MOMENTUM CIVIL
ENGINEERING CONSULTANTS

1145 BROADWAY, SUITE 115
TACOMA, WA 98402

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(253) 319-1504

O'BRIEN RESIDENCE

Drainage Report

MC# OBRI-0001
February 17, 2026

Drainage Report

February 17, 2026

Prepared for: Sean and Tracey O'Brien

Point of Contact: Sean and Tracey O' Brien

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Phone: 206-507-5050

Civil Engineer:

Momentum Civil

1145 Broadway, Suite 115

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Email: marcp@momentumcivil.com

Phone: 253-319-1505

Table of Contents

Table of Figures

Table of Appendices

Section 1 - Project Information

The project proponent, Sean and Tracey O'Brien, is applying for permits for the construction of a single-family residence with an attached car garage and an associated driveway. The project is located on King County parcel number 4139300406 at 9412 SE 33rd Street in Mercer Island, WA, 98040. The parcel has a total lot size of 0.27 acres. Please refer to **Figure 1** on the next page for the project Vicinity Map.

Applicable Permits

For this project, the following permits are anticipated:

- Site Development Permit
- Building Permit

Applicable Stormwater Regulations

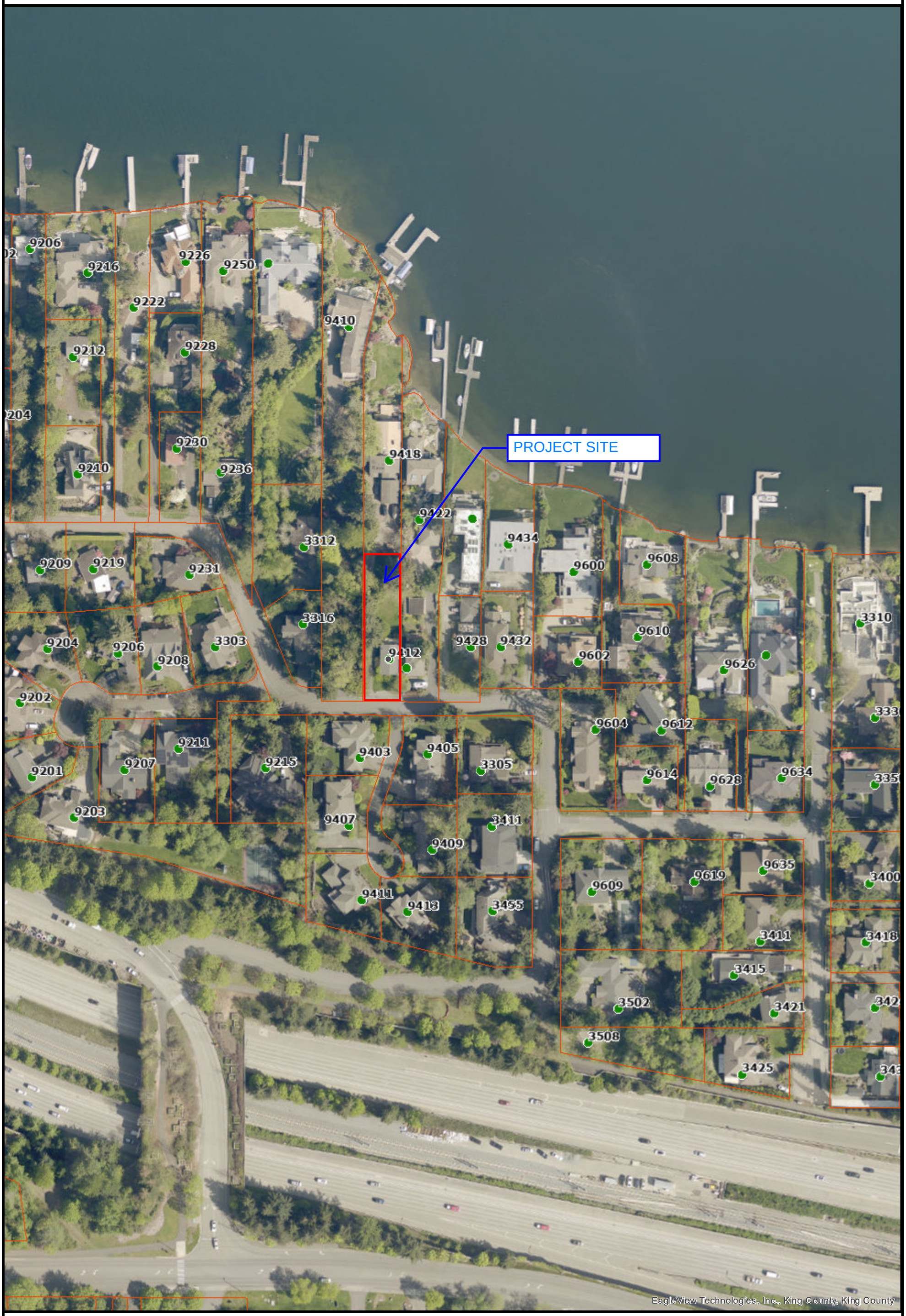
The parameters and Minimum Requirements set forth in the DOE 2019 Stormwater Management Manual for Western Washington (known herein as the "Manual") will be adhered to for this project.

The subject parcel is located within the larger Cedar River–Lake Washington watershed. Based on existing topography, stormwater runoff from the site flows toward adjacent parcels to the southwest and northeast. Upstream, to the south, there are two existing catch basins that collect runoff from the right-of-way and ultimately discharge to Lake Washington. This project is subject to Minimum Requirements #1 through #5 as outlined in the applicable stormwater regulations. No Additional Protective Measures are required for this development.

Project Overview

Stormwater management for the project will be accomplished through a combination of roof tightlines and surface runoff controls. Roof drainage will be directed to a dispersion trench measuring 34 feet in length, 2 feet in width, and 3.5 feet in depth. The proposed driveway will be constructed with permeable concrete to promote infiltration and minimize surface runoff. Foundation drains will be routed to a catch basin equipped with a storm pump, which will discharge into the public storm system. Additionally, runoff from approximately 330 square feet of the existing shared driveway access that currently flows to the northern neighboring parcel will be collected via a linear trench drain and will be directed to the public drainage system in the SE 33rd Street to mitigate for the area of the shared access that is being replaced.

Figure1: Vicinity Map



Date: 6/4/2025

Notes:

N

King County

Section 2 – Existing and Proposed Hydrology

Existing Conditions

The southern portion of the site is currently developed with a single-family residence. A driveway runs along the western property line, providing access to the adjacent property to the north. The remainder of the site is undeveloped and vegetated with a mix of grasses, shrubs, and trees of varying diameter. The topography slopes gently from south to north, with an overall elevation change of approximately 12 feet. According to City mapping, the site is located within designated seismic and potential landslide hazard areas. The property is bordered by residential parcels to the east, west, and north, and by SE 33rd Street to the south. Please see **Figure 2** for representation of the existing conditions

Soils Properties

Based on the Geologic Map of Mercer Island, the site is underlain by Pre-Olympia Fine Grained Deposits, which primarily consist of silts with fine sand. These soils become increasingly dense with depth and are considered nearly impermeable. As part of our evaluation, and per the Geotechnical Report by Cobalt Geoscience LLC dated April 25, 2025, one test pit was excavated on the property where accessible. Additional subsurface data was reviewed from explorations conducted on the adjacent property to the east by HWA in 2009. Field-logged soils, classified according to the Unified Soil Classification System (USCS), revealed approximately 6 inches of topsoil overlying about 2 feet of loose to medium dense silty fine to fine-grained sand with gravel (fill). Beneath the fill, the native soils consisted of medium dense to very dense silty fine to fine-grained sand, consistent with Pre-Olympia deposits, extending to the termination depth of the explorations. These native soils exhibit low infiltration capacity due to their fine-grained, dense composition and are susceptible to erosion when disturbed, particularly on slopes. Although groundwater was not encountered during the investigation, mottling in the shallow soils indicates that perched groundwater may develop above denser layers. Groundwater levels are expected to fluctuate seasonally and are influenced by precipitation, irrigation, land use, and soil permeability. Long-term groundwater monitoring using a piezometer would be necessary to determine typical groundwater depths over the course of a year.

Floodplain Analysis

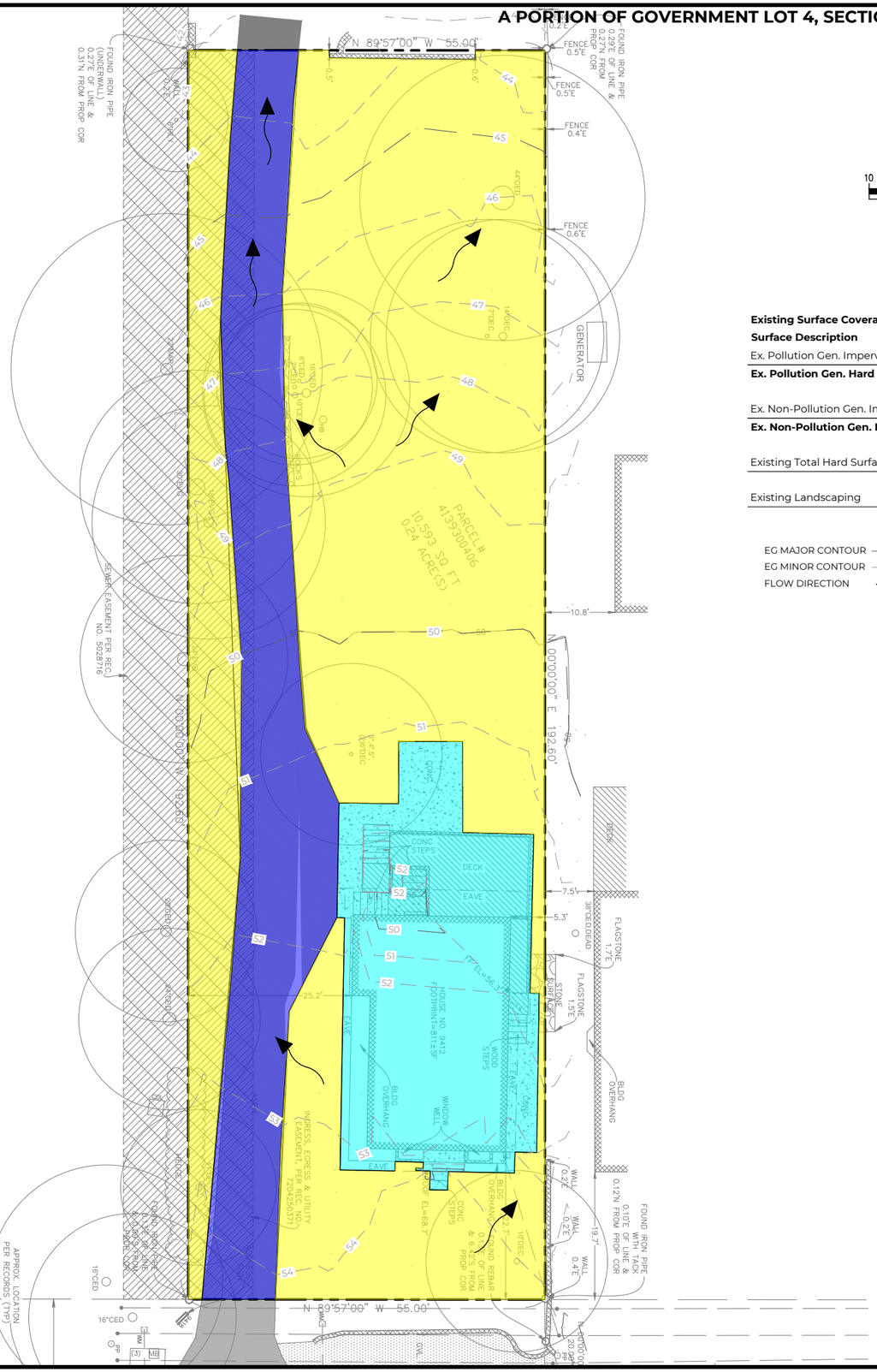
The project site is located outside the 100-year flood plain as identified by the FEMA FIRM panel 654G of King County, Washington.

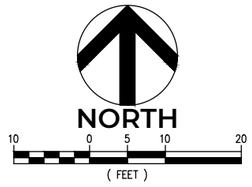
Critical Areas

According to the City of Mercer Island GIS maps, the site is located within a potential landslide and seismic hazard area, likely due to mapped geologic conditions and historical data. However, based on the geotechnical report prepared by Cobalt Geosciences, there was no observed evidence of soils susceptible to liquefaction or indications of past landslide activity. In our professional opinion, the site does not contain significant geologic hazards based on our field observations and subsurface

explorations. While there may be a small area of seismic concern near the shoreline, it lies within designated shoreline buffers and setbacks and does not fall within the boundaries of the subject property.

A PORTION OF GOVERNMENT LOT 4, SECTION 7, TOWNSHIP 24, RANGE 5 EAST, W.M.





Existing Surface Coverage

Surface Description	Area (sf)	Area (Ac)	
Ex. Pollution Gen. Impervious Surface (PGIS)	2,021 +/-	0.05 +/-	
Ex. Pollution Gen. Hard Surface (PGHS)	**2,021 +/-**	**0.05 +/-**	
Ex. Non-Pollution Gen. Impervious Surface (NPGIS)	1,734 +/-	0.04 +/-	
Ex. Non-Pollution Gen. Hard Surface (NPGIS)	**1,734 +/-**	**0.04 +/-**	
Existing Total Hard Surface	3,755 +/-	0.04 +/-	
Existing Landscaping	6,731 +/-	0.15 +/-	

EG MAJOR CONTOUR ——— 100 ———
EG MINOR CONTOUR — — — 101 — — —
FLOW DIRECTION

NO.	DATE	REVISION DESCRIPTION	BY	CK
△				

PERMIT

EXISTING SURFACE COVERAGE

O-BRIEN RESIDENCE
SEAN & TRACEY O'BRIEN
9412 SE 33RD STREET
MERCER ISLAND

MOMENTUM CIVIL
1145 BROADWAY, SUITE 115
TACOMA, WA 98402
PHONE: 253.319.1504

CHECKED BY: **MP**
DESIGNED BY: **JDLS**
DRAWN BY: **JDLS**

HORZ. DATUM: **NAD83**
VERT. DATUM: **NAVD88**

DATE: **02/13/2026**

PROJECT NO. **OBRI-0001**

SHEET NO. **5 OF 16**

REFERENCE NO. **FIG2**

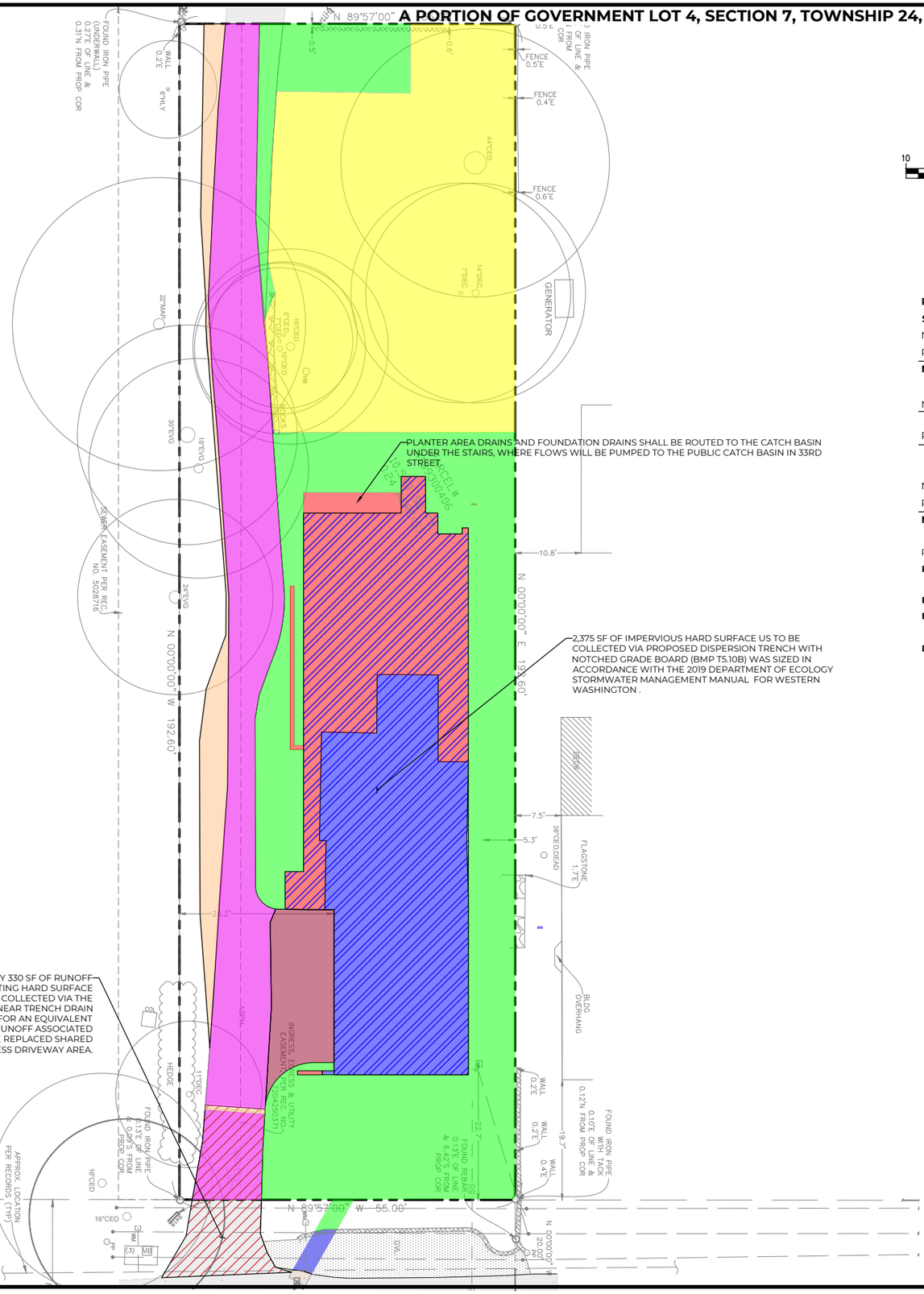
Plot Date: 6/4/2025 10:55 AM By: Jazmin Santos (Momentum Civil)
Save Date: 6/4/2025 10:55 AM By: JazminSantosFile:P:\OIOBRI\01-9412 SE 33rd St SFR\0400CAD\Sheets\Existing Surface Coverage 22x34.dwg

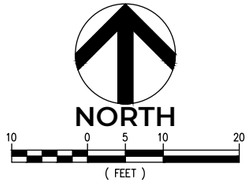
Proposed Conditions

The proposed development includes construction of a new single-family residence with an attached three-car garage, a driveway, and associated site improvements, including retaining walls and window wells. A portion of the existing shared driveway access will be removed and replaced, while the remainder will remain in place.

Stormwater management for the project will be achieved through a combination of roof tightlines and surface runoff controls. Roof drainage will be conveyed to a dispersion trench measuring 34 feet in length, 2 feet in width, and 3.5 feet in depth. The proposed driveway will be constructed of permeable concrete to promote infiltration and minimize surface runoff. Foundation drains will be routed to a catch basin equipped with a storm pump, which will discharge to the public storm system. Additionally, runoff from approximately 330 square feet of the existing shared driveway access will be collected by a linear trench drain to account for the portion of the shared access that is being replaced and all disturbed landscaped areas will be restored with amended soil in accordance with post-construction BMP soil depth requirements. Refer to **Figure 3** for a depiction of the proposed conditions.

A PORTION OF GOVERNMENT LOT 4, SECTION 7, TOWNSHIP 24, RANGE 5 EAST, W.M.





Proposed Surface Coverage

Surface Description	Area (sf)	Area (Ac)
New Impervious Hard Surface	1,089 +/-	0.03 +/-
Replaced Impervious Hard Surface	1,383 +/-	0.03 +/-
New & Replaced Impervious Hard Surface	**2,472 +/-**	**0.06 +/-**
New Permeable Hard Surface	272 +/-	0.01 +/-
Replaced Pollution Generating (PGHS) Hard Surface	340 +/-	0.01 +/-
New Hard Surface (Pervious & Impervious)	1,361 +/-	0.03 +/-
Replaced Hard Surface (Pervious & Impervious)	1,723 +/-	0.04 +/-
New & Replaced Hard Surface (Pervious & Impervious)	**3,084 +/-**	**0.07 +/-**
Replaced Landscaping/Soil Amendment	2,742 +/-	0.06 +/-
Replaced Landscaping/Soil Amend.	**2,742 +/-**	**0.06 +/-**
Existing Pollution Generating(PGHS) to Remain	1,514 +/-	0.03 +/-
Existing landscape to Remian	2,394 +/-	0.05 +/-
Disturbed Area	**5,826 +/-**	**0.13 +/-**

NO	DATE	REVISION DESCRIPTION	BY	CK
1	2/13/26	REVISED PER CITY COMMENTS	JDLS	MAP

PERMIT

O-BRIEN RESIDENCE
SEAN & TRACEY O'BRIEN

PROPOSED BASIN MAP

9412 SE 33RD STREET
MERCER ISLAND

MOMENTUM CIVIL
1145 BROADWAY, SUITE 115
TACOMA, WA 98402
PHONE: 253.319.1504

CHECKED BY: **MP**
DESIGNED BY: **JDLS**
DRAWN BY: **JDLS**

HORZ. DATUM: **NAD83**
VERT. DATUM: **NAVD88**

DATE: **02/13/2026**

PROJECT NO. **OBRI-0001**

SHEET NO. **7** OF **12**

REFERENCE NO. **FIG3**

Plot Date: 2/17/2026 10:56 AM By: Jazmin Santos (Momentum Civil)
Save Date: 2/17/2026 10:55 AM By: JazminSantos
File: C:\Users\JazminSantos\Momentum Civil\MOMENTUM CIVIL - Documents\PROJECTS\OAKP0002-Auto\OBRI01-9412 SE 33rd St SFR\0400CAD\Sheets\EXHIBITS\2026-01-15 Proposed Surface Coverage-OBRI001.dwg

Section 3 – Offsite Analysis

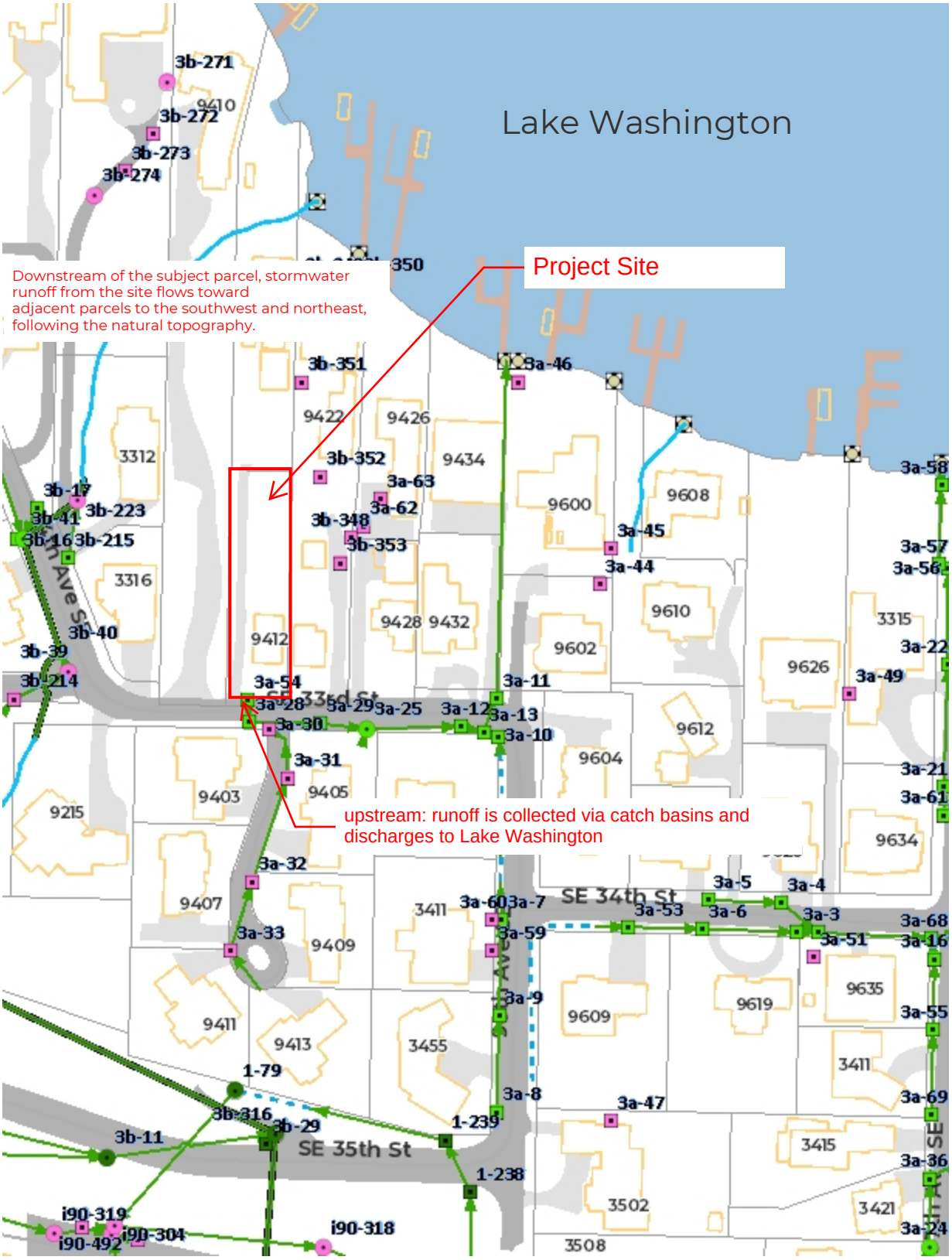
Upstream Tributary Sub-basin

Upstream of the subject parcel, to the south, there are two existing catch basins located within the public right-of-way. These catch basins collect runoff from surrounding areas at higher elevations and direct it away from the site, ultimately discharging to Lake Washington. This upstream drainage does not contribute flow to the proposed development area.

Downstream Analysis

Stormwater runoff from the subject parcel follows the natural topography, flowing toward adjacent properties to the southwest and northeast. These flows are conveyed to existing drainage infrastructure that ultimately discharges to Lake Washington. The proposed development will preserve the existing flow patterns, with on-site stormwater managed through a Type 50 catch basin connected to a Dispersion Trench with a Notched Grade Board.

Figure 6: offsite Analysis Map



Legend

- Storm Catch Basin
  - CB, City Owned
  - CB, Private
  - CB, Unknown
  - Type 2, City Owned
  - Type 2, Private
  - Type 2, Unknown
- Storm Main
  - Pipe
  - Open Watercourse
  - Piped Watercourse
  - Ditch
  - Culvert
  - Other
- Storm Main - Private
- Storm Discharge Poir
- Address
- Building
- Property Line
- Docks
- Freeway
- Major Street
- Street
- Paved Driveway
- Paved Road
- Paved Parking Area
- Lake Washington

1: 1,604

0.0 0 0.02 0.0 Miles

Map Printed: June 4, 2025

Notes

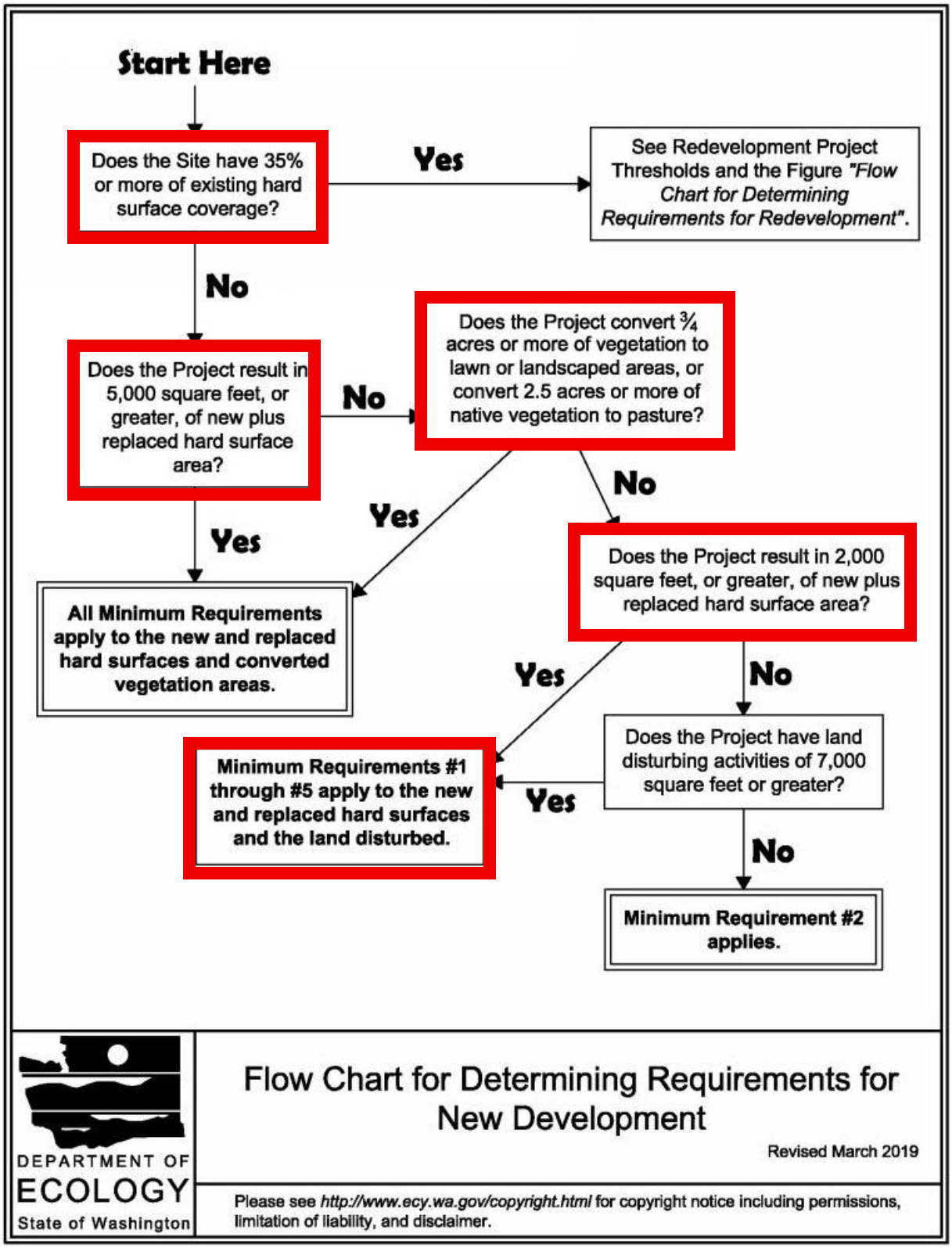
Section 4 – Discussion of Minimum Requirements and Site Layout

Stormwater Minimum Requirements Summary

This project will comply with the requirements outlined in the 2019 Stormwater Management Manual for Western Washington (SWMMWW).

The site currently has approximately 31% surface coverage and is classified as a new development project. As the proposed work will add less than 5,000 square feet of new and replaced hard surfaces, Minimum Requirements #1 through #9 will apply specifically to those new and replaced hard surfaces, as well as to areas where vegetation is converted. See **Figure 5** for the City of Mercer Island flow chart for determining the minimum requirements applicable for this project.

Figure 5: Flow Chart for Determining Requirements for New Development



MR #1 – Preparation of Stormwater Site Plans

A stormwater Site Plan has been prepared in accordance with the DOE requirements. This storm drainage report and the associated civil engineering plans fulfill this requirement.

MR #2 – Construction Stormwater Pollution Prevention Plan (CSWPPP)

A Temporary Erosion and Sediment Control Plan has been prepared as a part of the civil plans for this project which describes project specific measures to take based on the Department of Ecology's Best Management Practices. Control measures shall conform to the requirements as set forth established in the DOE 2019 Stormwater Management Manual for Western Washington.

The Construction Stormwater Pollution Prevention Plan is available as a stand-alone document as part of the permit submittal.

MR #3 – Source Control of Pollution

To address source control of pollution, the project will implement both construction-phase and permanent Best Management Practices (BMPs) in accordance with the 2019 Stormwater Management Manual for Western Washington. Construction-phase BMPs are detailed in the final Construction Drawings and represent the minimum expected control measures for managing interim construction site conditions. The contractor is responsible for maintaining and adjusting these BMPs as needed based on site-specific conditions throughout the construction process.

Permanent source control BMPs applicable to this site include, but are not limited to, the installation of a Dispersion Trench with Notched Grade Board (BMP T5.10B) to control roof runoff by facilitating distributed infiltration. The proposed driveway will be constructed using permeable pavement (BMP T5.15), which allows for on-site infiltration of stormwater and reduces runoff volume. In addition, all disturbed landscaped areas will be amended with compost and restored in accordance with BMP T5.13 – Post-Construction Soil Quality and Depth – to enhance stormwater absorption, reduce runoff, and improve water quality. Together, these BMPs provide comprehensive long-term source control and protect downstream water resources.

Permanent source control BMPs applicable to this project site are included under **Error! Reference source not found.**.

MR #4 – Preservation of Natural Drainage Systems and Outfalls

The project is designed to preserve the site's natural drainage patterns and existing outfalls to the greatest extent practicable. Runoff from SE 33rd Street is collected by existing catch basins located within the public right-of-way. These catch basins are part of the City's public stormwater system and ultimately discharge to Lake Washington. Onsite, stormwater runoff will continue to follow the natural topography, flowing toward adjacent parcels to the southwest and northeast, as it does under existing conditions. Proposed improvements, including a dispersion

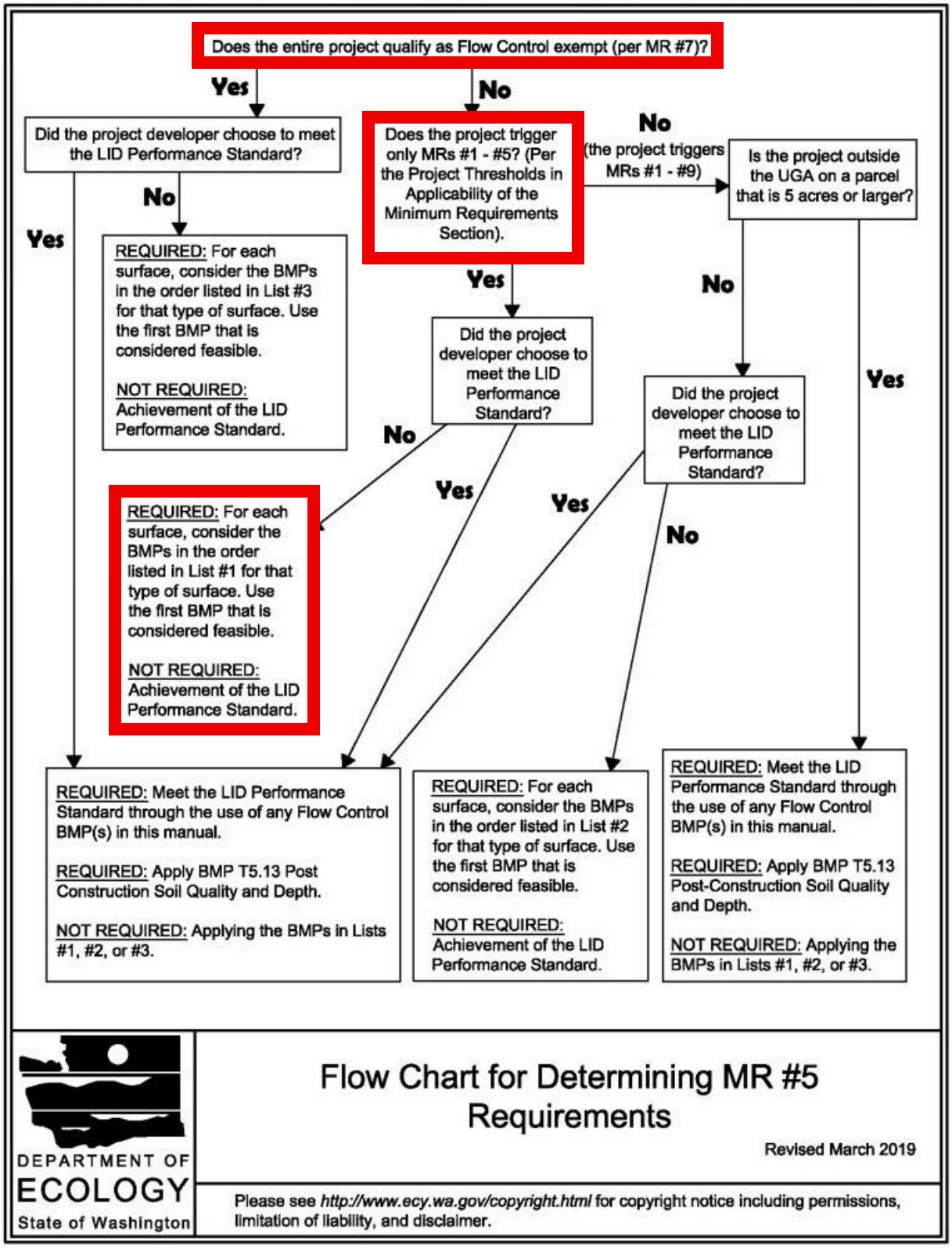
trench, permeable pavement for the proposed driveway are intended to manage runoff while maintaining natural flow paths. No new connections to the public storm system are proposed, and runoff will not be redirected in a way that adversely affects downstream properties. These measures are consistent with preserving natural drainage systems and outfalls in compliance with stormwater management regulations.

MR #5 – Onsite Stormwater Management

Per the Flow Chart for Determining LID MR #5 Requirements (see Figure 6), the project developer may choose to meet the LID Performance Standard or to use List #1. This project will use List #1. Please refer to Table 1 below for the completed List #1 approach:

BMP	Feasible?	Limitations on Feasibility
Lawn and Landscaped Areas:		
T5.13: Post Construction Soil Quality and Depth	(Y)/N	Feasible.
Roofs		
T5.30: Full Dispersion	Y/(N)	Project lacks required natural vegetated flowpath.
T5.10A: Downspout Infiltration System	Y/(N)	Not feasible based on the soil conditions and possibility of shallow interflow perched on denser native soils during the winter months.
T5.14A: Rain Gardens	Y/(N)	Project lacks infiltrative soils per Geotechnical Report.
T7.30: Bioretention	Y/(N)	Project lacks infiltrative soils per Geotechnical Report.
T5.10B: Downspout Dispersion Systems	(Y)/N	This project will use a DOE Figure V-4.5 -Standard dispersion trench with notched grade board.
T5.10C: Perforated Stub-Out Connections	Y/(N)	Project lacks infiltrative soils per Geotechnical Report.
Other Hard Surfaces		
T5.30: Full Dispersion	Y/(N)	Project lacks required natural vegetated flow path.
T5.15: Permeable Pavement	Y/(N)	Feasible, the proposed driveway will be constructed of permeable concrete.
T5.14: Rain Gardens	(Y)/N	Project lacks required natural vegetated flowpath.
T7.30: Bioretention	Y/(N)	Project lacks required natural vegetated flowpath.
T5.12: Sheet Flow Dispersion	Y/(N)	Project lacks required natural vegetated flowpath.
T5.11: Concentrated Flow Dispersion	Y/(N)	Project lacks required natural vegetated flowpath.

Figure 6: Flow Chart for Determining MR #5 Requirements



Section 5 – Permanent Stormwater Control Plan

Roof Dispersion Trench

The proposed Dispersion Trench with Notched Grade Board (BMP T5.01B) has been designed in accordance with the 2019 Department of Ecology Stormwater Management Manual for Western Washington to manage runoff from 2,375 square feet of impervious roof area.

Per BMP T5.01B design criteria, a minimum of 10 linear feet of dispersion trench is required for every 700 square feet of contributing impervious surface. Based on this requirement, the minimum required trench length is calculated as follows:

$$(2{,}375\,\text{sf} \div 700\,\text{sf}) \times 10\,\text{ft} = 33.98\,\text{ft}$$

To meet and exceed this requirement, a 34-foot-long by 2-foot-wide dispersion trench is proposed. The trench will be constructed in accordance with BMP T5.01B specifications and will include a notched grade board and gravel-filled trench section to promote energy dissipation, sheet flow, and infiltration.

Under existing built conditions, the downstream property receives concentrated downspout runoff from the site. The proposed dispersion trench represents an improvement over existing conditions by converting concentrated discharge into a broader, thinner, and more uniformly dispersed flow, thereby reducing erosion potential.

In addition, the dispersion trench discharges to a 67-foot vegetated flow path, which exceeds the 35-foot minimum flow path length required by the DOE manual. This represents a 168 percent increase over the minimum BMP requirement, providing additional protection against erosion and downstream impacts.

Based on trench sizing, dispersion features, and the extended vegetated flow path, the proposed design meets the intent of BMP T5.01B and ensures that stormwater runoff is dispersed without causing erosion or flooding of downstream properties.

Permeable Pavement

The small portion of proposed driveway in front of the proposed garage will be constructed using permeable pavement in accordance with BMP T5.15 – Permeable Pavement from the 2019 Department of Ecology Stormwater Management Manual for Western Washington. The permeable pavement is designed to manage runoff from approximately 300 square feet of impervious surface. Site soil infiltration testing confirmed a measured infiltration rate of 0.6 inches per hour, which meets the minimum requirement for permeable pavement applications. The pavement section will be constructed with a permeable concrete surface layer over a gravel reservoir designed to temporarily store and infiltrate stormwater runoff.

The onsite permeable roadway section has been designed using WWHM and the Results are included under Appendix B. An infiltration rate of 0.6 in/hour was used in the design, with a minimum permeable ballast section depth of 6 inches.

Other Hard surface

The runoff from the replaced hard surface area will be mitigated by capturing runoff from an equivalent impervious area (approximately 330 square feet) of existing hard surface via the proposed linear trench drain, which will discharge to the adjacent City storm system. The drainage pattern for the shared access driveway will remain unchanged, with runoff continuing to sheet flow toward the neighboring property under existing conditions. No changes are proposed to the existing drainage pattern for the remainder of the shared access driveway.

List of Appendices

Appendix A - Civil Engineering Plans

Appendix B - WWHM Calculations

WWHM2012

PROJECT REPORT

WWHM2012
PROJECT REPORT

Project Name: PERMEABLE PAVEMENT
Site Name: O'Brien Residence
Site Address: 9412 SE 33rd Street.
City : Mercer Isalnd
Report Date: 6/6/2025
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2023/01/27
Version : 4.2.19

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

MITIGATED LAND USE

Name : Permeable Pavement 1
Pavement Area: 0.0069 ft.
Pavement Length: 25.00 ft.
Pavement Width: 12.00 ft.
Pavement slope 1: 0.01 To 1
Pavement thickness: 0.5
Pour Space of Pavement: 0.2
Material thickness of second layer: 0.5
Pour Space of material for second layer: 0.3
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 0.6
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 1.882
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 1.882
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0.088

6" concrete
6" ballast
infiltration rate

Element Flows To:
Outlet 1 **Outlet 2**

Permeable Pavement Hydraulic Table

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

0.0000	0.006	0.000	0.000	0.000
0.0111	0.006	0.000	0.000	0.004
0.0222	0.006	0.000	0.000	0.004
0.0333	0.006	0.000	0.000	0.004
0.0444	0.006	0.000	0.000	0.004
0.0556	0.006	0.000	0.000	0.004
0.0667	0.006	0.000	0.000	0.004
0.0778	0.006	0.000	0.000	0.004
0.0889	0.006	0.000	0.000	0.004
0.1000	0.006	0.000	0.000	0.004
0.1111	0.006	0.000	0.000	0.004
0.1222	0.006	0.000	0.000	0.004
0.1333	0.006	0.000	0.000	0.004
0.1444	0.006	0.000	0.000	0.004
0.1556	0.006	0.000	0.000	0.004
0.1667	0.006	0.000	0.000	0.004
0.1778	0.006	0.000	0.000	0.004
0.1889	0.006	0.000	0.000	0.004
0.2000	0.006	0.000	0.000	0.004
0.2111	0.006	0.000	0.000	0.004
0.2222	0.006	0.000	0.000	0.004
0.2333	0.006	0.000	0.000	0.004
0.2444	0.006	0.000	0.000	0.004
0.2556	0.006	0.000	0.000	0.004
0.2667	0.006	0.000	0.000	0.004
0.2778	0.006	0.000	0.000	0.004
0.2889	0.006	0.000	0.000	0.004
0.3000	0.006	0.000	0.000	0.004
0.3111	0.006	0.000	0.000	0.004
0.3222	0.006	0.000	0.000	0.004
0.3333	0.006	0.000	0.000	0.004
0.3444	0.006	0.000	0.000	0.004
0.3556	0.006	0.000	0.000	0.004
0.3667	0.006	0.000	0.000	0.004
0.3778	0.006	0.000	0.000	0.004
0.3889	0.006	0.000	0.000	0.004
0.4000	0.006	0.000	0.000	0.004
0.4111	0.006	0.000	0.000	0.004
0.4222	0.006	0.000	0.000	0.004
0.4333	0.006	0.000	0.000	0.004
0.4444	0.006	0.000	0.000	0.004
0.4556	0.006	0.000	0.000	0.004
0.4667	0.006	0.001	0.000	0.004
0.4778	0.006	0.001	0.000	0.004
0.4889	0.006	0.001	0.000	0.004
0.5000	0.006	0.001	0.000	0.004
0.5111	0.006	0.001	0.000	0.004
0.5222	0.006	0.001	0.000	0.004
0.5333	0.006	0.001	0.000	0.004
0.5444	0.006	0.001	0.000	0.004
0.5556	0.006	0.001	0.000	0.004
0.5667	0.006	0.001	0.000	0.004
0.5778	0.006	0.001	0.000	0.004
0.5889	0.006	0.001	0.000	0.004
0.6000	0.006	0.001	0.000	0.004
0.6111	0.006	0.001	0.000	0.004
0.6222	0.006	0.001	0.000	0.004

0.6333	0.006	0.001	0.000	0.004
0.6444	0.006	0.001	0.000	0.004
0.6556	0.006	0.001	0.000	0.004
0.6667	0.006	0.001	0.000	0.004
0.6778	0.006	0.001	0.000	0.004
0.6889	0.006	0.001	0.000	0.004
0.7000	0.006	0.001	0.000	0.004
0.7111	0.006	0.001	0.000	0.004
0.7222	0.006	0.001	0.000	0.004
0.7333	0.006	0.001	0.000	0.004
0.7444	0.006	0.001	0.000	0.004
0.7556	0.006	0.001	0.000	0.004
0.7667	0.006	0.001	0.000	0.004
0.7778	0.006	0.001	0.000	0.004
0.7889	0.006	0.001	0.000	0.004
0.8000	0.006	0.001	0.000	0.004
0.8111	0.006	0.001	0.000	0.004
0.8222	0.006	0.001	0.000	0.004
0.8333	0.006	0.001	0.000	0.004
0.8444	0.006	0.001	0.000	0.004
0.8556	0.006	0.001	0.000	0.004
0.8667	0.006	0.001	0.000	0.004
0.8778	0.006	0.001	0.000	0.004
0.8889	0.006	0.001	0.000	0.004
0.9000	0.006	0.001	0.000	0.004
0.9111	0.006	0.001	0.000	0.004
0.9222	0.006	0.001	0.000	0.004
0.9333	0.006	0.001	0.000	0.004
0.9444	0.006	0.001	0.000	0.004
0.9556	0.006	0.001	0.000	0.004
0.9667	0.006	0.001	0.000	0.004
0.9778	0.006	0.001	0.000	0.004
0.9889	0.006	0.001	0.000	0.004
1.0000	0.006	0.001	0.000	0.004

Name : Lateral I Basin 1
Bypass: No

Impervious Land Use	**acre**
ROADS FLAT	**0.006**

Element Flows To:

Outlet 1	**Outlet 2**
Permeable Pavement 1	

ANALYSIS RESULTS

POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run. POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.Perlnd and Implnd Changes

No changes have been made.

Appendix C - Source Control BMPs

A7.17 Automobile Washing (Residential)

Most residents wash their cars in the driveway or on the street. Washwaters typically flow to a storm drain or ditch, which discharges stormwater directly to the nearest river, stream, lake, or Puget Sound. Soaps and detergents, even the biodegradable ones, can have immediate and long-term effects on organisms living in water bodies. Grime washed off the car also contains a variety of pollutants that can harm fish and wildlife.

Suggested BMPs

Away from Home (preferred option):

- Consider not washing your car at home. Take it to a commercial car wash that has a recycle system and discharges wastewater to the sanitary sewer for treatment.

At Home:

- Wash your car directly over your lawn or make sure the washwater drains to a vegetated area. This allows the water and soap to soak into the ground instead of running off into a local water body.
- Ideally, no soaps or detergents should be used, but if you do use one, select one without phosphates.
- Commercial products are available that allow you to clean a vehicle without water. These were developed for areas where water is scarce, so a water saving benefit is realized, as well as reduced pollution.
- Use a hose nozzle with a shut-off valve to save water.
- Do not wash your car if rain is expected. Rain events will rapidly wash chemicals and cleaning products from your property into the stormwater system (and to downstream waters).
- Pour the bucket of soapy, dirty washwater down your sink. This way the water doesn't pollute surface water. Instead, it's treated at the wastewater treatment plant.

A7.18 Automobile Maintenance (Residential)

We enjoy the cost savings of changing our own oil, antifreeze, topping off the battery with water, and generally making our car perform its' best. There is a lot of potential for stormwater pollution associated with these activities; however, the following BMPs will help you minimize pollution while servicing your car.

Required BMPs

- Recycle all oils, antifreeze, solvents, and batteries. Many local car parts dealers and gas stations accept used oil. The Household Hazardous Waste facilities at the Tacoma Landfill or LRI Landfill accept oil, oil filters, antifreeze, and solvents. Pierce County and Tacoma also hold Household Hazardous Waste turn-in days that will accept car wastes including old batteries. Old batteries can actually be worth money. Search for local battery recycling businesses to find out if any offer to buy used batteries. Use the numbers listed in Chapter 7 for more information.
- Never dump new or used automotive fluids or solvents on the ground, in a storm drain or street gutter, or in a water body. Eventually, it will make its way to local surface waters or groundwater, including the water we drink.
- Do not mix wastes. The chlorinated solvents in some carburetor cleaners can contaminate a huge tank of used oil, rendering it unsuitable for recycling. Always keep your wastes in separate containers which are properly labeled and store them out of the weather.

Suggested BMPs

- Fix all leaks, to keep the leaky material off streets and out of surface water.
- To dispose of oil filters, punch a hole in the top and let drain for 24 hours. This is where a large funnel in the top of your oil storage container will come in handy. After draining, wrap in 2 layers of plastic and dispose of in your regular garbage or recycle by taking it to the Tacoma Landfill or LRI Landfill Household Hazardous Waste facility for Tacoma residents and non-residents. Call the Hazardous Waste line at 18002876429 for up-to-date information on the appropriate disposal of consumer products.
- Use care in draining and collecting antifreeze to prevent accidental spills. Spilled antifreeze can be deadly to cats and dogs that ingest it.
- Perform your service activities on concrete or asphalt or over a plastic tarpaulin to make spill cleanup easier. Keep a bag of kitty litter on hand to absorb spills. If there is a spill, sprinkle a good layer on the spill, let it absorb for a little while and then sweep it up. Place the contaminated litter in a plastic bag, tie it up, and dispose of it in your regular garbage. Take care not to leave kitty litter out in the rain; it will form a sticky sludge that is hard to clean up.
- If you are doing body work outside, be sure to use a tarpaulin to catch material resulting from grinding, sanding, and painting. Dispose of this waste by double bagging in plastic and placing in your garbage.

A7.19 Storage of Solid Wastes and Yard Wastes

Improper storage of recycling, yard waste, and trash at residences can lead not only to water pollution problems, but problems with neighborhood pets and vermin. Following the BMPs listed below can help keep your property a clean and healthy place to live.

Suggested BMPs

All recycling and waste containers kept outside should have lids. If your lid is damaged, you should repair or replace it as soon as possible. If your container is supplied by your hauler, please call to have the lid repaired or replaced. Find your hauler's contact information at piercecountywa.gov/recycle.

- Leaking containers should be replaced. If your container is supplied by your hauler, contact the hauler to have damaged containers replaced.
- Store containers under cover if possible, or on grassy areas.
- Inspect the storage area regularly to pick up loose scraps of material and dispose of them properly.
- Tips for reducing waste:
    - Recycle as much as you can. Most Pierce County residents have access to curbside pickup for yard waste and recyclable materials. Use the online recycling menu to find more recycling options.
    - Purchase products with the least amount of packaging materials.
    - Compost biodegradable materials such as grass clippings and vegetable scraps instead of throwing them away. Your flowerbeds will love the finished compost, and you will be helping to conserve limited landfill space. Visit piercecountywa.gov/compost or call Pierce County Planning and Public Works at (253) 798-2179 for more information on composting or yard waste collection. See the section on composting for BMPs relating to that activity.
    - A fun alternative to traditional composting is worm composting. You can let worms do all the work for you by keeping a small vermiculture box just outside your kitchen. For more information on getting started with worms, visit piercecountywa.gov/compost or call the number listed above.

A7.20 Composting

Composting is an earth-friendly activity. If you choose to compost, the following BMPs should be used. More information can be found online at piercecountywa.gov/compost.

Suggested BMPs

- Compost piles must be located on an unpaved area where runoff can soak into the ground or be filtered by grass and other vegetation. Compost piles should be located in an area of your yard not prone to water ponding during storms, and should be kept well away from wetlands, streams, lakes, and other drainage paths.
- Compost piles must be maintained and turned over regularly to work properly. Large piles of unattended compost may create odor and vermin problems.
- Avoid putting hazardous, inorganic, plastics or metal waste in the pile.
- Cover the compost pile for two reasons:
    15. To keep stormwater from washing nutrients into waterways.
    16. To keep excess water from cooling down the pile, which will slow down the rate of decomposition.

Build Bins of wood, chicken wire, or fencing material to contain compost so it cannot be washed away. Visit piercecountywa.gov/compost to download plans for building your own bin, or call Pierce County Planning and Public Works at (253) 798-2179.

- Building a small earthen dike around your compost pile is an effective means of preventing nutrient-rich compost drainage from reaching stormwater paths.

A7.21 Yard Maintenance and Gardening

This section discusses normal yard maintenance activities we all perform at our homes. Overwatering, overfertilizing, improper herbicide application, and improper disposal of trimmings and clippings can all contribute to serious water pollution problems. Following the BMPs listed below will help alleviate pollutant runoff.

Required BMPs

- Follow the manufacturer's directions exactly for mixing and applying herbicides, fungicides, and pesticides, and use them sparingly. Never apply when it is windy or when rain is expected. Never apply over water, within 100 feet of a well-head, or adjacent to streams, wetlands, or other water bodies. Triple-rinse empty containers, using the rinsate for mixing your next batch of spray, and then double-bag and dispose of the empty container in your regular garbage. Never dispose of grass clippings or other vegetation in or near storm drains, streams, lakes, or Puget Sound.

Suggested BMPs

- Use natural, organic soil amendments like Pierce County's SoundGRO Mix. SoundGRO Mix is a 100 percent recycled blend of dewatered, Class A, "Exceptional Quality" biosolids, mixed with sawdust and sand. The excellent soil conditioning properties of the organic matter aid water retention in lighter soils and help to break up and aerate heavier soils, so roots can grow better and less watering is needed. It contains both readily available and long term nitrogen and other nutrients commonly lacking in Northwest soils. The slow release of nitrogen better matches the needs of plants. Thus, there is much less potential for nitrates to leach into surface or groundwater due both to less "excess nitrogen" and less water use. Better vegetative growth can also reduce erosion and runoff.
- Follow manufacturer's directions when applying fertilizers. More is not better, either for your lawn or for local water bodies. Never apply fertilizers over water or adjacent to ditches, streams, or other water bodies. Remember that organic fertilizers have a slow release of nitrogen, and less potential to pollute then synthetic fertilizers.
- Save water and prevent pollution problems by watering your lawn sensibly. Lawns and gardens typically need the equivalent of 1-inch of rainfall per week. You can check on how you're doing by putting a wide mouth jar out where you're sprinkling, and measure the water with a small plastic ruler. Overwatering to the point of runoff can carry polluting nutrients to the nearest water body.
- Consider planting a vegetated buffer zone adjacent to streams or other water bodies on your property. Call the Pierce County Conservation District at (253) 8459770 for advice and assistance in developing a planting plan. The Stream Team at the Conservation District may even be able to help you plant it.
- Reduce the need for pesticides and fertilizers on lawns by improving the health of the soil. Aerating, thatching, and topdressing with compost or the City of Tacoma's Tagro products will improve soil health and help wanted grasses compete with weeds and moss.
- Make sure all fertilizers and pesticides are stored in a covered location. Rain can wash the labels off of bottles and convert 50 pounds of fertilizer into either a solid lump or a river of nutrients.

- Use a mulching mower and mow higher to improve soil/grass health and reduce or eliminate pesticide use.
- Compost all yard clippings, or use them as mulch to save water and keep down weeds in your garden. See Composting section for more information.
- Practice organic gardening and virtually eliminate the need to use pesticides and fertilizers. Contact Pierce County Cooperative Extension at (253) 798-7180 or the Ask-A-Master Gardener program at (253) 798-7170 for information and classes on earth-friendly gardening.
- Pull weeds instead of spraying and get some healthy exercise, too. If you must spray, use the least toxic formulations that will get the job done. The Master Gardener program listed above can help advise you on which spray to use.
- Till fertilizers into the soil instead of letting them lie on the ground surface exposed to the next rain storm.
- Plant native vegetation which is suited to Northwest conditions, they require less water and little to no fertilizers and pesticides.
- Contact your local waste disposal company for curbside pickup and recycling of yard waste.

A7.22 Swimming Pool and Spa Cleaning and Maintenance

This section discusses water from pools, spas, hot tubs and fountains chemically treated or heated. Nutrients, pH, and chlorine can adversely affect fish and wildlife in water bodies. Following these BMPs will ensure the cleanliness of your pool and the environment.

Required BMPs

- Do not discharge water directly from a pool spa, hot tub or fountain process wastes, or wastewaters into storm drains except if the discharge water is dechlorinated to 0.1 mg/L if it is to be emptied into a ditch or to the stormwater drainage system. Contact your pool chemical supplier to obtain the neutralizing chemicals you will need. The rate of flow into the ditch or stormwater drainage system must be regulated so that it does not cause problems such as erosion, surcharging, or flooding. Water discharged to the ground or a lawn must not cross property lines and must not produce runoff.
- If pool, spa, hot tub, or fountain water cannot be dechlorinated, it must be discharged to the sanitary sewer. Prior to draining, your local wastewater treatment plant must be notified to ensure they are aware of the volume of discharge and the potential effects of chlorine levels (call (253) 798-3013). A pool service company can help you determine the frequency of cleaning and backwash of filters.
- Diatomaceous earth used in pool filters cannot be disposed of in surface waters, on the ground, or into stormwater drainage systems or septic systems. Dry it out as much as possible, bag it in plastic, and dispose of at the landfill.

Suggested BMPs

- Hire a professional pool service company to collect all pool water for proper disposal. Make sure to ask them where they will dispose of it and the kind of permits they hold to do so.
- Ensure that the pool, spa, hot tub, or fountain system is free of leaks and operates within the design parameters.
- Do not provide any permanent links to drainage systems. All connections should be visible and carefully controlled.
- If the dechlorination or cooling process selected requires the water to be stored for a time, it should be contained within the pool or appropriate temporary storage container.

A7.23 Household Hazardous Material Use, Storage, and Disposal

Once we really start looking around our houses, the amount of hazardous materials we have onsite is a real eye-opener. Oil-based paints and stains, paint thinner, gasoline, charcoal starter fluid, cleaners, waxes, pesticides, fingernail polish remover, and wood preservatives are just a few hazardous materials that most of us have around the house.

When products such as these are dumped on the ground or in a storm drain, they can be washed directly to receiving waters where they can harm fish and wildlife. They can also infiltrate into the ground and contaminate drinking water supplies. The same problem can occur if they are disposed of with your regular garbage; the containers can leak at the landfill and contaminate groundwater. The same type of contamination can also occur if hazardous products are poured down a sink or toilet into a septic system. Do not pour them down the drain if you're on municipal sewers, either. Many compounds can "pass through" the wastewater treatment plant without treatment and contaminate receiving waters, or they can harm the biological process used at the treatment plant, reducing overall treatment efficiency.

With such a diversity of hazardous products present in all homes in Pierce County, a large potential for serious environmental harm exists if improper methods of storage, usage, and disposal are employed. Using the following BMPs will help keep these materials out of our soils, sediments, and waters.

Required BMPs

- Hazardous Materials must be used in accordance with the manufacturer recommendation or guidelines as shown on the label.
- Always store hazardous materials in properly labeled containers, never in food or beverage containers which could be misinterpreted by a child as something to eat or drink.
- Dispose of hazardous materials and their containers properly. Never dump products labeled as poisonous, corrosive, caustic, flammable, inflammable, volatile, explosive danger, warning, caution, or dangerous outdoors, in a storm drain, or into sinks, toilets or drains. Visit piercecountywa.gov/hhw, call the Hazardous Waste Line at 1 (800) 287-6429, Tacoma-Pierce County Health Department (253) 798-6047, or the Tacoma Solid Waste Utility Household Hazardous Waste at (253) 591-5418 for information on disposal methods, collection events, and alternative products. Household hazardous waste from Pierce County residents and non-residents are accepted at the Tacoma Landfill and LRI Landfill.

Suggested BMPs

- Check hazardous material containers frequently for signs of leakage. If a container is rusty and has the potential of leaking soon, place it in a secondary container before the leak occurs and prevent a cleanup problem.
- Hazardous materials should be stored out of the reach of children.
- Store hazardous materials containers under cover and off the ground. Keep them out of the weather to avoid rusting, freezing, cracking, labels being washed off, etc.
- Keep appropriate spill cleanup materials on hand. Kitty litter is good for many oil-based spills.
- Ground cloths and drip pans must be used under any work outdoors which involves hazardous materials such as oil-based paints, stains, rust removers, masonry cleaners, and

Appendix D - Geotechnical Report

Cobalt Geosciences, LLC
P.O. Box 1792
North Bend, WA 98045

April 14, 2025

Sean O'Brien
sean@obrienrealestatenw.com

RE: Geotechnical Evaluation
Proposed Residence
9412 SE 33rd Street
Mercer Island, Washington

In accordance with your authorization, Cobalt Geosciences, LLC has prepared this letter to discuss the results of our geotechnical evaluation at the referenced site.

The purpose of our evaluation was to provide recommendations for foundation design, grading, and earthwork.

Site and Project Description

The site is located at 9412 SE 33rd Street in Mercer Island, Washington. The site consists of one nearly rectangular parcel (No. 4139300406) with a total area of 11,693 square feet.

The southern portion of the site is developed with a residence. There is a driveway along the west property line extending to the property to the north.

The remainder of the site is undeveloped and vegetated with grasses, bushes/shrubs, and variable diameter trees.

The site slopes downward from south to north at low magnitudes with relief of about 12 feet.

The site contains seismic and potential landslide hazard areas per City mapping.

The site is bordered to the east, west, and north by residential properties, and to the south by SE 33rd Street.

The proposed development includes a new residence in the northern half of the property. Associated construction will include walkways and driveway areas.

Site grading may include cuts and fills of about 3 feet or less for foundation placement. Foundation loads are expected to be light. We should be provided with the final plans to verify that our recommendations remain valid and do not require updating.

Area Geology

The Geologic Map of Mercer Island, indicates that the site is underlain by Pre-Olympia Fine Grained Deposits.

These deposits include mostly silts with fine sand. These depostis become denser with depth and are nearly impermeable.

Soil & Groundwater Conditions

As part of our evaluation, we excavated one test pit within the property, where accessible. We also reviewed numerous explorations from the property to the east by HWA in 2009.

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

The explorations encountered approximately 6 inches of topsoil underlain by approximately 2 feet of loose to medium dense, silty-fine to fine grained sand with gravel (Fill). These materials were underlain by medium dense to very dense, silty-fine to fine grained sand (Pre-Olympia Fine Grained Deposits), which continued to the termination depth of the exploration.

Groundwater was not observed; however, the shallow soils were mottled. Groundwater may become perched on denser soils in this area.

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

City of Mercer Island GIS Mapped Hazards

The City of Mercer Island GIS maps indicate that the site contains a potential slide and seismic hazard area. These designations are likely present due to the mapped geologic conditions and historical data.

We did not observe evidence of soil susceptible to liquefaction or landslide activity. It is our opinion that the site does not contain these geologic hazards based on our observations and subsurface explorations. There may be a small area of seismic hazards near the shoreline; however, this would be within buffers and setbacks from shorelines and not within the subject property.

Statement of Risk

Per Section 19.07.160B2 of the Mercer Island City Code, development within geologic hazard areas require that a Geotechnical Engineer licensed within the State of Washington provide a statement of risk with supporting documentation indicating that one of the following conditions can be met:

a. The geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe; or

b. An evaluation of site specific subsurface conditions demonstrates that the proposed development is not located in a geologic hazard area; or

c. Development practices are proposed for the alteration that would render the development as safe as if it were not located in a geologic hazard area; or

d. The alteration is so minor as not to pose a threat to the public health, safety and welfare.

The project meets the criteria of b from above. We did not observe the mapped GIS hazard criteria on these properties or within the development areas. No mitigation is required for any geologic hazard.

Erosion Hazard

The Natural Resources Conservation Services (NRCS) maps for King County indicate that the site is underlain by Kitsap silt loam (2 to 8 percent slopes). These soils would have a slight erosion potential in a disturbed state depending on the slope magnitude.

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

Seismic Parameters

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

We referenced the U.S. Geological Survey (USGS) Earthquake Hazards Program Website to obtain values for S_S, S_1, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The following tables provide seismic parameters from the USGS web site with referenced parameters from ASCE 7-16.

Seismic Design Parameters (ASCE 7-16)

Site Class	Spectral Acceleration at 0.2 sec. (g)	Spectral Acceleration at 1.0 sec. (g)	Site Coefficients		Design Spectral Response Parameters		Design PGA
			F_a	F_v	S_{DS}	S_{D1}	
D	1.393	0.485	1.0	Null	0.929	Null	0.596

Additional seismic considerations include liquefaction potential and amplification of ground motions by soft/loose soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table.

The site has a relatively low likelihood of liquefaction due to the very dense soil conditions where groundwater is likely present. For items listed as "Null" see Section 11.4.8 of the ASCE.

Conclusions and Recommendations

General

The site is underlain by weathered to unweathered pre-Olympia fine grained deposits which become stiff to hard. The depth to bearing will vary with location and overexcavation should be expected for new foundation elements.

The residence may be supported on a shallow foundation system bearing on medium dense/stiff native soils or on properly compacted structural fill on the native soils. Local overexcavation of the weathered native soils may be necessary depending on foundation elevations. We must be on site to verify bearing capacity at foundation locations.

Stormwater should be collected and routed to City infrastructure. Dispersion devices and permeable pavements are likely feasible; however, we should review the locations and elevations to confirm suitability.

Site Preparation

Trees, shrubs and other vegetation should be removed prior to stripping of surficial organic-rich soil and fill. Based on observations from the site investigation program, it is anticipated that the stripping depth will be 6 to 18 inches. Deeper excavations will be necessary in any areas underlain by loose soils at depth and below foundation elements.

The native soils consist of silty-sand and silt with sand. Soils with more than 40 percent fines should not be used as structural fill. Some of the native soils may be used as structural fill provided they achieve compaction requirements and are within 3 percent of the optimum moisture. Some of these soils may only be suitable for use as fill during the summer months, as they will be above the optimum moisture levels in their current state. These soils are HIGHLY moisture sensitive and may degrade during periods of wet weather and under equipment traffic. Silt and sandy silt should not be used as structural fill.

Imported structural fill should consist of a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). Structural fill should be placed in maximum lift thicknesses of 12 inches and should be compacted to a minimum of 95 percent of the modified proctor maximum dry density, as determined by the ASTM D 1557 test method.

Temporary Excavations

Based on our understanding of the project, we anticipate that the grading could include local cuts on the order of approximately 3 feet or less for foundation placement. Temporary excavations should be sloped no steeper than 1.5H:1V (Horizontal:Vertical) in loose native soils and fill and 1H:1V in medium dense native soils. If an excavation is subject to heavy vibration or surcharge loads, we recommend that the excavations be sloped no steeper than 2H:1V, where room permits.

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

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

Soil conditions may not be completely known from the geotechnical investigation. In the case of temporary cuts, the existing soil conditions may not be completely revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of temporary slopes will need to be re-evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed and required deadlines can be met.

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

Foundation Design

The proposed residential structure may be supported on a shallow spread footing foundation system bearing on undisturbed medium dense or firmer native soils or on properly compacted structural fill placed on the suitable native soils. Any undocumented fill and/or loose native soils should be removed and replaced with structural fill below foundation elements. Structural fill below footings should consist of clean angular rock 5/8 to 4 inches in size. We should verify soil conditions during foundation excavation work.

For shallow foundation support, we recommend widths of at least 16 and 24 inches, respectively, for continuous wall and isolated column footings supporting the proposed structure. Provided that the footings are supported as recommended above, a net allowable bearing pressure of 2,000 pounds per square foot (psf) may be used for design.

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

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

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

Resistance to lateral footing displacement can be determined using an allowable friction factor of 0.30 acting between the base of foundations and the supporting subgrades. Lateral resistance for footings can also be developed using an allowable equivalent fluid passive pressure of 250 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglect the upper 12 inches below grade in exterior areas). The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance.

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

Concrete Retaining Walls

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls with a level backslope. Contact Cobalt if an alternate retaining wall system is used. This has been included for new cast in place walls, if any are proposed.

Wall Design Criteria	
"At-rest" Conditions (Lateral Earth Pressure – EFD[+])	55 pcf (Equivalent Fluid Density)
"Active" Conditions (Lateral Earth Pressure – EFD[+])	35 pcf (Equivalent Fluid Density)
Seismic Increase for "At-rest" Conditions (Lateral Earth Pressure)	14H* (Uniform Distribution)
Seismic Increase for "Active" Conditions (Lateral Earth Pressure)	7H* (Uniform Distribution)
Passive Earth Pressure on Low Side of Wall (Allowable, includes F.S. = 1.5)	Neglect upper 12 inches, then 250 pcf EFD[+]
Soil-Footing Coefficient of Sliding Friction (Allowable; includes F.S. = 1.5)	0.30

[*]H is the height of the wall; Increase based on one in 500 year seismic event (10 percent probability of being exceeded in 50 years),
[+]EFD – Equivalent Fluid Density. Assumes excavation into stiff to hard soils for passive pressures.

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

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

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

treatment, which may require that more extensive waterproofing be specified for walls, which require interior moisture sensitive finishes.

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

Stormwater Management Feasibility

The site is underlain by likely areas of fill and at depth by variably weathered pre-Olympia deposits. The denser silts acts as a restrictive layer. We performed a small scale pilot infiltration test (PIT) in TP-1. The test was performed in general accordance with the Washington State Department of Ecology stormwater manual.

The area was excavated to a testing depth of approximately 4 feet below the ground surface. During testing, we reduced the flow rate into the hole to the minimum available with the equipment and water source being used and continued to observe a rising water level. Since a steady state rate was not achieved, we performed a falling head test until the testing water was fully infiltrated.

The design infiltration rate was determined by applying correction factors to the measured infiltration rate as prescribed in Volume III, Section 3.3.6 of the DOE. The measured rate must be reduced through appropriate correction factors for site variability (CF_V), uncertainty of test method (CF_T), and degree of influent control (CF_M) to prevent siltation and bio-buildup.

It should be noted that construction traffic or other disturbance to the target infiltration area could compact the soil, which may decrease the effective infiltration rates. The correction factors and resulting design infiltration rate are also shown in the table below.

Test Number	Test Depth (ft)	Measured Infiltration Rate (in/hr)	Correction Factors			Design Infiltration Rate (in/hr)
			CF_V	CF_T	CF_M	
TP-1	4.0	0.6	0.7	0.5	0.9	0.19

Widespread infiltration of runoff is not feasible based on the soil conditions and possibility of shallow interflow perched on denser native soils during the winter months.

We recommend utilizing direct or perforated connection of runoff collection devices to City infrastructure. Dispersion devices are generally feasible if there is adequate space.

We can provide additional recommendations once a civil plan with planned grading and building elevations has been prepared. We should be provided with final plans for review to determine if the intent of our recommendations has been incorporated or if additional modifications are needed.

Slab-on-Grade

We recommend that the upper 18 inches of the existing native soils within slab areas be re-compacted to at least 95 percent of the modified proctor (ASTM D1557 Test Method).

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

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

Slabs on grade may be designed using a coefficient of subgrade reaction of 180 pounds per cubic inch (pci) assuming the slab-on-grade base course is underlain by structural fill placed and compacted as outlined above. A 4- to 6-inch-thick capillary break layer should be placed over the prepared subgrade. This material should consist of pea gravel or 5/8 inch clean angular rock.

A perimeter drainage system is recommended unless interior slab areas are elevated a minimum of 12 inches above adjacent exterior grades. If installed, a perimeter drainage system should consist of a 4-inch diameter perforated drain pipe surrounded by a minimum 6 inches of drain rock wrapped in a non-woven geosynthetic filter fabric to reduce migration of soil particles into the drainage system. The perimeter drainage system should discharge by gravity flow to a suitable stormwater system.

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

Erosion and Sediment Control

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

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

Utilities

We do not anticipate the need for any new utilities; however, the following information has been provided in case any new or modified existing utilities are proposed.

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

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

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

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

CONSTRUCTION FIELD REVIEWS

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

- Monitor and test structural fill placement and soil compaction
- Observe bearing capacity at foundation locations
- Observe slab-on-grade preparation
- Monitor foundation drainage placement
- Observe excavation stability

Geotechnical design services should also be anticipated during the subsequent final design phase to support the structural design and address specific issues arising during this phase. Field and engineering review services will also be required during the construction phase in order to provide a Final Letter for the project.

CLOSURE

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

The recommendations contained in this report are based on assumed continuity of soils with those of our test holes and assumed structural loads. Cobalt Geosciences should be provided with final architectural and civil drawings when they become available in order that we may review our design recommendations and advise of any revisions, if necessary.

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

Sincerely,

Cobalt Geosciences, LLC

4/14/2025
Phil Haberman, PE, LG, LEG
Principal

Statement of General Conditions

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

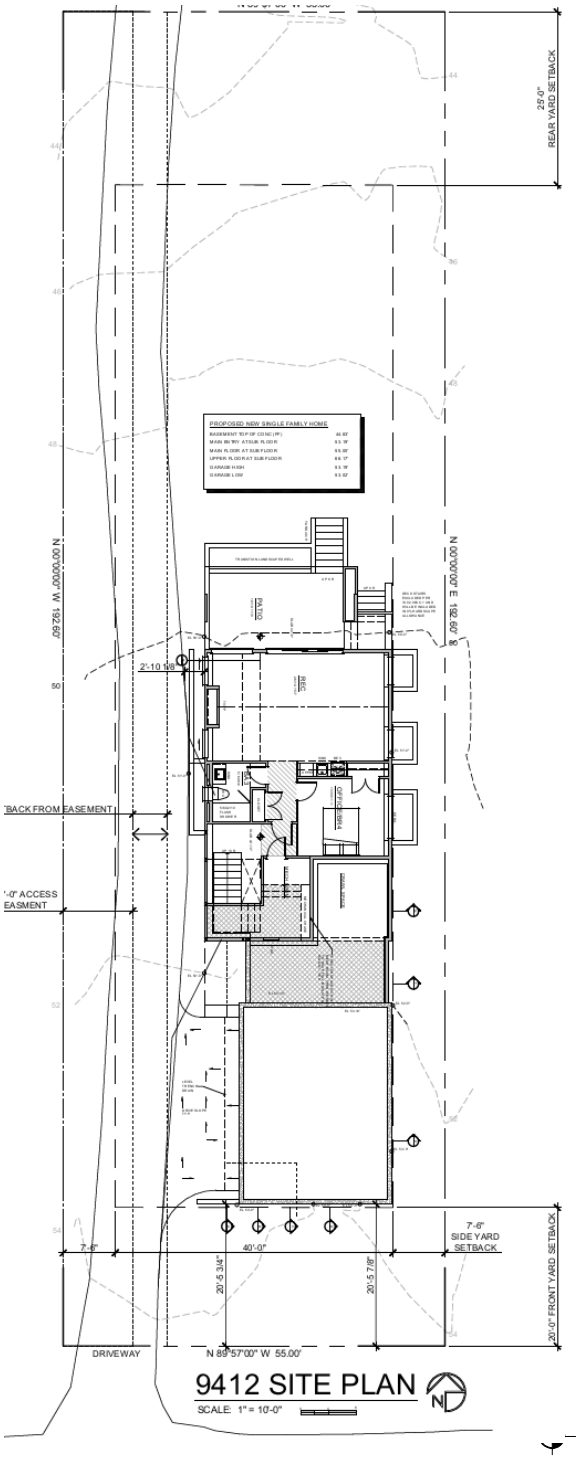
BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Cobalt Geosciences present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of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

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

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

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

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



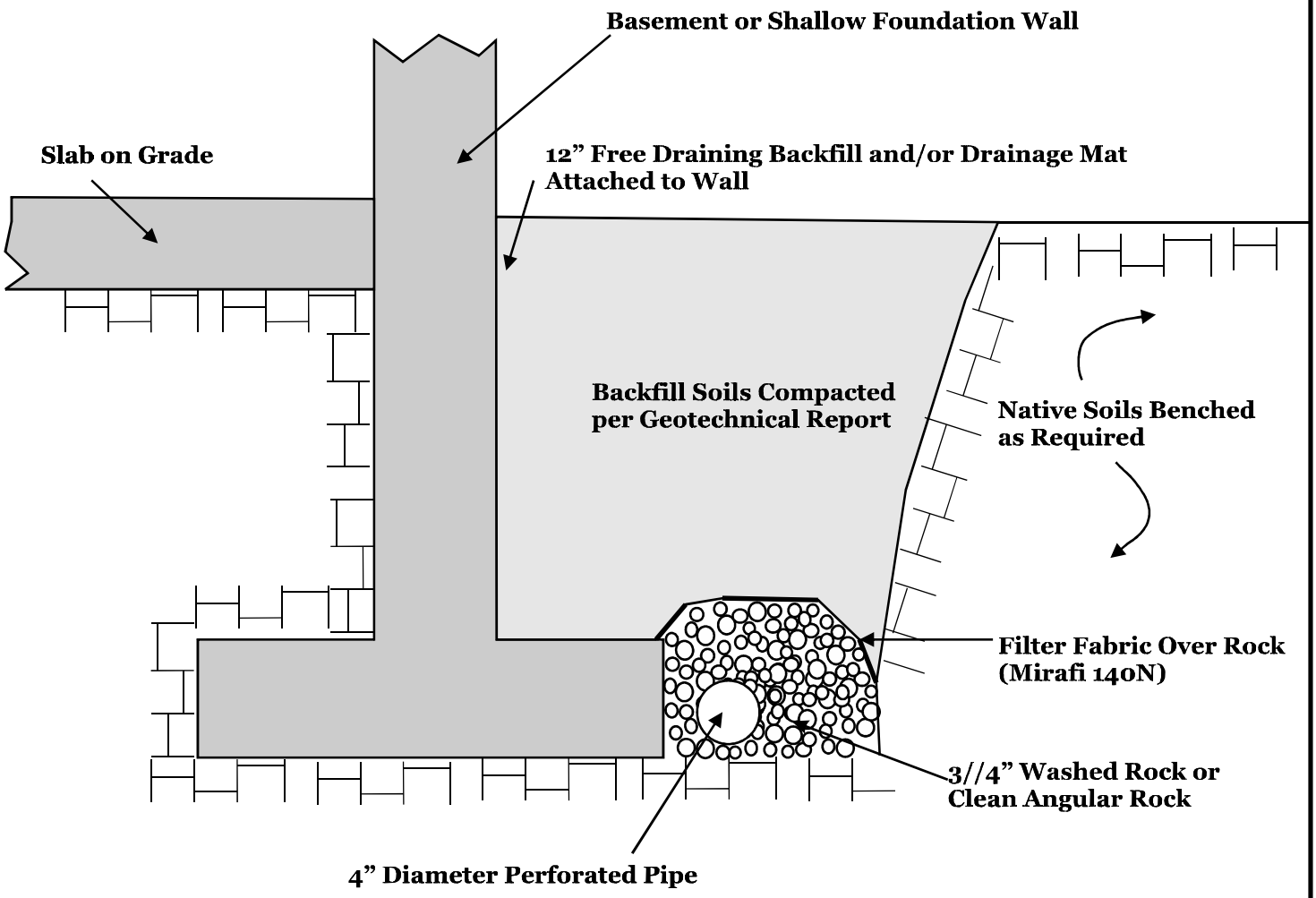
Provided site plan

TP-1 **Approximate Test Pit Location**

N

King County Imap Image

COBALT GEOSCIENCES	Proposed Development 9412 SE 33rd Street Mercer Island, Washington	**SITE MAPS** **FIGURE 1**	Cobalt Geosciences, LLC P.O. Box 82243 Kenmore, WA 98028 (206) 331-1097 www.cobaltgeo.com cobaltgeo@gmail.com



Not to Scale

COBALT GEOSCIENCES	**Typical Foundation Drain Detail**	**Attachment**	Cobalt Geosciences, LLC PO Box 1792 North Bend, WA 98045 (206) 331-1097 www.cobaltgeo.com phil@cobaltgeo.com

Unified Soil Classification System (USCS)

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

Classification of Soil Constituents

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

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

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

Grain Size Definitions

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

Relative Density (Coarse Grained Soils)

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

Consistency (Fine Grained Soils)

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

Moisture Content Definitions

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

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Soil Classification Chart

Figure C1

Log of Test Pit TP-1

Date: April 2025	Depth: 10'	Initial Groundwater: None
Contractor: Austin	Elevation:	Sample Type: Grab
Method: Excavator	Logged By: KK Checked By: PH	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
0						Vegetation/Topsoil
2					SM/ML	Loose to medium dense, silty-fine to fine grained sand trace gravel, yellowish brown to grayish brown, moist. (Fill)
4					SM/ML	Medium dense to very dense, silty-fine to fine grained sand, olive gray moist. (Pre-Olympia Deposits)
6						Dense at 7.5'
8						
10						End of Test Pit 10'
12						
14						
16						
18						
20						
22						
24						
26						
28						
30						
32						
34						

Groundwater

Moisture Content (%)
Plastic Limit — Liquid Limit

SPT N-Value
0 10 20 30 40 50

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Test Pit Log