DRAFT Drainage Control Plan Report

for

Ulery Business Suites

1070 Ulery St. SE
Lacey, WA 98503
TPN 09950002000

City of Lacey Project No. __-____
Olympic Engineering Project No. 22084

May 16, 2023

OLYMPIC ENGINEERING

PO Box 12690
Olympia WA 98508
360.705.2474
www.olyeng.com

COVER SHEET

ULERY BUSINESS SUITES

Lacey, Washington
May 16, 2023

Owner/Applicant

Prepared for:	Ulery Street, LLC
Contact:	Aaron Borden PO Box 7846 Olympia, WA 98507 (360) 789-3707 aaron@ajbservice.com

Reviewing Agency

Jurisdiction:	City of Lacey, Washington
Project Number:	__-____
Project Contact:	Samra Seymour, AICP, Senior Planner (360) 491-5642 sseymour@ci.lacey.wa.us

Contractor

Contact:

References

City of Lacey Stormwater Design Manual (SDM)*, 2022 ed.*

Project Engineer

Prepared by:	Olympic Engineering, Inc. PO Box 12690 Olympia, WA 98508 (360) 705-2474 www.olyeng.com
Contact:	Chris Merritt, PE
Olympic Project:	22084
File Name:	Draft Drainage Report

5/16/2023

"I hereby certify that this DRAFT Drainage Control Plan Report for the **Ulery Business Suites** project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Lacey does not and will not assume liability for the sufficiency, suitability, or performance of drainage BMPs prepared by me."

TABLE OF CONTENTS

APPENDICES

SECTION 1 – PROPOSED OVERVIEW

1.1 Site Information

Site Address
1070 Ulery St. SE
Lacey, WA 98503

Parcel Number
09950002000

Zoning
CBD 4

Owner
Ulery Street, LLC
Aaron Borden
PO Box 7846
Olympia, WA 98507
(360) 789-3707
aaron@ajbservice.com

1.2 Project Description

The proposal is to construct a single-story business suite building with associated parking lot, storm drainage, and utility improvements on a 0.977-acre parcel located off Ulery St. SE.

All proposed site work improvements are anticipated to be constructed in one phase with substantial site work construction completion by Winter/Spring 2024. The completion timeframe of the building is currently unknown.

1.3 Proposed Stormwater Drainage Design

- The access/parking lot will be constructed of Permeable Pavement (BMP T5.15).
- Stormwater runoff from the roof area will be tightlined to a Downspout Infiltration Trench (BMP T5.10A).
- Stormwater runoff from the sidewalks adjacent to lawn/landscape areas will be sheet flow dispersed (BMP T5.12) onto the lawn/landscape areas.
- Stormwater runoff from the sidewalks adjacent to the permeable pavement will sheet flow off onto the permeable pavement.
- Stormwater runoff from the paved approach off Ulery St. will sheet flow onto the permeable pavement.

This project will meet the LID Performance Standard as the majority of stormwater runoff will be infiltrated.

See Core Requirements in Section 2.5, along with Section 5, for additional information regarding these proposed stormwater BMPs.

1.4 Subarea Data Tabulations

The following areas are “after” right-of-way dedication.

Parcel Area:	42,564 sf
Off-Site Area:	807 sf
Total Project Area:	43,371 sf

Existing Surfaces	Surface Type	Area (sf)	Area (ac)
Gravel Driveway	Impervious	769	0.018
Forest (On-Site)	Pervious	39,458	0.906
Lawn/Landscaping (Off-Site)	Pervious	807	0.019
Brush/Grass (On-Site)	Pervious	2,337	0.054
Total		**43,371**	**0.996**

Proposed New/Replaced Surfaces	Surface Type	PGIS?	Area (sf)	Area (ac)
Driveway (On-Site)	Hard (permeable)	Yes	13,433	0.308
Driveway (On-Site) (1)	Impervious	Yes	634	0.015
Driveway (Off-Site) (1)	Hard (permeable)	Yes	313	0.007
Driveway (Off-Site)	Impervious	Yes	448	0.010
Sidewalk (On-Site) (1,2)	Impervious	No	3,810	0.088
Sidewalk (Off-Site) (2)	Impervious	No	46	0.001
Roof	Impervious	No	13,285	0.305
Lawn/Landscaping (On-Site)	Pervious	No	11,402	0.262
Total			**43,371**	**0.996**

Total Hard Surface:	31,969 sf
Total Impervious Surface:	18,223 sf
Total Lawn/Landscape:	11,402 sf

(1) Contributing to Permeable Pavement
(2) Sheet flow dispersed (2,077 sf)

The square-footage and acreage totals may not match due to rounding.

SECTION 2 – DEVELOPMENT CONDITIONS AND REQUIREMENTS

2.1 Project Vesting

The 2022 SDM is applicable to this project.

2.2 Permits Required

At this time, it is anticipated that the following permits may be required for this project:

- City of Lacey – Right-of-Way Access Permit
- City of Lacey – Grading Permit

2.3 Project Type and Size

This project is a new development project that will create 31,969 sf of new hard surface area; therefore, Core Requirements #1-9 are applicable.

2.4 Critical Areas

The project site is located within a Category 1 Critical Aquifer Recharge Area and within a 10-year time of travel zone of an existing well per Thurston County GIS. Stormwater runoff will not be discharged directly into an aquifer, signage prohibiting the use of pesticides will be installed if required, and all stormwater runoff will be treated. There are no other known critical areas (e.g. wetlands, steep slopes, etc.) on-site or within the immediate vicinity of the site.

2.5 Core Requirements

The total proposed "new and/or replaced" hard surface area is greater than 5,000 sf; therefore, this project is required to address Core Requirements (CR) #1-9 per Chapter 2, Section 2.2, of the City of Lacey Stormwater Design Manual (SDM).

This project will meet the LID Performance Standard as the majority of stormwater runoff will be infiltrated.

These Core Requirements have been addressed as follows:

Core Requirement #1 – Preparation of Stormwater Site Plans

A Drainage Plan has been prepared (see Appendix). After Site Plan approval, a final Drainage Control Plan Report and Plans meeting the requirements of Chapter 3, Section 3.3.3 of the SDM will be prepared and submitted to the city for review and approval. A Construction Stormwater Pollution Prevention Plan (SWPPP) will be provided with the Final Drainage Report (see CR#2 below).

Core Requirement #2 – Construction Stormwater Pollution Prevention (SWPP)

A Draft SWPP plan has been prepared (see Appendix).

Core Requirement #3 – Source Control of Pollution

A Stormwater Maintenance and Pollution Source Control Manual will be provided with the final Drainage Control Plan Report and will be recorded prior to final project approval.

Core Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

There are no known natural drainage patterns or outfalls located on or adjacent to the parcel. If any are found, they will be maintained and will remain undisturbed to the maximum extent practical.

Core Requirement #5 – On-Site Stormwater Management

The project will meet the LID Performance Standard. The proposed stormwater Best Management Practices (BMPs) are as follows:

Lawn and Landscape Areas:

- All disturbed and/or new lawn and landscape areas will contain soils meeting the Post-Construction Soil Quality and Depth (BMP T5.13) requirements.

Roof Areas:

- Stormwater runoff from the roof area will be tightlined to a Downspout Infiltration Trench (BMP T5.10A) (100% infiltration).

Other Hard Surface Areas:

- The access/parking lot will be constructed of Permeable Pavement (BMP T5.15) (100% infiltration) with an underlying sand filter (for Enhanced Treatment, see Section 6.1).
- Stormwater runoff from the sidewalks adjacent to lawn/landscape areas will be sheet flow dispersed (BMP T5.12) onto the lawn/landscape areas.
- Stormwater runoff from the sidewalks adjacent to the permeable pavement will sheet flow off onto the permeable pavement.
- Stormwater runoff from the paved access off Ulery St. will sheet flow onto the permeable pavement.

Modeling Narrative

- Stormwater runoff from the sidewalks being dispersed per BMP T5.12 and have been modeled as a dispersed “lawn” area in WWHM.

- All lawn/landscape areas that meet the Post-Construction Soil Quality and Depth (BMP T5.13) requirements have been modeled as “pasture” in WWHM.

- The permeable pavement was modeled with a 1 in/hr design infiltration rate in WWHM, as recommended by QualityGeo. The assumed infiltration rate of a sand filter per Section 8.7.8 of the SDM is 1 in/hr.

- The downspout infiltration trench was modeled using a 1 in/hr rate in WWHM, as recommended by QualityGeo NW.

- The impervious areas (driveway approach off Ulery St., sidewalks)

sheet flowing onto the permeable pavement have been modeled as a lateral flow impervious area connected to the permeable pavement element.

Core Requirement #6 – Runoff Treatment

This project will create and/or replace more than 5,000 square-feet of new pollution generating hard surface (PGHS) area; therefore, Runoff Treatment facilities are required per Section 2.2.6 of the SDM. See Core Requirement #5 above for a description of the proposed stormwater BMPs.

See Core Requirement #5 above for a description of the proposed stormwater BMPs. Additionally, see Sections 4.3 and 6.1 for additional information regarding soil suitability for infiltration treatment along with enhanced treatment requirements.

Core Requirement #7 – Flow Control

This project will have less than 10,000 square-feet of new "effective" hard surface area; convert less than ¾-acre of vegetation to lawn/landscape; and cause less than a 0.15-cfs increase in the 100-year recurrence interval flow frequency; therefore, the Flow Control standard has been met. Additionally, the project will meet the LID Performance Standard as the majority of stormwater runoff from the proposed hard surface areas will be infiltrated.

See Core Requirement #5 above for a description of the proposed stormwater BMPs.

Core Requirement #8 – Wetlands Protection

There are no known wetlands on-site or within the immediate vicinity; therefore, this Core Requirement is not applicable.

Core Requirement #9 – Operation and Maintenance

A Stormwater Maintenance and Pollution Source Control Manual will be recorded prior to final project approval. The owner will be responsible for all maintenance of the stormwater infrastructure.

Additional Requirements –Financial Guarantees

Maintenance and/or operational bonding or other financial guarantees will be provided prior to final project approval, if required.

SECTION 3 – SITE AND VICINITY DESCRIPTION

3.1 Existing Physiography

The parcel is undeveloped and mostly forested with mature fir trees. Site topography generally slopes down from the west to east with an average slope of 1.8%.

There are no creeks, lakes, ponds, springs, etc. on or near the subject parcel.

Per FEMA FIRM Panel #53067C0191E the project is located in Zone X (an area

determined to be outside the 0.2% annual chance floodplain).

3.2 Existing Improvements

The site is currently undeveloped.

No known underground or leaking storage tanks are located on-site per a field visit and review of the Washington State Department of Ecology (DOE) UST/LUST map.

No known wells were located within 200-feet of the project site per a site visit and DOE well log search.

No known septic systems are located on or near the project site.

3.3 Drainage Patterns

There is no known off-site drainage affecting the subject parcel and there is no known runoff from the subject parcel affecting adjacent parcels. There are no known historical drainage problems such as flooding, erosion, etc. on or near the subject parcel.

Stormwater runoff from the east half of Ulery St. SE sheet flow disperses over existing adjacent lawn area where it appears to infiltrate through the surface soils almost immediately. This will remain as-is as no road or drainage improvements are proposed of Ulery St.

See Section 4.1 below for the soil conditions.

This project is not located within any known adopted basin plan areas.

The project site is located within the Henderson Inlet Watershed.

3.4 Qualitative Analysis

The majority of stormwater runoff generated by the new improvements (on- and off-site) will be collected, stored, and infiltrated and there will be no direct discharge to a downstream conveyance system. Any emergency overflow from the permeable pavement section will temporarily pond in the parking lot area and may eventually flow into the catch basin associated with the downspout infiltration trench. Any emergency overflow from the downspout infiltration trench would flow onto the permeable pavement.

All infiltration facilities have been designed to provide a minimum of 12” of freeboard.

3.5 Quantitative Analysis

Based on the information in Section 3.4 above, a Quantitative Analysis is not warranted.

SECTION 4 – SOIL AND INFILTRATION ANALYSIS

4.1 Summary of Soils and Geotechnical Data

The Natural Resource Conservation Service (NRCS) classifies the on-site soils as Nisqually Loamy Fine Sand (HSG A). A Soils Report has been prepared by QualityGeo NW (see Appendix). Three test pits were evaluated to depths of up to

12’ below-grade and the soils generally consisted of topsoil overlying silty sand (SM). The proposed stormwater facilities will target the SM soil unit.

No fill was encountered in any test pits and the soils appeared to be in their native condition.

4.2 Subsurface Factors

Groundwater, nor any indications of groundwater, were encountered in any test pits. Based on nearby well log records, the groundwater elevation is inferred to be at 32’ below-grade.

4.3 Infiltration Rates

Per the Soils Report, the initial Ksat was 4.37 in/hr to 18.48 in/hr, the corrected Ksat was 1.09 in/hr to 4.62 in/hr, respectively, and the recommended long-term design infiltration rate was 1.09 in/hr in the SM soils. For shallow open facilities such as permeable pavement or rain gardens, a 1”/hr long-term infiltration rate is recommended due to greater potential for compaction during construction and sedimentation.

The soils have a Cation Exchange Capacity of 4.3 to 9.9 meq/100g and an organic content of 1.6% to 1.7% which, on average, meets minimum infiltration treatment requirements.

.

SECTION 5 – ON-SITE STORMWATER MANAGEMENT AND LOW IMPACT DEVELOPMENT (CORE REQUIREMENT #5)

5.1 LID Site Design

The effective impervious surface area has been minimized to the maximum extent practical by utilizing permeable pavement (BMP T5.13) and fully infiltrating roof runoff. See Section 2.5 for additional information.

5.2 Methodology

The project will meet the LID Performance Standard along with the Runoff Treatment and Flow Control Requirements (see Sections 2.5, 5.1, and 5.5 for additional information).

5.3 LID Practices

The access/parking lot will be constructed of Permeable Pavement (BMP T5.15) and roof runoff will be fully infiltrated (see Sections 2.5, 5.4, and 5.5 for additional information).

5.4 Post-Construction Soil Quality and Depth

See Section 2.5. All disturbed and proposed lawn/landscape areas will meet the Post-Construction Soils Quality and Depth requirements. It is anticipated that the bulk of this requirement will be met by stockpiling and reusing existing topsoil. Any additional soil/compost needed to meet this requirement will be imported from approved sources.

5.5 Retained Trees and Aesthetics

The proposed stormwater systems consist of permeable pavement and/or will be located below-grade; therefore, landscaping associated with these drainage facilities is not applicable.

A landscape and irrigation plan will be prepared meeting City of Lacey requirements.

Due to the proposed development coverage, no significant trees are proposed to be retained at this time.

SECTION 6 – RUNOFF TREATMENT AND FLOW CONTROL (CORE REQUIRMENTS #6 AND #7

6.1 Runoff Treatment Selections

Step 1: There are no receiving waters.
Step 2: Oil control is not applicable as this is not a high-use site.
Step 3: Some of the native subgrade soil is not fully conducive for pollutant control due to the in-situ infiltration rate of the native soils exceeding 9 in/hr. However, the subgrade soils do meet the requirements for organic content and CEC. Therefore, a 6" sand filter beneath the permeable pavement section is proposed to satisfy the pollutant removal requirements.
Step 4: Phosphorus control is not applicable as there will be no discharges to fresh water bodies or wetlands.
Step 5: Enhanced treatment is required since this the project is located within a Category I critical aquifer recharge area. Per Table 8.2 in Section 8.3.4 of the SDM, a sand filter provides Enhanced Treatment.

Per Section 8.3.4 of the SDM, the proposed Permeable Pavement (BMP T5.13) with a 6" sand filter will meet the Enhanced Treatment requirements and 100% of the runoff will be treated.

6.2 BMP Types & Descriptions

See Section 2.5 for the proposed stormwater BMPs.

6.3 Facility Selection and Design Data

See Section 2.5 for the proposed stormwater BMPs, Section 6.1 for the treatment selection, and Section 6.4 for the Design Data. All treatment and flow control BMPs were sized using WWHM.

6.4 Design Calculations

Over 95% of the stormwater runoff generated by this project will be fully infiltrated, 5% will be dispersed, and 100% of the runoff from pollution generating hard surface areas will be treated. See Section 4.3 for the design infiltration rates uses. See WWHM report in the Appendix.

SECTION 7 – RUNOFF COLLECTION & CONVEYANCE SYSTEM

7.1 System Design & Layout

Stormwater runoff from the proposed roof areas will be tightlined by 6" diam. pipes to a Downspout Infiltration Trench (BMP T5.10A).

7.2 Conveyance System Calculations Summary

Conveyance systems are designed to convey the 25-year 24-hour storm event, at a minimum. The roof drainage conveyance systems comprise of 6" diameter pipes for conveyance to the downspout infiltration trench. Detailed calculations will be provided with the final Drainage Control Plan Report.

SECTION 8 – SOURCE CONTROL

8.1 Potential Sources of Pollution

Based on the proposed commercial use, it is expected that the most common sources of pollution will be from fertilizers and pesticides associated with mostly lawn and landscaping maintenance. Other sources may come from vehicles leaking oils and greases along with suspended solids in the drive aisle and parking lot areas.

8.2 Source Control BMPs

Based on the proposed commercial use, it is anticipated that the following Source Control BMPs are applicable to this project:

S410 Correcting Illicit Discharges to Storm Drains
S411 Landscaping and Lawn/Vegetation Management
S417 Maintenance of Stormwater Drainage and Treatment Systems
S421 Parking and Storage of Vehicles and Equipment
S424 Roof / Building Drains at Manufacturing and Commercial Buildings
S435 Pesticides and an Integrated Pest Management Program
S442 Labeling Storm Drain Inlets On Your Property
S443 Fertilizer Application
S450 Irrigation
S453 Formation of a Pollution Prevention Team
S454 Preventive Maintenance / Good Housekeeping
S455 Spill Prevention and Cleanup
S456 Employee Training
S457 Inspections
S458 Record Keeping

8.3 Source Control Checklist and Worksheet

A Source Control Checklist and Source Control Worksheets will be provided with the final Drainage Control Plan Report.

SECTION 9 – COVENANTS, DEDICATIONS, EASEMENTS, AGREEMENTS, AND GUARANTEES

9.1 Covenants, Dedications, and Easements

No covenants, dedications, or easements are proposed or required for the stormwater facilities as the parcel is not being subdivided and it will remain under a single ownership.

9.2 Agreements and Guarantees

The owner will be responsible for maintenance of the on-site storm drainage systems. A Maintenance and Source Control Manual and declaration of covenant will be recorded prior to final project approval.

Maintenance and/or operational bonding or other financial guarantees will be provided prior to final project approval, if required.

Appendix 1
Drainage Plans

SURVEY NOTE

THE BOUNDARY AND TOPOGRAPHIC SURVEY INFORMATION DEPICTED HEREON WAS PROVIDED BY MTN 2 COAST PROFESSIONAL LAND SURVEYORS AND OBTAINED FROM CITY RECORDS. THIS SURVEY INFORMATION WAS NOT FIELD VERIFIED BY OLYMPIC ENGINEERING AND OLYMPIC ENGINEERING ASSUMES NO LIABILITY IN THE ACCURACY OF THIS INFORMATION OR FOR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO THESE DRAWINGS AS A RESULT.

LEGEND

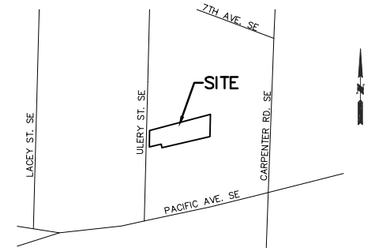
EXISTING	PROPOSED	
SS	SS	SANITARY SEWER
W	W	WATER
P		POWER
SD		STORM
	RD	ROOF DRAIN
G		GAS
T		TELEPHONE

PROJECT INFORMATION

OWNER/APPLICANT:	ULERY STREET, LLC PO BOX 7846 OLYMPIA, WA 98507
PARCEL NO:	09950002000
SITE ADDRESS:	1070 ULERY ST. SE LACEY, WA 98503
ZONING:	CBD 4
PARCEL AREA:	0.977 AC (42,564 SF)
BUILDING FLOOR AREA:	12,830 SF
PARKING REQUIRED:	±26-52 (GEN. BUSINESS PARK)
PARKING PROVIDED:	28 (INCL. 2 ADA & 8 COMPACT)
WATER/SEWER:	CITY OF LACEY
TELECOMMUNICATIONS:	COMCAST & LUMEN
POWER/GAS:	PUGET SOUND ENERGY
FIRE DISTRICT:	LACEY
REFUSE/RECYCLING:	PACIFIC DISPOSAL
SOIL TYPE:	NISQUALLY LOAMY FINE SAND (HSG A) PER NRCS
FEMA FIRM DESIGNATION:	ZONE X (PANEL #53067C0191E), OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN
BUILDING SETBACKS:	15' FRONT, 10' SIDE, 25' REAR
BUILDING COVERAGE:	30.1% (50% ALLOWED PER ZONING)
HARD SURFACE COVERAGE:	
ROOF:	13,285 SF
DRIVE/PARKING:	14,067 SF
SIDEWALK/MISC:	3,810 SF
TOTAL:	31,162 SF
CONSTRUCTION TYPE:	II-B

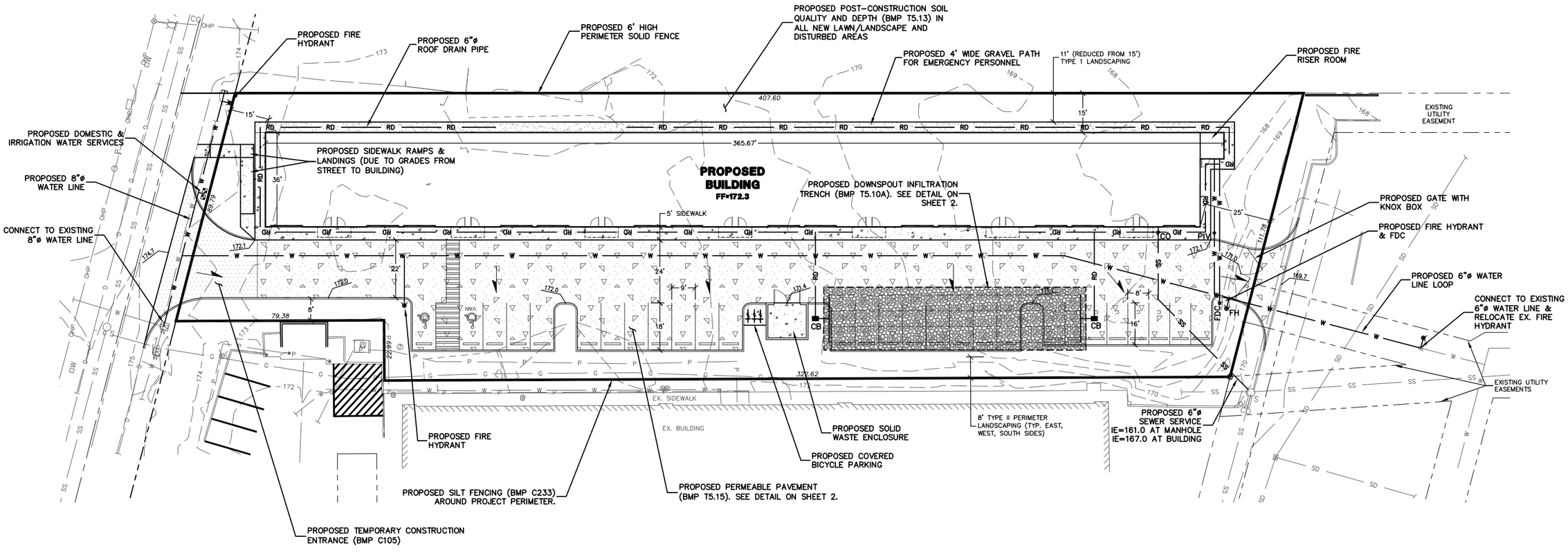
VICINITY MAP

N.T.S.



SCALE: 1 INCH = 20 FEET

0 10 20 40



NO.	DATE	REVISION

ULERY BUSINESS SUITES

CITY OF LACEY, WASHINGTON

SITE PLAN

DESIGNED BY:	CMM
DRAWN BY:	CMM
CHECKED BY:	
SCALE:	1" = 20'
DATE:	5/16/2023

PO Box 12690
Olympia, WA 98508
360.705.2474
www.olyeng.com

OLYMPIC ENGINEERING

Civil Engineering, Land Planning, Project Management

JOB NUMBER: 22084

DRAWING NAME: 22084_SITE

SHEET: 1 OF 2

BIORETENTION SOIL MIX (BSM) REQUIREMENTS

Contractor shall submit proposed BSM specifications to Olympic Engineering and Pacific Testing & Inspection for review and approval prior to installation.

Bioretention soil shall be a well-blended mixture of mineral aggregate and composted material measured on a volume basis. Bioretention soil shall consist of two parts fine compost (approximately 35 to 40 percent) by volume and three parts mineral aggregate (approximately 60 to 65 percent), by volume. The mixture shall be well blended to produce a homogeneous mix.

Mineral Aggregate:
- Percent Fines: A range of 2 to 4 percent passing the US #200 sieve is ideal and fines should not be above 5 percent for a proper functioning specification according to ASTM D422.

Mineral Aggregate Gradation:
- Mineral Aggregate shall be free of wood, waste, coating, or any other deleterious material. The aggregate portion of the Bioretention Soil Mix (BSM) should be well-graded. According to ASTM D 2487-98 (Classification of Soils for Engineering Purposes (Unified Soil Classification System)), well-graded sand should have the following gradation coefficients:
  a. Coefficient of Uniformity (Cu = D60/D10) equal to or greater than 4, and
  b. Coefficient of Curve (Cc = (D30)2/D60 x D10) greater than or equal to 1 and less than or equal to 3.

Aggregate shall be analyzed by an accredited lab using the US sieve numbers and gradation noted below.

US Sieve Number	Percent Passing
0.375 inch	100
4	95-100
10	75-90
40	24-40
100	4-10
200	2-5

Where existing soils meet the above aggregate gradation, those soils may be amended rather than importing mineral aggregate.

Compost to Aggregate Ratio, Organic Matter Content, Cation Exchange Capacity:

- Compost to aggregate ratio: 60-65 percent mineral aggregate, 35-40 percent compost.
- Organic matter content: 5-8 percent by weight.
- Cation Exchange Capacity (CEC) must be > 5 milliequivalents/100 g dry soil. Note: Soil mixes meeting the above specifications do not have to be tested for CEC. They will readily meet the minimum CEC.

Composted Material
To ensure that the BSM will support healthy plant growth and root development, contribute to biofiltration of pollutants, and not restrict infiltration when used in the proportions cited herein, the following compost standards are required:

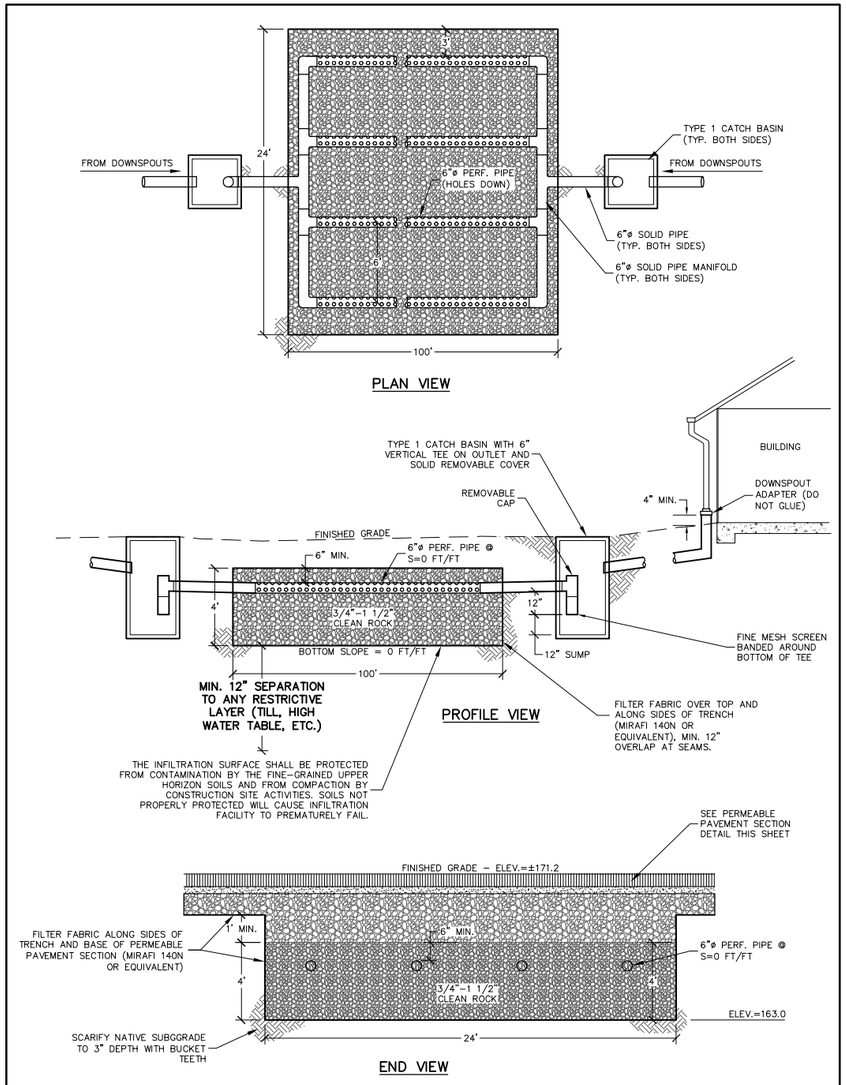
- Material must meet the definition of "composted material" in WAC 173-350-100 and complies with the testing parameters and standards in wac 173-350-220.
- Material must be produced at a composting facility that is permitted by a jurisdictional health authority. Permitted compost facilities in Washington State are included on a list available at <https://ecology.wa.gov/Waste-Toxics/Reducing-recycling-waste/Organic-materials/Managing-organics-compost>.

- The completed compost product must originate a minimum of 65 percent by volume from recycled plant waste comprising "yard debris", "crop residues", and "bulking agents" as those terms are defined in WAC 173-350-100. A maximum of 35 percent by volume of "postconsumer food waste" as defined in WAC 173-350-100, but no including biosolids, may be substituted for recycled plant waste.
- Moisture content must be such that there is no visible free water or dust produced when handling the material.
- The material shall be tested in accordance with the U.S. Composting Council "Test Method for the Examination of Compost and Composting" (TMECC), as established in the Composting Council's "Seal of Testing Assurance" (STA) program. Most Washington compost BMPs now use these tests.
- Composted material shall meet the size gradations established in the U.S. Composting Council's Seal of Testing Assurance (STA) program, as follows: Fine Compost shall meet the following gradation by dry weight:

	Min.	Max.
Percent passing 2"	100	
Percent passing 1"	99	100
Percent passing 0.625"	90	100
Percent passing 0.25"	75	100

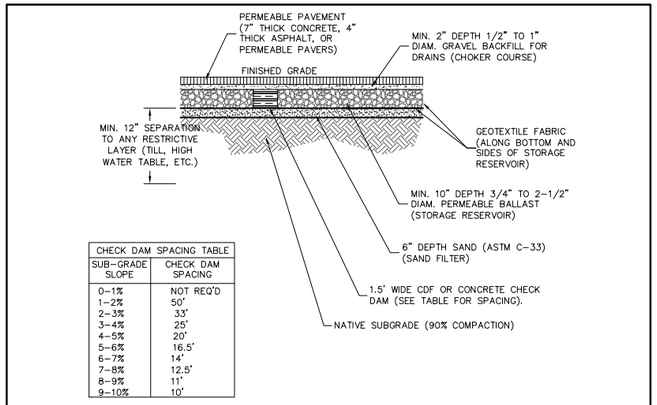
- The pH shall be between 6.0 and 8.5 (TMECC 04.11-A).
- "Physical contaminants" (as defined in WAC 173-350-100) content shall be less than 1 percent by weight (TMECC 03.08-A) total, not to exceed 0.25 percent film plastic by dry weight.
- Minimum organic matter content shall be 40 percent by dry weight basis as determined by TMECC 05.07-A, "Loss-On-Ignition Organic Matter Method."
- Soluble salt contents shall be less than 4.0 dS/mm (mmhos/cm) tested in accordance with TMECC 04.10-A, "1:5 Slurry Method, Mass Basis."
- Maturity indicators from a cucumber bioassay shall be greater than 80 percent for both emergence and vigor, in accordance with TMECC 05.05-A, "Germination and Vigor".
- The material must be stable (low oxygen use and CO2 generation) and mature (capable of supporting plant growth). This is critical to plant success in a bioretention soil mixes. Stability shall be 7 mg CO2-C/g OM/day or below in accordance with TMECC 05.08-B, "Carbon Dioxide Evolution Rate."
- Fine Compost shall have a carbon to nitrogen ratio of less than 25:1 as determined using TMECC 05.02A "Carbon to Nitrogen Ratio" which uses the TMECC 04.01 "Organic Carbon" and TMECC 04.02-D "Total Nitrogen by Oxidation." The Engineer may specify a Carbon:Nitrogen ratio up to 35:1 for projects where the plants selected are entirely Puget Sound lowland native species, and up to 40:1 for coarse compost to be used as a surface mulch (not in a soil mix).

Compost not conforming to the above requirements or taken from a source other than those tested and accepted shall be immediately removed from the project and replaced.



DOWNSPOUT INFILTRATION TRENCH (BMP T5.10A) DETAIL

N.T.S.



CHECK DAM SPACING TABLE	
SUB-GRADE SLOPE	CHECK DAM SPACING
0-1%	NOT REQ'D
1-2%	50'
2-3%	33'
3-4%	25'
4-5%	20'
5-6%	16.5'
6-7%	14'
7-8%	12.5'
8-9%	11'
9-10%	10'

NOTES:
1. ALL THICKNESSES ARE COMPACTED DEPTHS (90%).
2. MAXIMUM PAVING SLOPES SHALL BE 5% FOR PERMEABLE ASPHALT, 6% FOR PERMEABLE CONCRETE, 10% FOR INTERLOCKING PAVERS, AND 6% FOR GRID/LATTICE SYSTEMS.
3. EXCAVATE TO GRADE WITH LIGHT EQUIPMENT WITH RUBBER TIRES. MINIMIZE DISTURBANCE OF THE SUBGRADE SOILS TO THE EXTENT PRACTICAL.
4. WASHED AGGREGATES SHALL MEET THE WSDOT SPECIFICATIONS FOR GRAVEL BACKFILL FOR DRAINS 9-03.12(4) AND PERMEABLE BALLAST 9-03.9(2).
5. GEOTEXTILE FABRIC SHALL BE MIRAFI 160N OR EQUAL.
6. PROVIDE CONTROLLED DENSITY FILL (CDF) OR CONCRETE CHECK DAMS PERPENDICULAR TO THE PAVEMENT SLOPE TO PREVENT WATER FROM FLOWING LATERALLY WITHIN THE STORAGE RESERVOIR SECTION.
7. ANY FILL NEEDED TO BRING THE PERMEABLE PAVEMENT SECTION UP TO GRADE SHALL CONSIST OF "PERMEABLE BALLAST PER WSDOT 9-03.9(2)".

PERMEABLE PAVEMENT (BMP T5.15) SECTION

N.T.S.

TEMPORARY CONSTRUCTION BMP'S

THE FOLLOWING BEST MANAGEMENT PRACTICES (BMP'S) ARE PROPOSED DURING THE CONSTRUCTION PHASE OF THE PROJECT TO PREVENT SEDIMENTATION, EROSION, AND RELEASE OF POLLUTANTS TO WATERS OF WASHINGTON STATE, ADJACENT PROPERTIES, AND DRAINAGE FACILITIES:

- C101 PRESERVING NATURAL VEGETATION
- C105 STABILIZED CONSTRUCTION ENTRANCE/EXIT
- C121 MULCHING
- C123 PLASTIC COVERING
- C125 TOPSOILING/COMPOSTING
- C140 DUST CONTROL
- C150 MATERIALS ON HAND
- C151 CONCRETE HANDLING
- C152 SAWCUTTING AND SURFACING POLLUTION PREVENTION
- C154 CONCRETE WASHOUT AREA
- C160 CERTIFIED EROSION AND SEDIMENT CONTROL LEAD
- C233 SILT FENCING

PERMANENT STORMWATER BMP'S

THE FOLLOWING PERMANENT STORMWATER BEST MANAGEMENT PRACTICES (BMP'S) ARE PROPOSED:

- T5.10A DOWNSPOUT INFILTRATION TRENCH
- T5.13 POST-CONSTRUCTION SOIL QUALITY AND DEPTH (LAWN/LANDSCAPE AND DISTURBED AREAS)
- T5.15 PERMEABLE PAVING (DRIVE/PARKING AREA)

NO. | DATE | REVISION

ULERY BUSINESS SUITES

CITY OF LACEY, WASHINGTON

DETAILS AND NOTES

DESIGNED BY: CMM
DRAWN BY: CMM
CHECKED BY:
SCALE: N.T.S.
DATE: 5/16/2023

PO Box 12690
Olympia, WA 98508
360.705.2474
www.olyeng.com
OLYMPIC ENGINEERING
Civil Engineering • Land Planning • Project Management

JOB NUMBER: 22084
DRAWING NAME: 22084_DETL

SHEET: 2 OF 2

Appendix 2
Drainage Calculations

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	22084_051523
Site Name:	Ulery Business Suites
Site Address:	1070 Ulery St. SE
City:	Lacey
Report Date:	5/15/2023
Gage:	Woodland Creek
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	0.889
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Forest, Flat	0.906
A B, Pasture, Flat	0.054
A B, Lawn, Flat	0.019
Pervious Total	0.979

Impervious Land Use	acre
DRIVEWAYS FLAT	0.018
Impervious Total	0.018
Basin Total	0.997

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Roof

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.305
Impervious Total	0.305
Basin Total	0.305

Element Flows To:

Surface	Interflow	Groundwater
Downspout Infiltration Trench	Downspout Infiltration Trench	

Impermeable Driveway/Sidewalk runon

Bypass:	No
Impervious Land Use	acre
DRIVEWAYS MOD LAT	0.066
Element Flows To:	
Outlet 1	Outlet 2
Permeable Pavement	

Basin 1

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.048
A B, Pasture, Flat	0.262
Pervious Total	0.31
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.31

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Routing

Downspout Infiltration Trench

Bottom Length:	100.00 ft.
Bottom Width:	24.00 ft.
Trench bottom slope 1:	0.0000001 To 1
Trench Left side slope 0:	0.0000001 To 1
Trench right side slope 2:	0.0000001 To 1
Material thickness of first layer:	4
Pour Space of material for first layer:	0.4
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	58.55
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	58.55
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	6 in.
Element Flows To:	
Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.055	0.000	0.000	0.000
0.0444	0.055	0.001	0.000	0.055
0.0889	0.055	0.002	0.000	0.055
0.1333	0.055	0.002	0.000	0.055
0.1778	0.055	0.003	0.000	0.055
0.2222	0.055	0.004	0.000	0.055
0.2667	0.055	0.005	0.000	0.055
0.3111	0.055	0.006	0.000	0.055
0.3556	0.055	0.007	0.000	0.055
0.4000	0.055	0.008	0.000	0.055
0.4444	0.055	0.009	0.000	0.055
0.4889	0.055	0.010	0.000	0.055
0.5333	0.055	0.011	0.000	0.055
0.5778	0.055	0.012	0.000	0.055
0.6222	0.055	0.013	0.000	0.055
0.6667	0.055	0.014	0.000	0.055
0.7111	0.055	0.015	0.000	0.055
0.7556	0.055	0.016	0.000	0.055
0.8000	0.055	0.017	0.000	0.055
0.8444	0.055	0.018	0.000	0.055
0.8889	0.055	0.019	0.000	0.055
0.9333	0.055	0.020	0.000	0.055
0.9778	0.055	0.021	0.000	0.055
1.0222	0.055	0.022	0.000	0.055

1.0667	0.055	0.023	0.000	0.055
1.1111	0.055	0.024	0.000	0.055
1.1556	0.055	0.025	0.000	0.055
1.2000	0.055	0.026	0.000	0.055
1.2444	0.055	0.027	0.000	0.055
1.2889	0.055	0.028	0.000	0.055
1.3333	0.055	0.029	0.000	0.055
1.3778	0.055	0.030	0.000	0.055
1.4222	0.055	0.031	0.000	0.055
1.4667	0.055	0.032	0.000	0.055
1.5111	0.055	0.033	0.000	0.055
1.5556	0.055	0.034	0.000	0.055
1.6000	0.055	0.035	0.000	0.055
1.6444	0.055	0.036	0.000	0.055
1.6889	0.055	0.037	0.000	0.055
1.7333	0.055	0.038	0.000	0.055
1.7778	0.055	0.039	0.000	0.055
1.8222	0.055	0.040	0.000	0.055
1.8667	0.055	0.041	0.000	0.055
1.9111	0.055	0.042	0.000	0.055
1.9556	0.055	0.043	0.000	0.055
2.0000	0.055	0.044	0.000	0.055
2.0444	0.055	0.045	0.000	0.055
2.0889	0.055	0.046	0.000	0.055
2.1333	0.055	0.047	0.000	0.055
2.1778	0.055	0.048	0.000	0.055
2.2222	0.055	0.049	0.000	0.055
2.2667	0.055	0.050	0.000	0.055
2.3111	0.055	0.050	0.000	0.055
2.3556	0.055	0.051	0.000	0.055
2.4000	0.055	0.052	0.000	0.055
2.4444	0.055	0.053	0.000	0.055
2.4889	0.055	0.054	0.000	0.055
2.5333	0.055	0.055	0.000	0.055
2.5778	0.055	0.056	0.000	0.055
2.6222	0.055	0.057	0.000	0.055
2.6667	0.055	0.058	0.000	0.055
2.7111	0.055	0.059	0.000	0.055
2.7556	0.055	0.060	0.000	0.055
2.8000	0.055	0.061	0.000	0.055
2.8444	0.055	0.062	0.000	0.055
2.8889	0.055	0.063	0.000	0.055
2.9333	0.055	0.064	0.000	0.055
2.9778	0.055	0.065	0.000	0.055
3.0222	0.055	0.066	0.017	0.055
3.0667	0.055	0.067	0.090	0.055
3.1111	0.055	0.068	0.184	0.055
3.1556	0.055	0.069	0.277	0.055
3.2000	0.055	0.070	0.346	0.055
3.2444	0.055	0.071	0.385	0.055
3.2889	0.055	0.072	0.423	0.055
3.3333	0.055	0.073	0.454	0.055
3.3778	0.055	0.074	0.484	0.055
3.4222	0.055	0.075	0.511	0.055
3.4667	0.055	0.076	0.537	0.055
3.5111	0.055	0.077	0.562	0.055
3.5556	0.055	0.078	0.586	0.055
3.6000	0.055	0.079	0.609	0.055

3.6444	0.055	0.080	0.632	0.055
3.6889	0.055	0.081	0.653	0.055
3.7333	0.055	0.082	0.674	0.055
3.7778	0.055	0.083	0.694	0.055
3.8222	0.055	0.084	0.714	0.055
3.8667	0.055	0.085	0.733	0.055
3.9111	0.055	0.086	0.751	0.055
3.9556	0.055	0.087	0.769	0.055
4.0000	0.055	0.088	0.787	0.055

Permeable Pavement

Pavement Area:0.3153 acre.Pavement Length:117.20 ft.

Pavement Width:	117.20 ft.
	Pavement slope 1:0.02 To 1
Pavement thickness:	0.33
Pour Space of Pavement:	0.4
Material thickness of second layer:	0.17
Pour Space of material for second layer:	0.4
Material thickness of third layer:	1
Pour Space of material for third layer:	0.4
Infiltration On	
Infiltration rate:	1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	69.693
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	69.693
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	3.655
Element Flows To:	
Outlet 1	Outlet 2

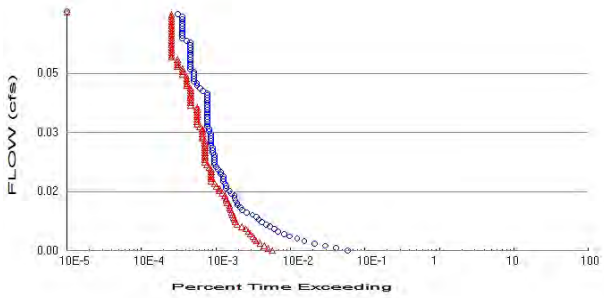
Permeable Pavement Hydraulic Table

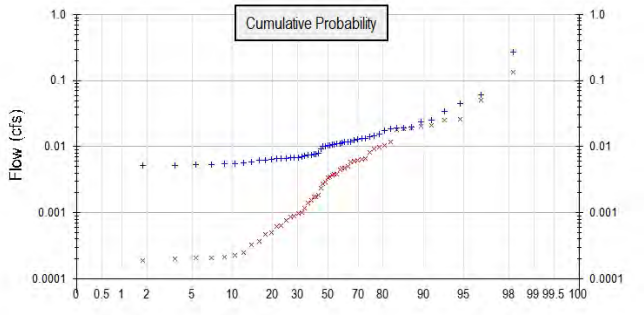
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.315	0.000	0.000	0.000
0.0167	0.315	0.002	0.000	0.318
0.0333	0.315	0.004	0.000	0.318
0.0500	0.315	0.006	0.000	0.318
0.0667	0.315	0.008	0.000	0.318
0.0833	0.315	0.010	0.000	0.318
0.1000	0.315	0.012	0.000	0.318
0.1167	0.315	0.014	0.000	0.318
0.1333	0.315	0.016	0.000	0.318
0.1500	0.315	0.018	0.000	0.318
0.1667	0.315	0.021	0.000	0.318
0.1833	0.315	0.023	0.000	0.318
0.2000	0.315	0.025	0.000	0.318
0.2167	0.315	0.027	0.000	0.318
0.2333	0.315	0.029	0.000	0.318
0.2500	0.315	0.031	0.000	0.318
0.2667	0.315	0.033	0.000	0.318
0.2833	0.315	0.035	0.000	0.318
0.3000	0.315	0.037	0.000	0.318
0.3167	0.315	0.039	0.000	0.318
0.3333	0.315	0.042	0.000	0.318
0.3500	0.315	0.044	0.000	0.318
0.3667	0.315	0.046	0.000	0.318
0.3833	0.315	0.048	0.000	0.318
0.4000	0.315	0.050	0.000	0.318
0.4167	0.315	0.052	0.000	0.318
0.4333	0.315	0.054	0.000	0.318
0.4500	0.315	0.056	0.000	0.318
0.4667	0.315	0.058	0.000	0.318
0.4833	0.315	0.061	0.000	0.318
0.5000	0.315	0.063	0.000	0.318

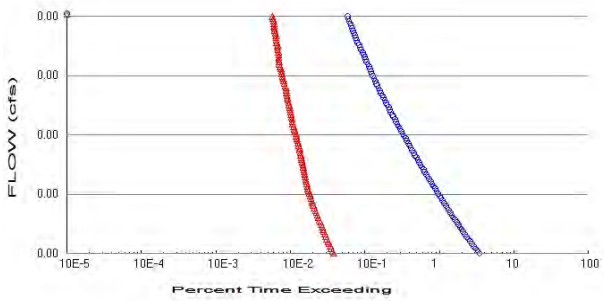
0.5167	0.315	0.065	0.000	0.318
0.5333	0.315	0.067	0.000	0.318
0.5500	0.315	0.069	0.000	0.318
0.5667	0.315	0.071	0.000	0.318
0.5833	0.315	0.073	0.000	0.318
0.6000	0.315	0.075	0.000	0.318
0.6167	0.315	0.077	0.000	0.318
0.6333	0.315	0.079	0.000	0.318
0.6500	0.315	0.082	0.000	0.318
0.6667	0.315	0.084	0.000	0.318
0.6833	0.315	0.086	0.000	0.318
0.7000	0.315	0.088	0.000	0.318
0.7167	0.315	0.090	0.000	0.318
0.7333	0.315	0.092	0.000	0.318
0.7500	0.315	0.094	0.000	0.318
0.7667	0.315	0.096	0.000	0.318
0.7833	0.315	0.098	0.000	0.318
0.8000	0.315	0.100	0.000	0.318
0.8167	0.315	0.103	0.000	0.318
0.8333	0.315	0.105	0.000	0.318
0.8500	0.315	0.107	0.000	0.318
0.8667	0.315	0.109	0.000	0.318
0.8833	0.315	0.111	0.000	0.318
0.9000	0.315	0.113	0.000	0.318
0.9167	0.315	0.115	0.000	0.318
0.9333	0.315	0.117	0.000	0.318
0.9500	0.315	0.119	0.000	0.318
0.9667	0.315	0.121	0.000	0.318
0.9833	0.315	0.124	0.000	0.318
1.0000	0.315	0.126	0.000	0.318
1.0167	0.315	0.128	0.000	0.318
1.0333	0.315	0.130	0.000	0.318
1.0500	0.315	0.132	0.000	0.318
1.0667	0.315	0.134	0.000	0.318
1.0833	0.315	0.136	0.000	0.318
1.1000	0.315	0.138	0.000	0.318
1.1167	0.315	0.140	0.000	0.318
1.1333	0.315	0.143	0.000	0.318
1.1500	0.315	0.145	0.000	0.318
1.1667	0.315	0.147	0.000	0.318
1.1833	0.315	0.149	0.000	0.318
1.2000	0.315	0.151	0.000	0.318
1.2167	0.315	0.153	0.000	0.318
1.2333	0.315	0.155	0.000	0.318
1.2500	0.315	0.157	0.000	0.318
1.2667	0.315	0.159	0.000	0.318
1.2833	0.315	0.161	0.000	0.318
1.3000	0.315	0.164	0.000	0.318
1.3167	0.315	0.166	0.000	0.318
1.3333	0.315	0.168	0.000	0.318
1.3500	0.315	0.170	0.000	0.318
1.3667	0.315	0.172	0.000	0.318
1.3833	0.315	0.174	0.000	0.318
1.4000	0.315	0.176	0.000	0.318
1.4167	0.315	0.178	0.000	0.318
1.4333	0.315	0.180	0.000	0.318
1.4500	0.315	0.182	0.000	0.318
1.4667	0.315	0.185	0.000	0.318

1.4833	0.315	0.187	0.000	0.318
1.5000	0.315	0.189	0.000	0.318

Analysis Results
POC 1







+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.979
Total Impervious Area: 0.018

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.31
Total Impervious Area: 0.686331

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.009916
5 year	0.018941
10 year	0.028117
25 year	0.044813
50 year	0.06211
100 year	0.08476

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.002436
5 year	0.009795
10 year	0.02059
25 year	0.046008
50 year	0.077843
100 year	0.125475

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.011	0.007
1957	0.014	0.010
1958	0.007	0.002
1959	0.010	0.005
1960	0.010	0.006
1961	0.007	0.003
1962	0.007	0.000
1963	0.024	0.026
1964	0.019	0.019
1965	0.010	0.006
1966	0.006	0.001
1967	0.012	0.005
1968	0.006	0.002
1969	0.005	0.001
1970	0.005	0.001
1971	0.045	0.025
1972	0.020	0.012
1973	0.006	0.000
1974	0.011	0.004
1975	0.011	0.003
1976	0.011	0.005
1977	0.014	0.000
1978	0.019	0.021
1979	0.012	0.006
1980	0.008	0.002
1981	0.013	0.009
1982	0.014	0.010
1983	0.017	0.003
1984	0.008	0.004
1985	0.011	0.001
1986	0.020	0.018
1987	0.016	0.008
1988	0.005	0.000
1989	0.006	0.000
1990	0.009	0.004
1991	0.062	0.051
1992	0.268	0.134
1993	0.035	0.019
1994	0.007	0.000
1995	0.011	0.002
1996	0.012	0.006
1997	0.025	0.020
1998	0.013	0.004
1999	0.008	0.001
2000	0.007	0.000
2001	0.006	0.000
2002	0.007	0.000
2003	0.005	0.000
2004	0.007	0.001
2005	0.005	0.000
2006	0.007	0.001
2007	0.007	0.001
2008	0.006	0.000
2009	0.008	0.001
2010	0.012	0.003
2011	0.006	0.002

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2678	0.1339
2	0.0617	0.0512
3	0.0447	0.0259
4	0.0346	0.0251
5	0.0250	0.0211
6	0.0242	0.0203
7	0.0199	0.0193
8	0.0195	0.0189
9	0.0191	0.0183
10	0.0185	0.0117
11	0.0175	0.0105
12	0.0155	0.0099
13	0.0144	0.0092
14	0.0144	0.0082
15	0.0135	0.0066
16	0.0132	0.0064
17	0.0131	0.0062
18	0.0124	0.0060
19	0.0120	0.0059
20	0.0119	0.0050
21	0.0119	0.0048
22	0.0115	0.0047
23	0.0111	0.0044
24	0.0111	0.0039
25	0.0109	0.0038
26	0.0108	0.0037
27	0.0105	0.0035
28	0.0103	0.0034
29	0.0101	0.0029
30	0.0100	0.0028
31	0.0092	0.0024
32	0.0080	0.0019
33	0.0077	0.0017
34	0.0077	0.0017
35	0.0076	0.0016
36	0.0074	0.0014
37	0.0072	0.0012
38	0.0071	0.0010
39	0.0069	0.0010
40	0.0068	0.0009
41	0.0067	0.0009
42	0.0067	0.0008
43	0.0066	0.0006
44	0.0065	0.0006
45	0.0065	0.0005
46	0.0063	0.0005
47	0.0062	0.0004
48	0.0059	0.0003
49	0.0057	0.0002
50	0.0056	0.0002
51	0.0056	0.0002
52	0.0054	0.0002
53	0.0054	0.0002
54	0.0053	0.0002

55	0.0052	0.0002
56	0.0046	0.0002

LID Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0008	68117	754	1	Pass
0.0008	64347	723	1	Pass
0.0009	60714	696	1	Pass
0.0009	57297	674	1	Pass
0.0010	54038	649	1	Pass
0.0010	51053	627	1	Pass
0.0010	48363	608	1	Pass
0.0011	45810	590	1	Pass
0.0011	43454	574	1	Pass
0.0012	41196	555	1	Pass
0.0012	39095	541	1	Pass
0.0013	37112	527	1	Pass
0.0013	35207	515	1	Pass
0.0013	33459	501	1	Pass
0.0014	31908	481	1	Pass
0.0014	30396	463	1	Pass
0.0015	28924	451	1	Pass
0.0015	27628	440	1	Pass
0.0016	26292	427	1	Pass
0.0016	25114	413	1	Pass
0.0016	23936	401	1	Pass
0.0017	22836	390	1	Pass
0.0017	21737	385	1	Pass
0.0018	20716	371	1	Pass
0.0018	19813	365	1	Pass
0.0018	18913	356	1	Pass
0.0019	18053	347	1	Pass
0.0019	17264	337	1	Pass
0.0020	16502	332	2	Pass
0.0020	15732	328	2	Pass
0.0021	15004	322	2	Pass
0.0021	14356	315	2	Pass
0.0021	13704	312	2	Pass
0.0022	13095	307	2	Pass
0.0022	12536	303	2	Pass
0.0023	11960	298	2	Pass
0.0023	11430	294	2	Pass
0.0023	10965	290	2	Pass
0.0024	10511	286	2	Pass
0.0024	10085	280	2	Pass
0.0025	9673	277	2	Pass
0.0025	9254	272	2	Pass
0.0026	8832	268	3	Pass
0.0026	8469	262	3	Pass
0.0026	8102	261	3	Pass
0.0027	7778	254	3	Pass
0.0027	7487	250	3	Pass
0.0028	7169	245	3	Pass
0.0028	6886	242	3	Pass
0.0029	6609	236	3	Pass
0.0029	6331	234	3	Pass
0.0029	6054	226	3	Pass
0.0030	5818	222	3	Pass

0.0030	5559	218	3	Pass
0.0031	5341	210	3	Pass
0.0031	5127	208	4	Pass
0.0031	4950	208	4	Pass
0.0032	4760	204	4	Pass
0.0032	4571	200	4	Pass
0.0033	4389	197	4	Pass
0.0033	4232	195	4	Pass
0.0034	4084	193	4	Pass
0.0034	3911	189	4	Pass
0.0034	3758	187	4	Pass
0.0035	3635	181	4	Pass
0.0035	3497	179	5	Pass
0.0036	3370	177	5	Pass
0.0036	3240	175	5	Pass
0.0037	3110	173	5	Pass
0.0037	3000	173	5	Pass
0.0037	2902	167	5	Pass
0.0038	2808	162	5	Pass
0.0038	2712	159	5	Pass
0.0039	2608	156	5	Pass
0.0039	2521	153	6	Pass
0.0039	2433	151	6	Pass
0.0040	2356	149	6	Pass
0.0040	2282	148	6	Pass
0.0041	2219	144	6	Pass
0.0041	2150	139	6	Pass
0.0042	2081	139	6	Pass
0.0042	2021	138	6	Pass
0.0042	1957	138	7	Pass
0.0043	1896	138	7	Pass
0.0043	1831	136	7	Pass
0.0044	1768	134	7	Pass
0.0044	1713	133	7	Pass
0.0045	1639	132	8	Pass
0.0045	1582	129	8	Pass
0.0045	1529	127	8	Pass
0.0046	1487	127	8	Pass
0.0046	1443	125	8	Pass
0.0047	1410	124	8	Pass
0.0047	1361	121	8	Pass
0.0047	1318	120	9	Pass
0.0048	1281	119	9	Pass
0.0048	1250	119	9	Pass
0.0049	1202	118	9	Pass
0.0049	1171	115	9	Pass
0.0050	1153	112	9	Pass

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0050	1153	112	9	Pass
0.0055	815	99	12	Pass
0.0061	578	88	15	Pass
0.0067	419	77	18	Pass
0.0073	302	69	22	Pass
0.0078	242	65	26	Pass
0.0084	191	62	32	Pass
0.0090	162	57	35	Pass
0.0096	134	54	40	Pass
0.0102	120	50	41	Pass
0.0107	105	44	41	Pass
0.0113	93	38	40	Pass
0.0119	81	36	44	Pass
0.0125	74	35	47	Pass
0.0130	69	34	49	Pass
0.0136	61	33	54	Pass
0.0142	51	32	62	Pass
0.0148	44	31	70	Pass
0.0153	42	30	71	Pass
0.0159	39	30	76	Pass
0.0165	38	28	73	Pass
0.0171	36	27	75	Pass
0.0177	35	27	77	Pass
0.0182	35	26	74	Pass
0.0188	32	24	75	Pass
0.0194	30	22	73	Pass
0.0200	27	22	81	Pass
0.0205	27	20	74	Pass
0.0211	26	19	73	Pass
0.0217	25	17	68	Pass
0.0223	25	17	68	Pass
0.0229	25	17	68	Pass
0.0234	23	17	73	Pass
0.0240	23	17	73	Pass
0.0246	21	17	80	Pass
0.0252	20	16	80	Pass
0.0257	19	15	78	Pass
0.0263	19	14	73	Pass
0.0269	19	14	73	Pass
0.0275	19	14	73	Pass
0.0280	19	14	73	Pass
0.0286	18	14	77	Pass
0.0292	18	14	77	Pass
0.0298	18	14	77	Pass
0.0304	17	14	82	Pass
0.0309	17	14	82	Pass
0.0315	17	14	82	Pass
0.0321	17	13	76	Pass
0.0327	17	13	76	Pass
0.0332	17	13	76	Pass
0.0338	16	13	81	Pass
0.0344	16	13	81	Pass
0.0350	15	12	80	Pass

0.0356	15	11	73	Pass
0.0361	15	11	73	Pass
0.0367	15	11	73	Pass
0.0373	15	11	73	Pass
0.0379	15	11	73	Pass
0.0384	15	11	73	Pass
0.0390	15	11	73	Pass
0.0396	15	11	73	Pass
0.0402	15	9	60	Pass
0.0408	15	9	60	Pass
0.0413	15	9	60	Pass
0.0419	15	9	60	Pass
0.0425	15	9	60	Pass
0.0431	15	9	60	Pass
0.0436	13	9	69	Pass
0.0442	12	9	75	Pass
0.0448	11	8	72	Pass
0.0454	11	8	72	Pass
0.0459	10	8	80	Pass
0.0465	10	8	80	Pass
0.0471	10	8	80	Pass
0.0477	10	7	70	Pass
0.0483	10	7	70	Pass
0.0488	9	7	77	Pass
0.0494	9	6	66	Pass
0.0500	9	6	66	Pass
0.0506	9	6	66	Pass
0.0511	9	6	66	Pass
0.0517	9	5	55	Pass
0.0523	9	5	55	Pass
0.0529	9	5	55	Pass
0.0535	9	5	55	Pass
0.0540	9	5	55	Pass
0.0546	9	5	55	Pass
0.0552	9	5	55	Pass
0.0558	8	5	62	Pass
0.0563	7	5	71	Pass
0.0569	7	5	71	Pass
0.0575	7	5	71	Pass
0.0581	7	5	71	Pass
0.0586	7	5	71	Pass
0.0592	7	5	71	Pass
0.0598	7	5	71	Pass
0.0604	7	5	71	Pass
0.0610	7	5	71	Pass
0.0615	7	5	71	Pass
0.0621	6	5	83	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Downspout Infiltration Trench	☐	53.28			☐	100.00			
Permeable Pavement POC	☐	63.42			☐	100.00			
Total Volume Infiltrated		116.70	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

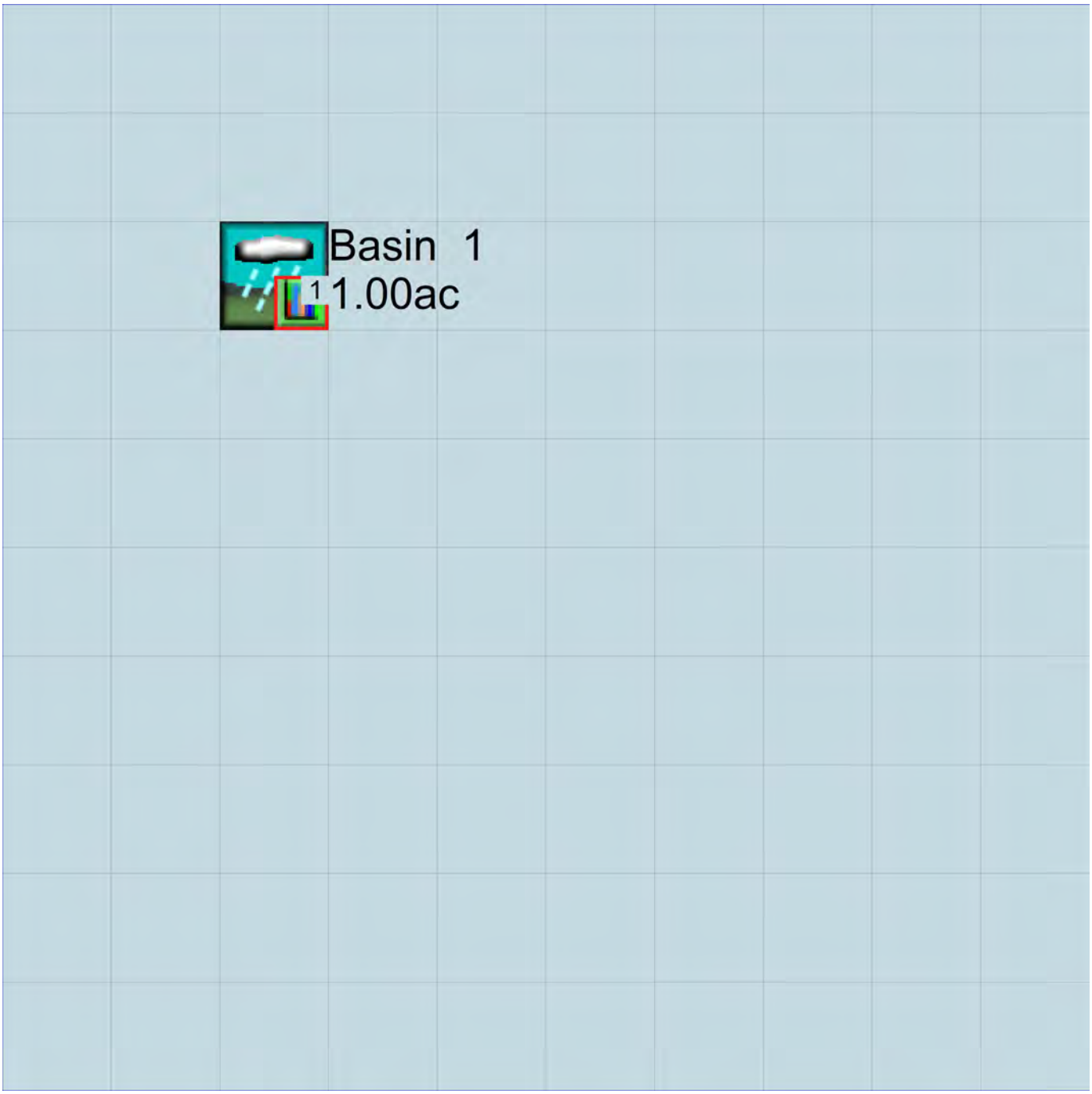
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Appendix 3
Soils Reports

4/27/2023

Aaron Borden

Subject: **Borden - Geotechnical Services Report**
1070 Ulery Street, Lacey, WA
Project Number: QG23-067

Dear Client,

At your request, Quality Geo NW, PLLC (QG) has completed a soils investigation of the above-referenced project. The investigation was performed in accordance with our proposal for professional services.

We would be pleased to continue our role as your geotechnical consultant of record during the project planning and construction phases, as local inspection firms have not been found to be as familiar or reliably experienced with geotechnical design. This may include soil subgrade inspections, periodic review of special inspection reports, or supplemental recommendations if changes occur during construction. We will happily meet with you at your convenience to discuss these and other additional *Time & Materials* services.

We thank you for the opportunity to be of service on this project and trust this report satisfies your project needs currently. QG wishes you the best while completing the project.

Respectfully Submitted,
Quality Geo NW, PLLC

Luke Preston McCann, L.E.G.
Owner + Principal

Ray Gean II
Staff Geologist/Project Manager

SOILS REPORT

BORDEN GEO
1070 ULERY STREET
LACEY, WA

Aaron Borden

Prepared by:

Alexander Barnes, G.I.T.
Staff Geologist, Laboratory Supervisor

Approved by:

State of Washington
Engineering Geologist
19110623
Licensed Geologist

4/27/2023

LUKE PRESTON MCCANN

Luke Preston McCann, L.E.G.
Principal Licensed Engineering Geologist

Quality Geo NW, PLLC
Geotechnical Investigation & Engineering Consultation
Phone: 360-878-9750 | Web: qualitygeonw.com
Mail: 4631 Whitman Ln SE, Ste D, Lacey, WA 98513

4/27/2023

QG Project # QG23-067

Copyright © 2023 Quality Geo NW, PLLC

All Rights Reserved

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the findings and recommendations of Quality Geo NW's (QG) soil investigation conducted in support of new site surface improvements.

1.1 PROJECT DESCRIPTION

QG understands the project entails new construction, within a presently undeveloped parcel. QG has been contracted to perform a soils investigation of the proposed site to provide foundation, stormwater, and earthwork recommendations.

1.2 FIELD WORK

Site exploration activities were performed on 3/29/2023. Exploration locations were marked in the field by a QG Staff Geologist with respect to the provided map and cleared for public conductible utilities. Our exploration locations were selected by an QG Staff Geologist prior to field work to provide safest access to relevant soil conditions. The geologist directed the advancement of 2 excavated test pits (TP). The test pits were advanced within the vicinity of the anticipated development footprint areas, to maximum depths of 12.0 feet below present grade (BPG) in general accordance with the specified contract depth.

During explorations QG logged each soil horizon we encountered, and field classified them in accordance with the Unified Soil Classification System (USCS). Representative soil samples were collected from each unit, identified according to boring location and depth, placed in plastic bags to protect against moisture loss, and were transported to the soil laboratory for supplemental classification and other tests.

QG advanced 1 Wildcat Dynamic Cone Penetrometer (DCP) tests at a representative location within the vicinity of the proposed development and as slope conditions permitted. The penetrometer test was terminated upon reaching the equipment's maximum practical extent. During penetrometer advancement, blow counts were recorded in 10-centimeter increments as a thirty-five-pound weight was dropped 15 inches. Blow counts were then converted to resistance (kg/cm2), standard penetration blow counts (N-values), and corresponding soil consistency, with complete results shown on the attached logs.

2.0 EXISTING SITE CONDITIONS

2.1 AREA GEOLOGY

QG reviewed available map publications to assess known geologic conditions and hazards present at the site location. The Washington Geologic Information Portal (WGIP), maintained by the Department of Natural Resources Division of Geology and Earth Resources, provides 1:24,000-scale geologic mapping of the region. Geology of the site location and vicinity consists of Pleistocene continental glacial drift (Qgos). The sediment deposits on site are described as "Moderately well-sorted, moderately to well-rounded, fine- to medium-grained sand with minor silt; noncohesive and highly permeable; thickness inferred from wells reaches up to 100 ft; deposited in and around the margins of glacial lakes; surrounds numerous steep-walled lakes and depressions (kettles), evidence that this unit was largely deposited during deglaciation when there was stagnant ice occupying much of the southern Puget Lowland."

The WGIP Map also offers layers of mapped geohazard conditions within the state. According to the regional-scale interactive map, there are no mapped recent deep seated landslide deposits to exist within the vicinity of the parcel. Available LiDAR imagery of the site did not reveal obvious or prominent landslide features within the site as well as within the vicinity.

The United States Department of Agriculture portal (USDA) provides a soil mapping of the region. The soils in the vicinity are mapped as Nisqually loamy fine sand (73, 74) formed as terraces derived from sandy glacial outwash. The soils are described as loamy fine sand from 0 to 31 inches and loamy sand from 31 to 60 inches. Depth to restrictive feature is more than 80 inches. Capacity of most limiting layer to transmit water (ksat) is listed as high (1.98 to 5.95 in/hr). Depth to water table is more than 80 inches.

2.2 SITE & SURFACE CONDITIONS

The project area is relatively flat, near the same elevation as the adjacent road. The currently undeveloped and is vegetated with shrubs and trees. To the south is a shopping center, to the north is a residential property.

2.3 SOIL LOG

Site soil conditions were generally consistent across the property in both test pits. Representative lab samples were taken from TP-1 and TP-2. Soil conditions on site were as follows:

- **0' to 1.0' – Topsoil:**

  An overriding 1.0-foot layer of topsoil was present over the site. This layer was brown with no cobbles and abundant organic matter.

- **1.0’ to 12.0’ – Silty Sand (SM)**

  Beneath topsoil was an approximately 11-foot layer of light brown to grey, moist soil with heavy organics and no cobbles present within the layer. This layer has more fines in TP-2. Between 7.5 and 9.75 feet, the layer transitions to a brown-grey layer with minor organics and fewer fines. No groundwater was encountered in either of the test pits.

2.4 SURFACE WATER AND GROUNDWATER CONDITIONS

No active surface water features are present on site. In the near vicinity, Lake Lois is ~1000 feet northeast and Goose Pond is ~1,250 feet southeast of the parcel. During our test pit explorations, no pervasive groundwater table was encountered in any of test pits. Based on well logs made publicly available by the WA Department of Ecology, local groundwater conditions are approximately 32 feet below the surface. Due to the sandy soil on site, we infer these conditions to be consistent with the property.

QG’s scope of work did not include determination or monitoring of seasonal groundwater elevation variations, formal documentation of wet season site conditions, or conclusive measurement of groundwater elevations at depths past the extent feasible for explorations at the time of the field explorations.

3.0 GEOTECHNICAL RECOMMENDATIONS

3.1 SHALLOW FOUNDATION RECOMMENDATIONS

Assuming site preparation is completed as described below, we recommend the following:

- **Subgrade Preparation**

  QG recommends excavating and clearing any loose or organic cover soils, including the overriding layer of topsoil where necessary, from areas of proposed pavement construction, down to firm bearing conditions and benching the final bottom of subgrade elevation flat. Excavations should be performed with a smooth blade bucket to limit disturbance of subgrade soils. Vibratory compaction methods are suitable for densification of the non-organic native soils.

  After excavations have been completed to the planned subgrade elevations, but before placing fill or structural elements, the exposed subgrade should be evaluated under the periodic guidance of a QG representative. Any areas that are identified as being soft or yielding during subgrade evaluation should be brought to the attention of the geotechnical engineer. Where over excavation is performed below a structure, the over excavation area should extend beyond the outside of the footing a distance equal to the depth of the over excavation below the footing. The over-excavated areas should be backfilled with properly compacted structural fill.

  The proposed buildings may utilize either stepped or continuous footings with slab-on-grade elements. For continuous footing elements, upon reaching bearing strata, we recommend benching foundation lines flat. Continuous perimeter and strip foundations may be stepped as needed to accommodate variations in final subgrade level. We also recommend maximum steps of 18 inches with spacing of at least 5 feet be constructed unless specified otherwise by the design engineer. Structural fill may then be placed as needed to reestablish final foundation grade.

- **Allowable Bearing Capacity:**
  - Up to 1,500 pounds per square foot (psf) for foundations placed on **12-inches of an approved structural fill** over compacted native soil placed in accordance with the recommendations of *Section 4.2*. Bearing capacities, at or below 1,500 psf may eliminate the need for additional inspection requirements if approved by the county. The allowable bearing capacity may be increased by 1/3 for transient loading due to wind and seismic events.

- **Minimum Footing Depth:**

  For a shallow perimeter and spread footing system, all exterior footings shall be embedded a minimum of 18 inches and all interior footings shall be embedded a minimum of 12 inches below the lowest adjacent finished grade, but not less than the depth required by design. However, all footings must also penetrate to the prescribed bearing stratum cited above. Minimum depths are referenced per IBC requirements for frost protection; other design concerns may dictate greater values be applied.

- **Minimum Footing Width:**

  Footings should be proportioned to meet the stated bearing capacity and/or the IBC 2018 (or current) minimum requirements. For a shallow perimeter and spread footing system, continuous strip footings should be a minimum of 16 inches wide and interior or isolated column footings should be a minimum of 24 inches wide.

- **Estimated Settlements:**

  All concrete settles after placement. We estimate that the maximum settlements will be on the order of 0.5 inch, or less, with a differential settlement of ½ inch, or less, over 50 linear feet. Settlement is anticipated to occur soon after the load is applied during construction.

3.1.1 BUILDING SLAB ON GRADE FLOOR

QG anticipates that slab-on-grade floors are planned for the interior of the proposed building. Based on typical construction practices, we assume finished slab grade will be similar to or marginally above present grade for the below recommendations. If floor grades are planned to be substantially raised or lowered from existing grade, QG should be contacted to provide revised or alternative recommendations.

- **Capillary Break:**

  A capillary break will be helpful to maintain a dry slab floor and reduce the potential for floor damage resulting from shallow perched water inundation. To provide a capillary moisture break, a 6-inch thick, properly compacted granular mat consisting of open-graded, free-draining angular aggregate is recommended below floor slabs. To provide additional slab structural support, or to substitute for a structural fill base pad where specified, QG recommends the capillary break should consist of crushed rock all passing the 1-inch sieve and no more than 3 percent (by weight) passing the U.S. No. #4 sieve, compacted in accordance with *Section 4.2.2* of this report.

- **Vapor Barrier:**

  A vapor retarding membrane such as 10 mil polyethylene film should be placed beneath all floor slabs to prevent transmission of moisture where floor coverings may be affected. Care should be taken during construction not to puncture or damage the membrane. To protect the membrane, a layer of sand no more than 2 inches thick may be placed over the membrane if desired. If excessive relict organic fill material is discovered at any location, additional sealant or more industrial gas barriers may be required to prevent off-gassing of decaying material from infiltrating the new structure. These measures shall be determined by the structural engineer to meet local code requirements as necessary.

- **Structural Design Considerations:**

  QG assumes design and specifications of slabs will be assessed by the project design engineer. We suggest a minimum unreinforced concrete structural section of 4.0 inches be considered to help protect against cracking and localized settlement, especially where larger equipment or localized loads are anticipated. It is generally recommended that any floor slabs and annular exterior concrete paving subject to vehicular loading be designed to incorporate reinforcing. Additionally, some level of reinforcing, such as a wire mesh may be desirable to prolong slab life due to the overwhelming presence of such poor underlying soils. It should be noted that QG does not express any guarantee or warranty for proposed slab sections.

3.2 INFILTRATION RATE DETERMINATION

QG understands the design of on-site stormwater controls are pending the results of this study to confirm design parameters and interpreted depths to perched seasonal groundwater and restrictive soil features.

3.2.1 GRADATION ANALYSIS METHODS & RESULTS

During test pit excavations for general site investigation, QG additionally collected representative samples of native soil deposits among potential infiltration strata and depths. Representative soil samples were selected from the western and eastern portions of the site (TP-1, TP-2) to characterize the local infiltration conditions.

We understand the project will be subject to infiltration design based on the Washington Department of Ecology Stormwater Management Manual for Western Washington (DoE SMMWW). For initial site infiltration characterization within the scope of this study, laboratory gradation analyses were completed including sieve and hydrometer tests for stormwater design characterization and rate determination to supplement field observations. Results of laboratory testing in terms of rate calculation are summarized below.

Laboratory results were interpreted to recommended design inputs in accordance with methods of the City of Lacey 2022 Stormwater Design Manual. Gradation results were applied to the Massmann (2003) equation (1) to calculate Ksat representing the initial saturated hydraulic conductivity.

(1) $\log10(Ksat) = -1.57 + 1.90*D10 + 0.015*D60 - 0.013*D90 - 2.08*ff$

Corrected Ksat values presented below are a product of the initial Ksat and correction factor CFT. For a generalized site-wide design situation, we have applied a site variability factor of CFv = 0.7 along with typical values of CFt = 0.4 (for the Grain Size Method) and CFm = 0.9 (assuming standard influent control).

(2) $CFT = CFv \times CFt \times CFm = 0.7 \times 0.4 \times 0.9 = 0.25$

Results were cross-referenced with test pit logs to determine the validity and suitability of unique materials as an infiltration receptor. Additional reduction factors were applied for practical rate determination based on our professional judgement.

Table 1. Results Of Massmann Analysis

TP #	**Sample Depth** *(BPG)*	**Unit Extent** *(ft)*	**Soil Type**	**D10**	**D60**	**D90**	**Fines** (%)	**Ksat** *(in/hr)*	**CorrectedKsat** *(in/hr)*	**LT Design Infiltration Rate***(in/hr)*	**Cation Exchange Capacity** (meq/100g)	**Organic Content %**
1	2.5ft	1.0 to 12.0	SM	0.039	0.21	0.40	18.6	18.48	4.62	**4.62**	4.3	1.6
2	3.0ft	1.0 to 12.0	SM	0.007	0.11	0.22	45.8	4.37	1.09	**1.09**	9.9	1.7

In-ground infiltration structures are required to maintain a minimum of 5-feet separation from restrictive soil & perched water features. During QG's field investigation no groundwater was encountered. Available well logs do not indicate the potential for shallow groundwater. The required separation appears to be achievable across the site. At this time, QG does not recommend mounding analysis due to the generally suitable site conditions. In-field testing may be necessary if greater infiltration rates are desired.

For in-ground infiltration galleries, we recommend a maximum design rate of up to 1.09 inches/hour be considered. For any shallow infiltration features such as rain gardens, pervious pavement or swales, we recommend the designer consider a reduced rate of 1.0 inches per hour which is typically suitable and considers potential reductions from compaction during construction.

QG recommends the facility designer review these results and stated assumptions per reference literature to ensure applicability with the proposed development, level of anticipated controls, and long- term maintenance plan. The designer may make reasonable adjustments to correction factors

and the resulting design values based on these criteria to ensure design and operational intent is met. We recommend that we be contacted if substantial changes to rate determination are considered.

3.2.2 TREATMENT POTENTIAL

Depending on stormwater and runoff sources, some stormwater features, such as rain gardens or pervious pavements may require treatment. Stormwater facilities utilizing native soils as treatment media typically require Cation Exchange Capacities (CEC) of greater than 5 milliequivalents per 100grams (meq/100g) and organic contents greater than 1% (this may vary depending on local code). The soil in the western portion of the site **does not** meet the minimum required standards, however soil in the eastern portion of the site with a higher fines content **does** meet these minimum requirements.

3.2.3 DRAINAGE RECOMMENDATIONS

QG recommends proper drainage controls for stormwater runoff during and after site development to protect the site. The ground surface adjacent to structures should be sloped to drain away at a 5% minimum to prevent ponding of water adjacent to them.

QG recommends all stormwater catchments (new or existing) be tightlined (piped) away from structures to an existing catch basin, stormwater system, established channel, or approved outfall to be released using appropriate energy-dissipating features at the outfall to minimize point erosion. Roof and footing drains should be tightlined separately or should be gathered in an appropriately sized catch basin structure and redistributed collectively. If storm drains are incorporated for impervious flatworks (driveways, sidewalks, etc.) collected waters should also be discharged according to the above recommendations.

3.3 IMPERVIOUS PAVEMENT CONSIDERATIONS

Exploration results indicate that the native and fill soil deposits are in a typically soft state and fine-grained components can be expected to hinder compaction. Therefore, QG recommends applying a conservative bulk CBR value of 2.0 for pavement design, based on observed soft and loose shallow soil conditions at likely subgrade depths.

Due to the moderate fines content, QG recommends that the client either utilize structural fill to bridge over the loose native soil or incorporate geogrid to overcome the soil conditions. If fill is preferred, we recommend pavement and base aggregate sections bear over 12 inches of compacted structural fill, placed over compacted native soils. Revised pavement sections were derived assuming the incorporation of commonly available Tensar Technology TriAx TX160 geogrid, representing a

standard level of geotextile application, or an equivalent product. Geogrid materials shall be placed in accordance with the manufacturer's recommended instructions.

The following table summarizes the proposed new minimum pavement sections.

Table 2. Summary of Minimum Flexible Pavement Sections

Scenario	Pavement	CSTC	Gravel Base	Soil Amendment
Heavy Pavement Section	4 inches	2 inches	10 inches	Geogrid, or 12" Structural fill
Car Access and Parking	3 inches	2 inches	8 inches	Geogrid, or 12" Structural fill

Existing soils at the new bottom subgrade level should be graded level with minimal disturbance, in an effort to prevent degradation. Smooth bladed equipment should be used for final grading. For any saturated, organic rich, or deteriorated soils encountered, unsuitable soils shall be removed and replaced with approved compacted imported structural fill. This will provide an even surface for paving application that will also serve as additional support to the flexible pavement sections that can increase design life and reduce repair regularity in the long term.

One of the important considerations in designing a high-quality and durable pavement is providing adequate drainage. Drainage design for the proposed pavement section is outside of the scope of QG for this project. It is important that bird baths (leeching basins) and surface waves are not created during construction of the HMA layer. A proper slope should be allowed, and drainage should be provided along the edges of pavements and around catch basins to prevent the accumulation of free water within the base course, which otherwise may result in subgrade softening and pavement deterioration under exposure and repeated traffic conditions.

All pavements require regular maintenance and repair in order to maintain the serviceability of the pavement. These repairs and maintenance are due to normal wear and tear of the pavement surface and are required in order to extend the serviceability life of the pavement. However, after 10 years of service, a normal pavement structure is likely to deteriorate to a point where pavement rehabilitation may be required to maintain the serviceability. The deterioration is more likely if the pavement is constructed over poor subgrade soils or in area of higher traffic volumes.

These calculated sections should be considered preliminary until verifying the parameters, traffic loading, and assumed grading are applicable to final project design. We recommend pavement sections be reviewed by the civil designer, who may apply an alternative section for final project use based on the conditions reported herein and final design and construction preferences.

3.3.1 RIGID CONCRETE PAVEMENT AND FLATWORKS

Rigid pavement components are commonly utilized for portions of accesses and ancillary exterior improvements. The project civil designer may re-evaluate the below general recommendations for pavement thicknesses and base sections, if necessary, to ensure proper application to a given structure and use. QG recommends that we be contacted for further consultation if the below sections are proposed to be reduced.

Concrete driveway aprons and curb alignments, if utilized, should consist of a minimum 6-inch thickness of unreinforced concrete pavement over structural base fill. Base thickness should correspond to related location and anticipated traffic loading. For light traffic areas, a 6-inch minimum base thickness (total 12-inch section) can be applied. For heavy traffic zones, we recommend allotting a 12- inch minimum base section beneath the pavement over geogrid, and the incorporation of reinforcing steel in the concrete.

For other paved areas which experience repeated truck traffic, equipment or truck parking areas, entrances and exit aprons, or contain trash dumpster loading zones, a Portland Cement Concrete (PCC) pavement should be used. The PCC layer thickness is recommended to be 8.0 inches with a minimum of 6.0 inches thick crushed stone base course over geogrid but may be modified depending on the final design. The reinforcement details for PCC layers should be designed by the project design engineer as the project conditions dictate.

Concrete sidewalks, walkways and patios if present may consist of a minimum 4-inch section of plain concrete (unreinforced) installed over a 6-inch minimum compacted base of crushed rock. At locations where grade has been raised with structural fill, a 4-inch minimum crushed rock section may be used. Flatworks should employ frequent joint controls to limit cracking potential.

Specifications for concrete aprons and flatworks can be predetermined by the local municipality and may conflict with the above. In this case, we recommend either adhering to the more stringent option, or contacting QG for clarification.

3.4 PERVIOUS/PERMEABLE PAVEMENT CONSIDERATIONS

Site soil conditions appear generally amenable for pervious pavement surfaces, if necessary, to meet local stormwater code. Based on our infiltration and laboratory analysis, both rigid and flexible pervious pavement sections appear feasible.

The following recommendations are not given to serve as an engineering design but are given to assure that minimum adequate drainage is maintained for site features in relation to the present soil types, and do not reflect assumed ESALs, anticipated traffic loads, or rutting. These should be considered by the project civil site designer prior to finalizing their engineering design, as well as

considering the local municipal code requirements, or material manufacturer/supplier specifications. Alternatives may be utilized at the civil engineer's discretion.

Table 4: Preliminary Pervious Pavement Considerations

Scenario	Pavement Type	Pavement Thickness (in)	Choker Course (in)	Drainage Course (in)	Non-woven Fabric? (Y/N)
Car Access/Parking (Flexible)	Pervious Asphalt	4.0	2.0	10.0	Yes
Truck Access/Parking (rigid)	Pervious Concrete	7.0	2.0	12.0	Yes

Organic topsoil shall be removed from proposed pavement areas, exposing the silty sands below. Construction traffic over subgrades intended for pervious pavements should be limited as much as possible to prevent over-compaction and degradation of infiltration characteristics within these areas. Prior to placement of pavement sections, native subgrade should be adequately compacted to prevent settlement, but not so excessively that infiltration becomes infeasible.

Pervious pavement sections should consist of an unreinforced layer of pervious asphaltic concrete (PAC) for car access, or pervious cementitious concrete (PCC) for heavy truck access, overlaying a leveling course of crushed permeable ballast over a basal drainage course separated from in place native subgrade soils by a non-woven geotextile fabric. The drainage and leveling courses shall be gently compacted to allow for the maximum settlement of grains within the section. Excessive compaction of the pavement during placement should be avoided.

Geotextile fabric shall meet section 9-33.2(1), tables 1 and 2: Geotextile for Underground Drainage, from the WSDOT Standard Specifications. Aggregate within the leveling course shall be crushed, angular, relatively clean, and conform to the most recent WSDOT standard specification for Permeable Ballast (WSDOT section 9-03.9(2)), or an approved free draining alternative. The aggregate within the underlying drainage course shall conform to WSDOT Standard Specification *9-03.12(5) - Gravel Backfill for Drywells, or specification 9-03.12(4) Gravel Backfill for Drains* (or an approved alternative). Alternatively, the entire drainage course and leveling course may jointly be composed of WSDOT Permeable Ballast. Pervious pavement materials shall conform to those specified by the project civil designer and the supplying manufacturer and yield a minimum infiltration rate of 100 inches-per-hour when tested at any location per the procedures outlined in *ASTM C 1701-09, Infiltration Rate of In-Place Pervious Concrete*.

We recommend that the placement of material be monitored by a representative of QG to ensure proper placement and thickness.

4.0 CONSTRUCTION RECOMMENDATIONS

4.1 EARTHWORK

4.1.1 GRADING & EXCAVATION

A grading plan was not available to QG at the time of this report. However, based on provided conceptual plans, this study assumes finished site grade will approximate current grade. Therefore, depths referred to in this report are considered roughly equivalent to final depths. Excavations can generally be performed with conventional earthmoving equipment such as bulldozers, scrapers, and excavators.

4.1.2 SUBGRADE EVALUATION & PREPARATION

After excavations have been completed to the planned subgrade elevations, but before placing fill or structural elements, the exposed subgrade should be evaluated under the part-time observation and guidance of an QG representative.

The special inspection firm should continuously evaluate all backfilling. Any areas that are identified as being soft or yielding during subgrade evaluation should be over excavated to a firm and unyielding condition or to the depth determined by the geotechnical engineer. Where over excavation is performed below a structure, the over excavation area should extend beyond the outside of the footing a distance equal to the depth of the over excavation below the footing. The over excavated areas should be backfilled with properly compacted structural fill.

4.1.3 SITE PREPARATION, EROSION CONTROLL, WET WEATHER

Any silty or organic rich native soils may be moisture-sensitive and become soft and difficult to traverse with construction equipment when wet. During wet weather, the contractor should take measures to protect any exposed soil subgrades, limit construction traffic during earthwork activities, and limit machine use only to areas undergoing active preparation.

Once the geotechnical engineer has approved subgrade, further measures should be implemented to prevent degradation or disturbance of the subgrade. These measures could include, but are not limited to, placing a layer of crushed rock or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tarp and keeping construction traffic off the subgrade. Once subgrade has been approved, any disturbance because the subgrade was not protected should be repaired by the contractor at no cost to the owner.

During wet weather, earthen berms or other methods should be used to prevent runoff from draining into excavations. All runoffs should be collected and disposed of properly. Measures may

also be required to reduce the moisture content of on-site soils in the event of wet weather. These measures can include, but are not limited to, air drying and soil amendment, etc.

QG recommends earthwork activities take place during the summer dry season.

4.2 STRUCTURAL FILL MATERIALS AND COMPACTION

4.2.1 MATERIALS

All material placed below structures or pavement areas should be considered structural fill. Excavated native soils may be considered suitable for reuse as structural fill on a case-by-case basis. Imported material can also be used as structural fill. Care should be taken by the earthwork contractor during grading to avoid contaminating stockpiled soils that are planned for reuse as structural fill with native organic materials. Frozen soil is not suitable for use as structural fill. Fill material may not be placed on frozen soil.

Structural fill material shall be free of deleterious materials, have a maximum particle size of 4 inches, and be compactable to the required compaction level. Imported structural fill material should conform to the WSDOT manual Section 9-03.14(1) Gravel Borrow, or an approved alternative import material. Controlled-density fill (CDF) or lean mix concrete can be used as an alternative to structural fill materials, except in areas where free-draining materials are required or specified.

Imported materials utilized for trench back fill shall conform to Section 9-03.19, Trench Backfill, of the most recent edition (at the time of construction) of the State of Washington Department of Transportation *Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications)*. Imported materials utilize as grade fill beneath roads shall conform to WSDOT Section 9-03.10, Gravel Base.

Pipe bedding material should conform to the manufacturer's recommendations and be worked around the pipe to provide uniform support. Cobbles exposed in the bottom of utility excavations should be covered with pipe bedding or removed to avoid inducing concentrated stresses on the pipe.

Soils with fines content near or greater than 10% fines content may likely be moisture sensitive and become difficult to use during wet weather. Care should be taken by the earthwork contractor during grading to avoid contaminating stockpiled soils that are planned for reuse as structural fill with native organic materials.

The contractor should submit samples of each of the required earthwork materials to the materials testing lab for evaluation and approval prior to delivery to the site. The samples should be

submitted **at least 5 days prior to their delivery** and sufficiently in advance of the work to allow the contractor to identify alternative sources if the material proves unsatisfactory.

4.2.2 FILL PLACEMENT AND COMPACTION

For lateral and bearing support, structural fill placement below footings shall extend at minimum a distance past each edge of the base of the footing equal to the depth of structural fill placed below the footing [i.e. extending at least a 1H:1V past both the interior and the exterior of the concrete footing].

Prior to placement and compaction, structural fill should be moisture conditioned to within 3 percent of its optimum moisture content. Loose lifts of structural fill shall not exceed 12 inches in thickness. All structural fill shall be compacted to a firm and unyielding condition and to a minimum percent compaction based on its modified Proctor maximum dry density as determined per ASTM D1557. Structural fill placed beneath each of the following shall be compacted to the indicated percent compaction:

- Foundation and Floor Slab Subgrades: 95 Percent
- Pavement Subgrades & wall backfill (upper 2 feet): 95 Percent
- Pavement Subgrades & wall backfill (below 2 feet): 90 Percent
- Utility Trenches (upper 4 feet): 95 Percent
- Utility Trenches (below 4 feet): 90 Percent

A sufficient number of tests should be performed to verify compaction of each lift. The number of tests required will vary depending on the fill material, its moisture condition and the equipment being used. Initially, more frequent tests will be required while the contractor establishes the means and methods required to achieve proper compaction.

Jetting or flooding is not a substitute for mechanical compaction and should not be allowed.

4.3 TEMPORARY EXCAVATIONS AND TRENCHES

All excavations and trenches must comply with applicable local, state, and federal safety regulations. Construction site safety is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing soil type information solely as a service to our client for planning purposes. Under no circumstances should the information be interpreted to mean that QG is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred. The contractor shall be responsible for the safety of personnel working in utility trenches. Given that steep excavations in native soils may be prone to caving, we recommend all utility trenches, but particularly those greater than 4 feet in depth, be supported in

accordance with state and federal safety regulations. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed near the top of any excavation.

Temporary excavations and trenches should be protected from the elements by covering with plastic sheeting or some other similar impermeable material. Sheeting sections should overlap by at least 12 inches and be tightly secured with sandbags, tires, staking, or other means to prevent wind from exposing the soils under the sheeting.

5.0 SPECIAL INSPECTION

The recommendations made in this report assume that an adequate program of tests and observations will be made throughout construction to verify compliance with these recommendations. Testing and observations performed during construction should include, but not necessarily be limited to, the following:

- Geotechnical plan review and engineering consultation as needed prior to construction phase,
- Observations and testing during site preparation, earthwork, structural fill, and pavement section placement,
- Consultation on temporary excavation cutslopes and shoring if needed,
- Consultation as necessary during construction.

QG recommends that we be retained for construction phase soils testing and periodic earthwork observation in accordance with the local code requirements. We also strongly recommend that QG be retained as the project Geotechnical Engineering Firm of Record (GER) during the construction of this project to perform periodic supplementary geotechnical observations and review the special inspectors reports during construction.

Our knowledge of the project site and the design recommendations contained herein will be of great benefit in the event that difficulties arise and either modifications or additional geotechnical engineering recommendations are required or desired. We can also, in a timely fashion observe the actual soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

We would be pleased to meet with you at your convenience to discuss the *Time & Materials* scope and cost for these services.

6.0 LIMITATIONS

Upon acceptance and use of this report, and its interpretations and recommendations, the user shall agree to indemnify and hold harmless QG, including its owners, employees and subcontractors, from any adverse effects resulting from development and occupation of the subject site. Ultimately, it is the owner's choice to develop and live in such an area of possible geohazards (which exist in perpetuity across the earth in one form or another), and therefore the future consequences, both anticipated and unknown, are solely the responsibility of the owner. By using this report for development of the subject property, the owner must accept and understand that it is not possible to fully anticipate all inherent risks of development. The recommendations provided above are intended to reduce (but may not eliminate) such risks.

This report does not represent a construction specification or engineered plan and shall not be used or referenced as such. The information included in this report should be considered supplemental to the requirements contained in the project plans & specifications and should be read in conjunction with the above referenced information. The selected recommendations presented in this report are intended to inform only the specific corresponding subjects. All other requirements of the above-mentioned items remain valid, unless otherwise specified.

Recommendations contained in this report are based on our understanding of the proposed development and construction activities, field observations and explorations, and laboratory test results. It is possible that soil and groundwater conditions could vary and differ between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, or if the scope of the proposed construction changes from that described in this report, QG should be notified immediately in order to review and provide supplemental recommendations.

The findings of this study are limited by the level of scope applied. We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the subject region. No warranty, expressed or implied, is made. The recommendations provided in this report assume that an adequate program of tests and observations will be conducted by a WABO approved special inspection firm during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the Client and their design consultants and only for the purposes stated within a reasonable time from its issuance, but in no event later than 18 months from the date of the report. It is the Client's responsibility to ensure that the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. Note that if another firm assumes Geotechnical Engineer of Record responsibilities, they need to review this report and either concur with the findings, conclusions, and recommendations or provide alternate findings, conclusions and recommendation.

Land or facility use, on- and off-site conditions, regulations, or other factors may change over time, and additional work may be required. Based on the intended use of the report, QG may recommend that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release QG from any liability resulting from the use of this report. The Client, the design consultants, and any unauthorized party, agree to defend, indemnify, and hold harmless QG from any claim or liability associated with such unauthorized use or non-compliance. We recommend that QG be given the opportunity to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted. We assume no responsibility for misinterpretation of our recommendations.

Appendix A. Region & Vicinity Maps

REGION

VICINITY

Quality Geo NW, PLLC	**Site Region** Borden Geo	Source: Google Imagery, 2023 **Scale & Locations are approx.** **Not for Construction**	**Figure 1**

Appendix B. Exploration Map

Quality Geo NW, PLLC	**Site Map** Borden Geo	Source: Thurston Co. GIS, 2023 **Scale & Locations are approx.** **Not for Construction**	**Figure 2**

Appendix C. Exploration Logs

Test Pit Log TP-1

PROJECT NUMBER QG23-067
PROJECT NAME Borden Geo
PROJECT LOCATION Lacey, WA

FIELD WORK DATE 3/29/2023
DRILLING METHOD Excavator

BORING LOCATION West side of Parcel

SURFACE ELEVATION Existing
LOGGED BY AW

COMMENTS

Depth (ft)	Samples	Is Analysed?	Graphic Log	USCS	Material Description
0.5				TS	TOPSOIL Brown, loose, damp, high organic content, no mottling, no cobbles
1				SM	SILTY SAND Light brown, loose, damp, high organic content, no mottling, no cobbles Gravel= 0% Sand= 81% Fines= 19%
2.5	TP-1@2.5ft				
7.5					SILTY SAND Brown-grey, medium dense, moist, minor organic content, no mottling, no cobbles Gravel= 0% Sand= 90% Fines= 10%
12					Terminated at Contracted Depth No Groundwater Encountered

Quality Geo NW, PLLC - Ph: 360-878-9705, qualitygeonw.com, 4631 Whitman Lane SE, Ste D, Lacey, WA

Page 1 of 1

produced by ESlog.ESdat.net on 26 Apr 2023

Test Pit Log TP-2

PROJECT NUMBER QG23-067
PROJECT NAME Borden Geo
PROJECT LOCATION Lacey, WA

FIELD WORK DATE 3/29/2023
DRILLING METHOD Excavator

BORING LOCATION East side of Parcel

SURFACE ELEVATION Existing
LOGGED BY AW

COMMENTS

Depth (ft)	Samples	Is Analysed?	Graphic Log	USCS	Material Description
0				TS	TOPSOIL Brown, loose, damp, high organic content, no mottling, no cobbles
0.5				SM	SILTY SAND Light brown-grey, dense, damp, moderate organic content, no mottling, no cobbles Gravel= <1% Sand= 54% Fines= 46%
1					
1.5					
2					
2.5					
3	TP-2@3ft				
3.5					
4					
4.5					
5					
5.5					
6					
6.5					
7					
7.5					
8					
8.5					
9					
9.5					
10					SILTY SAND Brown-grey, medium dense, moist, minor organic content, no mottling, no cobbles Gravel= 0% Sand= 90% Fines= 10%
10.5					
11					
11.5					
12					Terminated at Contracted Depth No Groundwater Encountered

Quality Geo NW, PLLC - Ph: 360-878-9705, qualitygeonw.com, 4631 Whitman Lane SE, Ste D, Lacey, WA

Page 1 of 1

produced by ESlog.ESdat.net on 26 Apr 2023

WILDCAT DYNAMIC CONE LOG

Quality Geo NW, PLLC
Geotechnical Consultants
Lacey, WA

PROJECT NUMBER: QG23-067
DATE STARTED: 03-29-2023
DATE COMPLETED: 03-29-2023

HOLE #: DCP-1
CREW: AW
PROJECT: Borden Geo
ADDRESS: 1070 Ulery Street, Lacey, WA
LOCATION: Center of Parcel

SURFACE ELEVATION: Existing
WATER ON COMPLETION: No
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

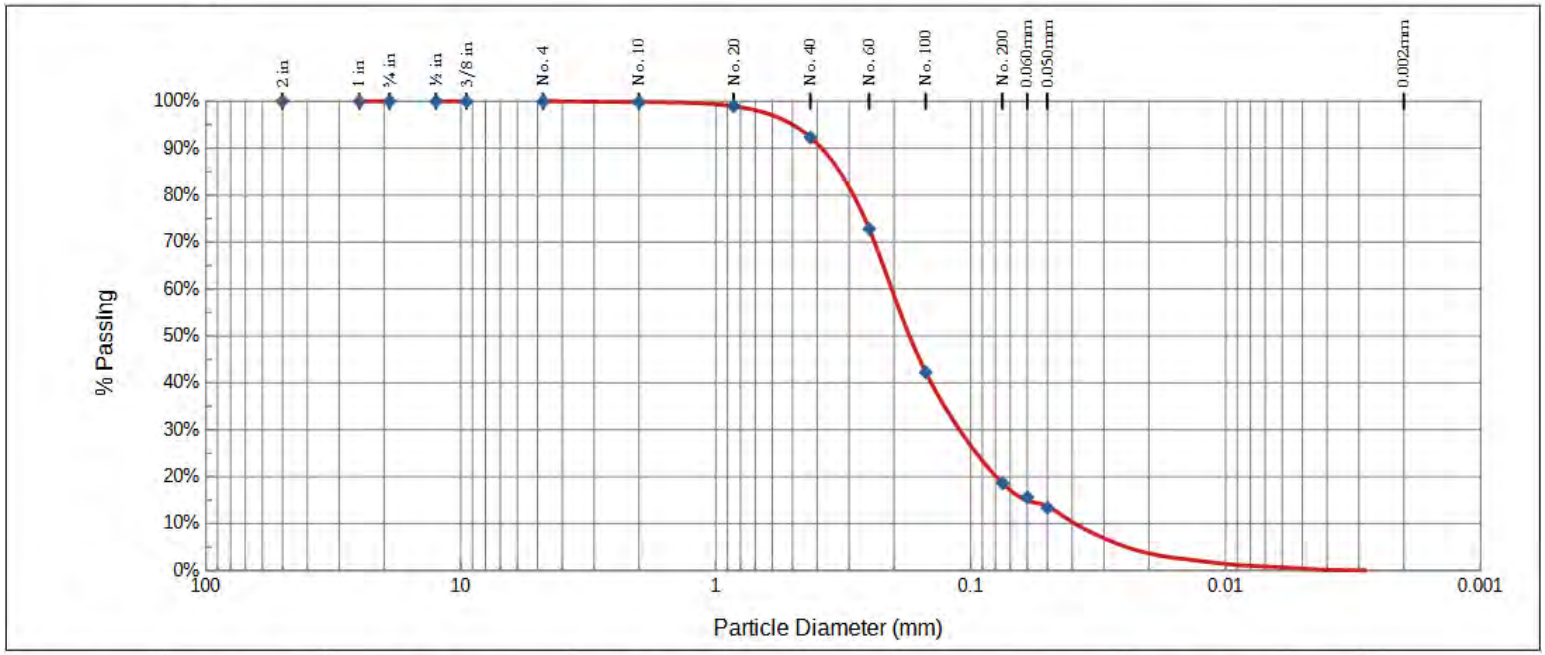
DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
- 1 ft	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	3	13.3	•••	3	VERY LOOSE	SOFT
-	3	13.3	•••	3	VERY LOOSE	SOFT
- 2 ft	3	13.3	•••	3	VERY LOOSE	SOFT
-	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
-	2	8.9	••	2	VERY LOOSE	SOFT
- 3 ft	1	4.4	•	1	VERY LOOSE	VERY SOFT
- 1 m	2	8.9	••	2	VERY LOOSE	SOFT
-	3	11.6	•••	3	VERY LOOSE	SOFT
- 4 ft	2	7.7	••	2	VERY LOOSE	SOFT
-	3	11.6	•••	3	VERY LOOSE	SOFT
-	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
- 5 ft	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
-	4	15.4	••••	4	VERY LOOSE	SOFT
-	9	34.7	•••••••••	9	LOOSE	STIFF
- 6 ft	12	46.3	••••••••••••	13	MEDIUM DENSE	STIFF
-	12	46.3	••••••••••••	13	MEDIUM DENSE	STIFF
- 2 m	16	61.8	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 7 ft	15	51.3	••••••••••••••	14	MEDIUM DENSE	STIFF
-	16	54.7	•••••••••••••••	15	MEDIUM DENSE	STIFF
-	15	51.3	••••••••••••••	14	MEDIUM DENSE	STIFF
- 8 ft	13	44.5	•••••••••••••	12	MEDIUM DENSE	STIFF
-	14	47.9	••••••••••••••	13	MEDIUM DENSE	STIFF
-	21	71.8	••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
- 9 ft	38	130.0	••••••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	50	171.0	••	25+	DENSE	HARD
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

Appendix D. Laboratory Results

SAMPLE ID: Tp-1@2.5ft

☑ Sieve Analysis | ☑ Wet Wash | ☑ Hydrometer | ☐ Atterberg Limits

Project Name:	Borden Geo
Project Number:	QG23-067
Date Collected:	03/29/23
Date Reported:	03/31/23
Boring ID:	Tp-1
Boring Depth:	2.5ft



USCS Scale	Coarse Gravel		Fine Gravel			Coarse Sand		Medium Sand		Fine Sand			(% of Fines Passing #200 Sieve) Hydrometer Method			Sand Total	Gravel Total
Sieve #	2"	1"	¾"	½"	3/8"	4	10	20	40	60	100	200	0.060	0.050	0.002		
Diameter, mm	50	25	19	12.5	9.5	4.75	2	0.85	0.425	0.25	0.15	0.075					
Retained	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	1.1%	7.7%	27.2%	57.8%	81.4%				**81.4%**	**0.0%**
Passing	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%	98.9%	92.3%	72.8%	42.2%	**18.6%**	15.6%	13.4%	-0.08%		

Graph Values

D90	0.40
D60	0.21
D30	0.111
D10	0.039

Coefficient of Uniformity: 1.87
Coefficient of Gradation: 1.52

CEC: 4.3 meq/100g
OM (LOI 360): 1.6 %

Unified Soil Classification System (USCS) Description	
SM	SILTY SAND

Staff Initials: T

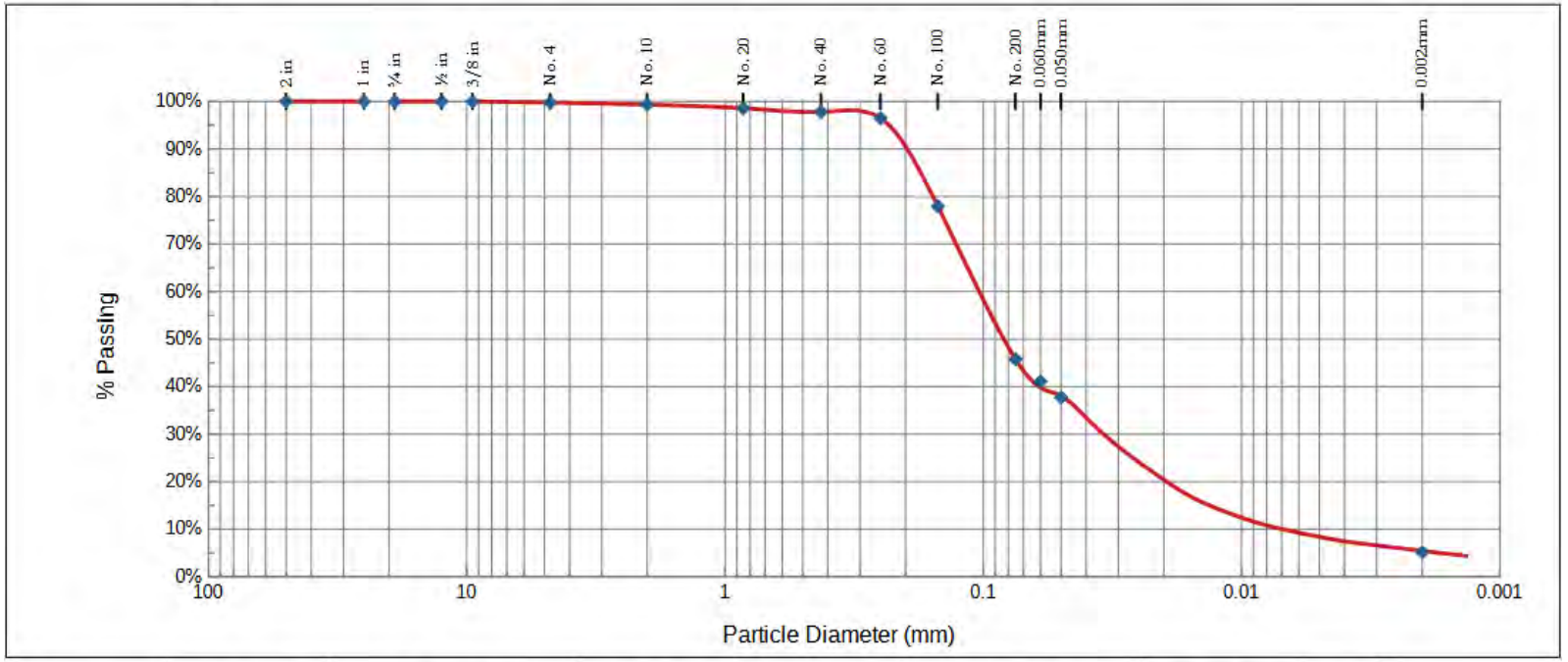
Test Methods: ASTM D6913, ASTM D7928

March 31, 2023

SAMPLE ID: TP-2@3ft

☑ Sieve Analysis | ☑ Wet Wash | ☑ Hydrometer | ☐ Atterberg Limits

Project Name:	Borden Geo
Project Number:	QG23-067
Date Collected:	03/29/23
Date Reported:	03/31/23
Boring ID:	TP-2
Boring Depth:	3ft



USCS Scale	Coarse Gravel		Fine Gravel			Coarse Sand		Medium Sand		Fine Sand			(% of Fines Passing #200 Sieve) Hydrometer Method			Sand Total	Gravel Total
Sieve #	2"	1"	¾"	½"	3/8"	4	10	20	40	60	100	200					
Diameter, mm	50	25	19	12.5	9.5	4.75	2	0.85	0.425	0.25	0.15	0.075	0.060	0.050	0.002		
Retained	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.7%	1.4%	2.2%	3.5%	22.1%	54.2%				**54.0%**	**0.2%**
Passing	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%	99.3%	98.6%	97.8%	96.5%	77.9%	**45.8%**	41.1%	37.7%	5.17%		

Graph Values

D90	0.22				
D60	0.11	**Coefficient of Uniformity:**	3.15	**CEC:**	9.9 meq/100g
D30	0.034	**Coefficient of Gradation:**	1.56	**OM (LOI 360):**	1.7 %
D10	0.007				

Unified Soil Classification System (USCS) Description	
SM	SILTY SAND

Staff Initials: T

Test Methods: ASTM D6913, ASTM D7928

March 31, 2023

Appendix 4
SWPPP

DRAFT
Construction Stormwater Pollution Prevention Plan (SWPPP)

for

Ulery Business Suites

1070 Ulery St. SE
Lacey, WA 98503
TPN 09950002000

City of Lacey Project No. __-____
Olympic Engineering Project No. 22084

May 16, 2023

Prepared by:

OLYMPIC ENGINEERING

PO Box 12690
Olympia WA 98508
360.705.2474
www.olyeng.com

Certified Erosion and Sediment Control Lead (CESCL)

_____
_____
_____
_____

Civil Engineer

Chris Merritt, PE
Olympic Engineering, Inc.
PO Box 12690
Olympia, WA 98508
(360) 705-2474
chris@olyeng.com

Applicant

Ulery Street, LLC
Aaron Borden
PO Box 7846
Olympia, WA 98507
(360) 789-3707
aaron@ajbservice.com

Contractor

_____
_____
_____
_____

This SWPPP has been prepared by Olympic Engineering based on our estimate of anticipated site conditions throughout construction along with anticipated construction methods and sequencing used by the contractor. The BMP's suggested in this SWPPP are simply suggestions and the contractor and/or owner is responsible for implementing all BMPs necessary to minimize and prevent erosion and sedimentation throughout construction and through final site stabilization.

<u>The owner retains the ultimate responsibility for environmental protection at the site and for ensuring the project is in compliance at all times.</u>

5/16/2023

*"I hereby state that this DRAFT Construction SWPPP for the **Ulery Business Suites** project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Lacey does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me."*

Project Overview

The proposal is to construct a single-story business suite building with associated parking lot, storm drainage, and utility improvements on a 0.977-acre parcel located off Ulery St. SE.

All proposed site work improvements are anticipated to be constructed in one phase with substantial site work construction completion by Winter/Spring 2024. The completion timeframe of the building is currently unknown.

Proposed Stormwater BMP's:

- The access/parking lot will be constructed of Permeable Pavement (BMP T5.15).
- Stormwater runoff from the roof area will be tightlined to a Downspout Infiltration Trench (BMP T5.10A).
- Stormwater runoff from the sidewalks adjacent to lawn/landscape areas will be sheet flow dispersed (BMP T5.12) onto the lawn/landscape areas.
- Stormwater runoff from the sidewalks adjacent to the permeable pavement will sheet flow off onto the permeable pavement.
- Stormwater runoff from the paved approach off Ulery St. will sheet flow onto the permeable pavement.

This project will meet the LID Performance Standard as the majority of stormwater runoff will be infiltrated.

The parcel is undeveloped and mostly forested with mature fir trees. Site topography generally slopes down from the west to east with an average slope of 1.8%.

There are no critical areas (e.g. wetlands, creeks) on or near the subject parcel.

Per FEMA FIRM Panel #53067C0191E the project is located in Zone X (an area determined to be outside the 0.2% annual chance floodplain).

The Natural Resource Conservation Service (NRCS) classifies the on-site soils as Nisqually Loamy Fine Sand (HSG A). A Soils Report has been prepared by QualityGeo NW. Three test pits were evaluated to depths of up to 12' below-grade and the soils generally consisted of topsoil overlying silty sand (SM).

The project site is located within a Category 1 Critical Aquifer Recharge Area and within a 10-year time of travel zone of an existing well.

Objective

To control erosion and prevent sediment and other pollutants from leaving the site during the construction phase of a project. To have fully functional stormwater facilities and BMPs for the developed site upon completion of construction.

Supplemental Guidelines

If a Construction SWPPP is found to be inadequate (with respect to erosion and sediment control requirements), then the Plan Approval Authority within the City shall require that other BMPs be implemented, as appropriate.

The Plan Approval Authority may allow development of generic Construction SWPPP's that apply to commonly conducted public road activities, such as road surface replacement, that trigger this core requirement. They may also develop an abbreviated SWPPP format for project sites that will disturb less than 1 acre.

Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance. The local permitting authority shall take enforcement action - such as a notice of violation, administrative order, penalty, or stop-work order under the following circumstances:

- If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard; or
- If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

General Requirements

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas shall be delineated on the site plans and the development site.

The SWPPP shall be implemented beginning with initial land disturbance through final stabilization. Sediment and Erosion control BMPs shall be consistent with the BMPs contained in Chapter 5 of the City of Lacey Stormwater Design Manual (SDM)*, 2022 ed.*

Seasonal Work Limitations - From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site. See Element #12 below for additional information.

Project Requirements - Construction SWPPP Elements

In most cases, all of the following elements shall apply and be implemented throughout construction. Self-contained sites (discharges only to groundwater) must comply with all elements with the exception of Element 3: Control Flow Rates.

The suggested BMPs underlined and in **bold** are proposed for use in all phases of construction. Additional BMP's shall be implemented as necessary to minimize and prevent erosion and sedimentation throughout construction. See Chapter 5 of the SDM for reference. All BMP's shall be maintained until final site stabilization.

Element #1: Preserve Vegetation/Mark Clearing Limits

- Prior to beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. These shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
- Clearly visible plastic, metal, or stake wire fence may be used to mark the clearing limits.
- The duff layer, native topsoil, and natural vegetation shall be retained in an undisturbed state to the maximum degree practicable. If it is not practicable to retain the duff layer in place, stockpile it on-site, cover it to prevent erosion, and replace it immediately upon completion of the ground disturbing activities.

Suggested BMPs:

- **BMP C100: Preservation of Native Topsoil (On-site)**
- BMP C101: Preserving Natural Vegetation (On-site)
- BMP C102: Buffer Zones
- BMP C103: High Visibility Plastic Fence.
- **BMP C233: Silt Fence**

Element #2: Establish Construction Access

- Limit construction vehicle access and exit to one route, if possible, or two for linear projects such as roadways where more than one access is necessary for large equipment maneuvering.
- Stabilize access points with a pad of quarry spalls or crushed rock, or equivalent BMP prior to traffic leaving the construction site to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located on site, if the stabilized construction entrance is not effective in preventing sediment from being tracked on public roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example during wet weather) to prevent sediment from entering waters of the state. Remove sediment from roads by shoveling or pickup sweeping and transport to a controlled sediment disposal area. Street washing is allowed only after sediment is removed in this manner.
- Control street wash wastewater by pumping back on site to an approved infiltration facility, or otherwise preventing it from discharging into systems tributary to the city municipal separated storm sewer system, wetlands, or waters of the State. Other options include discharge to the sanitary sewer, or discharge to an approved offsite treatment system. For discharges to the sanitary sewer, permits must be obtained from the local jurisdiction providing the sewer.

Element #3: Control Flow Rates

- Protect properties and waterways downstream from development sites from erosion and the associated discharge of turbid waters due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
- Downstream analysis is necessary if changes in offsite flows could impair or alter conveyance systems, stream banks, bed sediment, or aquatic habitat. See Volume I, Chapter 2, for potential offsite analysis requirements and guidelines (Core Requirement #11).
- Where necessary to comply with Core Requirement #7, construct stormwater retention/detention facilities as one of the first steps in grading. Ensure that detention facilities are functional prior to construction of site improvements (e.g., impervious surfaces).
- Outlet structures designed for permanent detention ponds are not appropriate for use during construction without modification. If used during construction, install an outlet structure that will allow for long-term storage of runoff and enable sediment to settle. Verify that the pond is sized appropriately for this purpose. Restore ponds to their original design dimensions, remove sediment, and install a final outlet structure at completion of the project.
- Sites that must implement flow control (Core Requirement #7) for the developed site condition must also control stormwater release rates during construction. Construction site stormwater discharges shall not exceed the discharge durations of the pre-developed condition for the range of pre-developed discharge rates from ½ of the 2-year flow through the 10-year flow as predicted by an approved continuous runoff model. Match the pre-developed condition to the land cover condition immediately prior to the development project.
- The City may require pond designs that provide additional or different stormwater flow control if necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
- If permanent infiltration ponds are used for flow control during construction, protect them from siltation during the construction phase.

Suggested BMPs:

- BMP C203: Water Bars
- BMP C207: Check Dams
- BMP C209: Outlet Protection
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- Refer to Volumes III and V for site suitability and sizing for infiltration facilities and for design of Detention and Infiltration Facilities for flow control.

Element #4: Install Sediment Controls

- Prior to leaving a construction site or prior to discharge to an infiltration facility, pass stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP.
- Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3, the first bullet. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The City shall inspect and approve areas fully stabilized by means other than pavement or quarry spalls.

- Construct sediment ponds, vegetated buffer strips, sediment barriers or filters, dikes, and other BMPs intended to trap sediment on site as one of the first steps in grading. Ensure that these BMPs are functional before other land disturbing activities take place.
- Where feasible, design outlet structures that withdraw impounded water from the surface to avoid discharging sediment that is still suspended lower in the water column.
- Seed and mulch earthen structures such as dams, dikes, and diversions according to the timing indicated in Element #5.
- Locate BMPs intended to trap sediment on site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages, often during non-storm events, in response to rain event changes in stream elevation or wetted area.
- If installing a floating pump structure, include a stopper to prevent the pump basket from hitting the bottom of the pond.

Suggested BMPs:

- BMP C231: Brush Barrier
- BMP C232: Gravel Filter Berm
- **BMP C233: Silt Fence**
- BMP C234: Vegetated Strip
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration.

Element #5: Stabilize Soils

- Stabilize all exposed and un-worked soils by application of effective BMPs that prevent erosion; protect the soil from the erosive forces of raindrop impact, flowing water, and wind.
- Control stormwater volume and velocity within the site to minimize erosion; and control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- From October 1 through April 30, no soils shall remain exposed and un-worked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and un-worked for more than 7 days. This condition applies to all soils on site, whether at final grade or not. These time limits may be adjusted by the City if it can be shown that the average time between storm events justifies a different standard.
- Stabilize soils at the end of the shift before a holiday or weekend if the weather forecast calls for precipitation. Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.
- Soil stabilization measures should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures, and when possible, be located away from storm drain inlets, waterways and drainage channels.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.

- Ensure that gravel base used for stabilization is clean and does not contain fines or sediment.
- Linear construction activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirements and time periods set forth above.

Suggested BMPs:

- o **BMP C120: Temporary and Permanent Seeding**
- o **BMP C121: Mulching**
- o BMP C122: Nets and Blankets
- o **BMP C123: Plastic Covering**
- o BMP C124: Sodding
- o **BMP C125: Topsoiling/Composting**
- o BMP C126: Polyacrylamide for Soil Erosion Protection
- o BMP C130: Surface Roughening
- o BMP C131: Gradient Terraces
- o **BMP C140: Dust Control**

Element #6: Protect Slopes

- Design and construct cut and fill slopes in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing the length of continuous slope with terracing and diversions, reducing slope steepness, and roughening slope surface.
- Divert offsite stormwater (run-on) or ground water away from slopes and disturbed areas with interceptor dikes, pipes, and/or swales. Manage offsite stormwater separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.
- Design temporary pipe slope drains to handle the peak 10-minute velocity of flow from a 10-year, 24-hour event assuming a Type 1A rainfall distribution. Alternatively, the 10-year, 1 hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. If a 15-minute (or less) time step is used, no correction factor is required. The hydrologic analysis shall use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas shall be modeled as “landscaped” area.
- Permanent pipe slope drains shall be sized for the 100-year, 24-hour event.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Place check dams at regular intervals within channels that are cut down a slope.
- Stabilize soils on slopes, as specified in Element #5.
- BMP combinations are the most effective method of protecting slopes with disturbed soils. For example, using both mulching and straw erosion control blankets in combination.

Suggested BMPs:

- o **BMP C120: Temporary and Permanent Seeding**
- o **BMP C121: Mulching**
- o **BMP C122: Nets and Blankets**

- o **BMP C123: Plastic Covering**
- o BMP C124: Sodding
- o BMP C130: Surface Roughening
- o BMP C131: Gradient Terraces
- o BMP C200: Interceptor Dike and Swale
- o BMP C201: Grass-Lined Channels
- o BMP C203: Water Bars
- o BMP C204: Pipe Slope Drains
- o BMP C205: Subsurface Drains
- o BMP C206: Level Spreader
- o BMP C207: Check Dams
- o BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam).

Element #7: Protect Drain Inlets

- Protect all storm drain inlets made operable during construction so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
- Keep all approach roads clean. Do not allow sediment and street wash water to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the state.
- Inspect inlets weekly at a minimum and daily during storm events. Clean inlet protection devices, or remove and replace when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

Suggested BMPs:

- o **BMP C220: Storm Drain Inlet Protection**

Element #8: Stabilize Channels and Outlets

- Design, construct, and stabilize all temporary on-site conveyance channels to prevent erosion from the expected peak 10 minute velocity of flow from a Type 1A, 10-year, 24-hour frequency storm. Alternatively, the 10-year, 1-hour time step flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. If a 15-minute (or less) time step is used, no correction factor is required. The hydrologic analysis shall use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas shall be modeled as “landscaped” area.
- Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches at the outlets of all conveyance systems.
- The best method for stabilizing channels is to completely line the channel with a blanket product first, then add check dams as necessary to function as an anchor and to slow the flow of water.

Suggested BMPs:

- o BMP C122: Nets and Blankets
- o BMP C202: Channel Lining

- BMP C207: Check Dams
- BMP C209: Outlet Protection

Element #9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.
- Handle and dispose all pollutants, including waste materials and demolition debris that occur on-site, in a manner that does not cause contamination of stormwater. Woody debris may be chipped, ground, or chopped and spread on site.
- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks shall include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest tank within the containment structure. Double- walled tanks do not require additional secondary containment.
- Use spill prevention and control measures when conducting fueling, maintenance and repair of heavy equipment and vehicles including oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff. Clean contaminated surfaces immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as a closed-loop recirculation or upland land application, or to the sanitary sewer, with local sewer district approval.
- Apply agricultural chemicals, including fertilizers and pesticides, in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' recommendations for application rates and procedures shall be followed.
- Use BMPs to prevent or treat contamination of stormwater runoff by pH modifying sources. These acidic or basic sources include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of the water quality standards. Projects must obtain written approval from the Department of Ecology prior to using chemical treatment other than CO2 or dry ice to adjust pH.
- Washout of concrete trucks shall be performed off-site or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State if prohibited. Do not use upland land applications for discharging wastewater from concrete washout areas.
- Wheel wash or tire bath wastewater shall not be mixed with wastewater from concrete washout areas.

Suggested BMPs:

- **BMP C151: Concrete Handling**
- **BMP C152: Sawcutting and Surfacing Pollution Prevention**
- **BMP C153: Material Delivery, Storage and Containment**
- **BMP C154: Concrete Washout Area**

- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration
- BMP C252: High pH Neutralization Using CO2
- BMP C253: pH Control for High pH Water.
- See Volume IV – Source Control BMPs.

Element #10: Control De-Watering

- Discharge foundation, vault, and trench de-watering water, which have similar characteristics to stormwater runoff at the site, into a controlled conveyance system prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element #8.
- Discharge clean, non-turbid de-watering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters or interfere with operation of the system. Do not route these clean waters through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- Handle highly turbid or contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, separately from stormwater.
- Discharging sediment-laden (muddy) water into waters of the State likely constitutes violation of water quality standards for turbidity. The easiest way to avoid discharging muddy water is through infiltration and preserving vegetation.
- Other treatment or disposal options, depending on site constraints, may include:

    - Infiltration
    - Transport offsite in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters
    - Ecology-approved on-site chemical treatment or other suitable treatment technologies
    - Sanitary sewer discharge with local sewer district approval, if there is no other option
    - Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Suggested BMPs:

- BMP C203: Water Bars
- BMP C236: Vegetative Filtration

Element #11: Maintain BMPs

- Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function. Conduct maintenance and repair in accordance with BMP specifications.
- Remove all temporary erosion and sediment control BMPs not designed to remain in place following construction (e.g. compost socks), within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Remove or stabilize trapped sediment on site. Permanently stabilize disturbed soil resulting from removal of BMPs or vegetation.
- Protect all BMPs installed for the permanent control of stormwater from sediment and compaction. All BMPs that are to remain in place following completion of construction shall be examined and placed in full operating condition. If sediment enters the BMPs during

construction, it shall be removed and the facility shall be returned to the conditions specified in the construction documents.

Suggested BMPs

- o **BMP C150: Materials On Hand**
- o BMP C160: Certified Erosion and Sediment Control Lead

Element #12: Manage the Project

Phasing of Construction:

- Phase development projects to the maximum extent practicable and take into account seasonal work limits in order to prevent soil erosion and, to reduce to the maximum extent practicable, the transport of sediment from the site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.
- Clearing and grading activities for developments are permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, minimize the removal of existing trees and the disturbance/compaction of native soils except as needed for building purposes. Delineate the permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by the City, on the site plans and the development site.

Seasonal Work Limitations:

- From October 1 through April 30, clearing, grading, and other soil disturbing activities will not be permitted unless it is shown to the satisfaction of the City that silt-laden runoff will be prevented from leaving the site through a combination of the following:

  - o Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters; and
  - o Limitations on activities and the extent of disturbed areas; and
  - o Proposed erosion and sediment control measures.

- Based on the information provided and/or local weather conditions, the City may expand or restrict the seasonal limitation on site disturbance. The City shall take enforcement action – such as a notice of violation, administrative order, penalty, or stop-work order under the following circumstances:

  - o If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard; or
  - o If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

- The following activities are exempt from the seasonal clearing and grading limitations:

  - o Routine maintenance and necessary repair of erosion and sediment control BMPs;

- Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
- Activities where there is 100 percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Coordination with Utilities and Other Contractors:

The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

Inspection and Monitoring:

- For construction sites that will disturb 1 acre or more a Certified Erosion and Sediment Control Lead (CESCL) shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. Certification must be obtained through an approved training program that meets the erosion and sediment control training standards established by Ecology.
- Project sites less than one acre (not part of a larger common plan of development or sale) may have a person without CESCL certification conduct inspections. The person shall be identified in the Construction SWPPP and shall be on-site or on-call at all times.
- All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted at least weekly and immediately following any substantial rainfall event by a person who is knowledgeable in the principles and practices of erosion and sediment control. The CESCL or inspector (project sites less than one acre) must have the skills to:

    1) Assess the site conditions and construction activities that could impact the quality of stormwater, and
    2) Assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

- The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. They must evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.
- Implement appropriate BMPs or design changes as soon as possible whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant.
- Based on the results of the inspection, construction site operators must correct the problems identified by:

    - Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within 7 days of the inspection.
    - Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, the construction site operator may request and extension from the City within the initial 10-day response period.
    - Documenting BMP implementation and maintenance in the site log book (sites larger than 1-acre).

- The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week). The CESCL or inspector may reduce the inspection frequency for temporarily stabilized, inactive sites to once every calendar month.

Maintaining an Updated Construction SWPPP:

- The Construction SWPPP shall be retained on-site or within reasonable access to the site.
- The SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.
- The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, City or a state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

Suggested BMPs

- **BMP C150: Materials On Hand**
- BMP C160: Certified Erosion and Sediment Control Lead
- **BMP C162: Scheduling**

Element #13: Protect Low Impact Development BMPs

- Protect all Bioretention and Rain Garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden BMPs.
- Restore Bioretention and Rain Garden BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP includes removal of sediment and any sediment-laden Bioretention/Rain Garden soils, and replacing the removed soils with soils meeting the design specification.
- Prevent compaction of Bioretention, Rain Garden, and other infiltration BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.
- Protect surrounding land uses from erosion and manage to avoid introducing sediment onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-lade runoff onto permeable pavements.
- Clean pavements fouled with sediments or no longer passing an initial infiltration test using procedures acceptable to the City or in accordance with manufacturer's procedures.
- Keep heavy equipment off of existing soils under LID facilities (Bioretention, Rain Gardens, Infiltration Ponds, Permeable Pavements, etc.) that have been excavated to final grade to retain the infiltration rate of the soils.

Suggested BMPs

- BMP C102: Buffer Zone

- BMP C103: High Visibility Fence
- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (TSD) (Geotextile-Encased Check Dam).
- BMP C231: Brush Barrier
- **BMP C233: Silt Fence**
- BMP C234: Vegetated Strip
- Additional Guidance: See Chapter 5: Precision Site Preparation and Construction in the LID Technical Guidance Manual for Puget Sound for more detail on protecting LID integrated management practices.