civil & structural
engineering & planning

# STORMWATER SITE PLAN REPORT

## Brumbaugh Residence

4124 83rd Ave SE
Mercer Island, WA 98040


*05/12/22*

CG Project No.: 22032.20

250 4th Ave S Ste 200
Edmonds, WA 98020
Phone: (425) 778-8500
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# Section I – Project Overview

**Section I Summary**

*Narrative*
*Existing Condition*
*Developed Condition*
*Minimum Requirements*

The proposed project is a redeveloped single-family residence with an associated driveway and walkways on a 14,078 sf (0.32 ac) lot. The existing site consists of a single-family residence, a shed, an asphalt driveway, and a concrete patio. The site is landscaped and there are several trees along the south and east property lines. The project will add greater than 5,000 sf of new/replaced impervious surface and will comply with Minimum Requirements #1-9 of the 2014 Stormwater Management Manual for Western Washington (herein referred to as the SWMMWW).

Address: 4124 83rd Ave SE, Mercer Island, WA 98040
Tax Parcel Number: 362650-0030
Watershed: Lake Washington
Zoning: R-9.6

Existing Condition

Inside the area of proposed development on-site, topography descends from the SE to the NW with an average slope of about 3%. Adjacent parcels contain single-family residences. The west property line borders 83rd Ave SE, and the south, east and west property lines are shared borders with other single-family residences' property lines. There are exiting sewer and water mains running along 83rd Ave SE, and there is an existing stormwater running south on the east side of 83rd Ave SE.

Developed Condition

In the developed condition, a house, two concrete driveways, a front walkway, and a back patio, deck, and pool will be constructed. The project adds over 5,000 sf of new/replaced impervious surface, and the project will comply with Minimum Requirements #1-9 of the 2014 SWMMWW. The project will implement a detention pipe for on-site stormwater management.

The proposed new/replaced hard surface areas on-site are as follows:

| *New/Replaced Hard Surface* | |
|---|---|
| Roof: | 4,851 sf (0.11 ac) |
| Concrete Driveway/Walkways: | 1,688 sf (0.04 ac) |
| ROW Concrete Driveway: | 596 sf (0.01 ac) |
| ROW Gravel Driveway: | 599 sf (0.01 ac) |
| Total: | 6,893 sf (0.16 ac) |

Minimum Requirements:

The project will comply with all Minimum Requirements (#1-9) of the SWMMWW. These are discussed below.

**Minimum Requirement #1: Preparation of Stormwater Site Plans**: The stormwater site plan consists of this report and the civil drawings and is prepared in accordance with Chapter 3 of Volume 1 of the SWMMWW.

**Minimum Requirement #2**: **Construction Stormwater Pollution Prevention Plan (SWPPP)**: The SWPPP consists of the DOE's SWPPP template because it is a Large Impact Project. The completed SWPPP can be found in the submittal forms.

**Minimum Requirement #3: Source Control of Pollution**: All known, available and reasonable source control BMPs must be required for all projects approved by the City. All multi-family residential projects shall, at a minimum, incorporate required BMPs from SWMMWW Volume IV, 2.1 – Applicable Operational Source Control BMPs. The Operation & Maintenance Manual found in Section VIII contains guide sheets for the applicable BMPs.

**Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls:** Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down gradient properties. All projects shall submit an off-site qualitative analysis. A qualitative analysis of the upstream and downstream system entering the site is presented in Section III.

**Minimum Requirement #5: On-Site Stormwater Management:** The project shall either use On-Site Stormwater Management BMPs from List #2 (per SWMMWW I-2.5.5) for all new plus replaced hard surfaces and land disturbed or demonstrate compliance with the LID Performance Standard. The project will use BMPs from List #2. See Section V.

**Minimum Requirement #6: Runoff Treatment:** The project proposes less than 5,000 square feet of new/replaced pollution-generating hard surfaces (PGHS), and runoff treatment is not required.

**Minimum Requirement #7: Flow Control:** Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. Flow control is required for projects in which the total of effective impervious surfaces is 10,000 sf or more in a threshold discharge area, convert ¾ acres or more of vegetation to lawn or landscape, or cause a 0.15 cfs or more increase in the 100-year flow frequency between the existing and developed conditions. The project will meet the flow control standard. See Section V.

**Minimum Requirement #8: Wetlands Protection:** This project site's stormwater does not discharge into a wetland and does not require wetland protection.

**Minimum Requirement #9: Operation and Maintenance:** An Operation and Maintenance Manual that is consistent with the provisions in Volume V of the SWMMWW is required for proposed stormwater BMPs/facilities. The party (or parties) responsible for maintenance and operation shall be identified in the

operation and maintenance manual. For private facilities approved by the City, a copy of the operation and maintenance manual shall be retained on-site or within reasonable access to the site and shall be transferred with the property to the owner. For public facilities, a copy of the operation and maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection.

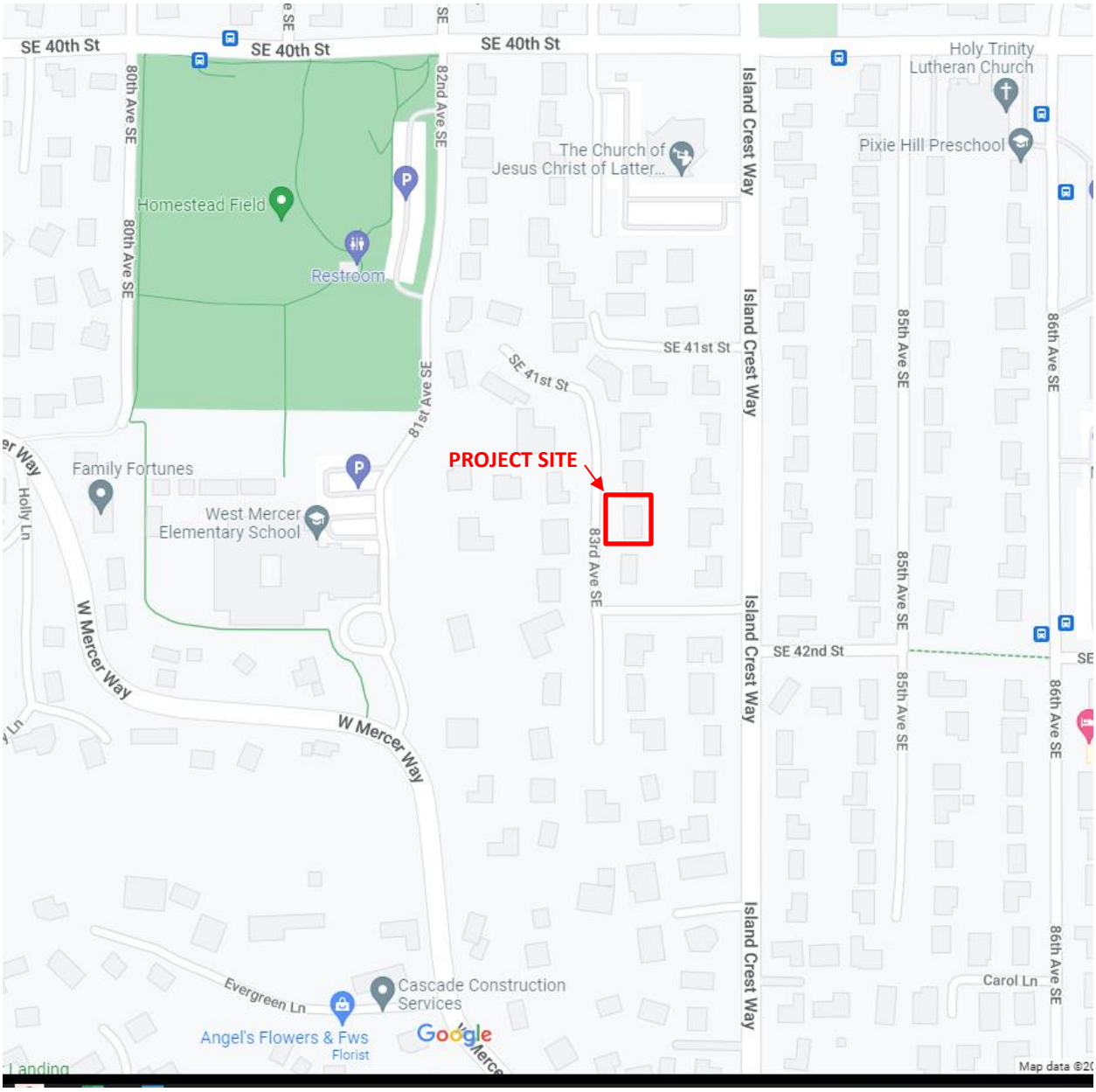


**Figure I-1. Vicinity map (from Google Maps).**

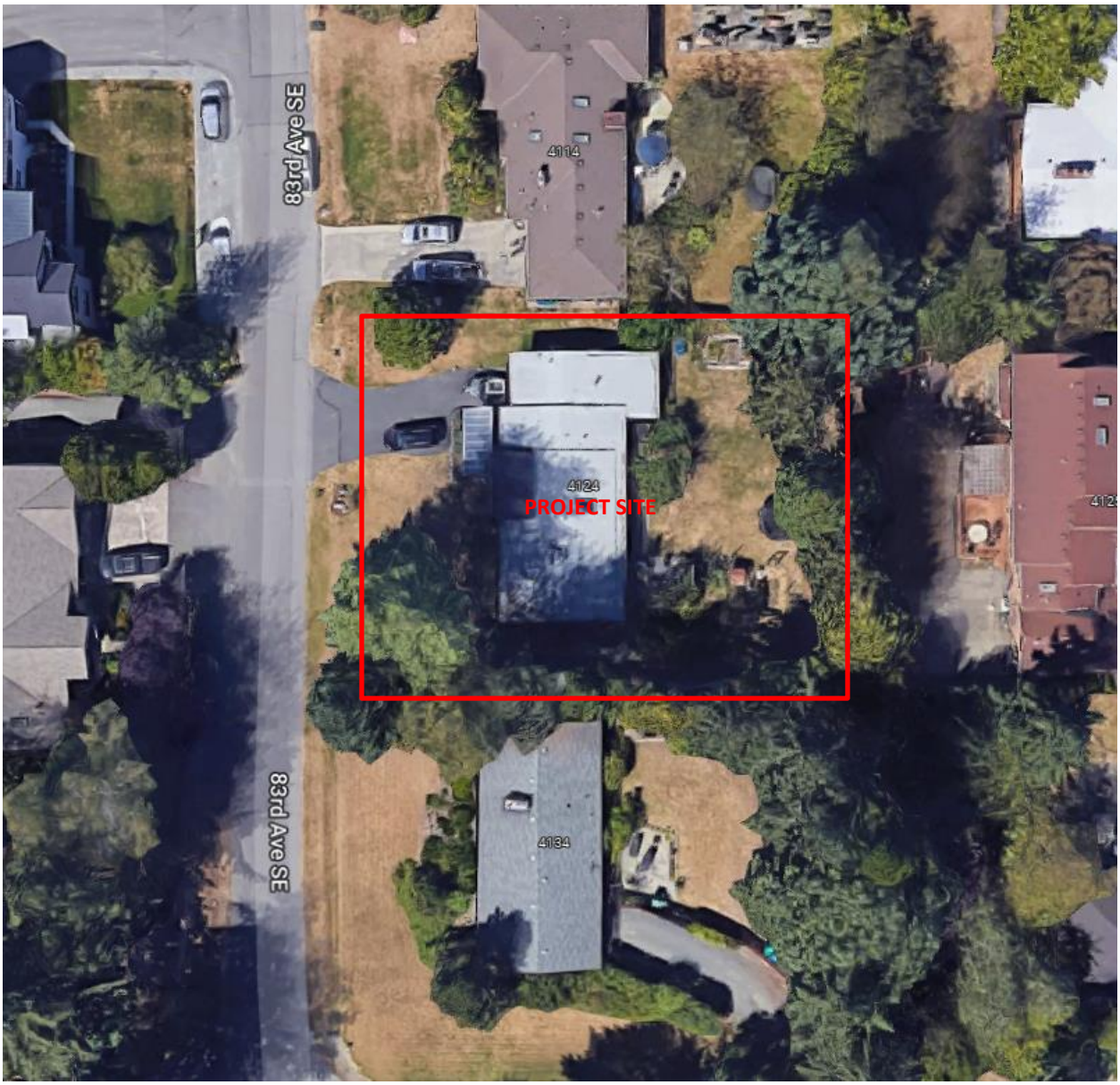


**Figure I-2. Aerial image (from Google Maps).**

# Section II –Existing Conditions Summary

**Section II Summary**

*Narrative*

The existing site contains a house, asphalt driveway, front stone walkway, back concrete patio, and a shed. The site is landscaped with lawn and has several trees along the south and east property lines. The site slopes from southeast to northwest at an average of 3 percent.

Adjacent parcels contain single-family residences. The site borders 83rd Ave SE to the west. There is an 8" concrete sewer main, a water main with an existing service to the site, and a 12" concrete stormwater main running south on 83rd Ave SE.

Underlying soils were found to be Arents, Alderwood Material, 2 to 8% slopes for most of the site, corresponding to hydrologic soil group "B" per the Natural Resources Conservation Service Soil Survey resource.



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# Section III – Off Site Analysis

**Section III Summary**

The study area is defined as the project site and the area one mile downstream (minimum flow path distance) from the proposed discharge location for the purposes of Task 2 and is defined as the project site and a minimum of one-quarter mile downstream from the proposed discharge location for the purposes of Tasks 3, 4, and 5. The figure below was taken from the City of Mercer Island online mapping portal and shows the study area.

Drainage and problems and complaints were investigated using the King County iMap website. None were found within the range of the required downstream analysis. Water Quality issues were found with the DOE 303d online map. No 303d water quality listings are downstream from the site.

Environmentally Sensitive Areas were investigated using the King County iMap and Mercer Island GIS Portal. The site is located in an area infeasible for infiltration, a potential slide area, and an erosion hazard area.

On-site stormwater management BMPs are infeasible for the site (see Section V), and the site will use a detention pipe, designed per Mercer Islands on-site detention design table, with an outfall to a catch basin in the ROW. There are no existing or anticipated problems with the proposed drainage system.

There to not appear to be any existing drainage problems on site or in the downstream path from the site.



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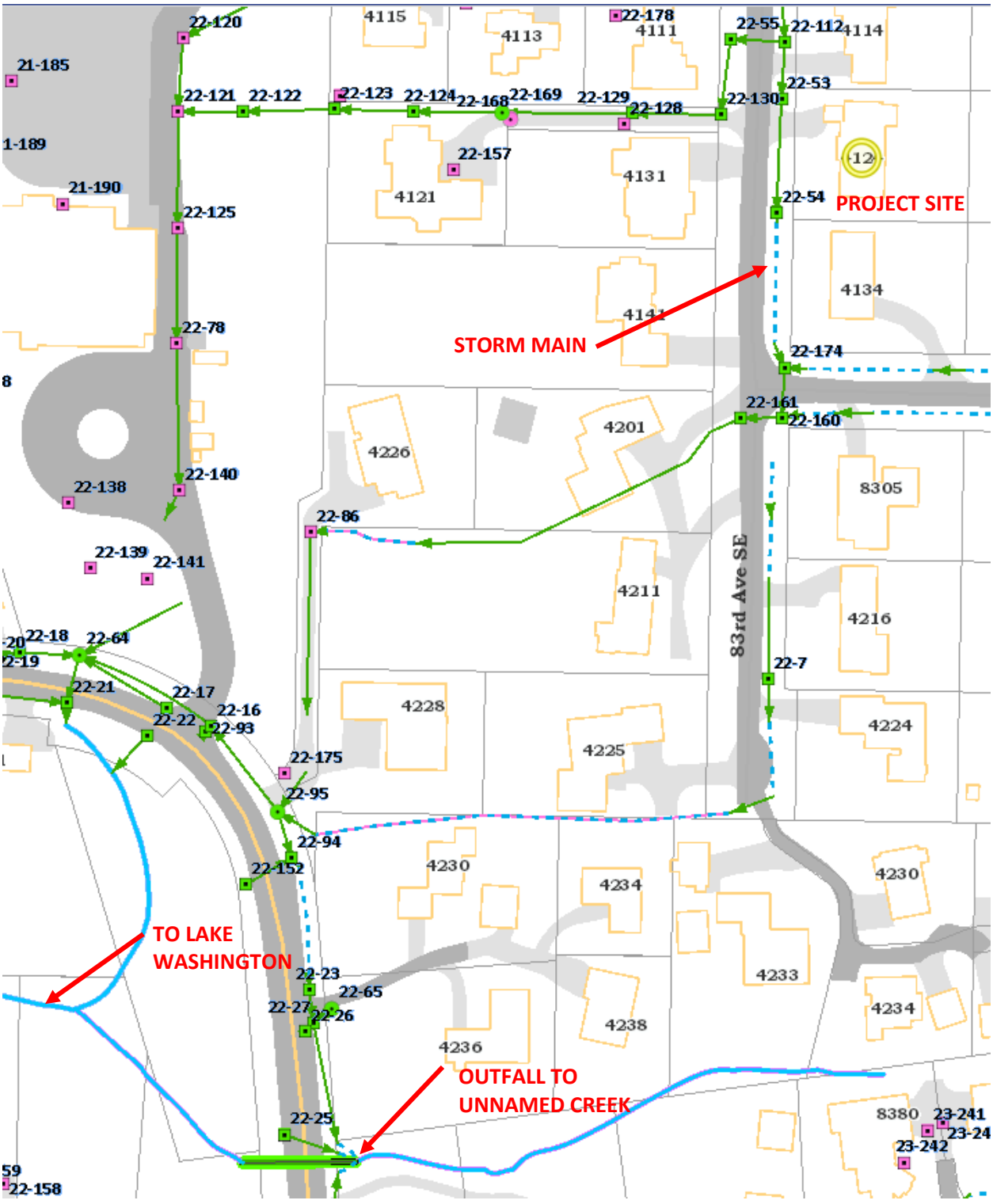


**Figure III-1. Study area (from City of Mercer Island GIS Portal).**


**Figure III-2. Mercer Island GIS Map and Key.**

# Section IV – Stormwater Pollution Prevention Plan (SWPPP) Narrative

**Section IV Summary**

*Narrative*

The purpose of this section of the report is to provide a summary of erosion controls and source controls for the site and serves as a supplement to the erosion control plan.

ESC measures were chosen per Volume II of the SWMMWW. The following ESC measures are suggested for each category below:

**Element 1: Mark Clearing Limits**

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin. The BMPs relevant to marking the clearing limits that will be applied for this project include:

High Visibility Plastic or Metal Fence (BMP C103)

**Element 2: Establish Construction Access**

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads. The specific BMPs related to establishing construction access that will be used on this project include:

Stabilized Construction Entrance (BMP C105)

**Element 3: Control Flow Rates**

Flow controls will be used for energy dissipation. The specific BMPs related to controlling flow rates include:

Silt Fence (BMP C233)

**Element 4: Install Sediment Controls**

All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction site or prior to being discharged. Pollution prevention facilities on the erosion control plan must be constructed prior to or in conjunction with all clearing and grading so as to ensure that the transport of sediment to surface waters and adjacent properties is minimized. The specific BMPs to be used for controlling sediment on this project include:

Silt Fence (BMP C233)

**Element 5: Stabilize Soils**

Exposed and unworked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project. Soils must not remain exposed and unworked for more than 7 days during the dry season (May 1 – September 30) and more than 2 days during the wet season (October 1 – April 30). The specific BMPs for soil stabilization that shall be used on this project include:

Temporary and Permanent Seeding (BMP C120)
Mulching (BMP C121)
Plastic Covering (BMP C123)
Sodding (BMP C124)
Topsoiling/Composting (BMP C125)
Dust Control (BMP C140)

**Element 6: Protect Slopes**
Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking). The specific BMPs to be used for protecting slopes for this project include:

BMPs from Element 5
Surface Roughening (BMP C130)

**Element 7: Protect Drain Inlets**
Stormwater shall not enter the conveyance system without first being filtered or treated to remove sediment. All existing storm drains, and storm drain inlets made operable during construction shall have inlet protection. Inlet protection devices shall be cleaned or removed and replaced when sediment has filled one-third of the available storage (or as specified by the manufacturer). The specific BMPs to be used for protecting drain inlets are:

Storm Drain Inlet Protection (BMP C220)

**Element 8: Stabilize Channels and Outlets**
Not applicable. There are no known on-site conveyance channels.

**Element 9: Control Pollutants**
Design, install, implement, and maintain effective pollution prevention measures to minimize the discharge of pollutants. The suggested BMPs are:

Concrete Handling (BMP C151)
Sawcutting and Surfacing Pollution Prevention (BMP C152)
Material Delivery, Storage and Containment (BMP C153)

**Element 10: Control Dewatering**
All deep excavations on the site should be shored, thereby eliminating the danger of sluffing slopes. Any other temporary slopes should be covered in plastic and sandbags and lined with hay. A double layer of silt fence may be necessary on the downstream perimeter. If excess groundwater is encountered during construction, the contractor should pump the groundwater to a clean gravel/plastic-lined sump before it is conveyed to the public storm system. It may be necessary to install a temporary pond or storage facility to allow the settlement of particulates prior to draining to the public storm system.

**Element 11: Maintain BMPs**
All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to ensure continued performance of their intended function.

**Element 12: Manage the Project**

- Phase development projects to the maximum degree practicable and take into account seasonal work limits.

- Inspection and monitoring – Inspect, maintain, and repair all BMPs as needed to assure continued performance of their intended function. Conduct site inspections and monitoring in accordance with the Construction Stormwater General Permit or local plan approval authority.

- Maintaining an updated construction SWPPP – Maintain, update, and implement the SWPPP in accordance with the Construction Stormwater General Permit.

**Element 13: Protect Low Impact Development BMPs**
There are no low impact development BMPs proposed for this site.


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# Section V – Permanent Stormwater Control Plan Narrative

**Section V Summary**

*PART A: Summary*
*PART B: Performance Standards and Goals*
*PART C: Low Impact Development Features*
*PART D: Flow Control System*
*PART E: Water Quality System*
*PART F: Conveyance System Analysis and Design*
*Detention Pipe Table and Detail*

***PART A: Summary***

Since the project triggers Minimum Requirements #1-9, the project review feasibility of LID BMPs from List #2 for all surfaces or achieve the LID performance standard and apply BMP T5.13: Post Construction Soil Quality and Depth. The project will use List #2.

The proposed land coverage is as follows:

| | |
|---|---|
| *New/Replaced Hard Surface* | |
| Roof: | 4,851 sf (0.11 ac) |
| Concrete Driveway/Walkways: | 1,688 sf (0.04 ac) |
| ROW Concrete Driveway: | 596 sf (0.01 ac) |
| ROW Gravel Driveway: | 599 sf (0.01 ac) |
| Total: | 7,734 sf (0.16 ac) |
| | |
| *Pervious Areas* | |
| Lawn, HSG B | 7,539 sf (0.17 ac) |
| Total: | 7,539 sf (0.17 ac) |

***PART B: Performance Standards and Goals***

Low-Impact Development: The project will review feasibility for LID BMPs from List #2:

Lawn and landscaped areas:

1. Post-construction soil quality and depth in accordance with BMP T5.13 in Chapter 5 of Volume V of the SWMMWW will be used for all disturbed pervious areas.

Roofs:

1. Full Dispersion in accordance with BMP T5.30 is **infeasible** because there is no room on-site or enough forested area for a dispersion system.
2. Downspout Infiltration in accordance with BMP T5.10A is **infeasible** per the geotechnical report and the Mercer Island infiltration infeasibility map, both of which declare the site infeasible for infiltration.
3. Rain garden BMPs in accordance with Chapter 5 of Volume V is **infeasible** due to site constraints and setbacks.

4. Downspout Dispersion in accordance with BMP T5.10B is **infeasible** as site constraints do not allow for the 25-foot flow path required.
5. Perforated Stub-out Connections in accordance with BMP T5.10C are **infeasible** per the geotechnical report and the Mercer Island infiltration infeasibility map, both of which declare the site infeasible for infiltration.

Other Hard Surfaces:

1. Full Dispersion in accordance with BMP T5.30 is **infeasible** because there is no room on-site or enough forested area for a dispersion system.
2. Permeable Pavement in accordance with BMP T5.15 is **infeasible** as the geotechnical engineer does not recommend infiltration as there is dense soils and shallow perched groundwater.
3. Rain garden BMPs in accordance with Chapter 5 of Volume V is **infeasible** due to site constraints and setbacks.
4. Sheet Flow Dispersion in accordance with BMP T5.12 is **infeasible** since there is no room on-site to allow for a vegetated buffer and transition zone to disperse the runoff.

Flow Control Standard: The flow control standard will be met with a detention pipe sized according to the Mercer Island On-Site Detention Design Requirements worksheet.

Water Quality Standard: Not applicable. The total of pollution-generating hard surface (PGHS) is less than 5,000 sf.

***PART C: Low Impact Development Features***

All disturbed pervious surfaces shall meet the post-Construction Soil Quality and Depth per BMP T5.13. No LID BMPs were found to be feasible for the hard surfaces on-site.

***PART D: Flow Control System***

The project will implement a detention pipe and flow control structure, designed per the Mercer Island On-Site Detention Design Requirements worksheet. See the end of this Section for the selected detention pipe.

***PART E: Water Quality System***

Not applicable. The total of pollution-generating hard surface (PGHS) is less than 5,000 sf.

***PART F: Conveyance System Analysis and Design***

The project will tie into an existing storm main with an 8” pipe. The rational method was used to determine the conveyance capacity for the system. The following calculations justify the us of an 8” pipe sloped at 0.5% min for the site runoff.


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**Rational Method - Developed Conditions**
**for: Brumbaugh Residence**

$Q = C_{avg}iA$

**Tc =** 6.30 (assumed, since all pipe flow)

| | Area (ac) | C |
|---|---|---|
| **Dense Forest** | | 0.10 |
| **Light Forest** | | 0.15 |
| **Pasture** | | 0.20 |
| **Lawns** | 0.16 | 0.25 |
| **Gravel** | | 0.80 |
| **Pavement & Roofs** | 0.16 | 0.90 |
| **Open Water** | | 1.00 |
| **Other** | | 0.00 |

$C_{avg}$= 0.58

**Total Area (A) =** 0.32 **acres**

**i = (Pr)(ir)** Pr= total precipitation at the project site for 24-hr duration storm
ir= unit peak rainfall intensity factor

**ir= (ar)(Tc)^(-br)** ar, br= coefficients from Table 3.2.1.B of KCSWDM

| | | | | | |
|---|---|---|---|---|---|
| $(ir)_2$= | 0.54 | $i_2$= | 1.09 | $Q_2$ = | 0.20 |
| $(ir)_{10}$= | 0.75 | $i_{10}$= | 2.10 | $Q_{10}$ = | 0.39 |
| $(ir)_{25}$= | 0.80 | $i_{25}$= | 2.65 | $Q_{25}$ = | **0.49** |
| $(ir)_{100}$= | 0.82 | $i_{100}$= | 3.19 | $Q_{100}$ = | 0.59 |

| | | | | | |
|---|---|---|---|---|---|
| CG ENGINEERING | Rational Method | By | BJL | Date | 3/10/2022 |
| 250 4th Ave. South | Developed Conditions | Chkd | JPU | Date | 3/10/2022 |
| Suite 200 | | Scale | N.T.S. | Sheet No. | |
| Edmonds, WA 98020 | **Brumbaugh Residence** | Job No. | 22032 | | |

**Figure V-1. Rational Method Calculation.**

**Rational Method - Developed Conditions**
**for: Brumbaugh Residence**

**n= 0.013**

| Conveyance Capacity | | | | | |
|---|---|---|---|---|---|
| | **4-inch** | **6-inch** | **8-inch** | **10-inch** | **12-inch** |
| **Slope (ft/ft)** | | | | | |
| **0.005** | 0.13 | 0.40 | 0.87 | 1.55 | 2.52 |
| **0.010** | 0.19 | 0.56 | 1.23 | 2.20 | 3.57 |
| **0.015** | 0.23 | 0.69 | 1.50 | 2.69 | 4.37 |
| **0.020** | 0.27 | 0.79 | 1.74 | 3.11 | 5.05 |
| **0.025** | 0.30 | 0.89 | 1.94 | 3.47 | 5.65 |
| **0.030** | 0.33 | 0.97 | 2.13 | 3.81 | 6.18 |
| **0.035** | 0.36 | 1.05 | 2.30 | 4.11 | 6.68 |
| **0.040** | 0.38 | 1.12 | 2.46 | 4.39 | 7.14 |
| **0.045** | 0.40 | 1.19 | 2.60 | 4.66 | 7.57 |
| **0.050** | 0.43 | 1.26 | 2.75 | 4.91 | 7.98 |
| **0.055** | 0.45 | 1.32 | 2.88 | 5.15 | 8.37 |
| **0.060** | 0.47 | 1.38 | 3.01 | 5.38 | 8.75 |
| **0.065** | 0.49 | 1.43 | 3.13 | 5.60 | 9.10 |
| **0.070** | 0.50 | 1.49 | 3.25 | 5.81 | 9.45 |
| **0.075** | 0.52 | 1.54 | 3.36 | 6.02 | 9.78 |
| **0.080** | 0.54 | 1.59 | 3.47 | 6.21 | 10.10 |
| **0.085** | 0.56 | 1.64 | 3.58 | 6.40 | 10.41 |
| **0.090** | 0.57 | 1.68 | 3.68 | 6.59 | 10.71 |
| **0.095** | 0.59 | 1.73 | 3.78 | 6.77 | 11.01 |
| **0.100** | 0.60 | 1.78 | 3.88 | 6.95 | 11.29 |

*Use 8" PVC @ 0.5% min.

| | | | | |
|---|---|---|---|---|
| CG ENGINEERING<br>250 4th Ave. South<br>Suite 200<br>Edmonds, WA 98020 | Rational Method | | By BJL | Date 3/10/2022 |
| | Developed Conditions | | Chkd JPU | Date 3/10/2022 |
| | | | Scale N.T.S. | Sheet No. |
| | **Brumbaugh Res.** | | Job No. 22032 | |

**Figure V-2. Conveyance Capacity Table.**

# Table 1

ON-SITE DETENTION DESIGN FOR PROJECTS BETWEEN 500 SF AND 9,500 SF NEW PLUS REPLACED IMPERVIOUS SURFACE AREA

| New and Replaced Impervious Surface Area (sf) | Detention Pipe Diameter (in) | Detention Pipe Length (ft) | | Lowest Orifice Diameter (in)[3] | | Distance from Outlet Invert to Second Orifice (ft) | | Second Orifice Diameter (in) | |
|---|---|---|---|---|---|---|---|---|---|
| | | B soils | C soils | B soils | C soils | B soils | C soils | B soils | C soils |
| **500 to 1,000 sf** | 36" | 30 | 22 | 0.5 | 0.5 | 2.2 | 2.0 | 0.5 | 0.8 |
| | 48" | 18 | 11 | 0.5 | 0.5 | 3.3 | 3.2 | 0.9 | 0.8 |
| | 60" | 11 | 7 | 0.5 | 0.5 | 4.2 | 3.4 | 0.5 | 0.6 |
| **1,001 to 2,000 sf** | 36" | 66 | 43 | 0.5 | 0.5 | 2.2 | 2.3 | 0.9 | 1.4 |
| | 48" | 34 | 23 | 0.5 | 0.5 | 3.2 | 3.3 | 0.9 | 1.2 |
| | 60" | 22 | 14 | 0.5 | 0.5 | 4.3 | 3.6 | 0.9 | 0.9 |
| **2,001 to 3,000 sf** | 36" | 90 | 66 | 0.5 | 0.5 | 2.2 | 2.4 | 0.9 | 1.9 |
| | 48" | 48 | 36 | 0.5 | 0.5 | 3.1 | 2.8 | 0.9 | 1.5 |
| | 60" | 30 | 20 | 0.5 | 0.5 | 4.2 | 3.7 | 0.9 | 1.1 |
| **3,001 to 4,000 sf** | 36" | 120 | 78 | 0.5 | 0.5 | 2.4 | 2.2 | 1.4 | 1.6 |
| | 48" | 62 | 42 | 0.5 | 0.5 | 2.8 | 2.9 | 0.8 | 1.3 |
| | 60" | 42 | 26 | 0.5 | 0.5 | 3.8 | 3.9 | 0.9 | 1.3 |
| **4,001 to 5,000 sf** | 36" | 134 | 91 | 0.5 | 0.5 | 2.8 | 2.2 | 1.7 | 1.5 |
| | 48" | 73 | 49 | 0.5 | 0.5 | 3.6 | 2.9 | 1.6 | 1.5 |
| | 60" | 46 | 31 | 0.5 | 0.5 | 4.6 | 3.5 | 1.6 | 1.3 |
| **5,001 to 6,000 sf** | 36" | 162 | 109 | 0.5 | 0.5 | 2.7 | 2.2 | 1.8 | 1.6 |
| | 48" | 90 | 59 | 0.5 | 0.5 | 3.5 | 2.9 | 1.7 | 1.5 |
| | 60" | 54 | 37 | 0.5 | 0.5 | 4.6 | 3.6 | 1.6 | 1.4 |
| **6,001 to 7,000 sf** | 36" | 192 | 128 | 0.5 | 0.5 | 2.7 | 2.2 | 1.9 | 1.8 |
| | 48" | 102 | 68 | 0.5 | 0.5 | 3.7 | 2.9 | 1.9 | 1.6 |
| | 60" | 64 | 43 | 0.5 | 0.5 | 4.6 | 3.6 | 1.8 | 1.5 |
| **7,001 to 8,000 sf** | 36" | 216 | 146 | 0.5 | 0.5 | 2.8 | 2.2 | 2.0 | 1.9 |
| | 48" | 119 | 79 | 0.5 | 0.5 | 3.8 | 2.9 | 2.2 | 1.7 |
| | 60" | 73 | 49 | 0.5 | 0.5 | 4.5 | 3.6 | 2.0 | 1.6 |
| **8,001 to 8,500 sf[1]** | 36" | 228 | 155 | 0.5 | 0.5 | 2.8 | 2.2 | 2.1 | 1.9 |
| | 48" | 124 | 84 | 0.5 | 0.5 | 3.7 | 2.9 | 1.9 | 1.8 |
| | 60" | 77 | 53 | 0.5 | 0.5 | 4.6 | 3.6 | 2.0 | 1.6 |
| **8,501 to 9,000 sf** | 36" | NA [1] | 164 | 0.5 | 0.5 | NA [1] | 2.2 | NA [1] | 1.9 |
| | 48" | NA [1] | 89 | 0.5 | 0.5 | NA [1] | 2.9 | NA [1] | 1.9 |
| | 60" | NA [1] | 55 | 0.5 | 0.5 | NA [1] | 3.6 | NA [1] | 1.7 |
| **9,001 to 9,500 sf[2]** | 36" | NA [1] | 174 | 0.5 | 0.5 | NA [1] | 2.2 | NA [1] | 2.1 |
| | 48" | NA [1] | 94 | 0.5 | 0.5 | NA [1] | 2.9 | NA [1] | 2.0 |
| | 60" | NA [1] | 58 | 0.5 | 0.5 | NA [1] | 3.7 | NA [1] | 1.7 |

**Notes:**

▪ Minimum Requirement #7 (Flow Control) is required when the 100-year flow frequency causes a 0.15 cubic feet per second increase (when modeled in WWHM with a 15-minute timestep). Breakpoints shown in this table are based on a flat slope (0-5%). The 100-year flow frequency will need to be evaluated on a site-specific basis for projects on moderate (5-15%) or steep (> 15%) slopes.

▪ Soil type to be determined by geotechnical analysis or soil map.

▪ Sizing includes a Volume Correction Factor of 120%.

▪ Upper bound contributing area used for sizing.

[1] On Type B soils, new plus replaced impervious surface areas exceeding 8,500 sf trigger Minimum Requirement #7 (Flow Control)

[2] On Type C soils, new plus replaced impervious surface areas exceeding 9,500 sf trigger Minimum Requirement #7 (Flow Control)

[3] Minimum orifice diameter = 0.5 inches

in = inch

ft = feet

sf = square feet

**Basis of Sizing Assumptions:**

Sized per MR#5 in the Stormwater Management Manual for Puget Sound Basin (1992 Ecology Manual)

SBUH, Type 1A, 24-hour hydrograph

2-year, 24-hour storm = 2 in; 10-year, 24-hour storm = 3 in; 100-year, 24-hour storm = 4 in

Predeveloped = second growth forest (CN = 72 for Type B soils, CN = 81 for Type C soils)

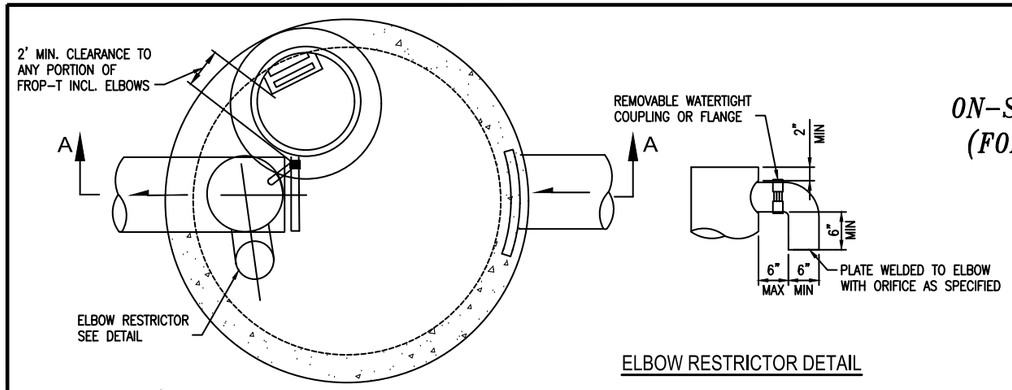
Developed = impervious (CN = 98)

0.5 foot of sediment storage in detention pipe

Overland slope = 5%

# *ATTACHMENT 1*
# *CITY OF MERCER ISLAND*
# *ON-SITE DETENTION SYSTEM WORKSHEET*
# *(FOR NEW PLUS REPLACED IMPERVIOUS AREA OF 9,500 SF OR LESS)*

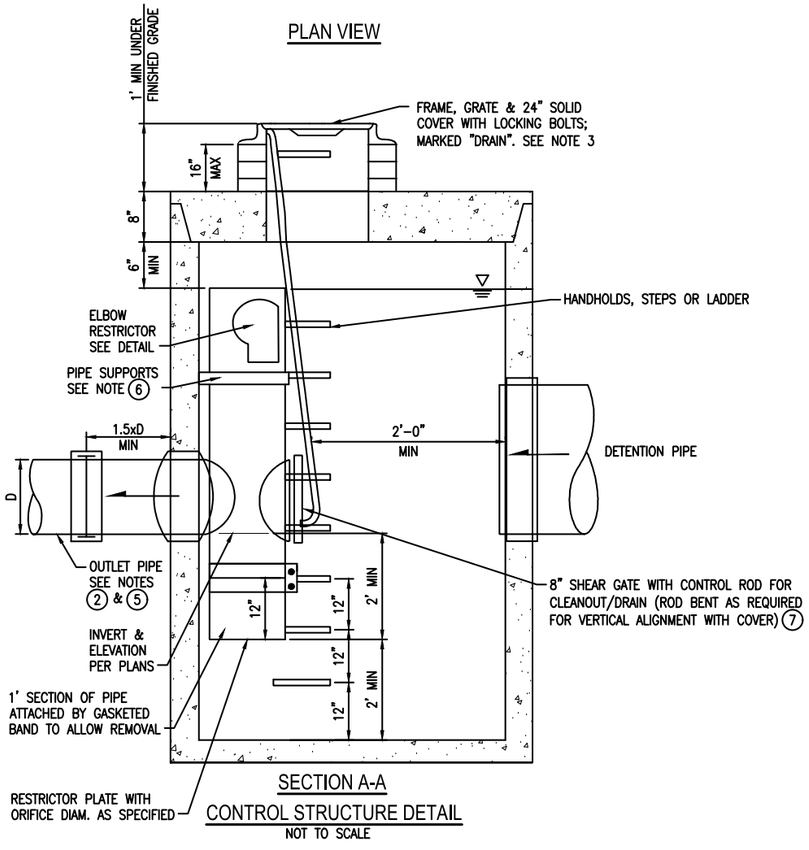
| | | | |
|---|---|---|---|
| OWNER: LAUREN & ELI BRUMBAUGH | ADDRESS: 4124 83RD AVE SE | PREPARED BY: BENNETT LANNERS | |
| PERMIT #: 2204-105 | MERCER ISLAND, WA 98040 | PHONE: 425.778.8500 | |
| | | DATE: 05/11/22 | |
| NEW PLUS REPLACED IMPERVIOUS SURFACE AREA (SF): 7,734 | DETENTION PIPE DIA (INCH): 36 | DETENTION PIPE LENGTH (FT): 216 | ORIFICE #1 DIA 0.5 INCH, ELEV 272.0 |
| SOIL TYPE: HSG B | PIPE MATERIAL: N-12 | | ORIFICE #2 DIA 2.0 INCH, ELEV 274.7 |




PLAN VIEW



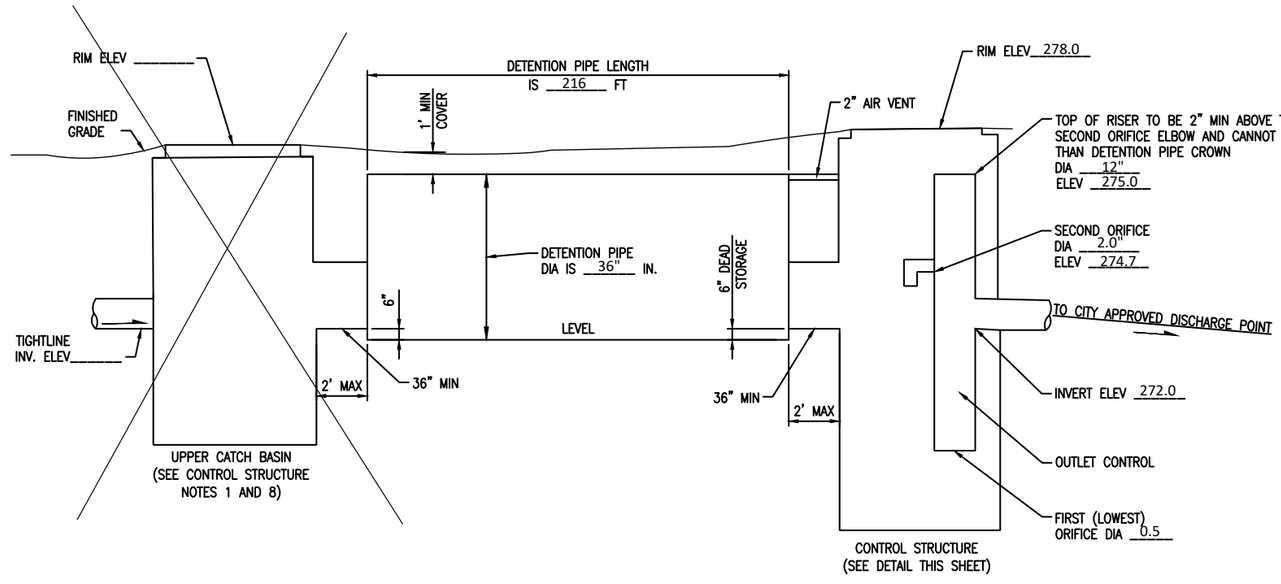

ELBOW RESTRICTOR DETAIL




SECTION A-A

CONTROL STRUCTURE DETAIL

NOT TO SCALE




ON-SITE DETENTION SYSTEM

NOT TO SCALE (ENGINEER TO FILL IN BLANKS)

## CONTROL STRUCTURE NOTES:

1. USE A MINIMUM OF A 54 IN. DIAM. TYPE 2 CATCH BASIN. THE ACTUAL SIZE IS DEPENDENT ON CONNECTING PIPE MATERIAL AND DIAMETER.
2. OUTLET PIPE: MIN. 6 INCH.
3. METAL PARTS: CORROSION RESISTANT. NON-GALVANIZED PARTS PREFERRED. GALVANIZED PIPE PARTS TO HAVE ASPHALT TREATMENT 1.
4. FRAME AND LADDER OR STEPS OFFSET SO:
   - A. CLEANOUT GATE IS VISIBLE FROM TOP;
   - B. CLIMB-DOWN SPACE IS CLEAR OF RISER AND CLEANOUT GATE;
   - C. FRAME IS CLEAR OF CURB.
5. IF METAL OUTLET PIPE CONNECTS TO CEMENT CONCRETE PIPE, OUTLET PIPE TO HAVE SMOOTH O.D. EQUAL TO CONCRETE PIPE I.D. LESS 1/4 IN.
6. PROVIDE AT LEAST ONE 3 X 0.090 GAUGE SUPPORT BRACKET ANCHORED TO CONCRETE WALL WITH 5/8 IN. STAINLESS STEEL EXPANSION BOLTS OR EMBEDDED SUPPORTS 2 IN. INTO CATCH BASIN WALL (MAXIMUM 3'-0" VERTICAL SPACING).
7. THE SHEAR GATE SHALL BE MADE OF ALUMINUM ALLOY IN ACCORDANCE WITH ASTM B 26M AND ASTM B 275, DESIGNATION ZG32A; OR CAST IRON IN ACCORDANCE WITH ASTM A 48, CLASS 30B.
   THE LIFT HANDLE SHALL BE MADE OF A SIMILAR METAL TO THE GATE (TO PREVENT GALVANIC CORROSION), IT MAY BE OF SOLID ROD OR HOLLOW TUBING, WITH ADJUSTABLE HOOK AS REQUIRED.
   A NEOPRENE RUBBER GASKET IS REQUIRED BETWEEN THE RISER MOUNTING FLANGE AND THE GATE FLANGE.
   INSTALL THE GATE SO THAT THE LEVEL-LINE MARK IS LEVEL WHEN THE GATE IS CLOSED.
   THE MATING SURFACES OF THE LID AND THE BODY SHALL BE MACHINED FOR PROPER FIT.
   ALL SHEAR GATE BOLTS SHALL BE STAINLESS STEEL.
8. THE UPPER CATCH BASIN IS REQUIRED IF THE LENGTH OF THE DETENTION PIPE IS GREATER THAN 50 FT.

## ON-SITE DETENTION SYSTEM NOTES:

1. CALL DEVELOPMENT SERVICES (206-275-7605) 24 HOURS IN ADVANCE FOR A DETENTION SYSTEM INSPECTION BEFORE BACKFILLING AND FOR FINAL INSPECTIONS.
2. RESPONSIBILITY FOR OPERATION AND MAINTANANCE OF DRAINAGE SYSTEMS ON PRIVATE PROPERTY IS RESPONSIBILITY OF THE PROPERTY OWNER. MATERIAL ACCUMULATED IN THE STORAGE PIPE MUST BE REMOVED FROM CATCH BASINS TO ALLOW PROPER OPERATION. THE OUTLET CONTROL ORIFICE MUST BE KEPT OPEN AT ALL TIMES.
3. PIPE MATERIAL, JOINT, AND PROTECTIVE TREATMENT SHALL BE IN ACCORDANCE WITH SECTION 7.04 AND 9.05 OF THE WSDOT STANDARD SPECIFICATION FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION, LATEST VERSION. SUCH MATERIALS INCLUDE THE FOLLOWING, LINED CORRUGATED POLYETHYLENE PIPE (LCPE), ALUMINIZED TYPE 2 CORRUGATED STEEL PIPE AND PIPE ARCH (MEETS AASHTO DESIGNATIONS M274 AND M36), CORRUGATED OR SPIRAL RIB ALUMINUM PIPE, OR REINFORCED CONCRETE PIPE. CORRUGATED STEEL PIPE IS NOT ALLOWED.
4. FOOTING DRAINS SHALL NOT BE CONNECTED TO THE DETENTION SYSTEM.

# Section VI – Special Reports and Studies

**Section VI Summary**

*Narrative*

The following reports are provided in this section:

1. NRCS Custom Soil Resource Report dated March 1, 2022.

2. Infiltration Test Report dated March 22, 2022, by PanGEO, Inc.



250 4th Avenue South, Suite 200
Edmonds, WA 98020
ph. 425.778.8500 | f. 425.778.5536
www.cgengineering.com

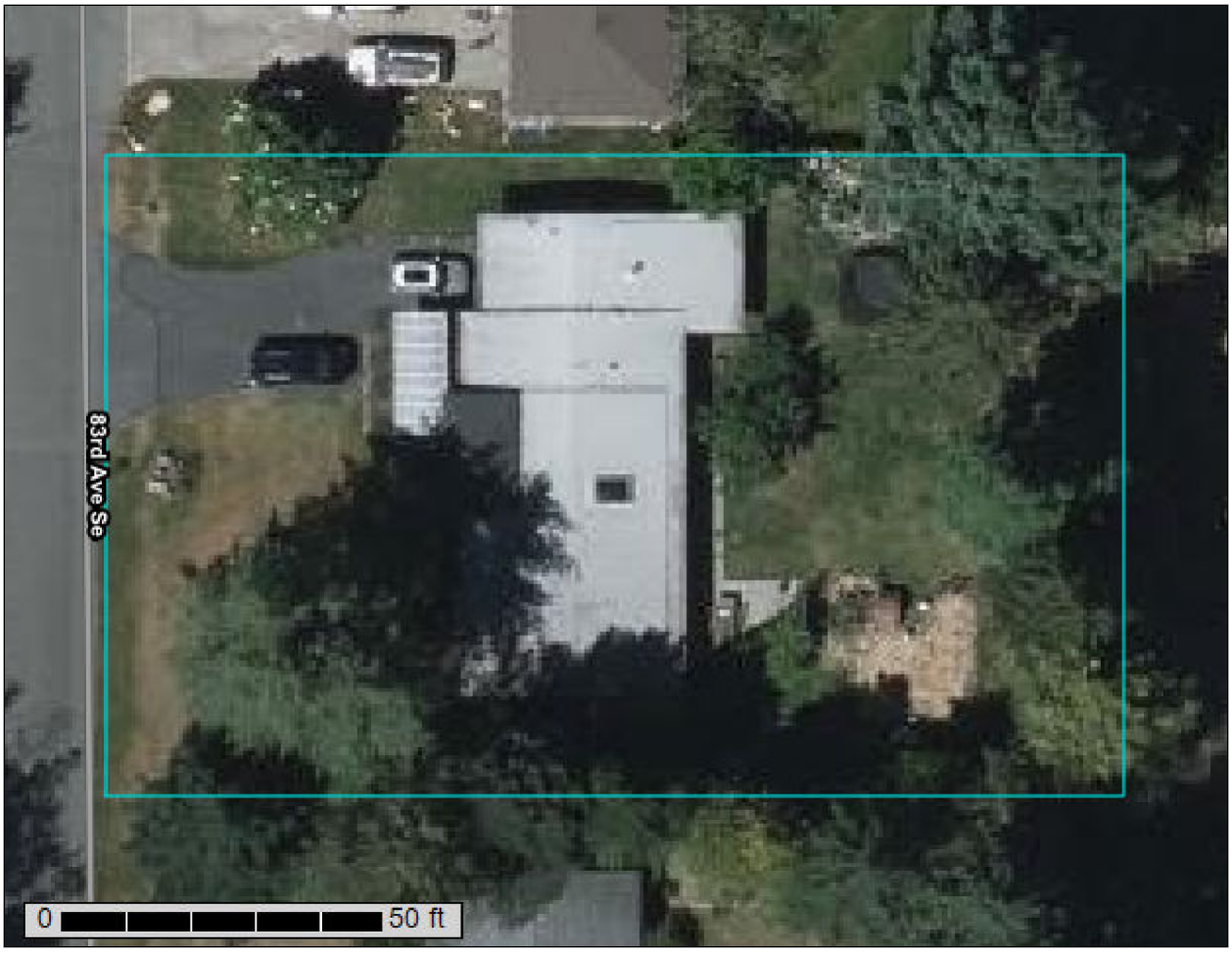
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for King County Area, Washington




March 1, 2022

# Custom Soil Resource Report
## Soil Map


Map Scale: 1:264 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 3 7 14 21

Feet
0 10 20 40 60

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| AmC | Arents, Alderwood material, 6 to 15 percent slopes | 0.4 | 100.0% |
| **Totals for Area of Interest** | | **0.4** | **100.0%** |

# King County Area, Washington

## AmC—Arents, Alderwood material, 6 to 15 percent slopes

### Map Unit Setting

*National map unit symbol:* 1hmsq
*Elevation:* 50 to 660 feet
*Mean annual precipitation:* 35 to 60 inches
*Mean annual air temperature:* 50 degrees F
*Frost-free period:* 150 to 200 days
*Farmland classification:* Prime farmland if irrigated

### Map Unit Composition

*Arents, alderwood material, and similar soils:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Arents, Alderwood Material

#### Setting

*Landform:* Till plains
*Parent material:* Basal till

#### Typical profile

*H1 - 0 to 26 inches:* gravelly sandy loam
*H2 - 26 to 60 inches:* very gravelly sandy loam

#### Properties and qualities

*Slope:* 6 to 15 percent
*Depth to restrictive feature:* 20 to 40 inches to densic material
*Drainage class:* Moderately well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
*Depth to water table:* About 16 to 36 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water supply, 0 to 60 inches:* Very low (about 2.3 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4s
*Hydrologic Soil Group:* B/D
*Hydric soil rating:* No

PanGEO INCORPORATED
*Geotechnical & Earthquake Engineering Consultants*

March 22, 2022
Project No. 22-026

Lauren and Eli Brumbaugh
4124 83rd Avenue SE
Mercer Island, WA 98040

**Subject: Infiltration Test Report**
**4124 83rd Avenue Southeast**
**Mercer Island, Washington**

Dear Lauren and Eli:

As requested, PanGEO, Inc. completed an infiltration testing program at the above-referenced site. We excavated two test pits at the site to about 5 to 7 feet deep on January 20, 2022. At the time of excavation and infiltration testing, test pit PIT-1 at the front yard encountered light groundwater seepage at the test depth of five feet which resulted in exfiltration of water and zero infiltration within the Vashon till unit. In test pit TP-2 at the back yard, perched groundwater seepage was encountered between three and four feet beneath the ground surface, within a surficial fill unit. Due to the observed groundwater conditions at time of testing, it is our opinion that infiltration of surface water is not feasible at this site and other stormwater BMPs should be considered.

We appreciate the opportunity to be of service. Please call if you have any questions.

Sincerely,

Johnny Chen

Johnny C. Chen, P.E.
Senior Geotechnical Engineer

3213 Eastlake Avenue E, Ste B
Seattle, WA 98102
Tel (206) 262-0370

TABLE OF CONTENTS



**LIST OF ATTACHMENTS**

# INFILTRATION TEST REPORT
# 4124 83RD AVENUE SOUTHEAST
# MERCER ISLAND, WASHINGTON

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## 1.0 INTRODUCTION

PanGEO completed an infiltration evaluation of the site soil at 4124 83rd Avenue Southeast in Mercer Island, Washington. Our service scope consisted of reviewing readily available geologic and geotechnical data, observing the excavation of two test pits, performing Small Pilot Infiltration Test (PIT), and providing the infiltration evaluation in this report.

## 2.0 SITE AND PROJECT DESCRIPTION

The project site is located at 4124 83rd Avenue Southeast in Mercer Island, Washington (see Figure 1, Vicinity Map). The site is a rectangular shaped parcel and approximately 14,078 square feet in size. It is bordered by 83rd Avenue Southeast to the west, and existing single-family residences to the other three sides. The site is currently occupied by a single-story house with crawlspace and attached garage at the approximate center of the property (see Figure 2, Site and Exploration Plan).

We understand that you plan to either add-on and renovate to the existing residence or demolish the existing residence and build another in the approximate center portion of the property. We also understand that infiltration will be used to dispose surface water from impervious areas, if feasible. Based on the information provided by your civil engineer, the proposed infiltration facility may be located at the front or back yard of the proposed residence with a design bottom approximately five feet below the existing grade, if feasible.

## 3.0 SUBSURFACE EXPLORATIONS

Two test pits (PIT-1 and TP-2) were excavated at the project site on January 20, 2022. PIT-1 was excavated to 5 feet for infiltration testing. TP-2 was initially excavated to about 5 feet for infiltration testing, then excavated to about 7 feet deep after perched groundwater conditions were encountered. The approximate test pit locations are shown on the attached Figure 2, Site and Exploration Plan.

A geologist from PanGEO was present during the field explorations to observe the test pit excavation, document the soil samples obtained from the borings, and perform the infiltration

tests. The summary test pit logs are included in Appendix A as Figures A-2 and A-3. The soil samples were described using the system outlined on Figure A-1.

## 4.0 SUBSURFACE CONDITIONS

### 4.1 SITE GEOLOGY

Based on review of *The Geologic Map of Mercer Island* (Troost and Wisher, 2006), the project site is underlain by Vashon Till (Geologic Map Unit *Qvt*). Vashon till is described by Troost and Wisher as dense to very dense, heterogeneous mixture of silt, sand, and gravel laid down at the base of an advancing glacial ice sheet. Vashon till is generally very dense in its undisturbed state and presents low infiltration feasibility.

### 4.2 SOIL CONDITIONS

The subsurface conditions encountered in the test borings are quite consistent, and we interpret as fill overlaying Vashon till. A general description of the soil units encountered in the test borings is presented below. A more detailed description of the soils encountered in the test borings can be found on the summary boring logs located in Appendix A.

**Unit 1: Fill** – A surficial layer of fill was encountered in both test pits completed at the site. Approximately 1½ feet of fill consisted of loose silty sand with trace gravels and roots was encountered in test pit PIT-1. In test pit TP-2, the fill was about 5½ foot thick and consisted of loose to medium dense silty sand and gravel with an increase of cobble and wood debris. This soil unit was disrupted and heavily reworked. We interpreted this soil unit as fill.

**Unit 2: Vashon Till –** Medium dense to dense silty sand with trace gravel was encountered below the fill and extended to the bottom of test borings at about 5 and 7 feet deep. The upper portion of this unit was iron-oxide stained and slightly diamict. This soil unit appears to be consistent with the mapped Vashon till.

### 4.3 GROUNDWATER

Groundwater was encountered in both test pits during excavation. Test pit PIT-1 encountered light groundwater seepage at the infiltration test depth of about 5 feet below the existing grade. Test pit PIT-2 encountered moderate perched groundwater seepage at about 3 to 4 feet below the existing grade within the surficial fill.

It should be noted that there will be fluctuations in groundwater conditions depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, the water level is higher and seepage rates are greater in the wetter, winter months (typically October through May).

## 5.0 INFILTRATION TESTING AND CONCLUSIONS

The field infiltration test was conducted in general accordance with the procedure for the Small Pilot Infiltration Test (PIT) as outlined in the *2012 Stormwater Management Manual for Western Washington, as Amended in December 2014* (SMMWW). In general, the test consisted of the following procedure:

- A test pit was excavated to the approximate design bottom of the proposed infiltration facility with a minimum bottom area of at least 12 square feet.
- The test pit was pre-soaked by maintaining a water level of about 12 inches above the bottom of the pit for at least 6 hours.
- At the end of the pre-soak period, a flow meter was used to monitor the amount of water needed to maintain a constant head of 12 inches for at least one hour and until at least a point at which a constant volume of water per time unit was achieved.
- At the end of the constant head test, we measured the falling head infiltration rate by shutting off the water flow and recording the drop in water level over regular time intervals for one hour or until all the water has infiltrated.

During our initial test pitting procedures at the target depth of the proposed infiltration facility at test pit PIT-1, we observed light groundwater seepage at about 5 feet below the existing grade. During the pre-soak period of the infiltration test, water at the source was turned off and the level of water in the test pit continued to rise, resultant of exfiltration of groundwater into the PIT-1. At test pit PIT-2 location, groundwater seepage was encountered at about 3 to 4 feet below the existing grade, which is above the bottom of proposed infiltration facility. Therefore, based on the subsurface conditions, it is our opinion that infiltration of surface water is not feasible at this site and other stormwater BMPs should be considered for this project.

## 6.0 LIMITATIONS

We have prepared this report for use by Nicole and Stephan Donaldson and the project team. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

Within the limitation of scope, schedule and budget, PanGEO engages in the practice of geotechnical engineering and endeavors to perform its services in accordance with generally accepted professional principles and practices at the time the Report or its contents were prepared. No warranty, express or implied, is made.

We trust that the information outlined in this letter meets your need at this time. Please call if you have any questions.

Sincerely,

**PanGEO, Inc.**


Spenser P. Scott, L.G.
Project Geologist

Chien-Lin (Johnny) Chen, P.E.
Senior Geotechnical Engineer

## 7.0 LIST OF REFERENCES

Troost, K.G., Wisher, A. P., 2006, *The Geologic Map of Mercer Island, Washington;* scale 1:12,000.

Washington State Department of Ecology. *2012 Stormwater Management Manual for Western Washington, as Amended in December 2014 (The 2014 SWMMWW),* Publication Number 14-10-055.

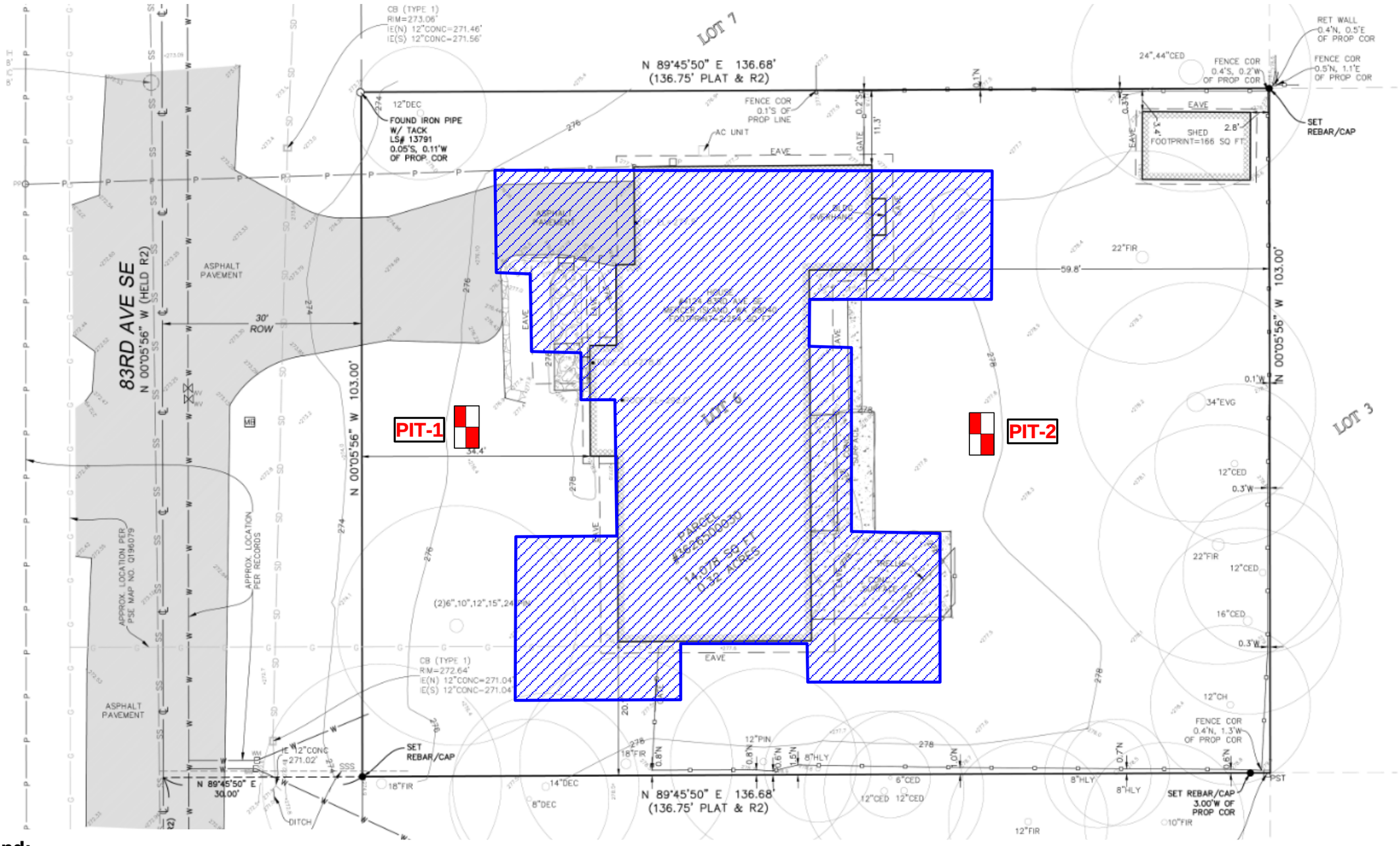

*Base Map: ESRI Topographic*

NORTH

**Not to Scale**

| | | | |
|---|---|---|---|
| PanGEO INCORPORATED | **Infiltration Test**<br>**4124 83rd Avenue Southeast**<br>**Mercer Island, Washington** | **VICINITY MAP** | |
| | | Project No. **22-026** | Figure No. **1** |

22-026 Fig 1 - Vicinity Map.grf 3/23/22 (10:57:31) SPS




**Legend:**

Approximate Test Pit Location
*PanGEO, Inc., January 2022*

Approximate Proposed Building

Approx. Scale:
1 inch = 15 feet

*Base map modified from Topographic & Boundary Survey by Terrane, dated May 21, 2021*

PanGEO INCORPORATED

**Infiltration Test**
**4124 83rd Avenue Southwest**
**Mercer Island, Washington**

**SITE AND EXPLORATION PLAN**

Project No. **22-026**

Figure No. **2**

22-026 Fig 2 Site and Exploration Plan.grf 3/23/22 (11:00:13) SPS

# APPENDIX A

# SUMMARY TEST PIT LOGS

## RELATIVE DENSITY / CONSISTENCY

| SAND / GRAVEL | | | SILT / CLAY | | |
|---|---|---|---|---|---|
| Density | SPT N-values | Approx. Relative Density (%) | Consistency | SPT N-values | Approx. Undrained Shear Strength (psf) |
| Very Loose | <4 | <15 | Very Soft | <2 | <250 |
| Loose | 4 to 10 | 15 - 35 | Soft | 2 to 4 | 250 - 500 |
| Med. Dense | 10 to 30 | 35 - 65 | Med. Stiff | 4 to 8 | 500 - 1000 |
| Dense | 30 to 50 | 65 - 85 | Stiff | 8 to 15 | 1000 - 2000 |
| Very Dense | >50 | 85 - 100 | Very Stiff | 15 to 30 | 2000 - 4000 |
| | | | Hard | >30 | >4000 |

## UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | GROUP DESCRIPTIONS | |
|---|---|---|---|
| Gravel<br>50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines. | GRAVEL (<5% fines) | GW | Well-graded GRAVEL |
| | | GP | Poorly-graded GRAVEL |
| | GRAVEL (>12% fines) | GM | Silty GRAVEL |
| | | GC | Clayey GRAVEL |
| Sand<br>50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines. | SAND (<5% fines) | SW | Well-graded SAND |
| | | SP | Poorly-graded SAND |
| | SAND (>12% fines) | SM | Silty SAND |
| | | SC | Clayey SAND |
| Silt and Clay<br>50%or more passing #200 sieve | Liquid Limit < 50 | ML | SILT |
| | | CL | Lean CLAY |
| | | OL | Organic SILT or CLAY |
| | Liquid Limit > 50 | MH | Elastic SILT |
| | | CH | Fat CLAY |
| | | OH | Organic SILT or CLAY |
| Highly Organic Soils | | PT | PEAT |

**Notes:** 1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

## DESCRIPTIONS OF SOIL STRUCTURES

**Layered:** Units of material distinguished by color and/or composition from material units above and below

**Laminated:** Layers of soil typically 0.05 to 1mm thick, max. 1 cm

**Lens:** Layer of soil that pinches out laterally

**Interlayered:** Alternating layers of differing soil material

**Pocket:** Erratic, discontinuous deposit of limited extent

**Homogeneous:** Soil with uniform color and composition throughout

**Fissured:** Breaks along defined planes

**Slickensided:** Fracture planes that are polished or glossy

**Blocky:** Angular soil lumps that resist breakdown

**Disrupted:** Soil that is broken and mixed

**Scattered:** Less than one per foot

**Numerous:** More than one per foot

**BCN:** Angle between bedding plane and a plane normal to core axis

## COMPONENT DEFINITIONS

| COMPONENT | SIZE / SIEVE RANGE | COMPONENT | SIZE / SIEVE RANGE |
|---|---|---|---|
| Boulder: | > 12 inches | Sand | |
| Cobbles: | 3 to 12 inches | Coarse Sand: | #4 to #10 sieve (4.5 to 2.0 mm) |
| Gravel | | Medium Sand: | #10 to #40 sieve (2.0 to 0.42 mm) |
| Coarse Gravel: | 3 to 3/4 inches | Fine Sand: | #40 to #200 sieve (0.42 to 0.074 mm) |
| Fine Gravel: | 3/4 inches to #4 sieve | Silt | 0.074 to 0.002 mm |
| | | Clay | <0.002 mm |

## TEST SYMBOLS

**for In Situ and Laboratory Tests listed in "Other Tests" column.**

| | |
|---|---|
| ATT | Atterberg Limit Test |
| Comp | Compaction Tests |
| Con | Consolidation |
| DD | Dry Density |
| DS | Direct Shear |
| %F | Fines Content |
| GS | Grain Size |
| Perm | Permeability |
| PP | Pocket Penetrometer |
| R | R-value |
| SG | Specific Gravity |
| TV | Torvane |
| TXC | Triaxial Compression |
| UCC | Unconfined Compression |

## SYMBOLS

**Sample/In Situ test types and intervals**

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

## MONITORING WELL

- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

## MOISTURE CONTENT

| | |
|---|---|
| Dry | Dusty, dry to the touch |
| Moist | Damp but no visible water |
| Wet | Visible free water |

PanGEO INCORPORATED
Phone: 206.262.0370

# Terms and Symbols for Boring and Test Pit Logs

**Figure A-1**

**Test Pit No. PIT-1**

Approximate ground surface elevation (NAVD88): 276 feet

Coordinates (Washington State Plane - North): 211676, 1296136

| Depth (ft) | Material Description |
|---|---|
| 0 – 1½ | Approximate 6-inch topsoil above loose, brown to dark brown, silty SAND; trace gravel and cobble, roots and rootlets; disrupted texture, non-plastic, moist **[Fill]** |
| 1½ – 3½ | Medium dense, orange-brown to gray-brown, silty SAND; trace gravel and cobble; slightly diamict texture; non-plastic, moist<br>• *Increasing moisture and sand content with depth* |
| 3½ – 5 | Dense, gray, silty SAND; trace gravel, iron-oxide staining; non-plastic, very moist **[Qvt – Vashon Till]** |


**Photo PIT-1 :** Shows PIT-1 at approximately 5 feet in depth during infiltration testing

Light groundwater seepage was encountered at approximately 5 feet below grade during explorations.

**Test Pit No. TP-2**

Approximate ground surface elevation (NAVD88): 278 feet

Coordinates (Washington State Plane - North): 211668, 1296217

| Depth (ft) | Material Description |
|---|---|
| 0 – 2 | Approximate 12-inch topsoil above loose to medium dense, brown to dark brown, silty SAND; trace gravel and cobble, roots and rootlets; disrupted, till-like texture, non-plastic, moist |
| 2 – 5½ | Medium dense, orange-brown, silty SAND; trace gravel and cobble, trace rootlets; slightly diamict texture; heavily reworked; non-plastic, moist to wet<br>• *Moderate groundwater seepage from 3 to 4 feet below grade*<br>**[Fill]** |
| 5½ – 7 | Dense, gray-brown, silty SAND; trace gravel, iron-oxide staining; slightly diamict texture; non-plastic, very moist<br>**[Qvt – Vashon Till]** |


**Photo TP-2 :** Shows TP-2 at approximately 7 feet in depth

Moderate perched groundwater seepage was encountered at approximately 3 to 4 feet below grade during explorations.

**Date of Excavations:** January 20, 2022

**Excavations Logged by:** S. Scott

# Section VII – Declaration of Covenant and Operation and Maintenance Manual

**Section VIII Summary**

*Narrative*

A Declaration of Covenant will be provided in future submittals if required by the City.

The Operation and Maintenance Manual is a standalone document that will be given to the owner(s) following the construction of the project.

The maintenance manual contained herein is for the Brumbaugh Residence building project. The contractor will be responsible for the maintenance and operation of all stormwater structures and BMPs requiring maintenance during construction, and, after construction, responsibility will pass to the homeowner(s). The project contractor will be responsible for passing along the information in this maintenance manual to the owner(s). Upon request by the City, it shall be made available for their inspection. It is generally expected that few to none of these defects will be present upon the yearly inspection of each facility.



250 4th Avenue South, Suite 200
Edmonds, WA 98020
ph. 425.778.8500 | f. 425.778.5536
www.cgengineering.com

**Brumbaugh Residence**
**4124 83rd Ave SE**
**Mercer Island, WA 98040**

# OPERATION AND MAINTENANCE MANUAL

**May 2022**

ENGINEERING
250 4th Avenue South, Suite 200
Edmonds, WA 98020
ph. 425.778.8500 | f. 425.778.5536
www.cgengineering.com

**Description:**
The proposed storm system consists of roof, footing and area drains that capture on site runoff and route it through conveyance pipes to a detention pipe and flow control structure. Included in this Operation and Maintenance Manual is an 11" x 17" grading and drainage plan sheet showing the location of these facilities. Please note that this map is generated during the design phase and may not reflect all changes made in permitting and construction. CG Engineering may be contacted for an updated copy of this map once the as-built drawings are completed for the site.

Included in this manual are facility-specific sheets indicating the various maintenance components of each facility:

**Catch Basins (similar to area drains):** Concrete structures with steel grates that collect stormwater runoff from the site and act as junctions for storm conveyance pipes. See "No. 5" for maintenance.

**Detention System:** An above or below ground facility, such as a pond or tank, that temporarily stores stormwater runoff and subsequently releases it at a slower rate than it is collected by the drainage facility system. There is little or no infiltration of stored stormwater.

Facilities shall be inspected yearly at a minimum for defects listed in the following facility sheets. Most maintenance tasks are generally reactionary to a defect being found, rather than a matter of constant upkeep. It is generally expected that few to none of these defects will be present upon the yearly inspection of each facility. The facility sheets list the potential conditions warranting maintenance and the expected result following any maintenance. Several engineer's notes for specific tasks are provided within the facility sheets. **Unless otherwise noted on the facility sheets the maintenance tasks should be performed on an "as needed" basis: (a) when the described defect is visible to whomever performs the yearly inspection, or (b) should any defect become apparent between inspections.**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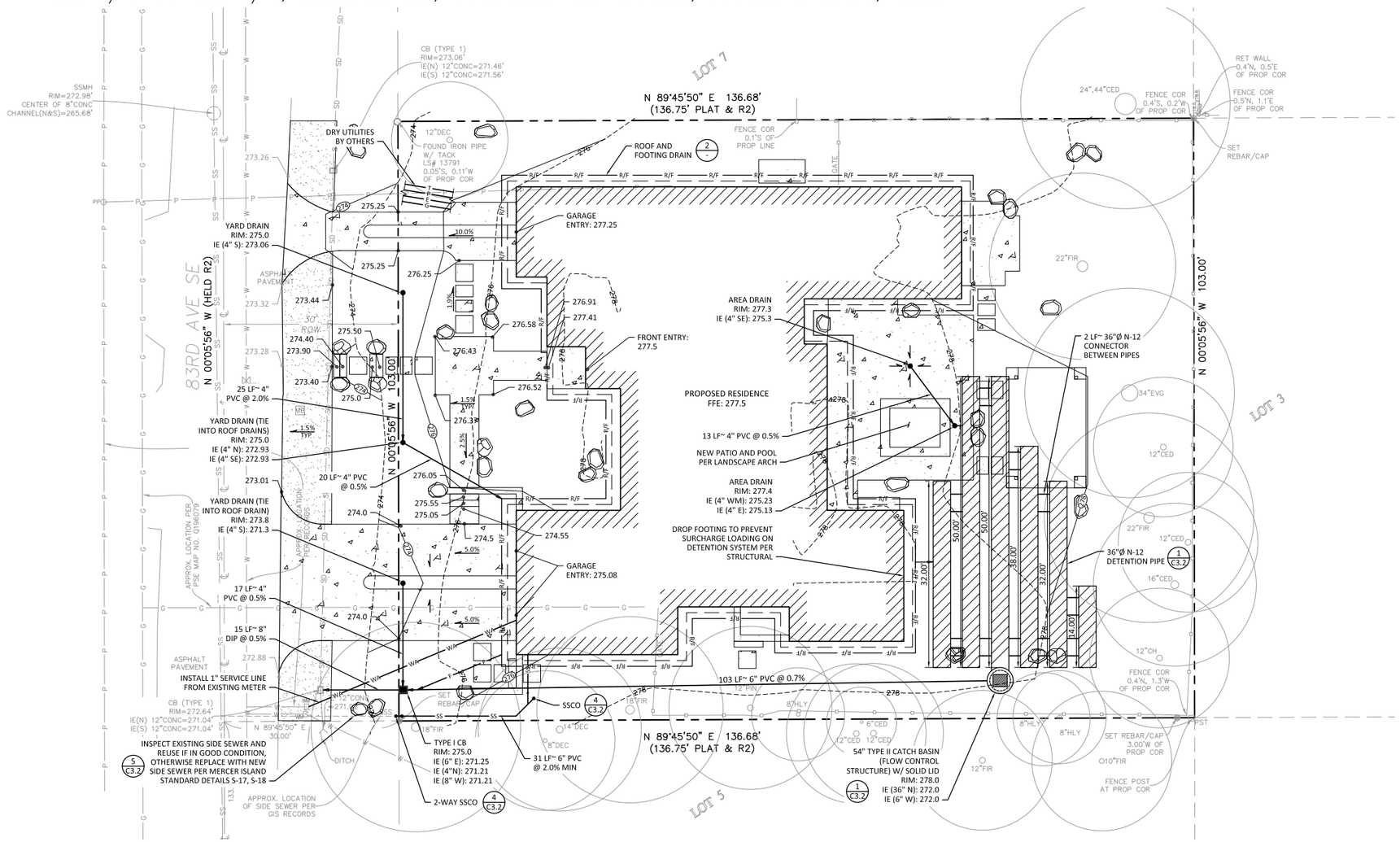
NE 1/4 OF NE 1/4, SECTION 32, TOWNSHIP 26 NORTH, RANGE 5 EAST, W.M.




## 1 GRADING AND UTILITY PLAN

SCALE: 1" = 10'

10 0 5 10 20

GRADING AND DRAINAGE NOTES:

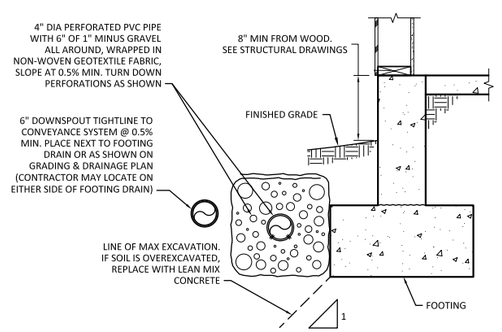
1. ALL DISTURBED AREAS ON AND OFF-SITE BE COMPOST-AMENDED PER THE REQUIREMENTS OF BMP T5.13 IN THE STORMWATER MANUAL VOLUME V, CHAPTER 5.
2. A TYPE II CATCH BASIN IN REQUIRED WHEREVER RIM TO INVERT EXCEEDS 5'.
3. A MINIMUM OF 2' OF COVER IS REQUIRED FOR ALL PIPES LOCATED UNDER DRIVEABLE SURFACES AND 1.5' OF COVER UNDER LANDSCAPE SURFACES.
4. NEW/REPLACE IMPERVIOUS SURFACE (INCLUDING ROW): 7,734 SF
   -- NEW BUILDING: 4,851 SF ROOF AREA (INCLUDING OVERHANGS). RUNOFF ROUTED TO DETENTION PIPE THROUGH ROOF DRAINS
   -- NEW WALKWAYS: 2,284 SF. RUNOFF ROUTED TO RUNOFF THROUGH YARD DRAINS, CONVEYANCE PIPES. SOME RUNOFF IN THE ROW AND SOUTH DRIVEWAY WILL BE ROUTED STRAIGHT TO PUBLIC STORM MAIN.
   -- NEW GRAVEL: 599 SF. RUNOFF ROUTED TO PUBLIC STORM MAIN. DETENTION SIZED TO INCLUDE ALL BYPASS AREA.

| GRADING QUANTITIES | |
|---|---|
| TOTAL EXCAVATION (CUT) - | 125 CU YDS TOTAL |
| EMBANKMENT (FILL) - | 25 CU YDS |
| TOTAL | 150 CU YDS |

THE QUANTITIES SHOWN ABOVE ARE FOR THE PERMIT PROCESS ONLY. THESE VALUES ARE APPROXIMATE. DO NOT USE FOR BIDDING, PAYMENT, OR ESTIMATING PURPOSES.

WATER AND SEWER PLAN NOTES:

1. PLUMBING CONSULTANT TO VERIFY METER & SERVICE SIZE. SIZING TO BE CONFIRMED ONCE PLUMBING PERMIT IS ISSUED AND REVIEWED.
2. PLUMBING CONSULTANT TO VERIFY SIZE OF EXISTING SEWER STUB IS ADEQUATE FOR PROPOSED BUILDING.
3. ALL THRUST BLOCKING PER 5/C4.1.
4. EXISTING LATERAL SHALL BE INSPECTED BY THE CITY SEWER DIVISION TO DETERMINE IF IT IS ACCETABLE CONDITION FOR REUSE. IF NOT, A NEW 6" LATERAL FROM THE MAIN TO THE PROPERTY LINE WILL BE REQUIRED.
5. A MINIMUM OF 3' SEPARATION IS REQUIRED BETWEEN THE DRY UTILITIES (POWER, GAS, PHONE, CABLE ETC) AND SEWER, WATER, AND STORM.




## 2 FOOTING AND ROOF DRAIN SECTION

SCALE: NTS


ENGINEERING
250 4TH AVE. S., SUITE 200
EDMONDS, WASHINGTON 98020
PHONE (425) 778-8500
FAX (425) 778-5536


GREG GUILLEN — STATE OF WASHINGTON — 22680 REGISTERED PROFESSIONAL ENGINEER

05/12/22

| MARK | DATE | DESCRIPTION |
|---|---|---|
| | 03/23/22 | PERMIT SUBMITTAL |
| | 05/12/22 | PERMIT RESUBMITTAL |

| | |
|---|---|
| DESIGN: | BJL |
| DRAWN: | JCP |
| CHECK: | JPU |
| JOB NO: | 22032.20 |
| DATE: | 03/23/22 |

BRUMBAUGH RESIDENCE
4124 83RD AVE SE
MERCER ISLAND, WA 98040

GRADING AND UTILITY PLAN

FILE NAME:

SHEET:

C3.1

## No. 1 – Detention Ponds

| Maintenance Component | Defect | Conditions When Maintenance Is Needed | Results Expected When Maintenance Is Performed |
|---|---|---|---|
| | Beaver Dams | Dam results in change or function of the facility. | Facility is returned to design function.<br>(Coordinate trapping of beavers and removal of dams with appropriate permitting agencies) |
| | Insects | When insects such as wasps and hornets interfere with maintenance activities. | Insects destroyed or removed from site.<br>Apply insecticides in compliance with adopted IPM policies |
| | Tree Growth and Hazard Trees | Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove<br>If dead, diseased, or dying trees are identified<br>(Use a certified Arborist to determine health of tree or removal requirements) | Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood).<br>Remove hazard Trees |
| Side Slopes of Pond | Erosion | Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.<br>Any erosion observed on a compacted berm embankment. | Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.<br>If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion. |
| Storage Area | Sediment | Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility. | Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion. |
| | Liner (If Applicable) | Liner is visible and has more than three 1/4-inch holes in it. | Liner repaired or replaced. Liner is fully covered. |
| Pond Berms (Dikes) | Settlements | Any part of berm which has settled 4 inches lower than the design elevation.<br>If settlement is apparent, measure berm to determine amount of settlement.<br>Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement. | Dike is built back to the design elevation. |
| | Piping | Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue.<br>(Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition. | Piping eliminated. Erosion potential resolved. |

## No. 1 – Detention Ponds

| Maintenance Component | Defect | Conditions When Maintenance Is Needed | Results Expected When Maintenance Is Performed |
|---|---|---|---|
| Emergency Overflow/ Spillway and Berms over 4 feet in height. | Tree Growth | Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.<br>Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm. | Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration. |
| | Piping | Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue.<br>(Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition. | Piping eliminated. Erosion potential resolved. |
| Emergency Overflow/ Spillway | Emergency Overflow/ Spillway | Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway.<br>(Rip-rap on inside slopes need not be replaced.) | Rocks and pad depth are restored to design standards. |
| | Erosion | See “Side Slopes of Pond” | |

## No. 5 – 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%. | No Trash or debris located immediately in front of catch basin or on grate opening. |
| | | 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. | No trash or debris in the catch basin. |
| | | Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. | Inlet and outlet pipes free of trash or debris. |
| | | Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane). | 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<br>(Intent is to make sure no material is running into basin). | Top slab is free of holes and cracks. |
| | | 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 | Frame is sitting 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. | Basin replaced or repaired to design standards. |
| | | 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. | 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. | No vegetation blocking opening to basin. |
| | | Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart. | No vegetation or root growth present. |
| | Contamination and Pollution | See "Detention Ponds" (No. 1). | No pollution present. |

## No. 5 – Catch Basins

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is performed |
|---|---|---|---|
| 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 Working | Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread. | Mechanism opens with proper tools. |
| | Cover Difficult to Remove | One maintenance person cannot remove lid after applying normal lifting pressure.<br>(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. |

## No. 6 – 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. | Bars are bent out of shape more than 3 inches. | Bars in place with no bends more than 3/4 inch. |
| | | Bars are missing or entire barrier missing. | Bars in place according to design. |
| | | Bars are loose and rust is causing 50% deterioration to any part of barrier. | Barrier replaced or repaired to design standards. |
| | Inlet/Outlet Pipe | Debris barrier missing or not attached to pipe | Barrier firmly attached to pipe |

## No. 18 – Catchbasin Inserts

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| General | Sediment Accumulation | When sediment forms a cap over the insert media of the insert and/or unit. | No sediment cap on the insert media and its unit. |
| | Trash and Debris Accumulation | Trash and debris accumulates on insert unit creating a blockage/restriction. | Trash and debris removed from insert unit. Runoff freely flows into catch basin. |
| | Media Insert Not Removing Oil | Effluent water from media insert has a visible sheen. | Effluent water from media insert is free of oils and has no visible sheen. |
| | Media Insert Water Saturated | Catch basin insert is saturated with water and no longer has the capacity to absorb. | Remove and replace media insert |
| | Media Insert-Oil Saturated | Media oil saturated due to petroleum spill that drains into catch basin. | Remove and replace media insert. |
| | Media Insert Use Beyond Normal Product Life | Media has been used beyond the typical average life of media insert product. | Remove and replace media at regular intervals, depending on insert product. |

**Applicable Operational BMPs:**

- Eliminate unpermitted wastewater discharges to storm sewer, ground water, or surface water.
- Convey unpermitted discharges to a sanitary sewer if allowed by the local sewer authority, or to other approved treatment.
- Obtain appropriate state and local permits for these discharges.

**Recommended Additional Operational BMPs**: At commercial and industrial facilities, conduct a survey of wastewater discharge connections to storm drains and to surface water as follows:

- Conduct a field survey of buildings, particularly older buildings, and other industrial areas to locate storm drains from buildings and paved surfaces. Note where these join the public storm drain(s).
- During non-stormwater conditions inspect each storm drain for non-stormwater discharges. Record the locations of all non-stormwater discharges. Include all permitted discharges.
- If useful, prepare a map of each area. Show on the map the known location of storm sewers, sanitary sewers, and permitted and unpermitted discharges. Aerial photos may be useful. Check records such as piping schematics to identify known side sewer connections and show these on the map. Consider using smoke, dye, or chemical analysis tests to detect connections between two conveyance systems (e.g., process water and stormwater). If desirable, conduct TV inspections of the storm drains and record the footage on videotape.
- Compare the observed locations of connections with the information on the map and revise the map accordingly. Note suspect connections that are inconsistent with the field survey.
- Identify all connections to storm sewers or to surface water and take the actions specified above as applicable BMPs.

## S411 BMPs for Landscaping and Lawn/ Vegetation Management

**Description of Pollutant Sources:** Landscaping can include grading, soil transfer, vegetation removal, pesticide and fertilizer applications, and watering. Stormwater contaminants include toxic organic compounds, heavy metals, oils, total suspended solids, coliform bacteria, fertilizers, and pesticides.

Lawn and vegetation management can include control of objectionable weeds, insects, mold, bacteria, and other pests with pesticides. Examples include weed control on golf course lawns, access roads, and utility corridors and during landscaping; sap stain and insect control on lumber and logs; rooftop moss removal; killing nuisance rodents; fungicide application to patio decks, and residential lawn/plant care. It is possible to

release toxic pesticides such as pentachlorophenol, carbamates, and organometallics to the environment by leaching and dripping from treated parts, container leaks, product misuse, and outside storage of pesticide contaminated materials and equipment. Poor management of the vegetation and poor application of pesticides or fertilizers can cause appreciable stormwater contamination.

**Pollutant Control Approach:** Control of fertilizer and pesticide applications, soil erosion, and site debris to prevent contamination of stormwater.

Develop and implement an Integrated Pest Management Plan (IPM) and use pesticides only as a last resort. Carefully apply pesticides/ herbicides, in accordance with label instructions. Maintain appropriate vegetation, with proper fertilizer application where practicable, to control erosion and the discharge of stormwater pollutants. Where practicable grow plant species appropriate for the site, or adjust the soil properties of the subject site to grow desired plant species.

**Applicable Operational BMPs for Landscaping:**

- Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
- Do not dispose of collected vegetation into waterways or storm sewer systems.

**Recommended Additional Operational BMPs for Landscaping:**

- Conduct mulch-mowing whenever practicable
- Dispose of grass clippings, leaves, sticks, or other collected vegetation, by composting, if feasible.
- Use mulch or other erosion control measures on soils exposed for more than one week during the dry season or two days during the rainy season.
- Store and maintain appropriate oil and chemical spill cleanup materials in readily accessible locations when using oil or other chemicals. Ensure that employees are familiar with proper spill cleanup procedures.
- Till fertilizers into the soil rather than dumping or broadcasting onto the surface. Determine the proper fertilizer application rate for the types of soil and vegetation encountered.
- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Use manual and/or mechanical methods of vegetation removal rather than applying herbicides, where practical.

**Applicable Operational BMPs for the Use of Pesticides:**

- Develop and implement an IPM (See section on IPM in *Applicable Operational BMPs for Vegetation Management*) and use pesticides only as a last resort.
- Implement a pesticide-use plan and include at a minimum: a list of selected pesticides and their specific uses; brands, formulations, application methods and quantities to be used; equipment use and maintenance procedures; safety, storage, and disposal methods; and monitoring, record keeping, and public notice procedures. All procedures shall conform to the requirements of Chapter 17.21 RCW and Chapter 16-228 WAC (Appendix IV-D R.7).
- Choose the least toxic pesticide available that is capable of reducing the infestation to acceptable levels. The pesticide should readily degrade in the environment and/or have properties that strongly bind it to the soil. Conduct any pest control activity at the life stage when the pest is most vulnerable. For example, if it is necessary to use a Bacillus thuringiens application to control tent caterpillars, apply it to the material before the caterpillars cocoon or it will be ineffective. Any method used should be site-specific and not used wholesale over a wide area.
- Apply the pesticide according to label directions. Do not apply pesticides in quantities that exceed manufacturer's instructions.
- Mix the pesticides and clean the application equipment in an area where accidental spills will not enter surface or ground waters, and will not contaminate the soil.
- Store pesticides in enclosed areas or in covered impervious containment. Do not discharge pesticide contaminated stormwater or spills/leaks of pesticides to storm sewers. Do not hose down the paved areas to a storm sewer or conveyance ditch. Store and maintain appropriate spill cleanup materials in a location known to all near the storage area.
- Clean up any spilled pesticides. Keep pesticide contaminated waste materials in designated covered and contained areas.
- The pesticide application equipment must be capable of immediate shutoff in the event of an emergency.
- Spraying pesticides within 100 feet of open waters including wetlands, ponds, and rivers, streams, creeks, sloughs and any drainage ditch or channel that leads to open water may have additional regulatory requirements beyond just following the pesticide product label. Additional requirements may include:
    - Obtaining a discharge permit from Ecology.
    - Obtaining a permit from the local jurisdiction.
    - Using an aquatic labeled pesticide.

- Flag all sensitive areas including wells, creeks, and wetlands prior to spraying.
- Post notices and delineate the spray area prior to the application, as required by the local jurisdiction or by Ecology.
- Conduct spray applications during weather conditions as specified in the label direction and applicable local and state regulations. Do not apply during rain or immediately before expected rain.

**Recommended Additional Operational BMPs for the use of pesticides:**

- Consider alternatives to the use of pesticides such as covering or harvesting weeds, substitute vegetative growth, and manual weed control/moss removal.
- Consider the use of soil amendments, such as compost, that are known to control some common diseases in plants, such as Pythium root rot, ashy stem blight, and parasitic nematodes. The following are three possible mechanisms for disease control by compost addition (USEPA Publication 530-F-9-044):
    1. Successful competition for nutrients by antibiotic production;
    2. Successful predation against pathogens by beneficial microorganism; and
    3. Activation of disease-resistant genes in plants by composts.

*Installing an amended soil/landscape system can preserve both the plant system and the soil system more effectively. This type of approach provides a soil/landscape system with adequate depth, permeability, and organic matter to sustain itself and continue working as an effective stormwater infiltration system and a sustainable nutrient cycle.*

- Once a pesticide is applied, evaluate its effectiveness for possible improvement. Records should be kept showing the effectiveness of the pesticides considered.
- Develop an annual evaluation procedure including a review of the effectiveness of pesticide applications, impact on buffers and sensitive areas (including potable wells), public concerns, and recent toxicological information on pesticides used/proposed for use. If individual or public potable wells are located in the proximity of commercial pesticide applications, contact the regional Ecology hydrogeologist to determine if additional pesticide application control measures are necessary.
- Rinseate from equipment cleaning and/or triple-rinsing of pesticide containers should be used as product or recycled into product.

*For more information, contact the Washington State University (WSU) Extension Home-Assist Program, (253) 445-4556, or Bio-Integral Resource Center (BIRC), P.O. Box 7414, Berkeley, CA.94707, or EPA to*

*obtain a publication entitled "Suspended, Canceled, and Restricted Pesticides" which lists all restricted pesticides and the specific uses that are allowed.*

**Applicable Operational BMPs for Vegetation Management:**

- Use at least an eight-inch "topsoil" layer with at least 8 percent organic matter to provide a sufficient vegetation-growing medium. Amending existing landscapes and turf systems by increasing the percent organic matter and depth of topsoil can substantially improve the permeability of the soil, the disease and drought resistance of the vegetation, and reduce fertilizer demand. This reduces the demand for fertilizers, herbicides, and pesticides. Organic matter is the least water-soluble form of nutrients that can be added to the soil. Composted organic matter generally releases only between 2 and 10 percent of its total nitrogen annually, and this release corresponds closely to the plant growth cycle. Return natural plant debris and mulch to the soil, to continue recycling nutrients indefinitely.
- Select the appropriate turfgrass mixture for the climate and soil type. Certain tall fescues and rye grasses resist insect attack because the symbiotic endophytic fungi found naturally in their tissues repel or kill common leaf and stem-eating lawn insects. However, they do not, repel root-feeding lawn pests such as Crane Fly larvae, and are toxic to ruminants such as cattle and sheep. The fungus causes no known adverse effects to the host plant or to humans. Endophytic grasses are commercially available; use them in areas such as parks or golf courses where grazing does not occur. Local agricultural or gardening resources such as Washington State University Extension office can offer advice on which types of grass are best suited to the area and soil type.
- Use the following seeding and planting BMPs, or equivalent BMPs to obtain information on grass mixtures, temporary and permanent seeding procedures, maintenance of a recently planted area, and fertilizer application rates: *Temporary and Permanent Seeding*, *Mulching*, *Plastic Covering*, and *Sodding* as described in Volume II.
- Adjusting the soil properties of the subject site can assist in selection of desired plant species. For example, design a constructed wetland to resist the invasion of reed canary grass by layering specific strata of organic matters (e.g., composted forest product residuals) and creating a mildly acidic pH and carbon-rich soil medium. Consult a soil restoration specialist for site-specific conditions.
- Aerate lawns regularly in areas of heavy use where the soil tends to become compacted. Conduct aeration while the grasses in the lawn are growing most vigorously. Remove layers of thatch greater than ¾-inch deep.

- Mowing is a stress-creating activity for turfgrass. Grass decreases its productivity when mown too short and there is less growth of roots and rhizomes. The turf becomes less tolerant of environmental stresses, more disease prone and more reliant on outside means such as pesticides, fertilizers, and irrigation to remain healthy. Set the mowing height at the highest acceptable level and mow at times and intervals designed to minimize stress on the turf. Generally mowing only 1/3 of the grass blade height will prevent stressing the turf.

***Irrigation:***

- The depth from which a plant normally extracts water depends on the rooting depth of the plant. Appropriately irrigated lawn grasses normally root in the top 6 to 12 inches of soil; lawns irrigated on a daily basis often root only in the top 1 inch of soil. Improper irrigation can encourage pest problems, leach nutrients, and make a lawn completely dependent on artificial watering. The amount of water applied depends on the normal rooting depth of the turfgrass species used, the available water holding capacity of the soil, and the efficiency of the irrigation system. Consult with the local water utility, Conservation District, or Cooperative Extension office to help determine optimum irrigation practices.

***Fertilizer Management:***

- Turfgrass is most responsive to nitrogen fertilization, followed by potassium and phosphorus. Fertilization needs vary by site depending on plant, soil, and climatic conditions. Evaluation of soil nutrient levels through regular testing ensures the best possible efficiency and economy of fertilization. For details on soils testing, contact the local Conservation District, a soils testing professional, or a Washington State University Extension office.
- Apply fertilizers in amounts appropriate for the target vegetation and at the time of year that minimizes losses to surface and ground waters. Do not fertilize when the soil is dry. Alternatively, do not apply fertilizers within three days prior to predicted rainfall. The longer the period between fertilizer application and either rainfall or irrigation, the less fertilizer runoff occurs.
- Use slow release fertilizers such as methylene urea, IDBU, or resin coated fertilizers when appropriate, generally in the spring. Use of slow release fertilizers is especially important in areas with sandy or gravelly soils.
- Time the fertilizer application to periods of maximum plant uptake. Ecology generally recommends application in the fall and spring, although Washington State University turf specialists recommend four fertilizer applications per year.

- Properly trained persons should apply all fertilizers. Apply no fertilizer at commercial and industrial facilities, to grass swales, filter strips, or buffer areas that drain to sensitive water bodies unless approved by the local jurisdiction.

***Integrated Pest Management***

An IPM program might consist of the following steps:

Step 1: Correctly identify problem pests and understand their life cycle

Step 2: Establish tolerance thresholds for pests.

Step 3: Monitor to detect and prevent pest problems.

Step 4: Modify the maintenance program to promote healthy plants and discourage pests.

Step 5: Use cultural, physical, mechanical or biological controls first if pests exceed the tolerance thresholds.

Step 6: Evaluate and record the effectiveness of the control and modify maintenance practices to support lawn or landscape recovery and prevent recurrence.

For an elaboration of these steps, refer to Appendix IV-F.

## S412 BMPs for Loading and Unloading Areas for Liquid or Solid Material

**Description of Pollutant Sources:** Operators typically conduct loading/unloading of liquid and solid materials at industrial and commercial facilities at shipping and receiving, outside storage, fueling areas, etc. Materials transferred can include products, raw materials, intermediate products, waste materials, fuels, scrap metals, etc. Leaks and spills of fuels, oils, powders, organics, heavy metals, salts, acids, alkalis, etc. during transfer may cause stormwater contamination. Spills from hydraulic line breaks are a common problem at loading docks.

**Pollutant Control Approach:** Cover and contain the loading/unloading area where necessary to prevent run-on of stormwater and runoff of contaminated stormwater.

**Applicable Operational BMPs:**

***At All Loading/ Unloading Areas:***

- A significant amount of debris can accumulate at outside, uncovered loading/unloading areas. Sweep these surfaces frequently to remove loose material that could contaminate stormwater. Sweep areas temporarily covered after removal of the containers, logs, or other material covering the ground.
- Place drip pans, or other appropriate temporary containment device, at locations where leaks or spills may occur such as hose connections, hose reels and filler nozzles. Always use drip pans when making and

## SAMPLE ACTIVITY LOG

| DATE | FACILITY | MAINTENANCE PERFORMED | RESULTS / NOTES |
|---|---|---|---|
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