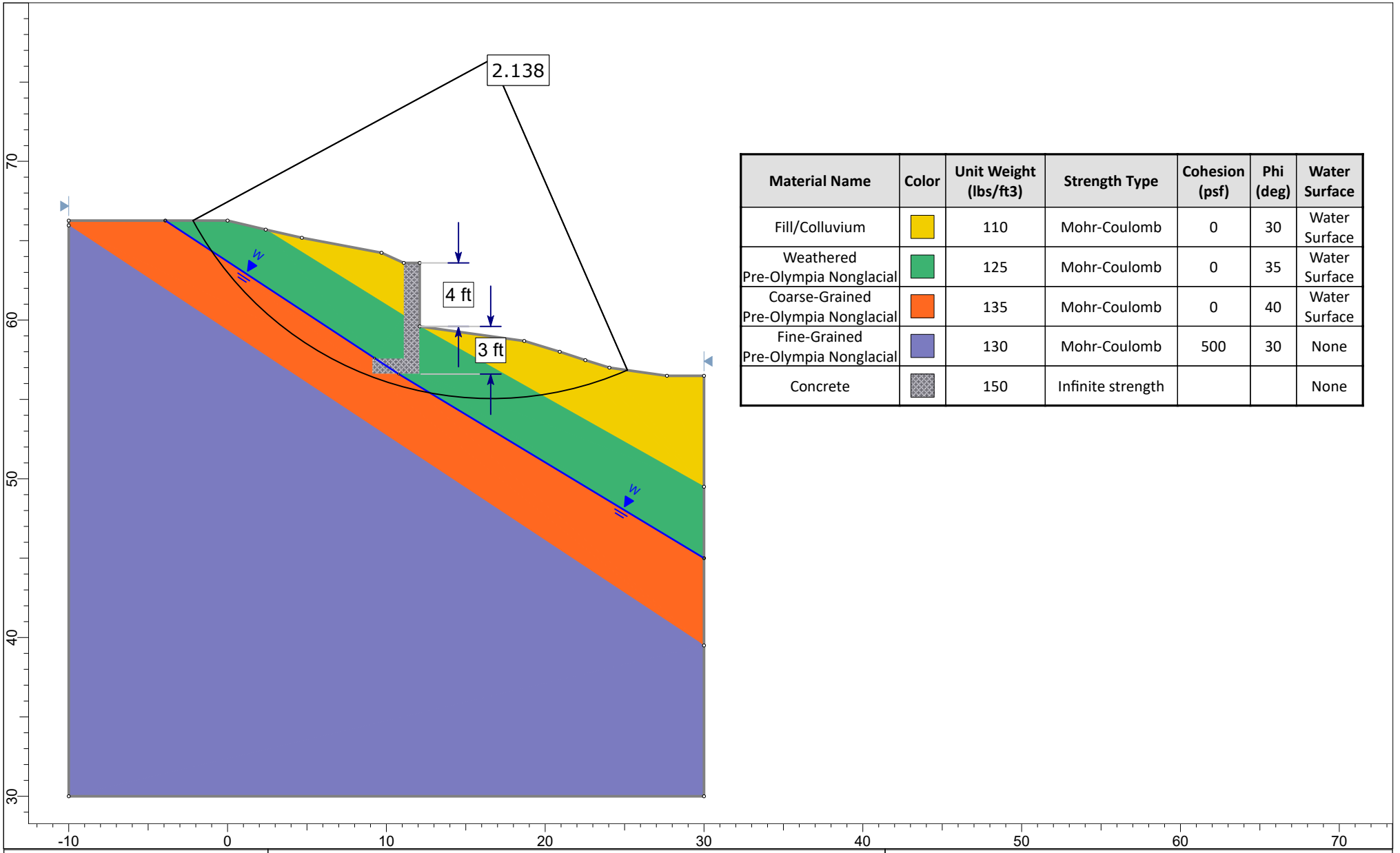
APPENDIX: **C-4**



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	Mohr-Coulomb	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	Mohr-Coulomb	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	Mohr-Coulomb	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	Mohr-Coulomb	500	30	None
Concrete		150	Infinite strength			None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section B-B'
Static

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:100

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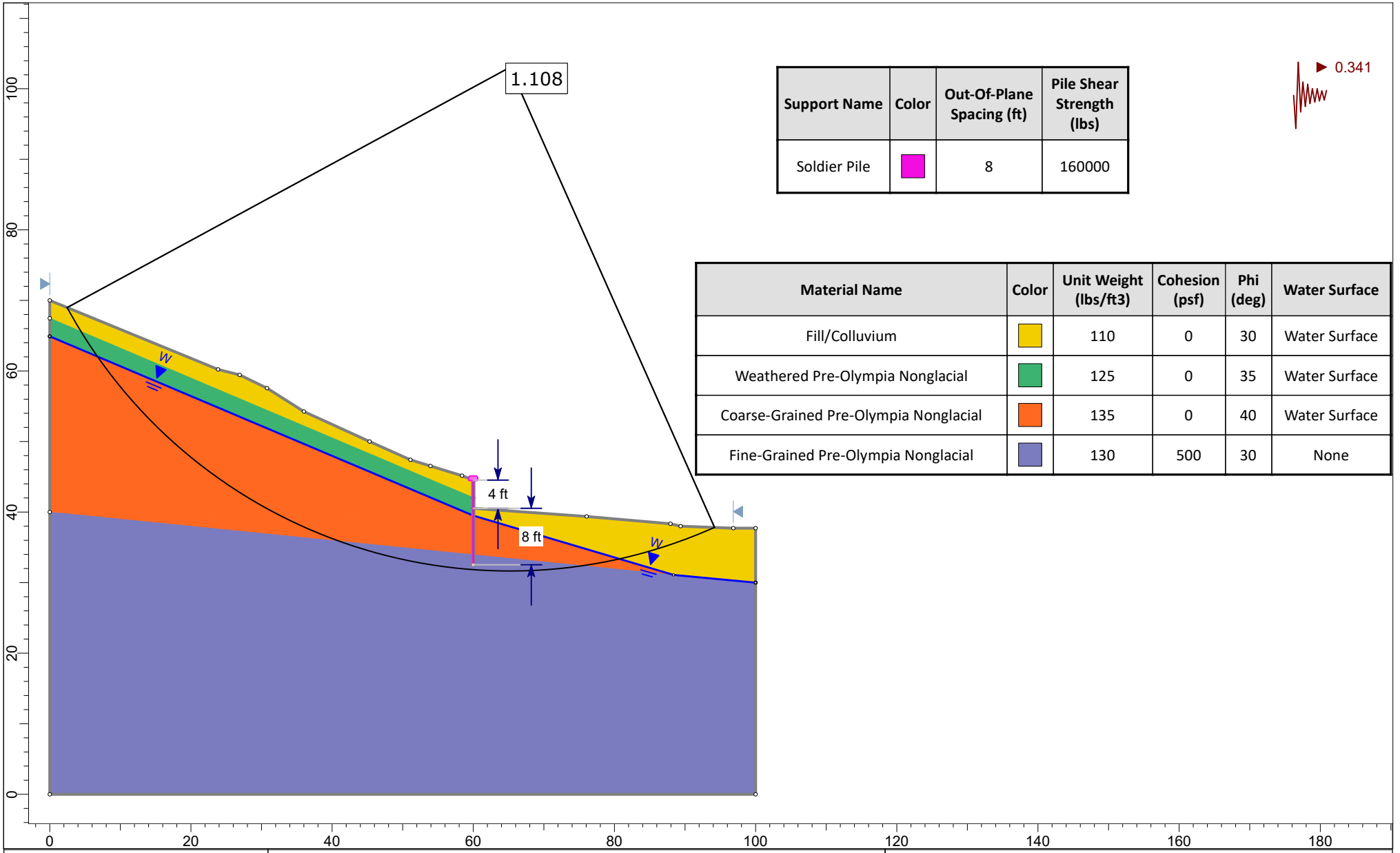
APPENDIX: **C-5**



Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
Soldier Pile		8	160000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	500	30	None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section C-C'
Seismic

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:225

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PROJECT NO. 200631

BY: MBR

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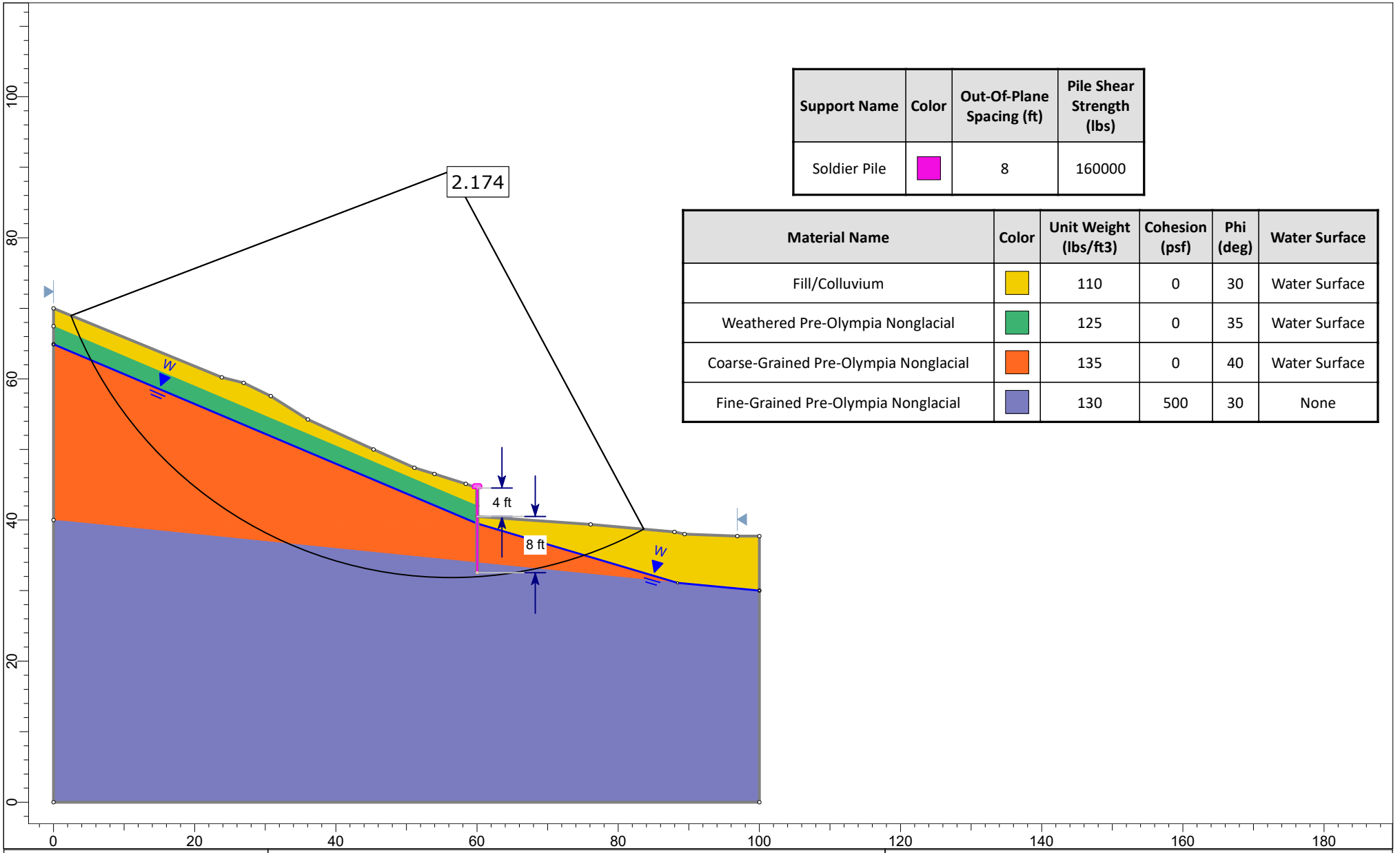
APPENDIX: **C-6**



Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
Soldier Pile		8	160000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	500	30	None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section C-C'
Static

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:225

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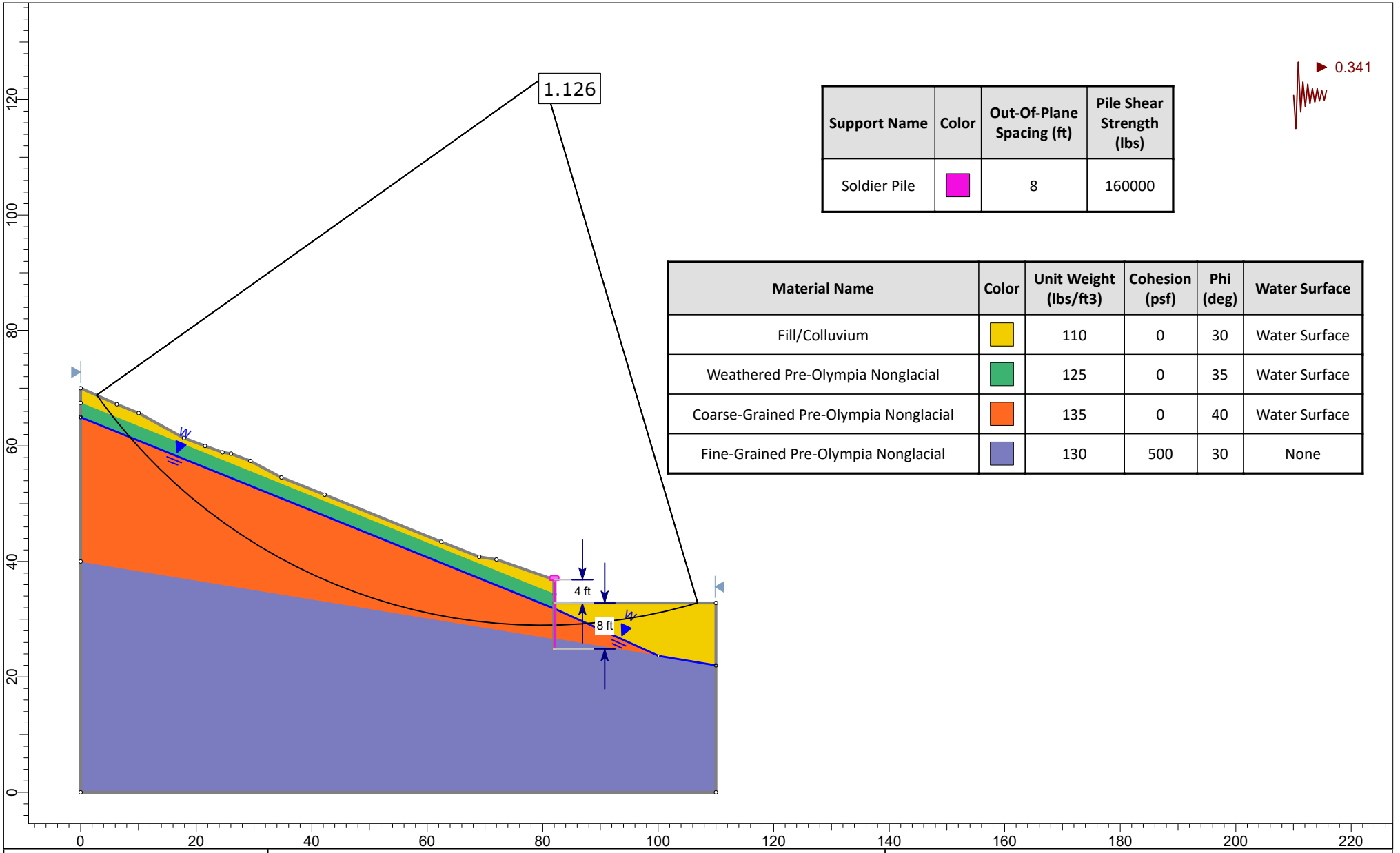
APPENDIX: **C-7**



Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
Soldier Pile		8	160000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	500	30	None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section D-D'
Seismic

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:275

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PROJECT NO. 200631

BY: MBR

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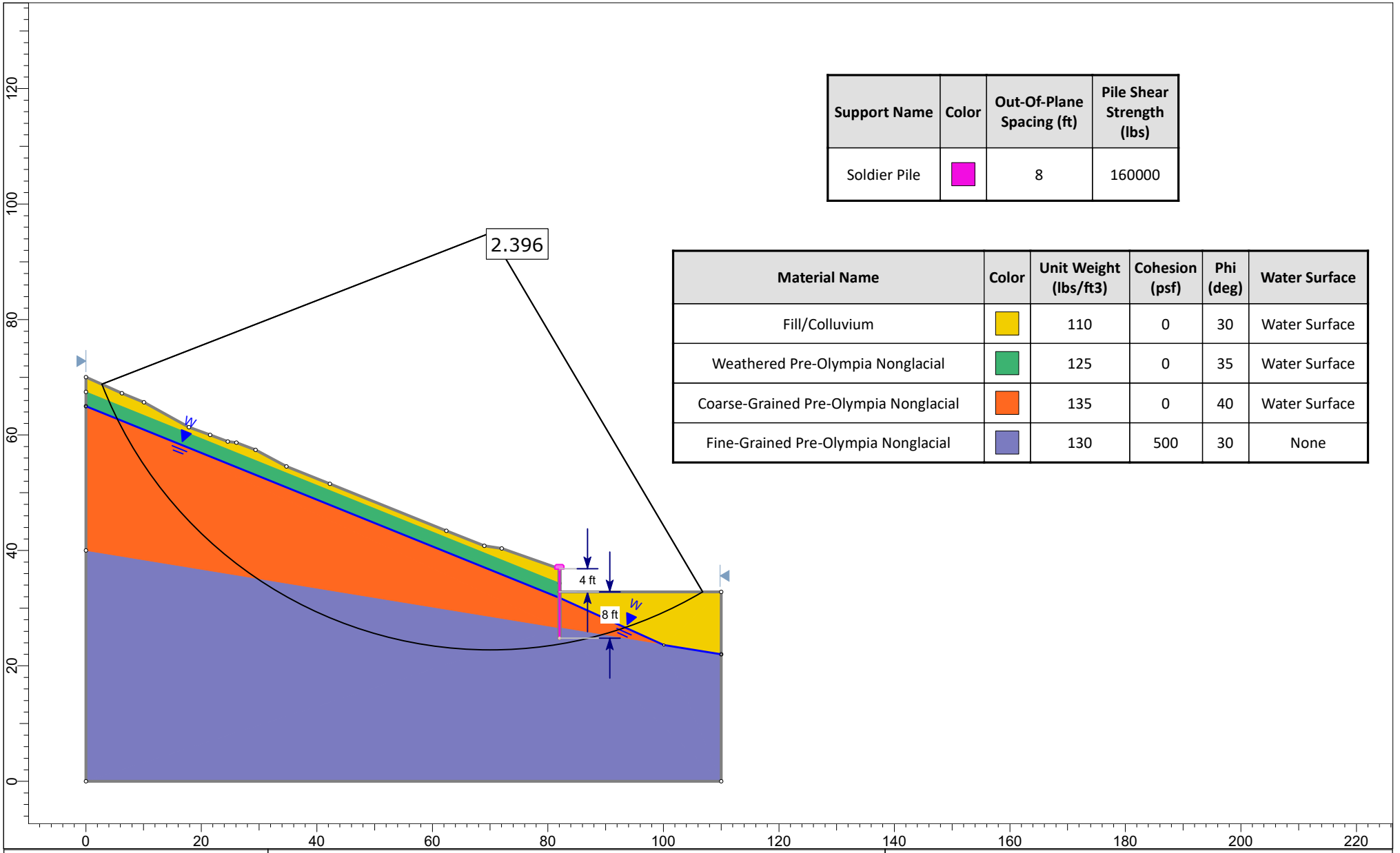
APPENDIX: **C-8**

Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
Soldier Pile		8	160000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	500	30	None



Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section D-D'
Static

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:275

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PROJECT NO. 200631

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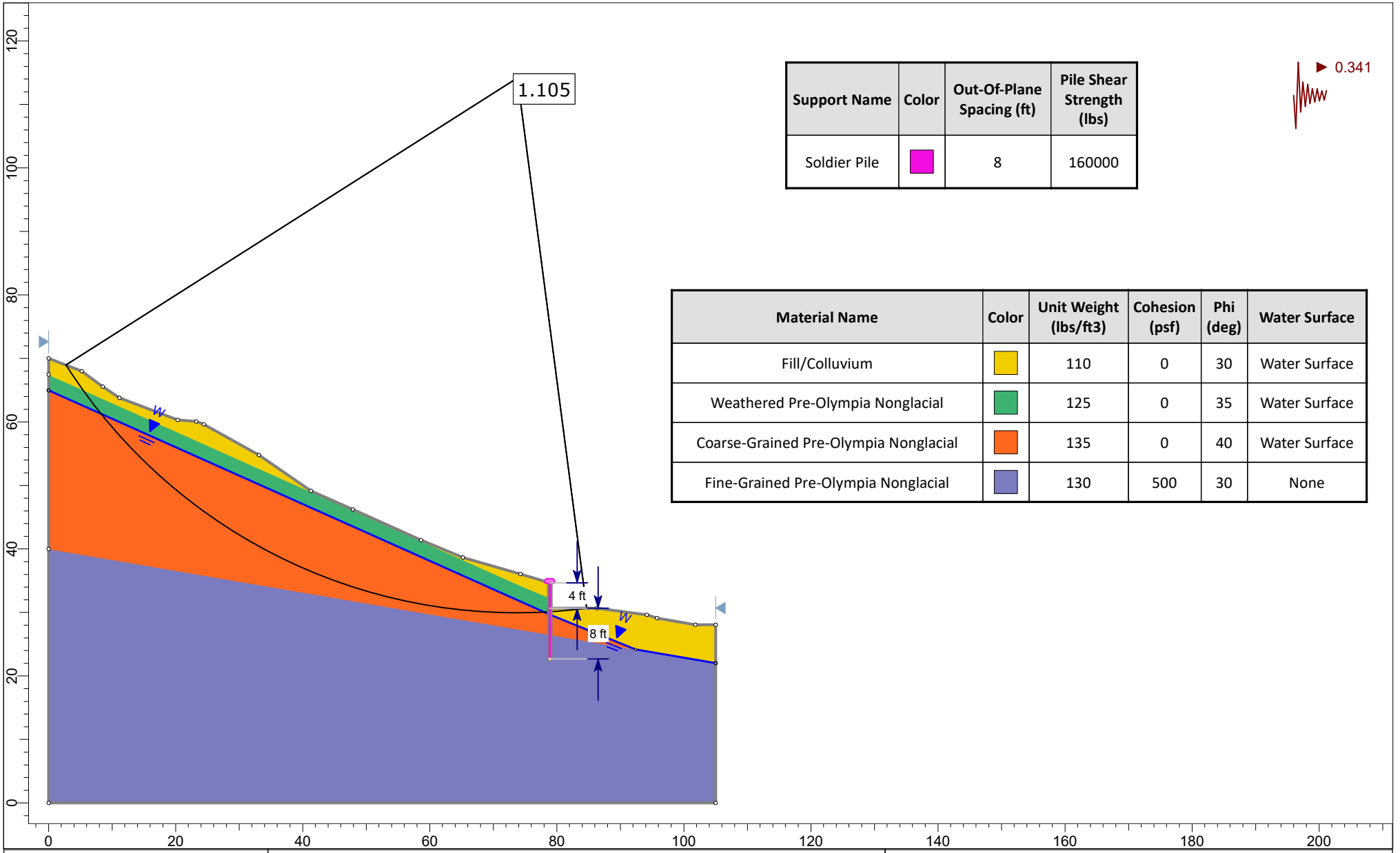
APPENDIX: **C-9**



Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
Soldier Pile		8	160000

0.341

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	500	30	None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section E-E'
Seismic

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:250

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PROJECT NO. 200631

BY: MBR

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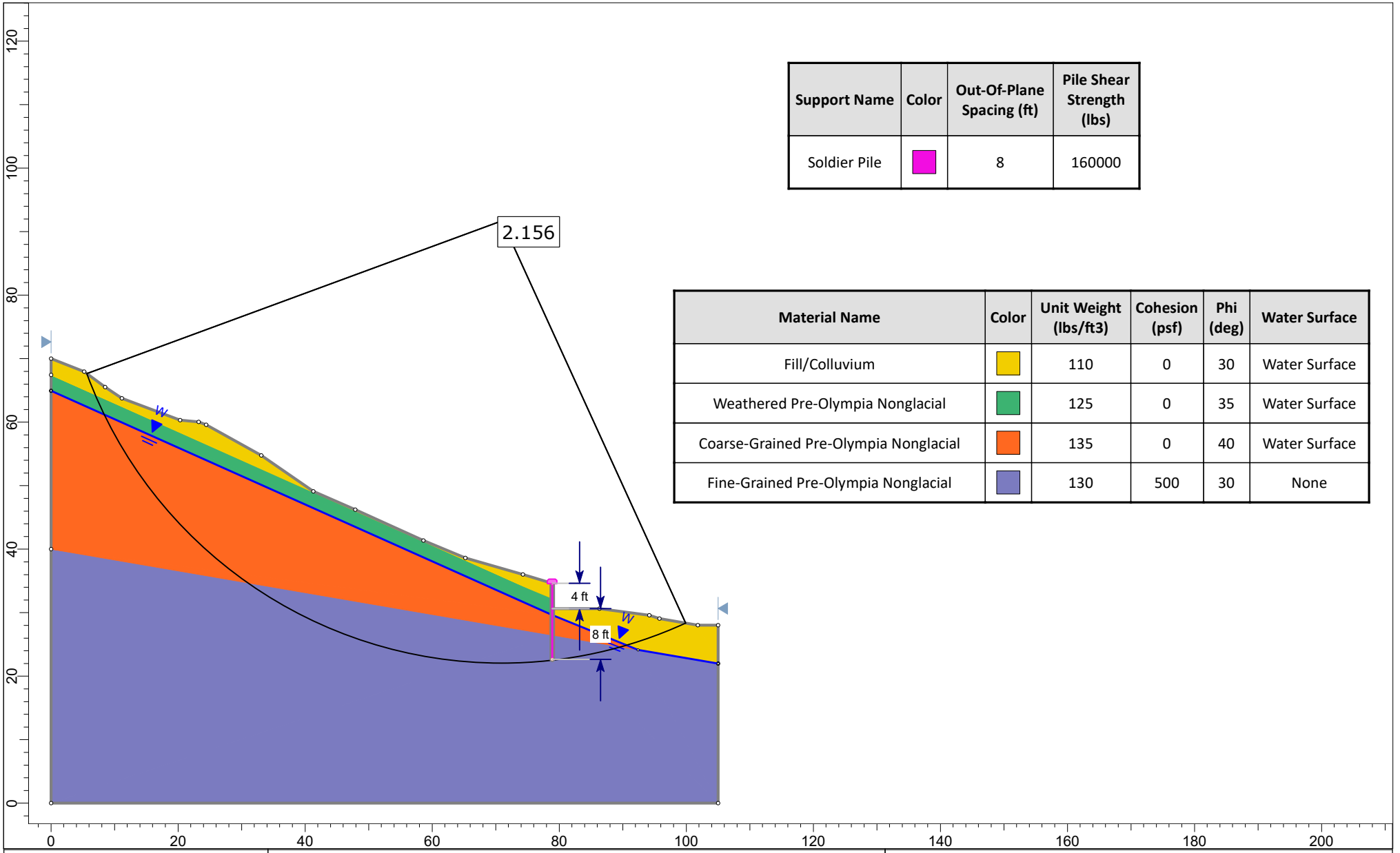
APPENDIX: **C-10**

Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
Soldier Pile		8	160000



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Water Surface
Fill/Colluvium		110	0	30	Water Surface
Weathered Pre-Olympia Nonglacial		125	0	35	Water Surface
Coarse-Grained Pre-Olympia Nonglacial		135	0	40	Water Surface
Fine-Grained Pre-Olympia Nonglacial		130	500	30	None

Legend

- Search Grid
- Search Limits
- Modeled Groundwater Level
- Boring Location and Depth

Section E-E'
Static

Global Stability Analysis

Geotechnical Engineering Report
Buttenwieser/Wiley Residence
Mercer Island, WA

SLIDEINTERPRET 8.032

SCALE: 1:250

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9/1/2021

PROJECT NO. 200631

BY: MBR

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APPENDIX: **C-11**

APPENDIX D

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND GUIDELINES FOR USE

Geoscience is Not Exact

The geoscience practices (geotechnical engineering, geology, and environmental science) are far less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or property, you should contact Aspect Consulting, LLC (Aspect).

This Report and Project-Specific Factors

Aspect's services are designed to meet the specific needs of our clients. Aspect has performed the services in general accordance with our agreement (the Agreement) with the Client (defined under the Limitations section of this project's work product). This report has been prepared for the exclusive use of the Client. This report should not be applied for any purpose or project except the purpose described in the Agreement.

Aspect considered many unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you;
- Not prepared for the specific purpose identified in the Agreement;
- Not prepared for the specific subject property assessed; or
- Completed before important changes occurred concerning the subject property, project, or governmental regulatory actions.

If changes are made to the project or subject property after the date of this report, Aspect should be retained to assess the impact of the changes with respect to the conclusions contained in the report.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods,

earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical, Geologic, and Environmental Reports Are Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions please contact the Aspect Project Manager for this project.

LPD engineering pllc

APPENDIX E

Operations and Maintenance

Table V-4.5.2(5) Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks. Frame is sit-

Table V-4.5.2(5) Maintenance Standards - Catch Basins (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	ting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into	Mechanism opens with

Table V-4.5.2(5) Maintenance Standards - Catch Basins (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Working	frame have less than 1/2 inch of thread.	proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Table V-4.5.2(6) Maintenance Standards - Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4

Table V-4.5.2(20) Maintenance Standards - Compost Amended Vegetated Filter Strip (CAVFS) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
	Erosion/scouring	Areas have eroded or scoured due to flow channelization or high flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with a 50/50 mixture of crushed gravel and compost. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the vegetated filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility Footprint				
Earthen side slopes and berms	B, S		Erosion (gullies/rills) greater than 2 inches deep around inlets, outlet, and alongside slopes	• Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				depth), temporary erosion control measures should be put in place until permanent repairs can be made. • Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention facility sizing; (2) flow velocities and gradients within the facility; and (3) flow dissipation and erosion protection strategies at the facility inlet.
	A		Erosion of sides causes slope to become a hazard	Take actions to eliminate the hazard and stabilize slopes
	A, S		Settlement greater than 3	Restore to design height

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
			inches (relative to undisturbed sections of berm)	
	A, S		Downstream face of berm wet, seeps or leaks evident	Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)
	A		Any evidence of rodent holes or water piping in berm	• Eradicate rodents (see "Pest control") • Fill holes and compact (may require consultation with engineer, particularly for larger berms)
Concrete sidewalls	A		Cracks or failure of concrete sidewalls	• Repair/ seal cracks • Replace if repair is insufficient
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)
Facility area		All maintenance visits (at least biannually)	Trash and debris present	Clean out trash and debris
Facility bottom area	A, S		Accumulated sediment to extent that infiltration rate is	• Remove excess sediment • Replace any vegetation damaged or

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
			reduced (see "Ponded water") or surface storage capacity significantly impacted	destroyed by sediment accumulation and removal • Mulch newly planted vegetation • Identify and control the sediment source (if feasible) • If accumulated sediment is recurrent, consider adding presettlement or installing berms to create a forebay at the inlet
		During/after fall leaf drop	Accumulated leaves in facility	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded
Low permeability check dams and weirs	A, S		Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice	Clear the blockage
	A, S		Erosion and/or undercutting present	Repair and take preventative measures to prevent future erosion and/or undercutting

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	A		Grade board or top of weir damaged or not level	Restore to level position
Ponded water	B, S		Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.	Determine cause and resolve in the following order: 1. Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris. 2. Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain. 3. Check for other water inputs (e.g., groundwater, illicit connections). 4. Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem,

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with an engineer is recommended.
Bioretention soil media	As needed		Bioretention soil media protection is needed when performing maintenance requiring entrance into the facility footprint	• Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils. • Never drive equipment or apply heavy loads in facility footprint. • Because the risk of compaction is higher during saturated soil

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions. â€¢ Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction. â€¢ If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the facility and away from the inlet structure	Reconfigure/ repair blocks to direct water to facility and away from structure
Curb cut inlet/outlet	M during the wet season and before severe storm	Weekly during fall leaf drop	Accumulated leaves at curb cuts	Clear leaves (particularly important for key inlets and low points along long, linear facilities)

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	is forecasted			
Pipe inlet/outlet	A		Pipe is damaged	Repair/ replace
	W		Pipe is clogged	Remove roots or debris
	A, S		Sediment, debris, trash, or mulch reducing capacity of inlet/outlet	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
		Weekly during fall leaf drop	Accumulated leaves at inlets/outlets	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
		A	Maintain access for inspections	• Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Erosion control at inlet	A		Concentrated flows are causing erosion	Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				cut or swale)
Trash rack	S		Trash or other debris present on trash rack	Remove/dispose
	A		Bar screen damaged or missing	Repair/replace
Overflow	A, S		Capacity reduced by sediment or debris	Remove sediment or debris/dispose
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	• Plant roots, sediment or debris reducing capacity of underdrain • Prolonged surface ponding (see "Ponded water"	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.
Vegetation				
Facility bottom area and upland slope vegetation	Fall and Spring		Vegetation survival rate falls below 75% within first two years of establishment (unless project O&M manual or record drawing stipulates more	• Determine cause of poor vegetation growth and correct condition • Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jur-

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
			or less than 75% survival rate).	isdictional species list for appropriate plant replacements (See Appendix 3 - Bioretention Plant List, in the LID Technical Guidance Manual for Puget Sound). • Confirm that plant selection is appropriate for site growing conditions • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Vegetation (general)	As needed		Presence of diseased plants and plant material	• Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • See Pacific North-

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				west Plant Disease Management Handbook for information on disease recognition and for additional resources • Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".
Trees and shrubs		All pruning seasons (timing varies by species)	Pruning as needed	• Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques • All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist
	A		Large trees and shrubs interfere with operation of the facility or access for maintenance	• Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. • Remove trees and

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				shrubs, if necessary.

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	Fall and Spring		Standing dead vegetation is present	• Remove standing dead vegetation • Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season) • If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately. • Determine cause of dead vegetation and address issue, if possible • If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.
	Fall and		Planting	• When working

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	Spring		beneath mature trees	around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.
	Fall and Spring		Presence of or need for stakes and guys (tree growth, maturation, and support needs)	• Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage • Monitor tree support systems: Repair and adjust as needed to

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				provide support and prevent damage to tree. • Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year. • Backfill stake holes after removal.
Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	A		Vegetation causes some visibility (line of sight) or driver safety issues	• Maintain appropriate height for sight clearance • When continued, regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location. • Remove or transplant if continual safety hazard • Consultation with a landscape architect is recommended for removal, transplant, or substitution of

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				plants
Flowering plants		A	Dead or spent flowers present	Remove spent flowers (deadhead)
Perennials		Fall	Spent plants	Cut back dying or dead and fallen foliage and stems
Emergent vegetation		Spring	Vegetation compromises conveyance	Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning)
Ornamental grasses (perennial)		Winter and Spring	Dead material from previous year's growing cycle or dead collapsed foliage	• Leave dry foliage for winter interest • Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow
Ornamental grasses (evergreen)		Fall and Spring	Dead growth present in spring	• Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				• Clean, rake, and comb grasses when they become too tall • Cut back to ground or thin every 2-3 years as needed
Noxious weeds		M (March - October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions • Apply mulch after weed removal (see "Mulch")
Weeds		M (March - October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management (see "Additional Maintenance Resources" section for more information on IPM protocols)
Excessive vegetation		Once in early to mid- May and once in early- to mid-September	Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil	• Edge or trim groundcovers and shrubs at facility edge • Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks • While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging
	As needed		Excessive vegetation density inhibits stormwater flow beyond design ponding or	• Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
			becomes a hazard for pedestrian and vehicular circulation and safety	• Determine if planting type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow) • Remove plants that are weak, broken or not true to form; replace in-kind • Thin grass or plants impacting facility function without leaving visual holes or bare soil areas • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
	As needed		Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass	Remove vegetation and sediment buildup

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Replenish mulch per O&M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels) • Keep all mulch away from woody stems
Watering				
Irrigation system (if any)		Based on manufacturer's instructions	Irrigation system present	Follow manufacturer's instructions for O&M
	A		Sprinklers or drip irrigation not directed/located to properly water plants	Redirect sprinklers or move drip irrigation to desired areas
Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				• Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present ◦ Pulse water to enhance soil absorption, when feasible ◦ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff • Add a tree bag or slow-release watering device (e.g.,

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present
Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present ◦ Pulse water to enhance soil absorption, when feasible ◦ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, fol-

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				lowed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff
Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear • Water during drought conditions or more often if necessary to main-

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				tain plant cover
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • To facilitate maintenance, manually remove standing water and direct to the storm drainage system (if runoff is from non pollution-generating surfaces) or sanitary sewer system (if runoff is from pollution-generating surfaces) after getting approval from sanitary sewer authority. • Use of pesticides or *Bacillus thuringiensis israelensis* (Bti) may be considered only as a temporary measure while addressing the standing water cause. If overflow to

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				a surface water will occur within 2 weeks after pesticide use, apply for coverage under the Aquatic Mosquito Control NPDES General Permit.
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	• Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.) • Place predator decoys • Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" section for more information on IPM protocols) • Remove pet waste regularly • For public and right-of-way sites consider adding garbage cans with dog bags for picking

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				up pet waste.
Insect pests	Every site visit associated with vegetation management		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	• Reduce hiding places for pests by removing diseased and dead plants • For infestations, follow IPM protocols (see "Additional Maintenance Resources" section for more information on IPM protocols)

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

IPM - Integrated Pest Management

ISA - International Society of Arboriculture

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				
Permeable	A, S		Runoff from	• Clean deposited soil or