

Preliminary Drainage Report

West Olympia Development
Olympia, WA

Prepared For:

RJ Development
401 Central Street SE
Olympia, WA

Prepared By:

LDC, Inc.
321 Cleveland Ave SE
Tumwater, WA 98501
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April 2024

Drainage Report

Project Information

Project: **West Olympia Development**
Prepared for: **RJ Development**
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Olympia, WA 98501
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Reviewing Agency

Jurisdiction: Thurston County

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Project Reference: C23-127
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Engineer\Drainage Report\2023-xxxx Stormwater Site Plan.docx

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Drainage Control Plan for the West Olympia Development 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 Thurston County does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Kyle Herrera

04/02/2024

Prepared by: Kyle Herrera, Design Engineer
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Date



04/02/2024

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Date

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1. PROPOSED PROJECT DESCRIPTION

The following report was prepared for the West Olympia Development project in Thurston County, WA. This report was prepared to comply with the minimum technical standards and requirements that are set forth in the *2022 Thurston County Drainage Design and Erosion Control Manual*.

Project Proponent:	RJ Development
Parcel Numbers:	09750029001
Total Parcel Area:	11.28 Acres
Current Zoning:	R-4-8
Required Permits:	Grading, Utility, Paving, Building, etc.
Site Addresses:	2000 24 th Ave NW
Section, Township, Range:	Section 10, Township 18 N, Range 2 W

The West Olympia Development, which is identified as parcel number 09750029001, is located within the Olympia UGA of Thurston County, east of Division St NW. The proposed project will disturb approximately 5.57 acres on-site and an additional 0.18-acres for the frontage improvements along 24th Ave NW for a total disturbed area of 5.75 acres. The project will be constructing 34 single-family lots, a new public roadway, extending available utilities, extending 24th Ave NW, and adding stormwater improvements. See **Appendix 1** for the site vicinity map.

Table 1: On-site Land Type Designations Summary Section

LAND TYPE DESIGNATION	AREA (ACRES)	% OF TOTAL AREA
Total Area	11.46	100
On-Site	11.28	98.4
Existing Pervious Surface	10.95	95.5
Existing Impervious Surface	0.33	2.9
Proposed Pervious Surface	8.88	77.5
Proposed Impervious Surface	2.40	20.9
Off-Site	0.18	1.6
Existing Pervious Surface	0.15	1.3
Existing Impervious Surface	0.03	0.3
Proposed Pervious Surface	0.00	0.0
Proposed Impervious Surface	0.18	1.6

1.1 SUMMARY OF COMPLIANCE ON-SITE

Per Figure I – 2.1 of the 2022 DDECM, the project is considered a new development that triggers Core Requirements #1-11 as shown in **Appendix 2**. The stormwater design complies with the 11 Core Requirements as follows:

Core Requirement #1 – Preparation of Stormwater Site Plans – A Drainage and Erosion Control Plan has been prepared for this project. This report satisfies the Drainage Report component of the plan.

Core Requirement #2 – Construction Stormwater Pollution Prevention – A pollution prevention plan has been included within the stormwater site plan as **Appendix 4** which describes the 13 required elements. Further, an erosion control plan has been prepared and is part of the engineering plan set. The contractor may need to amend and update these plans as part of development and/or management of the SWPPP. The contractor will be responsible for preparing the full SWPPP which shall comply with all of the required elements and the Washington Department of Ecology requirements for coverage under the NPDES Construction Stormwater General Permit.

Core Requirement #3 – Source Control of Pollution – All source control BMPs have been evaluated for feasibility and are identified in the Source Control Plan found in **Appendix 5**.

Core Requirement #4 – Preservation of Natural Drainage Systems and Outfalls – The project site is largely forested with an on-site residence and lawn area. Currently, the majority of the stormwater runoff from the western portion of the site sheet flows across the forested areas down into the existing wetlands on-site. Stormwater runoff from the western portion of the site that does not infiltrate, sheet flows into the native forest wetland buffer and into the wetland. The stormwater runoff from the eastern portion of the site is assumed to mostly infiltrate due to the gravelly sandy native soil type. The proposed development will preserve natural drainage patterns by continuing to infiltrate stormwater runoff generated within the eastern portion of the site while dispersing a portion of the runoff into the wetland buffer. The wetland and the majority of the wetland buffer will remain undisturbed throughout this development. The overall flow paths match the predeveloped condition by dispersing stormwater into the wetland buffer and utilizing on-site infiltration where it currently exists, therefore preserving the natural drainage path. See Section 8 of this report for more information.

Core Requirement #5 – On-site Stormwater Management – Per Figure I – 2.4 Flow Chart for Determining Core Requirement #5 of the 2022 DDECM, the project is not flow control exempt, triggers Core Requirements #1-11, and is located inside the UGA, therefore the project may choose to meet the LID performance standard or consider the BMPs in the order listed in List #2. The project will demonstrate compliance with List #2 from Table I – 2.2 of the 2022 DDECM, see below.

Lawn and Landscaped Areas:

- Per Volume V Chapter 2, of the 2022 DDECM, BMP LID.02 Post Construction Soil Quality and Depth will be utilized to the maximum extent practicable. See landscape plans for details.

Roofs:

- **Full Dispersion BMP LID.11 or Downspout Infiltration BMP LID.04:** Full dispersion is not feasible for this project site. Full dispersion requires that the site protects at least 65% of the site in a forest or native condition. For this reason alone, this BMP is not feasible. Downspout infiltration is feasible within the project limits for all of the proposed roof areas due to the infiltrative capacity of the native soils. Stormwater runoff generated from each roof will be tightlined to an underground drywell on each lot where the stormwater will fully infiltrate on-site. The native soils are conducive to infiltration and there is sufficient depth to the till layer as detailed in the Geotechnical report found in **Appendix 6**.

Other Hard Surfaces:

- **Full Dispersion BMP LID.11 (Chapter 2, Volume V):** Full dispersion is not feasible for this project site for the reasons mentioned above.
- **Permeable Pavement LID.09 (Chapter 2, Volume V):** The proposed pollution generating impervious surfaces require treatment prior to infiltration, therefore permeable pavement is

infeasible. Additionally, the soil varies across the site and would not be safe for the design of permeable pavement.

- **Bioretention BMP LID.08 (Chapter 2, Volume V):** Bioretention is not feasible for this project due to lack of available space within the proposed improvements. The long conveyance lengths and resulting depth needed for a facility outfall does not allow for a bioretention cell with a maximum depth of 1.5-feet.
- **Sheet Flow Dispersion BMP LID.06 (Chapter 2, Volume V) or Concentrated Flow Dispersion BMP LID.06 (Chapter 2, Volume V):** Sheet Flow Dispersion and Concentrated Flow Dispersion are infeasible for this project site due to the limitations of impervious area allowed per dispersion device. There are insufficient vegetated flow paths and dispersion device spacing available with the proposed development to provide enough dispersion devices.
- The stormwater runoff from Basin 1 will utilize BMP D.01 Detention Pond to provide flow control for the on-site and frontage roadways, all driveways, sidewalks, and adjacent landscaping areas. Stormwater runoff from this basin will be collected, treated, and conveyed to the southern detention pond prior to being discharged through a riprap protection outfall pas located outside of the adjacent wetland buffer. See Section 8 of this report for more information.

Core Requirement #6 – Runoff Treatment – Per Table I – 2.2 of the 2022 DDECM, this project requires treatment facilities and onsite stormwater BMPs for the pollution-generating hard surfaces. Per Section 4.2.5.2, enhanced treatment is not required for this project due to the site not being a multi-family development or in proximity to applicable water bodies. The proposed project will consist of Single-Family residential structures and therefore, basic treatment will be required. Even though basic treatment is required, enhanced treatment will be provided by manufactured treatment devices in the form of two modular wetlands, see Volume V Chapter 9. Treatment is applied through use of a bioretention media that removes pollutants as stormwater runoff moves through the system. The treatment BMPs were sized to treat all stormwater runoff generated from the on-site pollution generating surfaces. After treatment, the stormwater runoff will be conveyed via a 12-inch storm pipe to the detention pond where it will be released at the predeveloped flowrates through a dispersion device at the edge of the wetland buffer. See Section 8 of this report for more information.

Core Requirement #7 – Flow Control – The runoff generated from this project does not discharge into an exempt receiving waterbody and therefore must provide flow control to reduce the impacts of stormwater runoff from hard surfaces. Per Table I – 2.3 of the 2022 DDECM, this project will require flow control due to having greater than 10,000 SF of effective impervious area. Flow control will be provided for the proposed development through the use of one downspout infiltration facilities on each lot and one detention pond that will collect the stormwater runoff generated by the roadways, driveways, sidewalks, and landscaping areas. The detention pond will detain all of the stormwater runoff generated by the on-site road and 24th Ave NW, all driveways, sidewalks, and landscaping areas. The treated stormwater runoff from Basin 1 will be released from the detention pond at the predeveloped flowrates through a dispersion device located at the edge of the wetland buffer. See Section 8 of this report for more information.

Core Requirement #8 – Wetlands Protection – The proposed parcel contains one Category III wetland and two Category IV wetlands. The on-site wetlands have been confirmed by the wetland biologist to not contain a population of breeding amphibians due to having less than ¼-acre of thin-stemmed persistent plants or woody branches in the areas of seasonal ponding. Per Figure I – 2.5 Flow Chart for Determining Wetland Protection Levels Required of the 2022 DDECM, the on-site wetlands require general protection and protection from pollutants. Hydroperiod protection is not required for the on-site wetlands and therefore flow control will be provided for the stormwater runoff generated by the site. The stormwater runoff from Basin 1 will be treated prior to being released just outside of the wetland buffer at the predeveloped flowrates. The wetland protection flowchart can be found in **Appendix 2**. See **Appendix 11** for the wetland consultant report.

Core Requirement #9 – Operation and Maintenance – A Source Control Plan is included as **Appendix 5**.

Core Requirement #10 – Financial Liability – Financial Liability will be assumed by RJ Development.

Core Requirement #11 – Offsite Analysis and Mitigation – The stormwater runoff generated by the proposed project improvements will be collected and treated prior to infiltrating or discharging into the on-site wetland buffer in order to maintain the predeveloped drainage patterns. The stormwater runoff from Basin 1 will be collected and conveyed to mechanical treatment devices where it will receive enhanced treatment prior to being detained in the southern detention pond. The treated stormwater runoff from this basin will be released from the detention pond at the predeveloped flowrate just outside of the on-site wetland buffer. This stormwater will disperse through native forest vegetation prior to reaching the wetland. Stormwater runoff generated by Basin 2 will utilize on-lot drywells to infiltrate the stormwater runoff generated by the roofs and backyards. The proposed development will not result in any additional offsite stormwater runoff. The offsite stormwater runoff is anticipated to decrease with the proposed development due to the proposed infiltration facilities reducing the amount of stormwater runoff that is being conveyed to the on-site wetland than the existing condition. See Section 2 of this report for more information on the downstream analysis.

2. EXISTING SITE CONDITIONS

2.1 EXISTING ON-SITE CONDITIONS

The project site is +/- 11.28 acres in size and the topography generally slopes to the center of the parcel with slopes of 0 to 20%. The predeveloped condition consists of a single-family residence on the southeastern portion with a lawn area to the north and forest to the west. See the Existing Conditions figures below.

2.2 CRITICAL AREAS



Figure 1. Existing Conditions (1991)

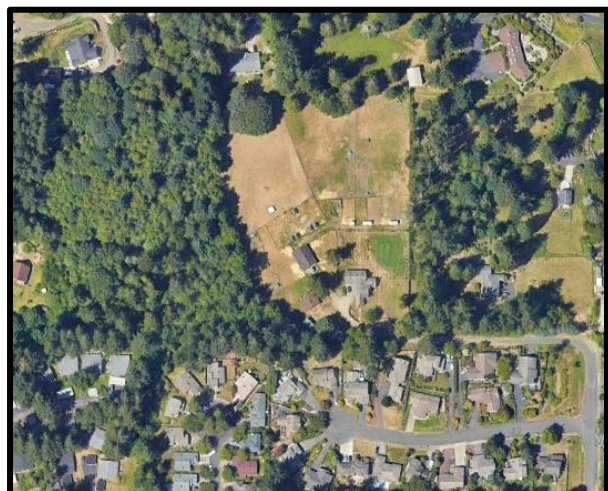


Figure 2. Existing Conditions (2022)

Flood Zones: The project parcel is located with Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 53067C0158F. According to the FIRM Map, the project parcel is located within Zone X. Zone X is determined to be an area of minimal flood hazard. See **Appendix 7** for the FIRM Map.

Critical Aquifer Recharge Areas (CARA): According to Washington State Department of Health and Thurston County, the proposed project is located within a Critical Aquifer Recharge Area Category II. See **Appendix 11** for the CARA Map.

2.3 QUALITATIVE UPSTREAM ANALYSIS

The existing roadway ends at the project parcel in a forested area and has no ditch, curbs, or gutters. The only area upstream of the proposed project site is the parcel to the northwest that contains mostly native forest. Stormwater runoff from the northwest parcel sheet flows and disperses over native vegetation before reaching the proposed project site. As part of the proposed development, stormwater runoff generated from the frontage improvements and extension of 24th Ave NW will be conveyed and collected on-site where it will receive enhanced treatment prior to being released through a dispersion device along the on-site wetland buffer. Therefore, there will be minimal to no on-site run-on from adjacent parcels.

2.4 QUALITATIVE/QUANTITATIVE DOWNSTREAM ANALYSIS

Currently, approximately 60% of the stormwater runoff from the proposed project site sheet flows into the on-site wetlands while the remaining 40% is assumed to infiltrate within the native soils. It is assumed that the majority of the stormwater runoff within the western half of the site disperses through native forest and vegetation prior to reaching the on-site wetlands. The remaining stormwater runoff is assumed to infiltrate within the eastern half of the site due to the infiltrative capacity of the native soils. Due to the low elevation at the wetland along the southern property line, it is assumed that a small portion of stormwater runoff that does not disperse, sheet flows south offsite and into the City of Olympia stormwater system west of Blossomwood Ct. The stormwater runoff that leaves the site enters a series of detention ponds before being conveyed south underneath Burbank Ave and discharging into an existing drainage ditch. It is conveyed south by the ditch, underneath Elliott Ave, and continues south until being discharged into Schneider Creek. After discharging into Schneider Creek, the stormwater runoff is conveyed east and is ultimately discharged into the Puget Sound near West Bay Drive. Any stormwater runoff that sheet flows offsite will be conveyed by existing City of Olympia drainage structures and conveyance systems. The stormwater runoff will discharge into Schneider Creek roughly 0.40 miles south of the site and ultimately outfalls in Puget Sound 1.01 miles away from the site.

After construction, the stormwater runoff from the on-site and frontage roads, sidewalks, driveways, and landscaping areas within Basin 1 will be collected, conveyed, treated, and detained within the proposed detention pond. The treated stormwater runoff from this basin will be released at the predeveloped flowrates at a maximum of 0.20 CFS through a riprap protection outfall pad located just outside of the on-site wetland buffer. Stormwater runoff generated by the proposed roof and backyard areas in Basin 2 will be tightlined to drywells located on each lot within the native gravelly soils with high infiltrative capacity as described by the geotechnical report. The detainment and flow control of the stormwater runoff from Basin 1 and the infiltration of the stormwater runoff from Basin 2 will result in less stormwater runoff entering the existing wetland than in the current existing conditions and therefore the offsite runoff is anticipated to decrease with the proposed development.

3. GEOTECHNICAL REPORT

3.1 ON-SITE SOILS INFORMATION

According to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), the site soil is identified as Alderwood gravelly sandy loam with slopes of 8 to 15%. A geotechnical investigation was provided by Insight Geologic in March 2023. Eight test pits at 4.5 feet to 9 feet below ground surface and four borings at 8 and 16 feet bgs were conducted on-site. The soil conditions varied from the western portion of the site containing the wetlands and the higher elevation eastern portion. The silty soil characteristics within the wetland and wetland buffer areas does not allow for infiltration, however, the eastern test pits #1-4 revealed 4-6 feet of gravelly sandy soils underlaying 1-3 feet of sod and silty upper layers. The soil sampling and percolation tests across the eastern half of the site yielded a recommended design infiltration rate of 2.6 inches/hour which will be utilized for the on-lot downspout infiltration facilities. The shallow glacial till and groundwater presents a significant restriction to infiltration facilities along the western half of the site and therefore no infiltration facilities are proposed in this location. A winter groundwater monitoring study was also performed by Insight Geologic which monitored the groundwater level in wells for a period of four months including two months between December 2022 and March 2023. The resulting report dated June 5, 2023 states the maximum groundwater observed occurred at an elevation of 218.31. The proposed lots utilizing downspout infiltration are located at elevations of 226-230 and therefore will achieve the required groundwater separation of at least 3-feet from the bottom of the facilities. Furthermore, Insight Geologic provided a geotechnical memorandum dated April 2, 2024, that elaborates on the infiltrative capacity of soils across the eastern portion of the site. This geotechnical memorandum confirms the viability of downspout infiltration systems for the proposed development. See **Appendix 6** for the on-site geotechnical reports and memorandum.

4. WELLS AND SEPTIC SYSTEMS

No wells were observed on or near the project site. There are no on-site septic systems for the proposed project parcel.

5. FUEL TANKS

No fuel tanks were observed at the project site.

6. ANALYSIS OF THE 100-YEAR FLOOD

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) classifies the project site as Zone X – Area of Minimal Flood Hazard, located in Panel 53067C0158F. See **Appendix 7** for the FIRM map.

7. AESTHETIC CONSIDERATIONS FOR FACILITIES

All of the stormwater facilities will be designed in such a way that they will provide necessary treatment and flow control, but also provide eye appeal to the residents. The proposed stormwater facilities are all located underground with the exception of the detention pond which will utilize hydroseeding and landscaping around the exterior to blend into the surroundings.

8. FACILITY SIZING AND OFFSITE ANALYSIS

8.1 SUMMARY SECTION

Following Figure 2.1 (See **Appendix 2**), this project classifies as a new development that triggers Core Requirements #1-11. The site does not have 35% or more of existing impervious coverage, and the project will add more than 5,000 S.F. of new impervious surfaces. See **Appendix 3** for the proposed stormwater facility locations and details. The Basin Area Analysis table below illustrates the existing and proposed impervious and pervious areas of the disturbed areas (See **Appendix 11** for the basin map).

Table 2. Basin Area Analysis

LAND TYPE DESIGNATIONS	AREA (ACRES)	% OF TOTAL AREA
TOTAL DISTURBED AREA	5.75	100
BASIN 1	2.36	41.1
Roof	0.00	0.0
Concrete	0.62	10.8
Asphalt	0.67	11.7
Pond	0.29	5.1
Pervious	0.78	13.6
BASIN 2	2.55	44.4
Roof*	1.22	21.3
Backyard**	1.33	52.2
BASIN 3	0.77	13.4
Pervious	0.77	13.4
BASIN 4	0.07	1.2
Permeable Concrete	0.07	1.2

*Roof areas are assumed to be 1,600 SF per lot and were not included in the detention pond modeling as the stormwater runoff generated by the roofs of the proposed homes will be collected and infiltrated in individual drywells.

**Backyard areas are assumed to be 1,700 SF per lot and were not included in the detention pond modeling as the stormwater runoff generated by the roofs of the proposed homes will be collected and infiltrated in individual drywells.

8.2 PERFORMANCE STANDARDS AND GOALS

Per Figure I – 2.1 of the 2022 DDECM, the project is considered a new development that triggers Core Requirements #1-11. The stormwater runoff generated from the proposed development will either be released into the on-site wetland buffer or infiltrated on-site.

Basin 1 consists of both the on-site and 24th Ave NW roadways, all 34 driveways, sidewalks, adjacent landscaping area, and detention pond for a total area of 2.36 acres. Basin 2 consists of the roof and backyard areas for each lot, summarized in Table 3 below, for a total of 2.55 acres. Basin 3 is a total of 0.77 acres of disturbed pervious area within the development that will utilize existing drainage patterns to provide on-site infiltration or dispersion through native vegetation. Basin 4 is the proposed sidewalk extension for the 24th Ave NW frontage improvements that will utilize permeable concrete for infiltration. Basin 5 contains 5.71-acres of undisturbed native forest, wetlands, and associated buffers that will not be part of the proposed project improvements. This basin will continue to function as it does today, utilizing sheet flow dispersion through the native vegetation.

CONTINGENCY PLANNING

- **Basin 1:** The stormwater facility within this basin consists of a 0.29-acre detention pond designed to collect the treated stormwater runoff generated by the proposed roads, driveways, sidewalks, and landscaping and release it into the wetland buffer at the predeveloped flowrates. In the event of system failure, stormwater runoff will overtop the proposed detention pond and will utilize the emergency overflow spillway provided to release stormwater into the on-site wetland buffer. Any stormwater that does not disperse will sheet flow south through the wetland and will utilize the drainage path mentioned in the downstream analysis section. If the facility does not function appropriately, additional capacity could be added by increasing the depth of the pond as there is additional elevation prior to reaching the till layer.

8.3 WETLAND PROTECTION REQUIREMENTS

Per Figure I – 2.5 of the 2022 DDECM, the on-site wetlands require General Protection and Protection from Pollutants. The project will meet the general protection requirements through preserving the wetland buffer and areas of native vegetation, minimizing general physical impacts, locating project improvements outside of the wetland buffer, and utilizing outfall protection to diffuse flow before entering the buffer. The on-site wetland will be protected from pollutants through effective use of construction stormwater BMPs, source control BMPs, on-site stormwater management, and runoff treatment prior to entering the wetland buffer. Hydroperiod protection is not required for the on-site wetlands as a result of having no breeding amphibians as confirmed by the wetland biologist. Therefore, Core Requirement #8 will not supersede Core Requirement #7 and flow control will be provided for all of the proposed project improvements.

This project will be utilizing TCC 24.30.060 to perform buffer averaging and reconfiguration to allow for lot spacing along the on-site wetland buffer. The reconfigured buffer contains the same square footage as the standard buffer and any area needed along the eastern boundary was added to the western boundary. Approximately 12,405 SF of buffer was reduced on the eastern boundary and approximately 12,469 SF was added to the western boundary. Per TCC 24.30.310, new stormwater detention facilities are allowed in the outer twenty-five percent of Category III and IV wetland buffers as long as the subsection requirements described therein are met. The constraints of the site and lack of available spacing for the proposed detention facility necessitated the employment of this County code section. The facility was designed to minimize impact to the wetland and buffer by being located mostly outside of the buffer, only extending within the outer twenty-five percent as needed. All stormwater released from this facility will be treated through enhanced treatment devices and discharged through a riprap outfall protection pad at or below the predeveloped flowrate to avoid channelized flows. See **Appendix 11** for the wetland consultant report.

8.4 FLOW CONTROL SYSTEM

The runoff generated from this project does not discharge into a flow control exempt receiving waterbody and therefore must provide flow control. Per Table I – 2.3 of the 2022 DDECM, this project will require flow control due to having greater than 10,000 SF of effective impervious area. Flow control will be provided for the proposed development through a combination of LID.04 Downspout Infiltration Systems, D.01 Detention Pond, and LID.09 Permeable Concrete. The Basin areas are summarized below. See **Appendix 11** for the existing and proposed basin maps and the flow control map.

Basin 1

This 2.36-acre basin includes stormwater runoff from both the on-site and 24th Ave NW roadways, 34 driveways, sidewalks, and adjacent landscaping areas. Flow control will be provided for this basin through the use of a flow control structure within the detention pond. The detention pond serving this basin was sized using MGS FLOOD which requires a live storage of 40,716 CF at 6-feet deep with an additional foot of freeboard. A detention pond with a live storage of 41,380 CF at a depth of 6-feet with an additional 1-foot of freeboard has been designed and provided on the plans. The pond was sized to detain the 100-year storm event for the site and release the resulting stormwater at 0.20 CFS through a riprap protection outfall pad located just outside of the on-site wetland buffer. The detention pond has been designed with an emergency overflow spillway and maintenance access road. See **Appendix 3** for the location and design of the detention pond facility, **Appendix 10** for the MGS FLOOD report, and **Appendix 11** for the basin maps.

Basin 2

This basin includes stormwater runoff from the roof and backyard areas of all 34 lots for a total of 2.55 acres, as summarized in Table 3. Flow control for this basin will be provided through the use of downspout infiltration systems located on each lot. The stormwater runoff from each roof and backyard will be tightlined to an on-lot drywell that will be sized per Table 2.3 in Volume V of the 2022 DDECM. The geotechnical investigation reports good infiltration soils for the eastern portion of the site at depths of 4-9 feet below ground surface with a design infiltration rate of 2.6 in/hr. See **Appendix 11** for the basin maps.

Basin 3

This 0.77-acre basin consists of pervious areas that will be disturbed as part of the proposed development but will utilize existing drainage patterns for flow control. The majority of stormwater runoff generated within this basin is assumed to infiltrate within the eastern soils, however, a small portion of runoff will utilize sheet flow dispersion through the native vegetation of the existing, undisturbed wetland buffers. See **Appendix 11** for the flow control map.

Basin 4

This 0.07-acre basin consists of permeable concrete sidewalk as part of the 24th Ave NW frontage improvements. Due to the length of proposed sidewalk and drop in elevation from the project site to 24th Ave NW, the stormwater runoff from this sidewalk is unable to be brought on-site for flow control. Permeable concrete will be utilized to provide flow control for the sidewalk improvement extending down to the Milroy St NW intersection. See **Appendix 11** for the flow control map.

Basin 5

Basin 5 consists of the undisturbed native forest, wetlands, and associated buffers located on-site for a total area of 5.71 acres. This area will not be touched as part of the proposed development and the existing drainage pattern will be preserved. Currently, stormwater runoff generated within this basin utilizes sheet flow dispersion through the native forest and vegetation to provide flow control as it drains towards the on-site wetland. This basin will continue to function the same in the post-developed condition of the site. See **Appendix 11** for the basin maps.

8.5 WATER QUALITY SYSTEM

Per Core Requirement #6 of the 2022 DDECM, basic treatment is required for this project. However, enhanced treatment will be provided for the proposed project through the use of two Modular Wetland Systems. The proposed treatment systems have been approved for the General Use Level Designation (GULD) from the Department of Ecology. One treatment system is located on the northern corridor of the site and the other on the southern corridor. Per Volume III Section 2.3 of the 2022 DDECM, treatment systems shall be sized using the 91 percent exceedance Water Quality Design Flow Rate when treatment occurs upstream of the detention BMP. Per MGS FLOOD, the resulting on-line design discharge rate for Basin 1 is 0.26 CFS. The modular wetlands will be sized at the time of civil permit submittal according to the manufacturer's treatment capacity flow rate for the contributing pollution generating hard surfaces. After treatment of the stormwater runoff from the pollution-generating surfaces, the runoff will be conveyed to the on-site detention pond where it will be released at the predeveloped flowrates through a riprap outfall protection pad located near the on-site wetland buffer.

See **Appendix 3** for the proposed treatment facility locations and **Appendix 10** for the MGS FLOOD report.

9. UTILITIES

Maintenance and/or operational bonding or other appropriate financial guarantees are required for all projects to ensure construction and functionality of drainage facilities in compliance with applicable standards. These guarantees are to be consistent with the most recent edition of the Thurston County Development Guidelines and Public Works Standards.

10. COVENANTS, DEDICATIONS, EASEMENTS

The stormwater maintenance plan for this site will remain privately owned and maintained. A maintenance agreement should be executed to ensure future maintenance of the facilities. The Establishment of Maintenance Covenant will be included herein as **Appendix 8** at the time of civil permit submittal.

11. PROPERTY OWNERS ASSOCIATION ARTICLES OF INCORPORATION

Articles of Incorporation shall be included at the time of civil permit submittal.

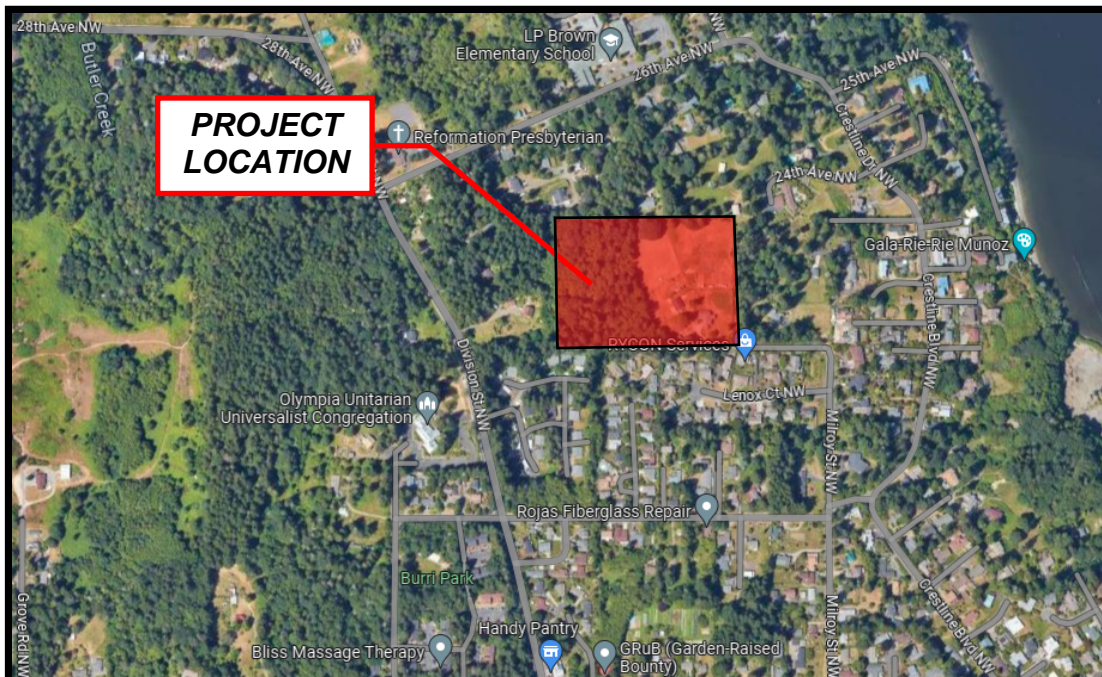
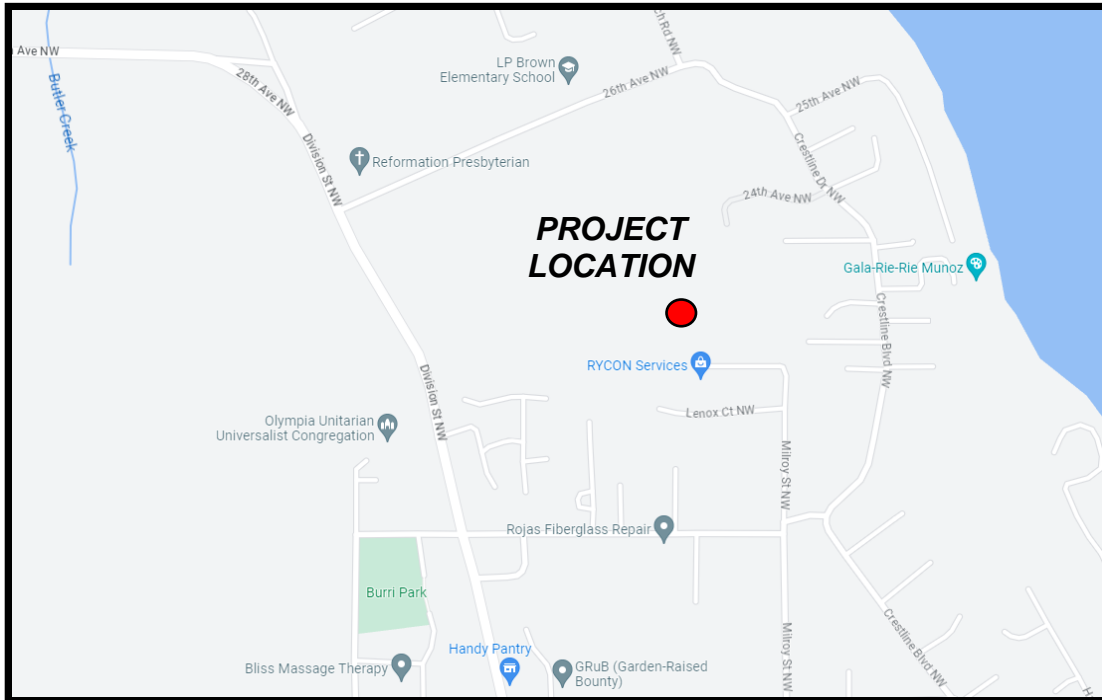
12. OTHER PERMITS OR CONDITIONS PLACED ON THE PROJECT

There are no other known required permits at this time.

END OF STORMWATER SITE PLAN

APPENDIX 1

SITE VICINITY MAP



APPENDIX 2

DETERMINATION OF CORE REQUIREMENTS WORKSHEET

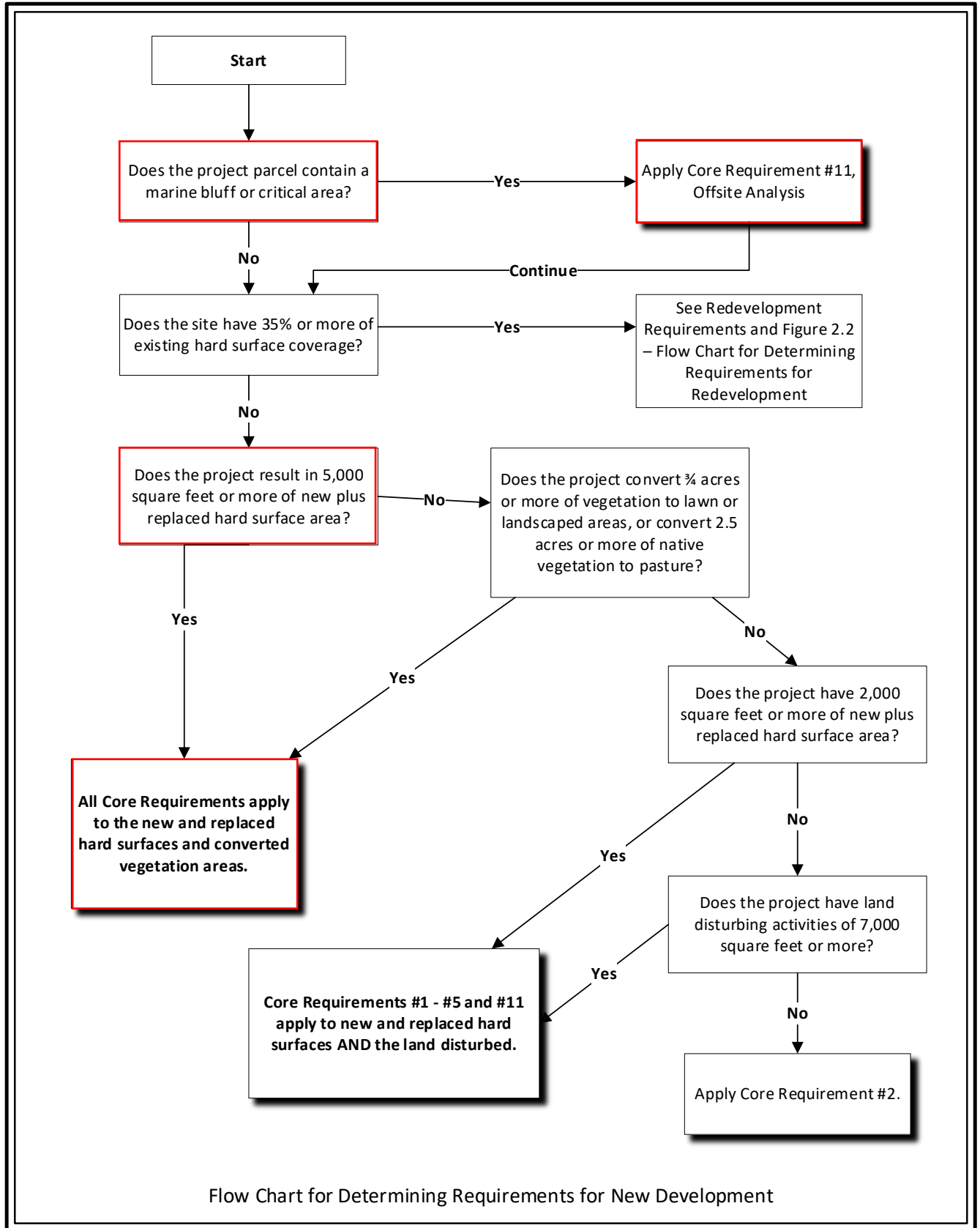


Figure I - 2.1 Flow Chart for Determining Requirements for New Development.

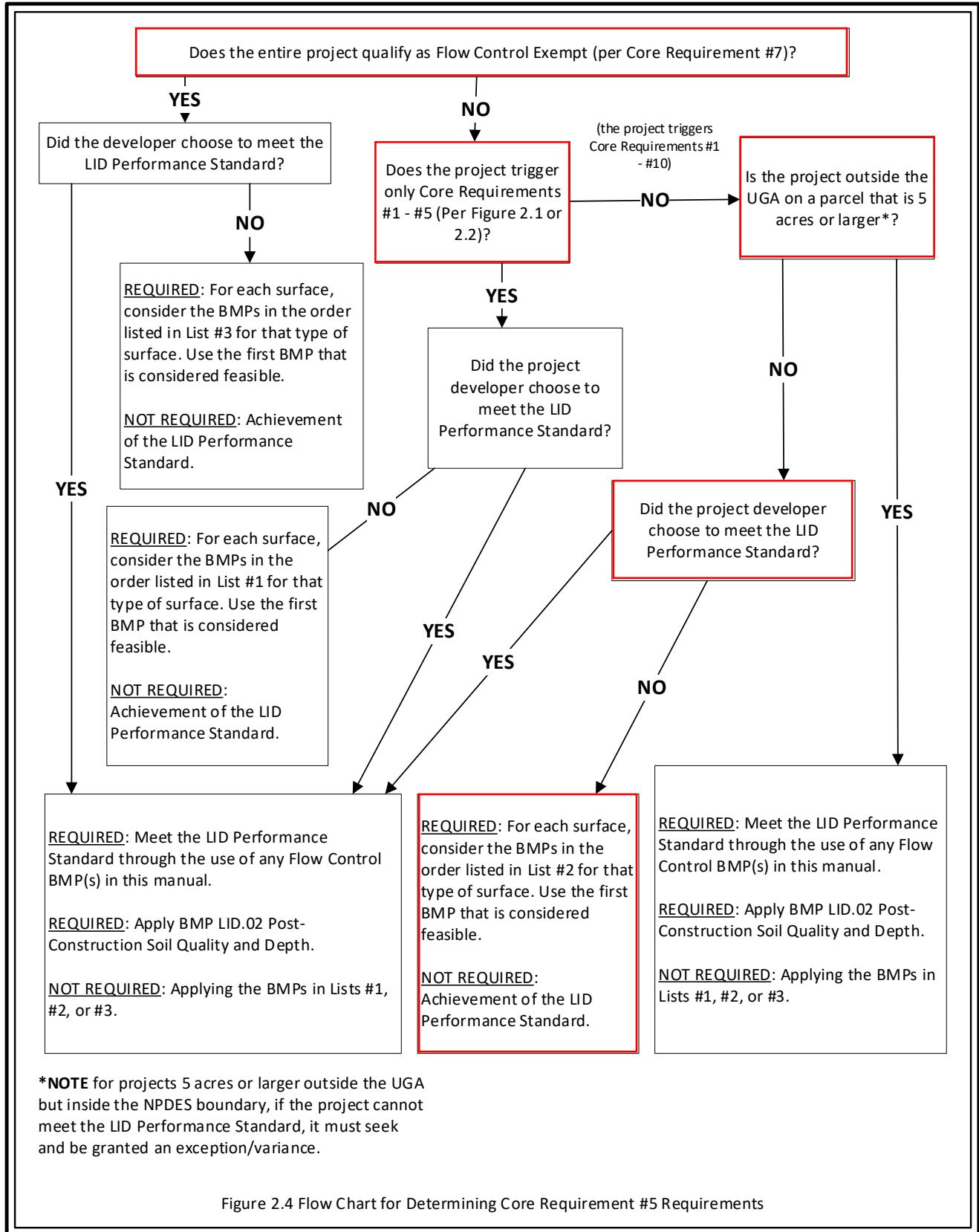


Figure I - 2.4 Flow Chart for Determining Core Requirement #5 Requirements

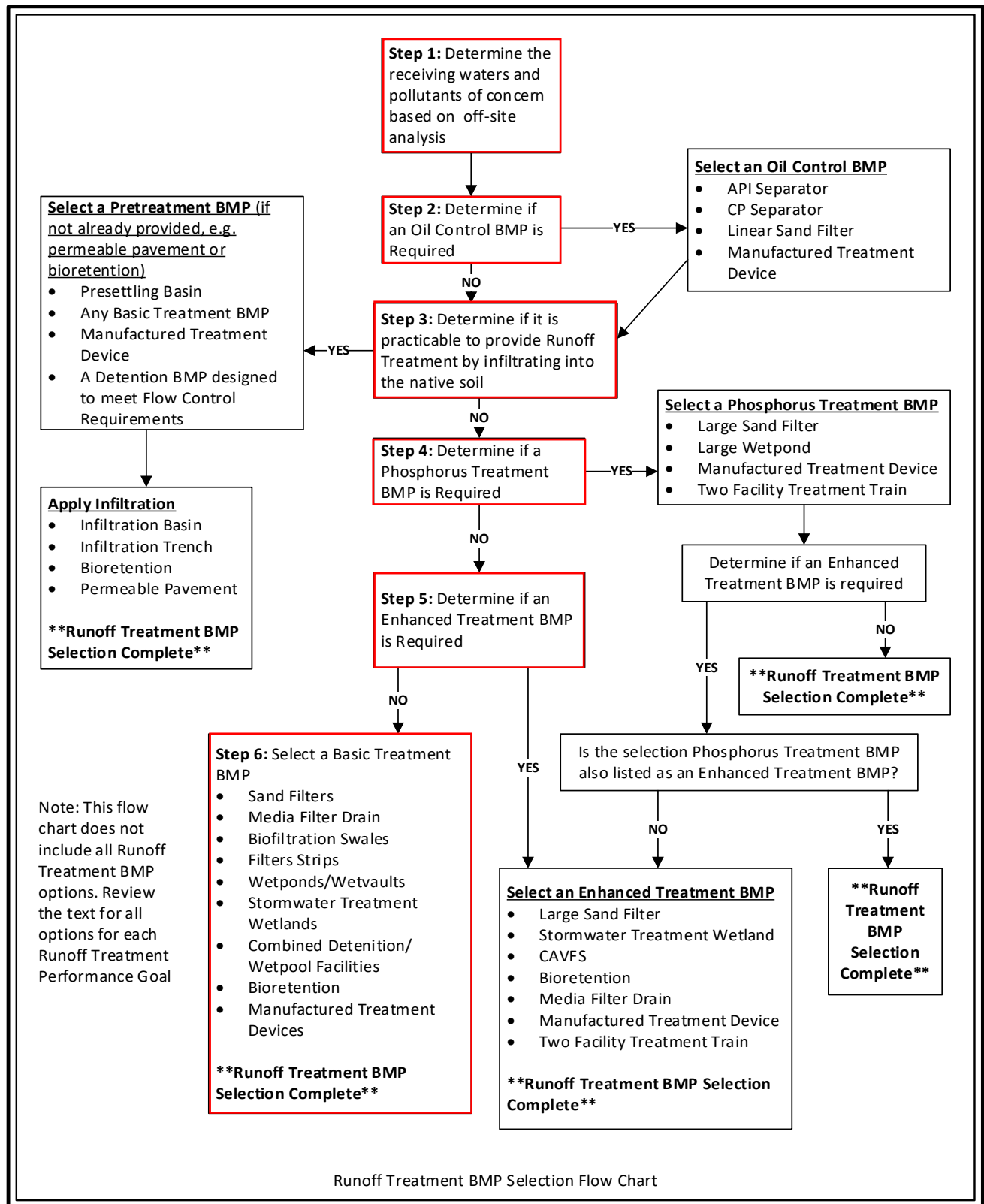


Figure I - 4.1 Runoff Treatment BMP Selection Flow Chart

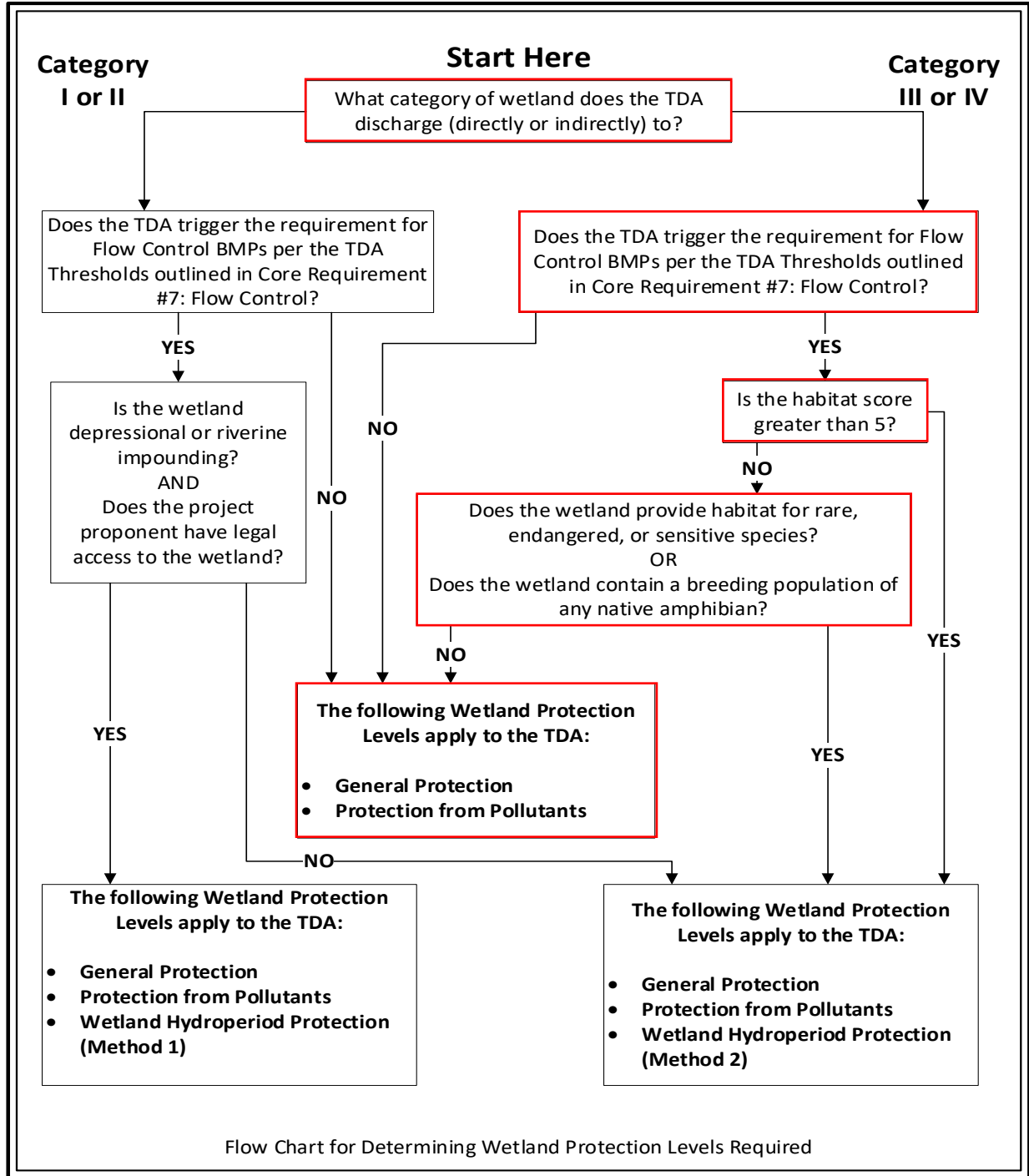


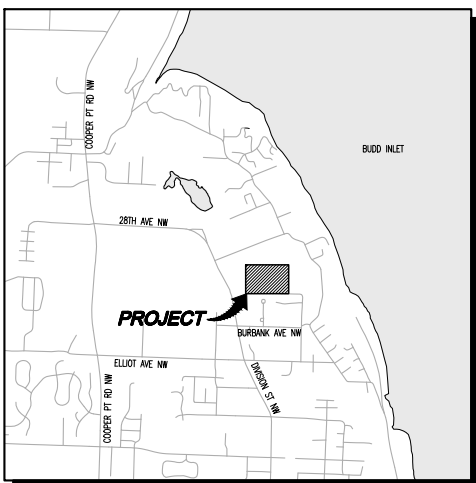
Figure I - 2.5 Flow Chart for Determining Wetland Protection Levels Required

2.4.9.3 Standard Requirement

Projects shall comply with Appendix I-C: Wetland Protection Guidelines of Ecology's 2019 Stormwater Management Manual for Western (SWMMWW). Where Ecology's SWMMWW's Minimum Requirements or BMPs are referenced, refer to the equivalent

APPENDIX 3

SITE DEVELOPMENT DRAWINGS



OWNER:
RJ DEVELOPMENT
401 CENTRAL STREET SE
OLYMPIA, WA 98501
CONTACT: CALEB PERKINS
PHONE: 360-810-8356
EMAIL: caleb@rjdevelopment.com

CIVIL ENGINEER:
LDC, INC.
321 CLEVELAND AVE SE SUITE 209
TUMWATER, WA 98501
CONTACT: ROSS JARVIS, PE
PHONE: (360) 634-2065
FAX: (425) 482-2893
EMAIL: rjarvis@ldccorp.com

SURVEYOR:
MTN 2 COAST, LLC
2320 MOTTMAN RD SW, SUITE 106
TUMWATER, WA 98512
CONTACT: SETH E. PRIGGE, PLS
PHONE: (360) 688-1949

OWNER/APPLICANT:
JAY BARCEL (C)

OWNER/APPLICANT:
TAX PARCEL(S):
SITE ADDRESS:
SITE AREA:
STORMWATER TRACT:
GRADING:
(FOR APPLICATION
PURPOSES ONLY)
ROADWAY AREA/LENGTH:
SOILS:
SANITARY SEWER/WATER:
GAS/POWER:
TELEPHONE/FIBER:
CABLE/TV:
FIRE DISTRICT:
SCHOOL DISTRICT:
FEMA FIRM DESCRIPTION:
EXISTING WELLS:
ZONING DESIGNATION:
SUBDIVISION APPLICATION
MAXIMUM ALLOWABLE (GR
MAXIMUM DWELLING UNIT
PROPOSED RESIDENTIAL
MINIMUM LOT SIZE:
PROPOSED MINIMUM (IND
MINIMUM LOT WIDTH:

RJ DEVELOPMENT
09750029001
2000 24TH AVE NW, OLYMPIA
11.28 ACRES (491,357 SF)
NONE
9,544 CY FILL
6,023 CY CUT

ROADWAY AREA/LENGTH:	1,233'
SOILS:	ALDERWOOD GRAVELLY SANDY LOAM
SANITARY SEWER/WATER:	CITY OF OLYMPIA
GAS/POWER:	PUGET SOUND ENERGY
TELEPHONE/FIBER:	COMCAST/CENTURY LINK
CABLE TV:	COMCAST
FIRE DISTRICT:	MCJANE - BLACK LAKE
SCHOOL DISTRICT:	OLYMPIA
FEMA FIRM DESCRIPTION:	ZONE X
EXISTING WELLS:	NONE
ZONING DESIGNATION:	R-4-8 (OLYMPIA UGA)
SUBDIVISION APPLICATION:	PRELIMINARY PLAT
MAXIMUM ALLOWABLE (GROSS) DENSITY:	8 UNITS/ACRE
MAXIMUM DWELLING UNITS ALLOWED:	65
PROPOSED RESIDENTIAL LOT:	5.0 UNITS/ACRE
MINIMUM LOT SIZE:	2,000 SF
PROPOSED MINIMUM (INDIVIDUAL) LOT SIZE:	2,565 SF
MINIMUM LOT WIDTH:	45'; 22' FOR TOWNHOUSE; 35' FOR COTTAGE
PROPOSED MINIMUM (INDIVIDUAL) LOT WIDTH:	28.50'
FRONT YARD SETBACK (FROM STREET):	20'
REAR YARD SETBACK:	20'
SIDE YARD SETBACK:	5'
MAXIMUM BUILDING HEIGHT:	2 STORIES OR 35', WHICHEVER IS LESS
MAXIMUM LOT COVERAGE:	40%

REQUIRED MIN. USABLE OPEN SPACE: 0.40 ACRES

TOTAL OPEN SPACE PROVIDED:	1.88 ACRES
TREE TRACT REQUIRED:	5% OF SITE - 0.56 ACRES
TREE TRACT PROVIDED (INCLUDED IN OPEN SPACE)	48.7% OF SITE - 5.49 ACRES

1 PP-01 PRELIMINARY PLAT MAP
2 PP-02 PRELIMINARY DRAINAGE AND TESC PLAN
3 PP-03 PRELIMINARY WATER AND SEWER PLAN
4 PP-04 PRELIMINARY PLAT DETAILS AND NOTES
5 PP-05 PRELIMINARY PLAT DETAILS AND NOTES

THE TOPOGRAPHIC SURVEY WAS PERFORMED BY MTN2COAST, LLC. IN DECEMBER 2022. ANY CHANGES TO THE SITE AFTER THIS DATE WILL NOT BE REFLECTED IN THE PLANS. ANY DISCREPANCIES FOUND BETWEEN WHAT IS SHOWN ON THE PLANS AND WHAT IS NOTED IN THE FIELD SHOULD BE BROUGHT IMMEDIATELY TO THE ATTENTION OF THE ENGINEER.



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www.LDCcorp.com

RJ DEVELOPMENT
WEST OLYMPIA DEVELOPMENT
2000 24TH AVE NW
PRELIMINARY PLAT MAP



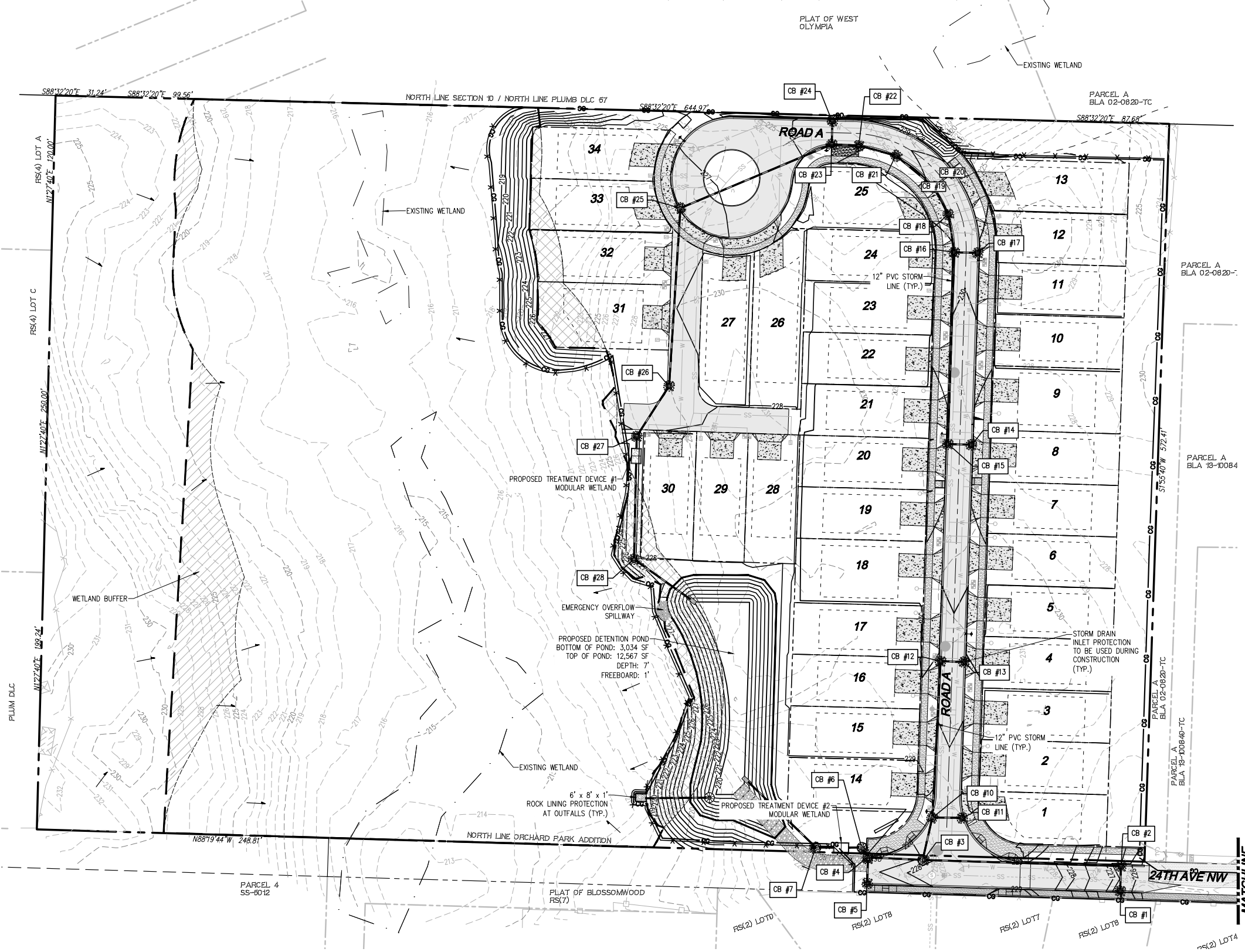
JOB NUMBER:	C23-127
DRAWING NAME:	C23-127 PP-01
DESIGNER:	KH
DRAFTING BY:	ES
DATE:	APRIL 2024
SCALE:	AS NOTED
JURISDICTION:	THURSTON

PP-01

SHEET 1 OF 5

PORTION OF SEC 10, TWN 18, RGE 2W, W.M., THURSTON COUNTY, WASHINGTON

PLAT OF WEST OLYMPIA



LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- CLEARING LIMITS
- SILT FENCE
- STABILIZED CONSTRUCTION ENTRANCE
- STORM DRAIN INLET PROTECTION
- TYPE 1 CATCH BASIN
- ASTM D3034 SDR35 PVC STORM PIPE, UNLESS OTHERWISE NOTED
- INFILTRATION TRENCH
- PRE DEVELOPMENT DRAINAGE FLOW PATH

STRUCTURE TABLE				
NAME	TYPE	RIM	INVERTS	
CB #1	TYPE 1	225.80	IE=222.80 (12") N	
CB #2	TYPE 1	225.78	IE=222.70 (12") S IE=222.70 (12") W	
CB #3	TYPE 2-48"	227.99	IE=221.94 (12") E IE=221.94 (12") W IE=221.94 (12") N	
CB #4	TYPE 2-48"	227.71	IE=221.72 (12") S IE=221.72 (12") NW IE=221.72 (12") E	
CB #5	TYPE 1	227.75	IE=224.75 (12") N	
CB #6	TYPE 2-48"	227.58	IE=221.68 (12") SE IE=221.68 (12") W	
CB #7	TYPE 2-48"	227.99	IE=221.50 (12") E IE=221.50 (12") NW	
CB #8	TYPE 1	221.27	IE=220.00 (12") W	
CB #10	TYPE 2-48"	228.22	IE=225.22 (12") S IE=225.22 (12") N IE=225.22 (12") E	
CB #11	TYPE 1	228.39	IE=225.34 (12") W	
CB #12	TYPE 1	229.46	IE=225.83 (12") S IE=225.83 (12") E	
CB #13	TYPE 1	229.46	IE=225.92 (12") W	
CB #14	TYPE 1	230.60	IE=225.69 (12") W	
CB #15	TYPE 1	230.60	IE=225.60 (12") N IE=225.60 (12") E	

STRUCTURE TABLE				
NAME	TYPE	RIM	INVERTS	
CB #16	TYPE 1	229.59	IE=224.86 (12") S IE=224.86 (12") N IE=224.86 (12") E	
CB #17	TYPE 1	229.59	IE=224.95 (12") W	
CB #18	TYPE 1	229.32	IE=224.71 (12") S IE=224.71 (12") NW	
CB #19	TYPE 1	229.09	IE=224.59 (12") SE IE=224.59 (12") NW IE=224.59 (12") NE	
CB #20	TYPE 1	229.10	IE=224.68 (12") SW	
CB #21	TYPE 1	228.74	IE=224.40 (12") SE IE=224.40 (12") W	
CB #22	TYPE 1	228.47	IE=224.25 (12") E IE=224.25 (12") W	
CB #23	TYPE 1	228.29	IE=224.15 (12") E IE=224.15 (12") SW IE=224.15 (12") N	
CB #24	TYPE 1	228.29	IE=224.24 (12") S	
CB #25	Null Structure	224.59	IE=223.51 (12") NE IE=223.51 (12") S	
CB #26	TYPE 1	227.32	IE=222.82 (12") N IE=222.82 (12") SW	
CB #27	TYPE 1	226.50	IE=222.59 (12") NE IE=222.59 (12") S	
CB #28	TYPE 1	226.50	IE=221.61 (12") N IE=221.61 (12") SE	

LOT DRAINAGE NOTES:

1. ROOF DOWNSPOUT INFILTRATION SYSTEMS SHALL BE PLACED ON EACH LOT. ALL ROOF DOWNSPOUT INFILTRATION SYSTEMS SHALL BE SIZED TO ACCOMMODATE STORM RUN-OFF PER THE THURSTON COUNTY DRAINAGE DESIGN AND EROSION CONTROL MANUAL.

UNANTICIPATED DISCOVERY NOTE:

WHEN AN UNANTICIPATED DISCOVERY OF PROTECTED CULTURAL MATERIAL (E.G., BONES, SHELLS, STONE TOOLS, BEADS, CERAMICS, OLD BOTTLES, HEARTHS, ETC.) OR HUMAN REMAINS ARE DISCOVERED, THE PROPERTY OWNER OR CONTRACTOR WILL IMMEDIATELY STOP ALL WORK, COMPLETELY SECURE THE LOCATION, AND CONTACT THE WASHINGTON STATE DEPARTMENT OF ARCHAEOLOGY AND HISTORIC PRESERVATION AND OTHER CONTACTS AS IDENTIFIED BY THURSTON COUNTY.

UTILITY NOTE

THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO ANY CONSTRUCTION. AGENCIES INVOLVED SHALL BE NOTIFIED WITHIN A REASONABLE TIME PRIOR TO THE START OF CONSTRUCTION.

DISCLAIMER

THE TOPOGRAPHIC SURVEY WAS PERFORMED BY MTN2COAST, LLC. IN DECEMBER 2022. ANY CHANGES TO THE SITE AFTER THIS DATE WILL NOT BE REFLECTED IN THE PLANS. ANY DISCREPANCIES FOUND BETWEEN WHAT IS SHOWN ON THE PLANS AND WHAT IS NOTED IN THE FIELD SHOULD BE BROUGHT IMMEDIATELY TO THE ATTENTION OF THE ENGINEER.



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REVISIONS

NO.	DATE	DESCRIPTION
-----	------	-------------

Surveying
Engineering
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LDC

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Olympia
321 CLEVELAND AVE. SUITE 209
TUMWATER, WA 98501
T 425.806.1869
www.LDCcorp.com
F 425.882.2893

RJ DEVELOPMENT

WEST OLYMPIA DEVELOPMENT
2000 24TH AVE NW
PRELIMINARY DRAINAGE AND TESC PLAN

JOB NUMBER: C23-127
DRAWING NAME: C23-127 PP-02
DESIGNER: KH
DRAFTING BY: ES
DATE: APRIL 2024
SCALE: AS NOTED
JURISDICTION: THURSTON

PP-02

SHEET 2 OF 5

APPENDIX 4

CONSTRUCTION SWPPP REPORT

Construction Stormwater Pollution Prevention Plan (SWPPP)

West Olympia Development
Olympia, Washington

April 2024



Construction SWPPP

Project Information

Project: **West Olympia Development**

Site Address: 2000 24th Ave NW
Olympia, WA 98502

Owner/Applicant: **RJ Development**
401 Central Street SE
Olympia, WA 98501

Reviewing Agency

Jurisdiction: Thurston County

Project Representative

Prepared by: **LDC Inc.**
321 Cleveland Ave SE
Tumwater, WA 98501

Contact: Ross Jarvis, PE
RJarvis@ldccorp.com

Project Reference: C23-127

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Appendix B – Construction BMP’s

Appendix C – Site Inspection Forms (and Site Log)

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1. NARRATIVE

1.1 STORMWATER BMPs

The following explains and illustrates the measures to be taken on the site to control erosion and sedimentation problems. The SWPPP is a guideline to follow during construction to prevent erosion and sedimentation. Erosion control measures are not limited to those shown on the TESC plan and in this SWPPP. Measures shall be installed as necessary to meet the Department of Ecology's (DOE) and the Thurston County's guidelines for stormwater pollution prevention and the requirements of the DOE National Pollutant Discharge Elimination System (NPDES) permit as applicable. Further, the SWPPP shall be updated by the contractor as required by the requirements of the DOE NPDES permit.

Total Disturbed Area: 5.75 acres
Property Use: R-4-8
Parcel Number: 09750029001
Section, Township, Range: Section 10, Township 18N, Range 2W, W.M.

1.1.1 *Element #1 –Mark Clearing Limits*

To protect adjacent properties and reduce the area of soil exposed, the limits of the construction will be clearly marked before land-disturbing activities begin. Where possible natural vegetation shall be preserved and the duff layer and native topsoil shall remain in place. The following BMP will be implemented where appropriate:

- BMP C101: Preserving Natural Vegetation
- BMP C233: Silt Fence

1.1.2 *Element #2 – Establish Construction Access*

Access points should be established to minimize the tracking of sediment onto public roads, and wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters. All wash wastewater shall be controlled on site.

Construction access will be granted using a construction entrance off of 24th Ave NW. Areas used throughout the parcel for construction storage and parking will be moved throughout the parcel depending on the location of the construction being conducted. It is important to note that the contractor shall not damage the existing site conditions that will remain throughout construction.

- BMP C105: Stabilized Construction Entrance
- BMP C106: Wheel Wash

1.1.3 *Element #3 – Control Flow Rates*

Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site. The following BMPs are applicable for this project. If the following BMPs are not shown on the construction plan set, the Owner and the Engineer reserves the right to direct the Contractor to install, construct, and/or implement said BMPs:

- BMP C207: Check Dams

In general, discharge rates of stormwater from the site will be controlled where increases in impervious area or soil compaction during construction could lead to downstream erosion, or where necessary to meet local agency stormwater discharge requirements. Care will be taken throughout construction to protect the existing wetland from sediments, while protecting the hydrology as well.

1.1.4 *Element #4 – Install Sediment Controls*

Prior to leaving a construction site, stormwater runoff must pass through a sediment pond or other appropriate sediment removal BMP. Silt fence barriers shall be installed in accordance with BMP C233. In addition, the following BMP's will be implemented where appropriate:

- BMP C233: Silt Fence
- BMP C235: Wattles

In addition, sediment will be removed from paved areas in and adjacent to work areas manually or using mechanical sweepers, as needed, to minimize tracking of sediments on vehicle tires away from the site and to minimize wash off of sediments from adjacent streets in runoff.

In some cases, sediment discharge in concentrated runoff can be controlled using permanent stormwater BMP's (e.g. infiltration swales, ponds, trenches). Sediment loads can limit the effectiveness of some permanent stormwater BMP's, such as those used for infiltration or biofiltration; however, those BMP's designed to remove solids by settling (wet ponds or detention ponds) can be used. When permanent stormwater BMP's will be used to control sediment discharge, the structure will be protected from excessive sedimentation with adequate erosion and sediment control BMP's. Any accumulated sediment shall be removed after construction is complete and the permanent stormwater BMP will be restabilized with vegetation per applicable design requirements once the remainder of the site has been stabilized. Concentrated runoff is not anticipated for this project.

1.1.5 *Element #5 – Stabilize Soils*

All exposed and unworked soils shall be stabilized by application of effective BMP's, which protect the soil from the erosive forces of raindrop impact and flowing water and from wind erosion. From October 01 through April 30 of each calendar year, no soils shall remain exposed and unworked for more than two (2) days. From May 01 to September 30 of each calendar year, no soils shall remain exposed and unworked for more than seven (7) days. This condition applies to all on-site soils, whether at final grade or not. Additionally, except where approved chemical treatment, full dispersion, or infiltration is

practiced, clearing, grading, and other soil disturbing activities are prohibited between November 1 and February 28.

In areas where construction activities have temporarily or permanently ceased, seeding and mulching shall be used in accordance with BMP's C120 and C121. Dust control shall be used as needed to prevent wind transport of dust from disturbed soil surfaces and in accordance with BMP C140.

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

The following BMPs can be used to stabilize the worked soils to satisfy Element #5 of the SWPPP:

- BMP C120: Temporary and Permanent Seeding, or
- BMP C121: Mulching, or
- BMP C122: Nets and Blankets, or
- BMP C123: Plastic Covering, or
- BMP C124: Sodding, or
- BMP C125: Top soiling, or
- BMP C140: Dust Control

1.1.6 *Element #6 – Protect Slopes*

Slopes shall be constructed in a manner that will minimize erosion. This shall include, but is not limited to: placing excavated material on the uphill side of trenches, collecting drainage at the top of slopes, etc. Slopes will be stabilized as indicated in Element #5 above. In addition, the following BMP's will be implemented where appropriate:

- BMP C207: Check Dams
- BMP C235: Wattles

1.1.7 *Element #7 – Protect Drain Inlets*

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

- BMP C220: Storm Drain Inlet Protection

1.1.8 *Element #8 – Stabilize Channels and Outlets*

All temporary on-site conveyance channels shall be constructed and stabilized to prevent erosion. Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent to

streambanks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems. The following BMP's will be implemented where appropriate:

- BMP C122: Nets and Blankets
- BMP C207: Check Dams

1.1.9 *Element #9 – Control Pollutants*

All pollutants, including waste materials, that occur on-site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater. Maintenance and repair of heavy equipment and vehicles involving 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 must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned 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. Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations shall be followed for application rates and procedures. No pH-Modifying sources will be present on-site.

Three source control BMP's will apply to this project:

- Spill Prevention Plan
- Maintenance of Storm Drainage Facilities
- Street Sweeping

In addition, the following BMP's shall be implemented where appropriate:

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

1.1.10 *Element #10 – Control Dewatering*

Clean, non-turbid de-watering water, as determined by the Certified Professional in Erosion and Sediment Control, can be discharged to systems tributary to state surface waters, provided the de-watering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds.

Highly turbid or otherwise contaminated de-watering water, such as from equipment operation shall be handled separately from stormwater at the site. Some disposal options, depending on site constraints, may include: 1) transport off-site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters, 2) on-site treatment using chemical treatment or other suitable treatment technologies such as Baker tanks or approved equal, or 3) sanitary sewer discharge with local sewer purveyor's approval if there is no other option.

1.1.11 *Element #11 – Maintain BMP's*

All temporary and permanent erosion and sediment control BMP's shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMP's specifications. Visual monitoring of the BMP's will be conducted per the inspection schedule in Section 6.

All temporary erosion and sediment control BMP's shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMP's are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMP's or vegetation shall be permanently stabilized.

- BMP C150: Materials on Hand
- BMP C160: Certified Erosion and Sediment Control Lead

1.1.12 *Element #12 – Manage the Project*

Erosion and sediment control BMP's for this project have been designed based on the following principles:

- Design the project to fit the existing topography, soils, and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.
- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures.

In addition, project management will incorporate the key components listed below:

Phasing

Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities during each phase of construction, per the Scheduling BMP (C162).

Inspection and Monitoring

All BMP's shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. This person has the necessary skills to:

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

A Certified Erosion and Sediment Control Lead shall be on-site or on-call at all times.

Whenever inspection and/or monitoring reveals that the BMP's identified in this SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMP's or design changes shall be implemented as soon as possible.

Maintaining an Updated SWPPP

This 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 construction activities 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, or the applicable local or 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 BMP's designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

1.1.13 Element #13 – Protect Low Impact Development BMPs

All temporary and permanent erosion and sediment control BMP's shall be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repairs shall be completed in accordance with the practices, procedures, and materials for each respective BMP. This project will not construct any Low Impact Development BMPs or infiltration BMPs. The contractor shall refrain from compacting the existing soils surrounding the project site.

- BMP C233: Silt Fence

1.2 PROJECT DESCRIPTION

The project is located at 2000 24th Ave NW, Olympia Washington. See Vicinity Map below.

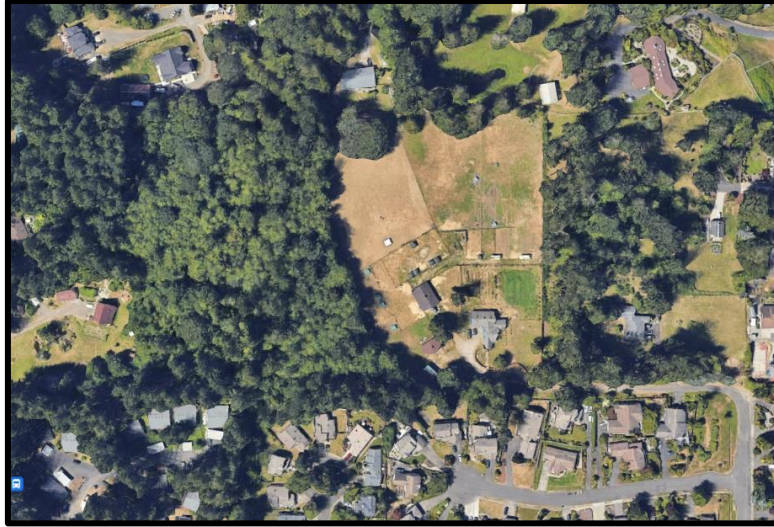


Figure 1) Vicinity Map

The proposed project will disturb approximately 5.57 acres of the 11.28-acre parcel and an additional 0.18 acres off-site for the 24th Ave NW frontage improvements. The proposed construction includes the demolition and removal of three (3) existing buildings, a portion of the existing gravel driveway, and several smaller structures such as sheds. The proposed development includes the construction of thirty four (34) single family lots, a new public roadway, 24th Ave NW frontage improvements, extension of available utilities, and stormwater improvements.

1.3 EXISTING SITE CONDITIONS

The project parcel is +/- 11.28 acres in size. Topography within the project parcel mostly sheet flows to the central portion of the site towards the wetland at slopes of approximately 0 to 30%. The rest of the site sheet flows to the east and infiltrates on-site. The project parcel currently contains one residential building with several accessory buildings. The site has remained relatively unchanged since at least 2003. There are no known treatment or flow control systems on-site. There are no known flooding problems on or downstream of the project site.

1.4 ADJACENT AREAS

The site is bounded by 24th Ave NW to the south and residential properties to the east, west, and north.

1.5 CRITICAL AREAS

The project site is located in a Category II Critical Aquifer Recharge Area/High Aquifer Recharge Class. There are no known wells, septic systems, or fuel tanks located on the site. According to the FEMA floodplain map, the project site is located in Zone X which is an area of minimal flood hazard. See **Appendix 11** of the Stormwater Site Plan for the Critical Aquifer Recharge Area Map and **Appendix 7** for the FEMA Firm map.

1.6 SOIL

A geotechnical investigation was provided by Insight Geologic in March 2023. Eight test pits at 4.5 feet to 9 feet below ground surface and four borings at 8 and 16 feet bgs were conducted on-site. The soil conditions varied from the western portion of the site containing the wetlands and the higher elevation eastern portion. The silty soil characteristics within the wetland and wetland buffer areas does not allow for infiltration, however, the eastern test pits #1-4 revealed 4-6 feet of gravelly sandy soils underlying 1-3 feet of sod and silty upper layers. The soil sampling and percolation tests across the eastern half of the site yielded a recommended design infiltration rate of 2.6 inches/hour which was utilized in the design and sizing of the downspout infiltration trenches. The shallow glacial till and groundwater presents a significant restriction to infiltration facilities along the western half of the site and therefore no infiltration facilities are proposed in this location. A winter groundwater monitoring study was also performed by Insight Geologic which monitored the groundwater level in wells for a period of four months including two months between December 2022 and March 2023. The resulting report dated June 5, 2023 states the maximum groundwater observed occurred at an elevation of 218.31. The proposed lots utilizing downspout infiltration trenches are located at elevations of 226-230 and therefore will achieve the required groundwater separation of at least 3-feet from the bottom of the facilities. According to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), the site soil is identified as Alderwood gravelly sandy loam with slopes of 8 to 15%. See **Appendix 6** of the Stormwater Site Plan for the on-site geotechnical reports.

1.7 POTENTIAL EROSION

Potential on-site erosion control problems are not anticipated at this time. The Certified Professional in Erosion and Sediment Control will be on-site or on-call during construction activities to identify any erosion control problems. If there is a problem, the Certified Professional in Erosion and Sediment Control will promptly authorize the Contractor to initiate corrective measures.

1.8 CONSTRUCTION PHASING

The BMP implementation schedule will be driven by the construction schedule. The key milestones for each segment are not available at this time.

1.9 CONSTRUCTION SCHEDULE

Not available at this time.

1.10 FINANCIAL/OWNERSHIP RESPONSIBILITIES

RJ Development will be the owner of the site and will have full responsibility financially. If or when a new owner takes over the site the new owner will have full financial responsibilities of the site.

1.11 ENGINEERING CALCULATIONS

All the engineering calculations from MGS FLOOD are documented in the Stormwater Site Plan **Appendix 10** prepared by LDC Inc dated April 2024.

1.12 POLLUTION PREVENTION TEAM

1.12.1 Roles and Responsibilities

The pollution prevention team consists of personnel responsible for implementation of the SWPPP, including the following:

- Certified Erosion and Sediment Control Lead – Primary contractor contact, responsible for site inspections (BMPs, visual monitoring, sampling, etc.); to be called upon in case of failure of any ESC measures.
- Project Engineer – For projects with engineered structures only (sediment pond/traps, sand filters, etc.): site representative for the owner that is the project's supervising engineer responsible for inspections and issuing instructions and drawings to the contractor's site supervisor or representative.
- Emergency Owner Contact – Individual that is the site owner or representative of the site owner to be contacted in the case of an emergency.
- Monitoring Personnel – Personnel responsible for conducting water quality monitoring; for most sites this person is also the CESCL.

1.12.2 Team Members

Title	Name (s)	Phone Number
Certified Erosion and Sedimentation Control Lead (CESCL)		
General Contractor		
Project Engineer	Ross Jarvis, LDC	360.634.2065
Emergency Owner Contact		
Emergency Ecology Contact	Southwest Regional Office	360.407.6300
Non-Emergency Ecology Contact	Evan Wood	360.706.4599
Monitoring Personnel	See CESCL	

1.13 SITE INSPECTIONS AND MONITORING

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

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections; and,
- Stormwater quality monitoring.

For convenience, the inspection form and water quality monitoring forms included in this SWPPP include the required information for the site log book. This SWPPP may function as the site log book if desired, or the forms may be separated and included in a separate site log book. However, if separated, the site log book must be maintained on site or within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

1.13.1 *Site Inspection*

All BMPs will be inspected, maintained, and repaired as needed to assure continued performance of their intended function. The inspector will be a CESCL per BMP C160. The name and contact information for the CESCL is provided in Section 1.12.2 of this SWPPP.

Site inspection will occur in all areas disturbed by construction activities and at all potential stormwater discharge points. Stormwater will be examined for the presence of suspended sediment, turbidity, discoloration, and oily sheen.

The site inspector will evaluate and document the effectiveness of the installed BMPs and determine if it is necessary to repair or replace any of the BMPs to improve the quality of the stormwater discharges. All maintenance and repairs will be documented in the site log book or forms provided in this document. All new BMPs or design changes will be documented in the SWPPP as soon as possible.

1.13.2 *Site Inspection Frequency*

Site inspection will be conducted at least once a week and within 24 hours following any discharge from the site. For sites with temporary stabilization measures, the site inspection frequency will be reduced to once every month.

1.13.3 *Site Inspection Documentation*

The site inspector will record each site inspection using the site log inspection forms provided in Appendix C. The site inspection log forms may be separated from this SWPPP document, but will be maintained on site or within reasonable access to the site and be made available upon request to Ecology, the local jurisdiction and the Engineer.

1.14 STORMWATER QUALITY MONITORING

1.14.1 *Turbidity*

Turbidity sampling and monitoring will be conducted during the entire construction phase of the project. Samples will be collected weekly at the discharge point nearest the current phase of the project work. If there is no flow at the discharge point, the attempt to sample will be recorded in the site log book and reported to Ecology in the monthly Discharge Monitoring Report (DMR) as "No Discharge". Samples will be analyzed for turbidity using the Hach 2100Q Turbidimeter.

The key benchmark turbidity value is 25 nephelometric turbidity units (NTU) for the downstream receiving water body. If the 25 NTU benchmark is exceeded in any sample collected, the following steps will be conducted:

1. Ensure all BMPs specified in this SWPPP are installed and functioning as intended.

-
2. Assess whether additional BMPs should be implemented, and document modified BMPs in the SWPPP as necessary.
 3. Sample discharge daily until the discharge is 25 NTU or lower.

If the turbidity exceeds 250 NTU at any time, the following steps will be conducted:

1. Notify ecology by phone within 24 hours of analysis (see Section 1.12.2 of this SWPPP for contact information).
2. Continue sampling daily until the discharge is 25 NTU or lower. Initiate additional treatment BMPs such as off-site treatment, infiltration, filtration and chemical treatment within 24 hours, and implement those additional treatment BMPs as soon as possible, but within a minimum of 7 days.
3. Describe inspection results and remedial actions taken in the site log book and in monthly discharge monitoring reports described in Section 1.15 of this SWPPP.

1.14.2 *pH*

Sampling and monitoring of pH occurs if significant concrete work (> 1,000 cubic yards throughout the life of the project) or use of engineered soils (e.g., cement-treated base) is anticipated. No significant concrete work or engineered soils is planned for this project; therefore, no pH testing will be conducted.

1.15 RECORDKEEPING

1.15.1 *Site Log Book*

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

- A record of the implementation of the SWPPP and other permit requirements;
- Site inspections; and,
- Stormwater quality monitoring.

For convenience, the inspection form included in this SWPPP include the required information for the site log book.

1.15.2 *Records Retention*

Records of all monitoring information (site log book, inspection reports/checklists, etc.), this Stormwater Pollution Prevention Plan, and any other documentation of compliance with permit requirements will be retained during the life of the construction project and for a minimum of three years following the termination of permit coverage in accordance with permit condition S5.C.

1.15.3 *Access to Plans and Records*

All applicable documentation, including but not limited to the SWPPP, General Permit, Notice of Authorization letter, and Site Log Book will be retained on site or within reasonable access to the site

and will be made immediately available upon request to Ecology or the local jurisdiction. A copy of this SWPPP will be provided to Ecology within 14 days of receipt of written request for the SWPPP from Ecology. Any other information requested by Ecology will be submitted within a reasonable time. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with the general permit condition S5.G.

1.15.4 *Updating the SWPPP*

In accordance with conditions S3, S4.B, and S.B.3 of the General Permit, this SWPPP will be modified if the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site or there has been a change in design, construction, operation, or maintenance at the site that has a significant effect on the discharge, or potential for discharge, of pollutants to the waters of the State. The SWPPP will be modified within seven days of determination based on inspection(s) that additional or modified BMPs are necessary to correct problems identified, and an updated timeline for BMP implementation will be prepared.

1.16 REPORTING

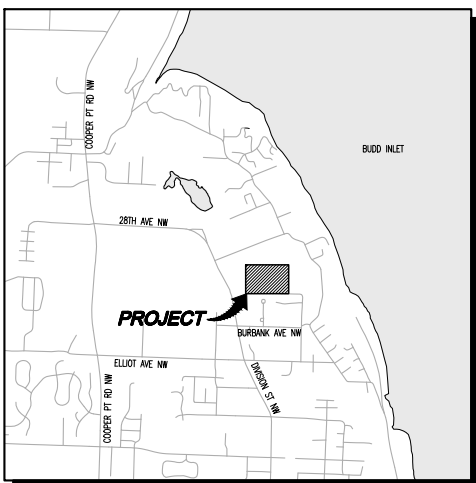
1.16.1 *Notification of Noncompliance*

If any of the terms and conditions of this permit is not met, and it causes a threat to human health or the environment, the following steps will be taken in accordance with permit section S5.F:

1. Ecology will be immediately notified of the failure to comply.
2. Immediate action will be taken to control the noncompliance issue and to correct the problem. If applicable, sampling and analysis of any noncompliance will be repeated immediately and submitted to Ecology within five days of becoming aware of the violation.
3. A detailed report describing the noncompliance will be submitted to Ecology within five days, unless requested earlier by Ecology.

APPENDIX A

EROSION CONTROL AND GRADING PLANS



OWNER:
RJ DEVELOPMENT
401 CENTRAL STREET SE
OLYMPIA, WA 98501
CONTACT: CALEB PERKINS
PHONE: 360-810-8356
EMAIL: caleb@rjdevelopment.com

CIVIL ENGINEER:
LDC, INC.
321 CLEVELAND AVE SE SUITE 209
TUMWATER, WA 98501
CONTACT: ROSS JARVIS, PE
PHONE: (360) 634-2065
FAX: (425) 482-2893
EMAIL: rjarvis@ldccorp.com

SURVEYOR:
MTN 2 COAST, LLC
2320 MOTTMAN RD SW, SUITE 106
TUMWATER, WA 98512
CONTACT: SETH E. PRIGGE, PLS
PHONE: (360) 688-1949

OWNER/APPLICANT:
JAY BARCEL (C)

OWNER/APPLICANT:
TAX PARCEL(S):
SITE ADDRESS:
SITE AREA:
STORMWATER TRACT:
GRADING:
(FOR APPLICATION
PURPOSES ONLY)
ROADWAY AREA/LENGTH:
SOILS:
SANITARY SEWER/WATER:
GAS/POWER:
TELEPHONE/FIBER:
CABLE/TV:
FIRE DISTRICT:
SCHOOL DISTRICT:
FEMA FIRM DESCRIPTION:
EXISTING WELLS:
ZONING DESIGNATION:
SUBDIVISION APPLICATION
MAXIMUM ALLOWABLE (GR
MAXIMUM DWELLING UNIT
PROPOSED RESIDENTIAL
MINIMUM LOT SIZE:
PROPOSED MINIMUM (IND
MINIMUM LOT WIDTH:

RJ DEVELOPMENT
09750029001
2000 24TH AVE NW, OLYMPIA
11.28 ACRES (491,357 SF)
NONE
9,544 CY FILL
6,023 CY CUT

ROADWAY AREA/LENGTH:	1,233'
SOILS:	ALDERWOOD GRAVELLY SANDY LOAM
SANITARY SEWER/WATER:	CITY OF OLYMPIA
GAS/POWER:	PUGET SOUND ENERGY
TELEPHONE/FIBER:	COMCAST/CENTURY LINK
CABLE TV:	COMCAST
FIRE DISTRICT:	MCJANE - BLACK LAKE
SCHOOL DISTRICT:	OLYMPIA
FEMA FIRM DESCRIPTION:	ZONE X
EXISTING WELLS:	NONE
ZONING DESIGNATION:	R-4-8 (OLYMPIA UGA)
SUBDIVISION APPLICATION:	PRELIMINARY PLAT
MAXIMUM ALLOWABLE (GROSS) DENSITY:	8 UNITS/ACRE
MAXIMUM DWELLING UNITS ALLOWED:	65
PROPOSED RESIDENTIAL LOT:	5.0 UNITS/ACRE
MINIMUM LOT SIZE:	2,000 SF
PROPOSED MINIMUM (INDIVIDUAL) LOT SIZE:	2,565 SF
MINIMUM LOT WIDTH:	45'; 22' FOR TOWNHOUSE; 35' FOR COTTAGE
PROPOSED MINIMUM (INDIVIDUAL) LOT WIDTH:	28.50'
FRONT YARD SETBACK (FROM STREET):	20'
REAR YARD SETBACK:	20'
SIDE YARD SETBACK:	5'
MAXIMUM BUILDING HEIGHT:	2 STORIES OR 35', WHICHEVER IS LESS
MAXIMUM LOT COVERAGE:	40%

REQUIRED MIN. USABLE OPEN SPACE: 0.40 ACRES

TOTAL OPEN SPACE PROVIDED:	1.88 ACRES
TREE TRACT REQUIRED:	5% OF SITE - 0.56 ACRES
TREE TRACT PROVIDED (INCLUDED IN OPEN SPACE)	48.7% OF SITE - 5.49 ACRES

1 PP-01 PRELIMINARY PLAT MAP
2 PP-02 PRELIMINARY DRAINAGE AND TESC PLAN
3 PP-03 PRELIMINARY WATER AND SEWER PLAN
4 PP-04 PRELIMINARY PLAT DETAILS AND NOTES
5 PP-05 PRELIMINARY PLAT DETAILS AND NOTES

THE TOPOGRAPHIC SURVEY WAS PERFORMED BY MTN2COAST, LLC. IN DECEMBER 2022. ANY CHANGES TO THE SITE AFTER THIS DATE WILL NOT BE REFLECTED IN THE PLANS. ANY DISCREPANCIES FOUND BETWEEN WHAT IS SHOWN ON THE PLANS AND WHAT IS NOTED IN THE FIELD SHOULD BE BROUGHT IMMEDIATELY TO THE ATTENTION OF THE ENGINEER.



Call 2 Business Days Before You Dig
811 or 1-800-424-5555
Utilities Underground Location Center

LDC | Surveying
Engineering
Planning

Woodville Olympia Kent
321 CLEVELAND AVE SE, SUITE 209
TUMWATER, WA 98501
T: 425-806-1869 www.LDCcorp.com F: 425-482-2893

RJ DEVELOPMENT
WEST OLYMPIA DEVELOPMENT
2000 24TH AVE NW
PRELIMINARY PLAT MAP



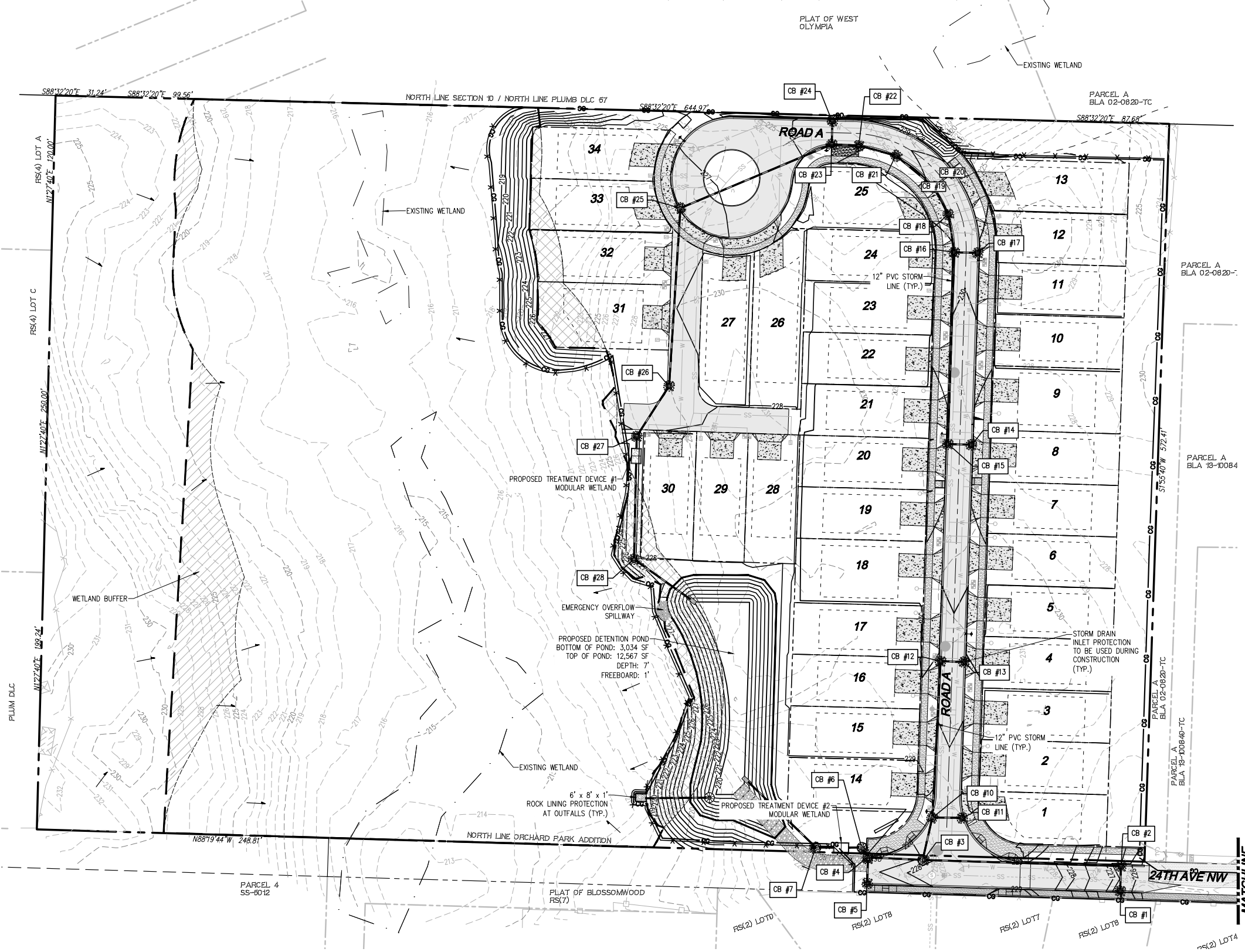
JOB NUMBER:	C23-127
DRAWING NAME:	C23-127 PP-01
DESIGNER:	KH
DRAFTING BY:	ES
DATE:	APRIL 2024
SCALE:	AS NOTED
JURISDICTION:	THURSTON

PP-01

SHEET 1 OF 5

PORTION OF SEC 10, TWN 18, RGE 2W, W.M., THURSTON COUNTY, WASHINGTON

PLAT OF WEST OLYMPIA



LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- CLEARING LIMITS
- SILT FENCE
- STABILIZED CONSTRUCTION ENTRANCE
- STORM DRAIN INLET PROTECTION
- TYPE 1 CATCH BASIN
- ASTM D3034 SDR35 PVC STORM PIPE, UNLESS OTHERWISE NOTED
- INFILTRATION TRENCH
- PRE DEVELOPMENT DRAINAGE FLOW PATH

STRUCTURE TABLE				
NAME	TYPE	RIM	INVERTS	
CB #1	TYPE 1	225.80	IE=222.80 (12") N	
CB #2	TYPE 1	225.78	IE=222.70 (12") S IE=222.70 (12") W	
CB #3	TYPE 2-48"	227.99	IE=221.94 (12") E IE=221.94 (12") W IE=221.94 (12") N	
CB #4	TYPE 2-48"	227.71	IE=221.72 (12") S IE=221.72 (12") NW IE=221.72 (12") E	
CB #5	TYPE 1	227.75	IE=224.75 (12") N	
CB #6	TYPE 2-48"	227.58	IE=221.68 (12") SE IE=221.68 (12") W	
CB #7	TYPE 2-48" W/ SOLID LOOKING LID	227.99	IE=221.50 (12") E IE=221.50 (12") NW	
CB #8	TYPE 1	221.27	IE=220.00 (12") W	
CB #10	TYPE 2-48"	228.22	IE=225.22 (12") S IE=225.22 (12") N IE=225.22 (12") E	
CB #11	TYPE 1	228.39	IE=225.34 (12") W	
CB #12	TYPE 1	229.46	IE=225.83 (12") S IE=225.83 (12") E	
CB #13	TYPE 1	229.46	IE=225.92 (12") W	
CB #14	TYPE 1	230.60	IE=225.69 (12") W	
CB #15	TYPE 1	230.60	IE=225.60 (12") N IE=225.60 (12") E	

STRUCTURE TABLE				
NAME	TYPE	RIM	INVERTS	
CB #16	TYPE 1	229.59	IE=224.86 (12") S IE=224.86 (12") N IE=224.86 (12") E	
CB #17	TYPE 1	229.59	IE=224.95 (12") W	
CB #18	TYPE 1	229.32	IE=224.71 (12") S IE=224.71 (12") NW	
CB #19	TYPE 1	229.09	IE=224.59 (12") SE IE=224.59 (12") NW IE=224.59 (12") NE	
CB #20	TYPE 1	229.10	IE=224.68 (12") SW	
CB #21	TYPE 1	228.74	IE=224.40 (12") SE IE=224.40 (12") W	
CB #22	TYPE 1	228.47	IE=224.25 (12") E IE=224.25 (12") W	
CB #23	TYPE 1	228.29	IE=224.15 (12") E IE=224.15 (12") SW IE=224.15 (12") N	
CB #24	TYPE 1	228.29	IE=224.24 (12") S	
CB #25	Null Structure	224.59	IE=223.51 (12") NE IE=223.51 (12") S	
CB #26	TYPE 1	227.32	IE=222.82 (12") N IE=222.82 (12") SW	
CB #27	TYPE 1	226.50	IE=222.59 (12") NE IE=222.59 (12") S	
CB #28	TYPE 1	226.50	IE=221.61 (12") N IE=221.61 (12") SE	

LOT DRAINAGE NOTES:

1. ROOF DOWNSPOUT INFILTRATION SYSTEMS SHALL BE PLACED ON EACH LOT. ALL ROOF DOWNSPOUT INFILTRATION SYSTEMS SHALL BE SIZED TO ACCOMMODATE STORM RUN-OFF PER THE THURSTON COUNTY DRAINAGE DESIGN AND EROSION CONTROL MANUAL.

UNANTICIPATED DISCOVERY NOTE:

WHEN AN UNANTICIPATED DISCOVERY OF PROTECTED CULTURAL MATERIAL (E.G., BONES, SHELLS, STONE TOOLS, BEADS, CERAMICS, OLD BOTTLES, HEARTHS, ETC.) OR HUMAN REMAINS ARE DISCOVERED, THE PROPERTY OWNER OR CONTRACTOR WILL IMMEDIATELY STOP ALL WORK, COMPLETELY SECURE THE LOCATION, AND CONTACT THE WASHINGTON STATE DEPARTMENT OF ARCHAEOLOGY AND HISTORIC PRESERVATION AND OTHER CONTACTS AS IDENTIFIED BY THURSTON COUNTY.

UTILITY NOTE

THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO ANY CONSTRUCTION. AGENCIES INVOLVED SHALL BE NOTIFIED WITHIN A REASONABLE TIME PRIOR TO THE START OF CONSTRUCTION.

DISCLAIMER

THE TOPOGRAPHIC SURVEY WAS PERFORMED BY MTN2COAST, LLC. IN DECEMBER 2022. ANY CHANGES TO THE SITE AFTER THIS DATE WILL NOT BE REFLECTED IN THE PLANS. ANY DISCREPANCIES FOUND BETWEEN WHAT IS SHOWN ON THE PLANS AND WHAT IS NOTED IN THE FIELD SHOULD BE BROUGHT IMMEDIATELY TO THE ATTENTION OF THE ENGINEER.



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811 or 1-800-424-5555
Utilities Underground Location Center

REVISIONS

NO.	DATE	DESCRIPTION

Surveying
Engineering
Planning

LDC

Woodville
321 CLEVELAND AVE SE, SUITE 209
TUMWATER, WA 98501
T 425.806.1869
www.LDCcorp.com
F 425.882.2893

RJ DEVELOPMENT

WEST OLYMPIA DEVELOPMENT
2000 24TH AVE NW
PRELIMINARY DRAINAGE AND TESC PLAN

JOB NUMBER: C23-127
DRAWING NAME: C23-127 PP-02
DESIGNER: KH
DRAFTING BY: ES
DATE: APRIL 2024
SCALE: AS NOTED
JURISDICTION: THURSTON

PP-02

SHEET 2 OF 5

APPENDIX B

CONSTRUCTION BMPS

BMP C101: Preserving Natural Vegetation

Purpose

Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers hold up to 50 percent of all rain that falls on them during a storm, with the size of the storm playing a large factor. As much as 30 percent of rain, on average, may never reach the ground but is taken up by the tree or evaporates. The rain held in the tree is released slowly to the ground after the storm.

Preserving natural vegetation is an important LID technique. It can help protect water quality and preserve the natural hydrology of a site by maintaining the infiltration capacity of soils, reducing impervious surfaces, and reducing fertilizer and irrigation requirements required to establish new vegetation.

Conditions of Use

- Preserve natural vegetation on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas.
- Where established native plants or ground cover are present, or where underlying soils have good infiltrative properties (Natural Resource Conservation Service Hydrologic Group A or B) they should be preserved to the maximum extent possible.
- At a minimum, the applicant shall comply with provisions for native vegetation preservation and/or replacement as set forth in applicable Thurston County Code including critical areas, zoning, grading and forest practices.
- Phase construction to preserve natural vegetation on the project site for as long as possible during the construction period.

Design and Installation Specifications

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines. The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved.
- Fence or clearly mark areas around trees to be saved. Keep ground disturbance at least outside the tree's dripline and preferably outside the critical root zone, see Figure II - 3.1.

Take the following steps to protect vegetation during construction:

- Map natural resource protection areas on all plans and delineate these areas on the site with silt, construction, or other appropriate fencing to protect soils and vegetation from construction damage.
- Meet and walk property with equipment operators to clarify construction boundaries and limits of disturbance.
- Protect drainage areas during construction. If an area has any type of channel or drainage swale that provides a hydrologic connection to vegetation protection area(s), the channel must also be protected throughout the construction phase by fencing and erosion control measures to prevent untreated runoff from the construction site to flow into the channel.
- Install signs and fences to identify and protect natural resource protection areas.
- Protect trees and tree root systems using the following methods:
 - Reduce soil compaction during the construction phase by protecting critical tree root zones that extend beyond the trees canopy or drip line. Determine the critical tree root zone using the tree's diameter breast height (6-inch diameter breast height = 8-foot radius; 10-inch diameter breast height = 10-foot radius, 30-inch diameter breast height = 45-foot radius) (see Figure II - 3.1).
 - Prohibit excavation within the critical tree root zone.
 - Prohibit stockpiling or disposal of excavated or construction materials in vegetation retention areas to prevent contaminants from damaging vegetation and soils.
 - Changing the natural grade level around a tree affects the tree's ability to obtain the necessary air, water and minerals. Avoid excavation or grade changes near trees designated for protection. If raising the grade level around a tree, a dry rock wall or rock well shall be constructed around the tree. The wall or well shall be placed at least outside of the dripline of tree canopy plus 5 feet and preferably outside of the critical root zone.
 - When there are fills more than 3 inches, it is necessary to supply air to the roots of trees. This can be done by placing a layer of gravel and a tile system over the roots before the fill is made. A tile system protects a tree from a raised grade. The tile system should be laid out on the original grade leading from a drywell around the

tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

- When there are cuts required around trees, keep the cut at least outside of the drip line plus 5 feet and preferably outside the critical root zone. Use retaining walls if necessary, to retain as much of the natural grade as possible.
- Restrict trenching in critical tree root zone areas. Where possible, the trenches should be routed around trees and large shrubs. If this is not possible, it is best to tunnel under them. Tunnel beneath root systems as close to the center of the main trunk to preserve most of the important feeder roots. If it is not possible to route the trench around plants to be saved or tunnel beneath them, then the following should be observed:
 - Cut as few roots as possible. When you have to cut, cut clean. Cover exposed roots with a heavy, wet material, such as burlap, and keep it moist. Remove material before backfilling the trench.
 - When roots will be exposed for more than an hour, wrap all exposed roots over 1.5 inches in diameter with a heavy, wet material, such as burlap, and keep moist until backfilling the trench. Remove material before backfilling.
 - Backfill the trench as soon as possible.
- Prevent wounds to tree trunks and limbs during the construction phase.
- Prohibit installation of impervious surfaces in critical root zone areas (see Figure II - 3.1). Where road or sidewalk surfaces are needed under a tree canopy, use un-mortared porous pavers or flagstone (rather than concrete or asphalt) or bridging techniques.

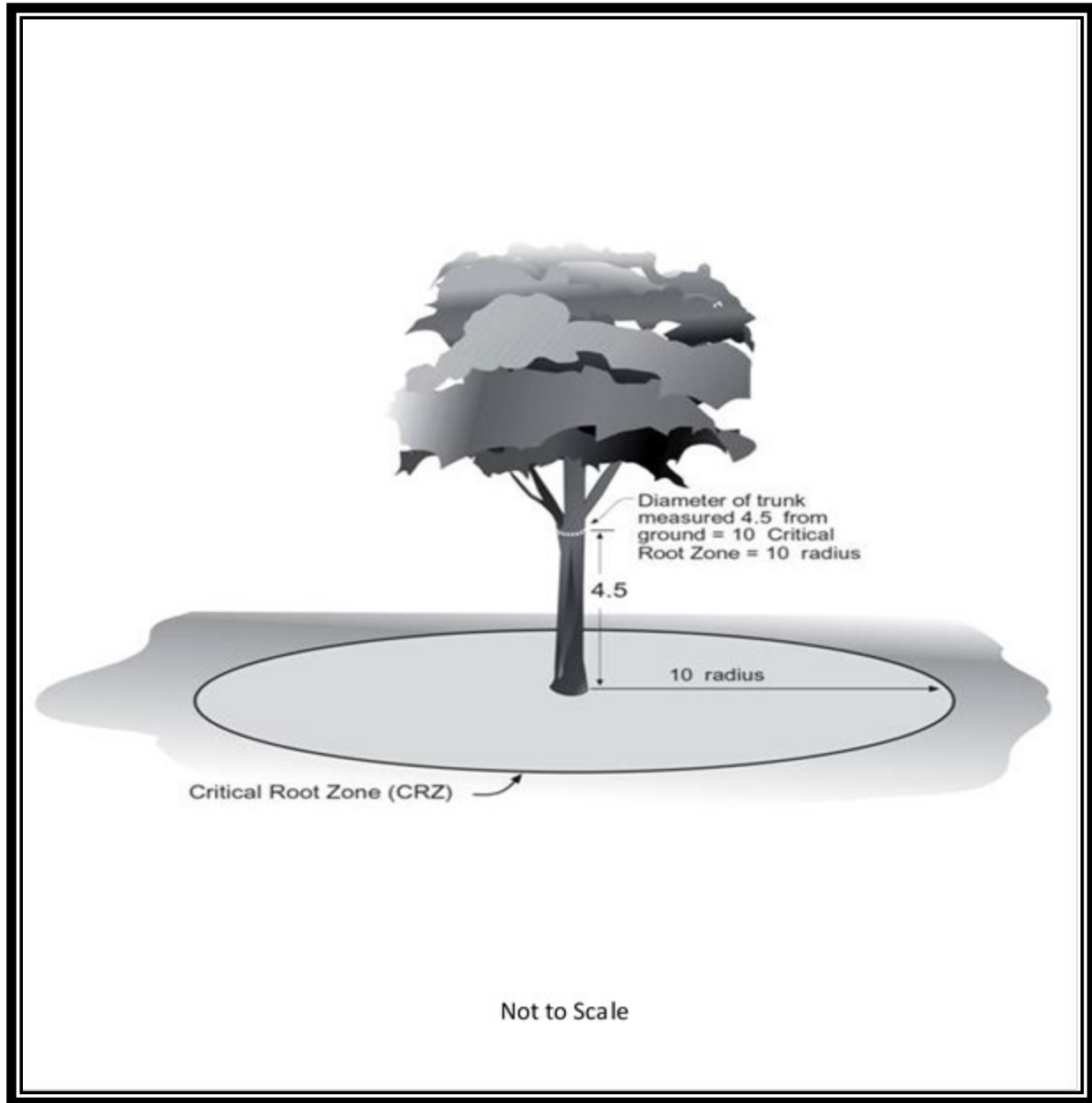


Figure II - 3.1 Critical Root Zone (CRZ), in feet

- Prepare tree conservation areas to better withstand the stresses of the construction phase by fertilizing (if necessary), watering, pruning, and mulching around them well in advance of construction activities. Mulch with a thin layer of compost to add nutrients and organic matter to the soil. Water areas around trees during and after construction to reduce stress and enhance recovery.

Problems that can be encountered with a few specific trees include:

- Maple, Dogwood, Red alder, Western hemlock, Western red cedar, and Douglas fir do not readily adjust to changes in environment, so take special care to protect these trees.
- The windthrow hazard of Pacific Silver Fir and Madrona is high, while that of Western hemlock is moderate. The danger of windthrow increases where dense stands have been thinned. Other species (unless they are on shallow, wet soils less than 20 inches deep) have a low windthrow hazard.
- Cottonwoods, maples, and willows have water-seeking roots that can infiltrate and block sewer lines, drain fields, and infiltration systems. However, these trees thrive in high moisture conditions that other trees would not.
- Thinning operations in pure or mixed stands of Grand Fir, Pacific Silver Fir, Noble Fir, Sitka Spruce, Western Red Cedar, Western Hemlock, Pacific Dogwood, and Red Alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

Maintenance Standards

Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately, and visibility restored.

If tree roots have been exposed or injured, “prune” cleanly with an appropriate pruning saw or loppers directly above the damaged roots and re-cover with native soils. Treatment of sap flowing trees (fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.

BMP C106: Wheel Wash

Purpose

To reduce the amount of sediment transported onto paved roads by motor vehicles.

Conditions of Use

- Use a wheel wash when a stabilized construction entrance (see BMP C105) is not preventing sediment from being tracked off site.
- Wheel washing is generally an effective BMP when installed with careful attention to topography. However, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where water from the dripping truck can run unimpeded into the street, for example.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.
- Wheel wash wastewater is not stormwater. It is commonly called process water and must be discharged to a separate on-site treatment system that prevents discharge to surface water, such as a closed-loop recirculation system to conserve water use, or to the sanitary sewer with local sewer district approval.
- Wheel wash or tire bath wastewater should not include wastewater from concrete washout areas.
- When practical, the wheel wash should be placed in sequence with BMP C105: Stabilized Construction Entrance/Exit. Locate the wheel wash such that vehicles exiting the wheel wash will enter directly onto BMP C105: Stabilized Construction Entrance/Exit. In order to achieve this, BMP C105: Stabilized Construction Entrance/Exit may need to be extended beyond the standard installation to meet the exit of the wheel wash.

Design and Installation Specifications

- Suggested details are shown in Figure II - 3.3. A minimum of 6 inches of asphalt treated base (ATB) over crushed base material or 8 inches over a good subgrade is recommended to pave the wheel wash.
- Use a low clearance truck to test wheel wash clearance before paving. Either a belly dump or lowboy will work well to test clearance.
- Keep the water level from 12 to 14 inches deep to avoid damage to truck hubs and filling the truck tongues with water.

- Midpoint spray nozzles are only needed in extremely muddy conditions.
- Design wheel wash systems with a small grade change (6 to 12 inches for a 10-foot-wide pond) to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment. Install a drainpipe with a 2- to 3-foot riser on the low side of the pond to allow for easy cleaning and refilling. Polymers may be used to promote coagulation and flocculation in a closed-loop system. Polyacrylamide (PAM) added to the wheel wash water at a rate of 0.25 – 0.5 pounds per 1,000 gallons of water increases effectiveness and reduces cleanup time. If PAM is already being used for dust or erosion control and is being applied by a water truck, the same truck can be used to change the wash water.

Maintenance Standards

- The wheel wash should start each day with fresh water.
- Change the wash water a minimum of once per day. On large earthwork jobs where more than 10 to 20 trucks per hour are expected, the wash water will need to be changed more often.

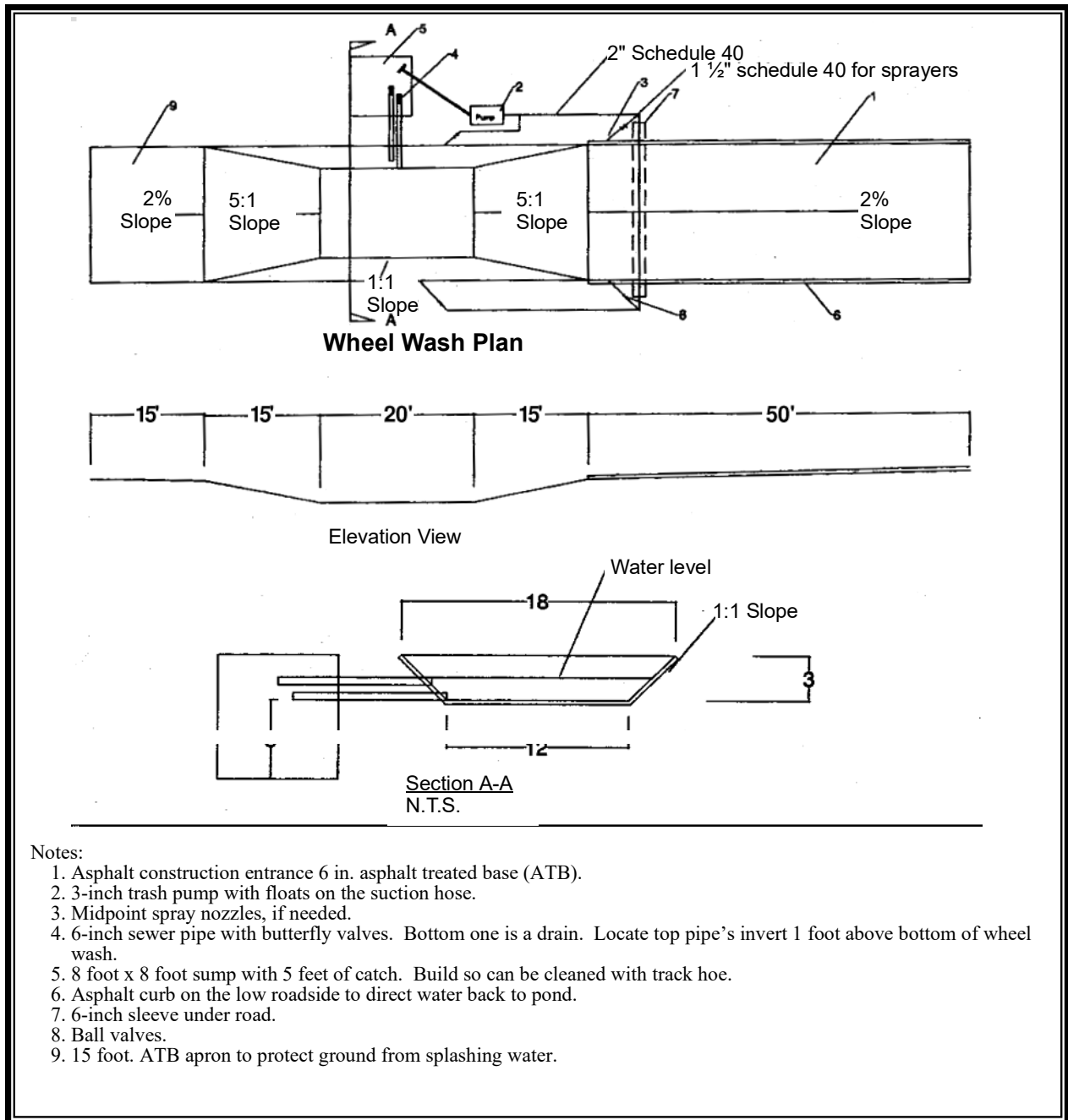


Figure II - 3.3 Wheel Wash

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

- Seeding shall be used throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.
- The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1.
- Between July 1 and August 30 seeding requires irrigation until 75 percent grass cover is established.
- Between October 1 and March 30 seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established.
- Mulch is required at all times for seeding because it protects seeds from heat, moisture loss, and transport due to runoff. Mulch can be applied on top of the seed or simultaneously by hydroseeding. See BMP C121: Mulching for specifications.
- All disturbed areas shall be reviewed in late August to early September and all seeding should be completed by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.
- At final site stabilization, all disturbed areas not otherwise vegetated or stabilized shall be seeded and mulched. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions or geotextiles) which will prevent erosion. See BMP LID.02: Post-Construction Soil Quality and Depth

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix. For vegetated channels that will have high flows, install erosion control blankets over hydroseed. Before allowing water to flow in vegetated channels, establish 75 percent vegetation cover. If

vegetated channels cannot be established by seed before water flow; install sod in the channel bottom – over hydromulch and erosion control blankets.

- To prevent seed from being washed away, confirm that all required surface water control measures have been installed.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 2 percent tackifier. See BMP C121: Mulching for specifications.
- Areas that will have seeding only and not landscaping may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Re-install native topsoil or use BMP LID.02 - Post-Construction Soil Quality and Depth on the disturbed soil surface before application.
- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. To overcome this, consider increasing seed quantities by up to 50 percent.

Roughening and Rototilling

- The seedbed should be firm and rough. All soil shall be roughened regardless of slope. If compaction is required for engineering purposes, slopes must be track walked before seeding. Backblading or smoothing of slopes greater than 4:1 is not allowed if they are to be seeded.
- New and more effective restoration-based landscape practices rely on deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum, permanent areas shall use BMP LID.02 - Post-Construction Soil Quality and Depth to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches, perform the rototilling process in multiple lifts, or the prepared soil system shall be prepared properly and then placed to achieve the specified depth.

Fertilizers

- Organic matter is the most appropriate form of “fertilizer” because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form. A natural system typically releases 2 to 10 percent of its nutrients annually. Chemical fertilizers have since been formulated to simulate what organic matter does naturally.
- In general, 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer can be used at a rate of 90 pounds per acre. Slow-release fertilizers should always be used because they are more efficient and have fewer

environmental impacts. It is recommended that areas being seeded for final landscaping conduct soil tests to determine the exact type and quantity of fertilizer needed. This will prevent the over-application of fertilizer. Fertilizer should not be added to the hydromulch machine or agitated more than 20 minutes before it is to be used. If agitated too much, the slow-release coating is destroyed. Do not use fertilizers in areas that have been amended with compost or used BMP LID.02 - Post-Construction Soil Quality and Depth.

- There are numerous products available on the market that take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100 percent cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal is a good source of long-term, slow-release, available nitrogen.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

- On steep slopes, use bonded fiber matrix (BFM) or mechanically bonded fiber matrix (MBFM) products. BFM/MBFM products are applied at a minimum rate of 3,000 pounds per acre of mulch with approximately 10 percent tackifier. Application is made so that a minimum of 95 percent soil coverage is achieved. Numerous products are available commercially and should be installed per manufacturer's instructions. Most products require 24 to 36 hours to cure before a rainfall and cannot be installed on wet or saturated soils. Generally, these products come in 40 to 50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs have some advantages over blankets, including:
 - No surface preparation required
 - Can be installed via helicopter in remote areas
 - On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety
 - BFMs and MBFMs are at least \$1,000 per acre cheaper to install.
- In most cases, the shear strength of blankets is not a factor when used on slopes, only when used in channels. BFMs and MBFMs are good alternatives to blankets in most situations where vegetation establishment is the goal.

Seeding and Seed Mixtures

- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. One way to overcome this is to increase seed quantities by up to 50 percent.
- Vegetation establishment can also be enhanced by dividing the hydromulch operation into two phases:
 - Phase 1 – Install all seed and fertilizer with 25 to 30 percent mulch and tackifier onto soil in the first lift;
 - Phase 2 – Install the rest of the mulch and tackifier over the first lift.

Or, enhance vegetation by:

- Installing the mulch, seed, fertilizer, and tackifier in one lift.
- Spread or blow straw over the top of the hydromulch at a rate of about 800 to 1,000 pounds per acre.
- Hold straw in place with a standard tackifier.

Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:

- Irrigation
- Reapplication of mulch
- Repair of failed slope surfaces.

This technique works with standard hydromulch (1,500 pounds per acre minimum) and Bonded Fiber Matrix/Mechanically Bonded Fiber Matrix BFM/MBFMs (3,000 pounds per acre minimum).

- Seed installed as a temporary measure may be installed by hand if it will be covered by straw, mulch, or topsoil. Seed installed as a permanent measure may be installed by hand on small areas (usually less than 1 acre) that will be covered with mulch, topsoil, or erosion blankets.
- The seed mixes listed below include recommended mixes for both temporary and permanent seeding. These mixes, with the exception of the wet area seed mix, shall be applied at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Apply the wet area seed mix at a rate of 60 pounds per acre.

- Consult local suppliers or the Thurston County Conservation District for recommendations because the appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the County may be used.
- Table II - 3.2 represents the standard mix for those areas where just a temporary vegetative cover is required.

Table II - 3.2 Temporary Erosion Control Seed Mix

	% Weight	% Purity	% Germination
Chewings or annual blue grass <i>Festuca rubra</i> var. <i>commutata</i> or <i>Poa annua</i>	40	98	90
Perennial rye <i>Lolium perenne</i>	50	98	90
Redtop or colonial bentgrass <i>Agrostis alba</i> or <i>Agrostis tenuis</i>	5	92	85
White dutch clover <i>Trifolium repens</i>	5	98	90

- Table II - 3.3 Provides just one recommended possibility for landscaping seed.

Table II - 3.3 Landscaping Seed Mix

	% Weight	% Purity	% Germination
Perennial rye blend <i>Lolium perenne</i>	70	98	90
Chewings and red fescue blend <i>Festuca rubra</i> var. <i>commutata</i> or <i>Festuca rubra</i>	30	98	90

- This turf seed mix in Table II - 3.4 is for dry situations where there is no need for much water. The advantage is that this mix requires very little maintenance.

Table II - 3.4 Low-Growing Turf Seed Mix

	% Weight	% Purity	% Germination
Dwarf tall fescue (several varieties) <i>Festuca arundinacea</i> var.	45	98	90
Dwarf perennial rye (Barclay) <i>Lolium perenne</i> var. <i>barclay</i>	30	98	90
Red fescue <i>Festuca rubra</i>	20	98	90

Colonial bentgrass <i>Agrostis tenuis</i>	5	98	90
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- Table II - 3.5 presents a mix recommended for bioswales and other intermittently wet areas.

Table II - 3.5 Bioswale Seed Mix^a

	% Weight	% Purity	% Germination
Tall or meadow fescue <i>Festuca arundinacea</i> or <i>Festuca elatior</i>	75-80	98	90
Seaside/Creeping bentgrass <i>Agrostis palustris</i>	10-15	92	85
Redtop bentgrass <i>Agrostis alba</i> or <i>Agrostis gigantea</i>	5-10	90	80

^a Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix

- The seed mix shown in Table II - 3.6 is a recommended low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Other mixes may be appropriate, depending on the soil type and hydrology of the area. Recent research suggests that bentgrass (*agrostis* sp.) should be emphasized in wet-area seed mixes. Apply this mixture at a rate of 60 pounds per acre.

Table II - 3.6 Wet Area Seed Mix

	% Weight	% Purity	% Germination
Tall or meadow fescue <i>Festuca arundinacea</i> or <i>Festuca elatior</i>	60-70	98	90
Seaside/Creeping bentgrass <i>Agrostis palustris</i>	10-15	98	85
Meadow foxtail <i>Alepocurus pratensis</i>	10-15	90	80
Alsike clover <i>Trifolium hybridum</i>	1-6	98	90
Redtop bentgrass <i>Agrostis alba</i>	1-6	92	85

^a Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix

- The meadow seed mix in Table II - 3.7 is recommended for areas that will be maintained infrequently or not at all and where native plant colonization is desired. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. The

appropriateness of clover in the mix may need to be considered, as this can be a fairly invasive species. If the soil is amended, the addition of clover may not be necessary.

Table II - 3.7 Meadow Seed Mix

	% Weight	% Purity	% Germination
Redtop or Oregon bentgrass <i>Agrostis alba</i> or <i>Agrostis oregonensis</i>	20	92	85
Red fescue <i>Festuca rubra</i>	70	98	90
White dutch clover <i>Trifolium repens</i>	10	98	90

Maintenance Standards

- Reseed any seeded areas that fail to establish at least 80 percent cover (100 percent cover for areas that receive sheet or concentrated flows).
- If reseeding is ineffective, an alternate method, such as sodding, mulching, or nets/blankets shall be used.
- If winter weather prevents adequate grass growth, time limits may be relaxed at the discretion of the County when sensitive areas would otherwise be protected.
- After adequate cover is achieved, any areas that experience erosion shall be reseeded and protected by mulch. If the erosion problem is drainage related, the problem shall be fixed, and the eroded area reseeded and protected by mulch.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes runoff.

Products Approved as Equivalent

Products approved by Ecology as equivalent to meet the requirements of BMP C120 are acceptable for use in Thurston County. The approved products are available for review on Ecology's website at:

<https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies>

BMP C121: Mulching

Purpose

To provide immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture and holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There is an enormous variety of mulches, but only the most common types are discussed in this section.

Conditions of Use

As a temporary cover measure, use mulch:

- On disturbed areas that require cover measures for less than 30 days.
- At all times for seeded areas, especially during the wet season and hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

For seeded areas mulch may be made up of 100 percent:

- cottonseed meal;
- fibers made from wood, recycled cellulose, hemp, kenaf;
- compost;
- or blends of these.

Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers.

Generally, mulches come in 40-50 pound bags. Seed and fertilizer are added at time of application.

Recycled cellulose may contain polychlorinated biphenyl (PCBs). Ecology recommends that products should be evaluated for PCBs prior to use.

Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.

Any mulch or tackifier product used shall be installed per manufacturer's instructions.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see Table II - 3.8. Consult with the local supplier or the local conservation district for their recommendations. Increase the application rate until the ground is 95% covered (i.e. not visible under the mulch layer). Note: Thicknesses may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.

Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material. Consult with WDFW as part of the Hydraulic Project Approval for mulch mixes allowed, if applicable.

Where the option of “Compost” is selected, it should be a coarse compost that meets the following size gradations when tested in accordance with the U.S. Composting Council “Test Methods for the Examination of Compost and Composting” (TMECC) Test Method 02.02-B.

Coarse Compost

- Minimum Percent passing 3” sieve openings 100%
- Minimum Percent passing 1” sieve openings 90%
- Minimum Percent passing ¾” sieve openings 70%
- Minimum Percent passing ¼” sieve openings 40%

Maintenance Standards

- The thickness of the cover must be maintained.
- Any areas that experience erosion shall be re-mulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area re-mulched.

Table II - 3.8 Mulch Standards and Guidelines

Mulch Material	Quality Standards	Application Rates	Remarks
Straw	Air-dried; free from undesirable seed and coarse material.	2 to 3 inches thick; 5 bales per 1,000 sf or 2 to 3 tons per acre	Cost-effective when applied with adequate thickness. Hand-application requires greater thickness than blown straw. Straw thickness may be reduced by half when used in conjunction with seeding. In windy areas, straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier since light winds will blow it away. Straw, however, has several deficiencies to consider when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and has no significant long-term benefits. Use straw only if mulches with long-term benefits are unavailable. It also shall not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	No growth inhibiting factors.	Approx. 25-30 lbs per 1,000 sf or 1,500-2,000 lbs per acre	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about 3/4 to 1 inch clog hydromulch equipment. Keep fibers to less than 3/4 inch.
Composted Mulch and Compost	No visible water or dust during handling. Must be purchased from supplier with Solid Waste Handling Permit (unless exempt) and produced in accordance with WAC 173-350.	2-in thick min.; approx. 100 tons per acre (approx. 800 lbs per yard)	Increase thickness to 3 inches to improve effectiveness. Excellent mulch for protecting final grades until landscaping, because it can be directly seeded or tilled into soil as an amendment. Composted mulch has a coarser size gradation than compost. It is more stable and practical to use in wet areas and during rainy weather conditions. Do not use composted mulch near wetlands or near phosphorous impaired water bodies.
Chipped Site Vegetation	Average size shall be several inches. Gradations from fines to 6 inches in length for texture, variation, and interlocking properties.	2-in thick min.	A cost-effective way to dispose of debris from clearing and grubbing, and eliminates problems associated with burning. Should not be used on slopes above about 10 percent because of its tendency to be transported by runoff. Not recommended within 200 feet of surface waters. If seeding is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment.

Mulch Material	Quality Standards	Application Rates	Remarks
Wood-based Mulch or Wood Straw	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.	2-in. thick min.; approx. 100 tons per acre (approx. 800 lbs. per cubic yard)	Often called "hog or hogged fuel." The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).
Wood Strand Mulch	A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.	2-in. thick min.	Cost-effective protection when applied with adequate thickness. A minimum of 95-percent of the wood strand shall have lengths between 2 and 10 inches, with a width and thickness between 1/16 and 3/8-inches. The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life. Sawdust or wood shavings shall not be used as mulch. (WSDOT specification 9-14.4(4))

BMP C122: Nets and Blankets

Purpose

To prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. Some nets and blankets can permanently reinforce turf to protect drainage ways during high flows. Nets (commonly called *matting*) are strands of material woven into an open but high-tensile strength net (for example, coconut fiber matting). Blankets are strands of material that are not tightly woven but form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). Blankets generally have lower tensile strength than nets but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use

Erosion control netting and blankets shall be made of natural plant fibers unaltered by synthetic materials.

Use erosion control nets and blankets:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). Using netting or blankets in drainage ditches and swales can protect bare soil from channelized runoff until vegetation is established. Nets and blankets can also capture a large amount of sediment due to their open, porous structure. Nets and blankets can permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap.

Disadvantages of nets and blankets include:

- Surface preparation required
- On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety
- They cost at least \$4,000 to \$6,000 per acre installed.

Advantages of nets and blankets include:

- Can be installed without mobilizing special equipment
- Can be installed by anyone with minimal training
- Can be installed in stages or phases as the project progresses

- Seed and fertilizer can be hand-placed by the installers as they progress down the slope
- Can be installed in any weather. There are numerous types of blankets that can be designed with various parameters in mind. Those parameters include fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

Design and Installation Specifications

- See Figure II- 3.2 and Figure II - 3.3 for typical orientation and installation of blankets used in channels and as slope protection. Note: these are typical only; all nets and blankets must be installed using manufacturer's installation instructions.
- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion. Installation of nets and blankets on slopes:
 1. Complete final grade and track walk up and down the slope.
 2. Install hydromulch with seed and fertilizer.
 3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.
 4. Install the leading edge of the net/blanket into the small trench and staple approximately every 18 inches. Staples are metal, "U" -shaped, and a minimum of 6 inches long. Longer staples are used in sandy soils. Biodegradable stakes are available.
 5. Roll the net/blanket slowly down the slope as installer walks backwards. The net/blanket rests against the installer's legs. Staples are installed as the blanket is unrolled. It is critical that the proper staple pattern is used for the net/blanket being installed. Do not allow the net/blanket to roll down the slope on its own as this stretches the net/blanket making it impossible to maintain soil contact. In addition, do not walk on the net/blanket after it is in place.
 6. If the net/blanket is not long enough to cover the entire slope length, the trailing edge of the upper blanket shall overlap the leading edge of the lower blanket and be stapled. On steeper slopes, install this overlap in a small trench, staple it, and cover it with soil.
- A wide variety of products is available. Therefore, it is critical that the design engineer consults the manufacturer's information and that a site

visit takes place in order to ensure that the product specified is appropriate. Information is also available in WSDOT's *Standard Specifications for Road, Bridge, and Municipal* Construction Division 8-01 and Division 9-14 (WSDOT, 2016).

- Jute matting must be used in conjunction with mulch (BMP C121). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets require mulch in order to prevent erosion because of their open structure. Blankets typically do not require mulch because they normally provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate locations for use of synthetic blankets, as are riverbanks, beaches and other high-energy environments. If synthetic blankets are used, hydromulch the soil first.
- 100 percent biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which can last up to a year.
- Most netting used with blankets is photodegradable, meaning they break down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Maintenance Standards

- Maintain good contact with the ground. Erosion must not occur beneath the net or blanket.
- Repair and staple any areas of the net or blanket that are damaged or not in close contact with the ground.
- Fix and protect eroded areas if erosion occurs due to poorly controlled drainage.

BMP C123: Plastic Covering

Purpose

To provide immediate, short-term erosion protection of slopes and disturbed areas.

Conditions of Use

Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.

- Plastic is particularly useful for protecting cut and fill slopes and stockpiles, but the rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than 6 months) applications.
- Due to rapid runoff caused by plastic sheeting, this method shall not be used upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring onsite measures to counteract the increases. Creating a trough with wattles or other material can convey water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- Plastic sheeting requires close monitoring and frequent maintenance to ensure proper performance. Water quality standards must be met at all times.
- While plastic is inexpensive to purchase, the cost of installation, maintenance, removal, and disposal add to the total costs of this BMP
- Whenever plastic is used to protect slopes, water collection measures must be installed at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to convey clean rainwater away from bare soil and disturbed areas. At no time is clean runoff from a plastic covered slope to be mixed with dirty runoff from a project.
- Other uses for plastic include:
 1. Temporary ditch liner
 2. Pond liner in temporary sediment pond
 3. Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored
 4. Emergency slope protection during heavy rains
 5. Temporary drainpipe ("elephant trunk") used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:
 1. Run plastic up and down slope, not across slope
 2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet
 3. Minimum of 8-inch overlap at seams
 4. Tape all seams on long or wide slopes, or slopes subject to wind
 5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath
 6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine and pound a wooden stake through each to hold them in place
 7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil which causes extreme erosion.
 8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.
- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace if the plastic begins to deteriorate due to ultraviolet radiation.
- Completely remove the plastic when it is no longer needed.
- Dispose of old tires used to weight down plastic sheeting appropriately.

BMP C124: Sodding

Purpose

To establish permanent turf for immediate erosion protection and stabilize drainage ways where concentrated overland flow will occur.

Conditions of Use

Sodding may be used in the following areas:

- Disturbed areas that require short-term or long-term cover.
- Disturbed areas that require immediate vegetative cover.
- All waterways that require vegetative lining. Waterways may also be seeded rather than sodded and protected with a net or blanket.

Design and Installation Specifications

Sod shall be free of weeds, of uniform thickness (approximately 1 inch thick), and shall have a dense root mat for mechanical strength.

The following steps are recommended for sod installation:

- Shape and smooth the surface to final grade in accordance with the approved grading plan. The swale needs to be over excavated 4 to 6 inches below design elevation to allow room for placing soil amendment and sod.
- Amend 4 inches (minimum) of compost into the top 8 inches of the soil if the organic content of the soil is less than ten percent or the permeability is less than 0.6 inches per hour. See <https://ecology.wa.gov/Waste-Toxics/Reducing-recycling-waste/Organic-materials/Managing-organics-compost> for further information.
- Fertilize according to the supplier's recommendations.
- Work lime and fertilizer into the top 1 to 2 inches of the soil and smooth the surface.²
- Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit.

² Lime and fertilizer shall only be applied if necessary, as determined by a soil test on the amended soil.

Stagger joints at least 12 inches. Staple on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.

- Roll the sodded area and irrigate.
- When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance Standards

If the grass is unhealthy, the cause shall be determined, and appropriate action taken to reestablish a healthy groundcover. If it is impossible to establish a healthy groundcover due to frequent saturation, instability, or some other cause, the sod shall be removed, the area seeded with an appropriate mix, and protected with a net or blanket.

BMP C125: Topsoiling/Composting

Purpose

To provide a suitable growth medium for final site stabilization with vegetation.

While not a permanent cover practice, topsoiling and composting are an integral component of providing permanent cover in areas with an unsuitable soil surface for plant growth. Use this BMP in conjunction with other BMPs such as seeding, mulching, or sodding.

Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but also serve as effective biofilters for urban pollutants and, by supporting more vigorous plant growth, reduce the water, fertilizer and pesticides needed to support installed landscapes. Topsoil does not include any subsoils but only the material from the top several inches including organic debris.

Conditions of Use

- Areas to be permanently landscaped shall provide a healthy topsoil that reduces the need for fertilizers, improves overall topsoil quality, provides for better vegetal health and vitality, improves hydrologic characteristics, and reduces the need for irrigation. This is required for most project and shall be completed in accordance with the requirements of BMP LID.02: Post –Construction Soil Quality and Depth (Volume V of DDECM).
- Leave native soils and the duff layer undisturbed as much as possible. Stripping of existing, properly functioning soil system and vegetation for the purpose of topsoiling during construction is not acceptable. If an existing soil system is functioning properly it shall be preserved in its undisturbed and uncompacted condition.
- Areas that already have healthy topsoil, such as undisturbed areas, do not require soil amendments.
- Restore, to the maximum extent practicable, native soils disturbed during clearing and grading to a condition where moisture-holding capacity is equal to or better than the original site conditions. This criterion can be met by using on-site native topsoil, incorporating amendments into on-site soil, or importing blended topsoil.
- Topsoiling is a required procedure when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.
- Beware of where the topsoil comes from, or what vegetation was on site before disturbance, invasive plant seeds may be included and could cause problems for establishing native plants, landscaped areas, or grasses.

- Topsoil from the site will contain mycorrhizal bacteria that are necessary for healthy root growth and nutrient transfer. These native mycorrhiza are acclimated to the site and will provide optimum conditions for establishing grasses. Use commercially available mycorrhiza products when using offsite topsoil.

Design and Installation Specifications

Meet the following requirements for disturbed areas that will be developed as lawn or landscaped areas at the completed project site:

- Maximize the depth of the topsoil wherever possible to provide the maximum possible infiltration capacity and beneficial growth medium. Topsoil shall have:
 - A minimum depth of 8-inches. Scarify subsoils below the topsoil layer at least 4 inches with some incorporation of the upper material to avoid stratified layers, where feasible. Ripping or restructuring the subgrade may also provide additional benefits regarding the overall infiltration and interflow dynamics of the soil system.
 - A minimum organic content of 10 percent dry weight in planting beds, and 5 percent organic matter content in turf areas. Incorporate organic amendments to a minimum 8-inch depth except where tree roots or other natural features limit the depth of incorporation.
 - A pH between 6.0 and 8.0 or matching the pH of the undisturbed soil.
 - If blended topsoil is imported, then fines should be limited to 25 percent passing through a 200 sieve.
- Mulch planting beds with 2 inches of organic material.
- Field exploration of the site shall be made to determine if there is surface soil of sufficient quantity and quality to justify stripping. Topsoil shall be friable and loamy (loam, sandy loam, silt loam, sandy clay loam, and clay loam). Avoid areas of natural groundwater recharge.
- Stripping shall be confined to the immediate construction area. A 4- to 6-inch stripping depth is common, but depth may vary depending on the particular soil. All surface runoff control structures shall be in place prior to stripping.
- Do not place topsoil while in frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding.
- In any areas requiring grading remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public

resources and critical areas. Stockpiled topsoil is to be reapplied to other portions of the site where feasible.

- Locate the topsoil stockpile so that it meets specifications and does not interfere with work on the site. It may be possible to locate more than one pile in proximity to areas where topsoil will be used.
- Stockpiling of topsoil shall occur in the following manner:
 - Side slopes of the stockpile shall not exceed 2H:1V.
 - Between October 1 and April 30:
 - An interceptor dike with gravel outlet and silt fence shall surround all topsoil stockpiles.
 - Within 2 days complete erosion control seeding, or cover stockpiles with clear plastic, or other mulching materials.
 - Between May 1 and September 30:
 - An interceptor dike with gravel outlet and silt fence shall be installed if the stockpile will remain in place for a longer period of time than active construction grading.
 - Within 7 days complete erosion control seeding, or cover stockpiles with clear plastic, or other mulching materials.
- When native topsoil is to be stockpiled and reused the following apply to ensure the mycorrhizal, bacterial, earthworms, and other beneficial organisms will not be destroyed:
 - Re-install topsoil within 4 to 6 weeks.
 - Do not allow the saturation of topsoil with water.
 - Do not use plastic covering.

Maintenance Standards

- Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded.
- Establish soil quality and depth toward the end of construction and once established, protect from compaction, such as from large machinery use, and from erosion.
- Plant and mulch soil after installation.

- Leave plant debris or its equivalent on the soil surface to replenish organic matter.
- Reduce and adjust, where possible, the use of irrigation, fertilizers, herbicides and pesticides, rather than continuing to implement formerly established practices.

BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection

Purpose

Polyacrylamide (PAM) is a soil binding agent used on construction sites to prevent soil erosion.

Applying PAM to bare soil in advance of rain significantly reduces erosion and controls sediment in two ways. First, PAM increases the soil's available pore volume, thus increasing infiltration through flocculation and reducing the quantity of stormwater runoff. Second, it increases flocculation of suspended particles and aids in their deposition, thus reducing stormwater runoff turbidity and improving water quality.

Conditions of Use

PAM shall only be applied with prior acceptance by the County and shall not be directly applied to water or allowed to enter a water body. Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used, as noted in the following paragraph.

The specific PAM copolymer formulation must be anionic. **Cationic PAM shall not be used in any application because of known aquatic toxicity problems.** Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, will be used for soil applications. Recent media attention and high interest in PAM has resulted in some entrepreneurial exploitation of the term "polymer." All PAM are polymers, but not all polymers are PAM, and not all PAM products comply with ANSI/NSF Standard 60. PAM use shall be reviewed and approved by the County. The Washington State Department of Transportation (WSDOT) has listed approved PAM products on their [web page](#).

In areas that drain to a sediment pond, PAM can be applied to bare soil in the following locations and under the following conditions:

- During rough grading operations
- In staging areas
- Balanced cut and fill earthwork
- Haul roads prior to placement of crushed rock surfacing
- Compacted soil road base
- Stockpiles
- After final grade and before paving or final seeding and planting
- Pit sites

- Sites having a winter shut down. In the case of winter shut down, or where soil will remain unworked for several months, use PAM together with mulch.

Design and Installation Specifications

PAM may be applied in dissolved form with water, or it may be applied in dry, granular or powdered form. The preferred application method is the dissolved form.

PAM is to be applied at a maximum rate of 2/3 pound PAM per 1,000 gallons water (80 mg/L) per 1 acre of bare soil. Table II - 3.9 can be used to determine the PAM and water application rate for a disturbed soil area. Higher concentrations of PAM **do not** provide any additional effectiveness.

Table II - 3.9 PAM and Water Application Rates

Disturbed Area (ac)	PAM (lbs.)	Water (gal)
0.50	0.33	500
1.00	0.66	1,000
1.50	1.00	1,500
2.00	1.32	2,000
2.50	1.65	2,500
3.00	2.00	3,000
3.50	2.33	3,500
4.00	2.65	4,000
4.50	3.00	4,500
5.00	3.33	5,000

The Preferred Method:

- Pre-measure the area where PAM is to be applied and calculate the amount of product and water necessary to provide coverage at the specified application rate (2/3 pound PAM/1,000 gallons/acre).
- PAM has high solubility in water, but dissolves very slowly. Dissolve pre-measured dry granular PAM with a known quantity of clean water in a bucket several hours or overnight. Mechanical mixing will help dissolve the PAM. Always add PAM to water - not water to PAM.
- Pre-fill the water truck about 1/8 full with water. The water does not have to be potable, but it must have relatively low turbidity – in the range of 20 NTU or less.

- Add PAM /Water mixture to the truck
- Completely fill the water truck to specified volume.
- Spray PAM/Water mixture onto dry soil until the soil surface is uniformly and completely wetted.

An Alternate Method:

PAM may also be applied as a powder at the rate of 5 lbs. per acre. This must be applied on a day that is dry. For areas less than 5 to 10 acres, a hand-held “organ grinder” fertilizer spreader set to the smallest setting will work. Tractor-mounted spreaders will work for larger areas.

The following shall be used for application of powdered PAM:

- PAM shall be used in conjunction with other BMPs and not in place of other BMPs.
- Do not use PAM on a slope that flows directly into a stream or wetland. The stormwater runoff shall pass through a sediment control BMP prior to discharging to surface waters.
- Do not add PAM to water discharging from site.
- When the total drainage area is greater than or equal to 5 acres, PAM treated areas shall drain to a sediment pond.
- Areas less than 5 acres shall drain to sediment control BMPs, such as a minimum of three check dams per acre. The total number of check dams used shall be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam shall be spaced evenly in the drainage channel through which stormwater flows are discharged offsite.
- On all sites, the use of silt fence shall be maximized to limit the discharges of sediment from the site.
- All areas not being actively worked shall be covered and protected from rainfall. PAM shall not be the only cover BMP used.
- PAM can be applied to wet soil, but dry soil is preferred due to less sediment loss.
- PAM will work when applied to saturated soil but is not as effective as applications to dry or damp soil.

- Keep the granular PAM supply out of the sun. Granular PAM loses its effectiveness in three months after exposure to sunlight and air.
- Proper application and re-application plans are necessary to ensure total effectiveness of PAM usage.
- PAM, combined with water, is very slippery and can be a safety hazard. Care must be taken to prevent spills of PAM powder onto paved surfaces. During an application of PAM, prevent over-spray from reaching pavement as pavement will become slippery. If PAM powder gets on skin or clothing, wipe it off with a rough towel rather than washing with water-this only makes cleanup messier and take longer.
- Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products shall be used.
- PAM designated for these uses should be “water soluble” or “linear” or “non-crosslinked”. Cross-linked or water absorbent PAM, polymerized in highly acidic (pH<2) conditions, are used to maintain soil moisture content.
- The PAM anionic charge density may vary from 2 to 30 percent; a value of 18 percent is typical. Studies conducted by the United States Department of Agriculture (USDA)/ARS demonstrated that soil stabilization was optimized by using very high molecular weight (12 to 15 mg/mole), highly anionic (>20 percent hydrolysis) PAM.
- PAM tackifiers are available and being used in place of guar and alpha plantago. Typically, PAM tackifiers should be used at a rate of no more than 0.5 to 1 lb. per 1,000 gallons of water in a hydromulch machine. Some tackifier product instructions say to use at a rate of 3 to 5 lbs. per acre, which can be too much. In addition, pump problems can occur at higher rates due to increased viscosity.

Maintenance Standards

- PAM may be reapplied on actively worked areas after a 48-hour period.
- Reapplication is not required unless PAM treated soil is disturbed or unless turbidity levels show the need for an additional application. If PAM treated soil is left undisturbed a reapplication may be necessary after 2 months. More PAM applications may be required for steep slopes, silty and clayey soils (USDA Classification Type "C" and "D" soils), long grades, and high precipitation areas. When PAM is applied first to bare soil and then covered with straw, a reapplication may not be necessary for several months.

- Loss of sediment and PAM may be a basis for penalties per RCW 90.48.080.

BMP C130: Surface Roughening

Purpose

To aid in the establishment of vegetative cover, reduce runoff velocity, increase infiltration, and provide for sediment trapping through the provision of a rough soil surface. Horizontal depressions are created by operating a tiller or other suitable equipment on the contour or by leaving slopes in a roughened condition by not fine grading them.

Use this BMP in conjunction with other BMPs such as seeding, mulching, or sodding.

Conditions for Use

- All slopes steeper than 3:1 and greater than 5 vertical feet require surface roughening to a depth of 2 to 4 inches prior to seeding.
- Areas that will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.
- Slopes with a stable rock face do not require roughening.
- Slopes where mowing is planned should not be excessively roughened.

Design and Installation Specifications

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, contour furrows, and tracking. See Figure II - 3.2 for tracking and contour furrows. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each “step” catches material that sloughs from above and provides a level site where vegetation can become established. Stairs should be wide enough to work with standard earth moving equipment. Stair steps must be on contour or gullies will form on the slope.
- Areas that will be mowed (these areas should have slopes less steep than 3:1) may have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on the contour.

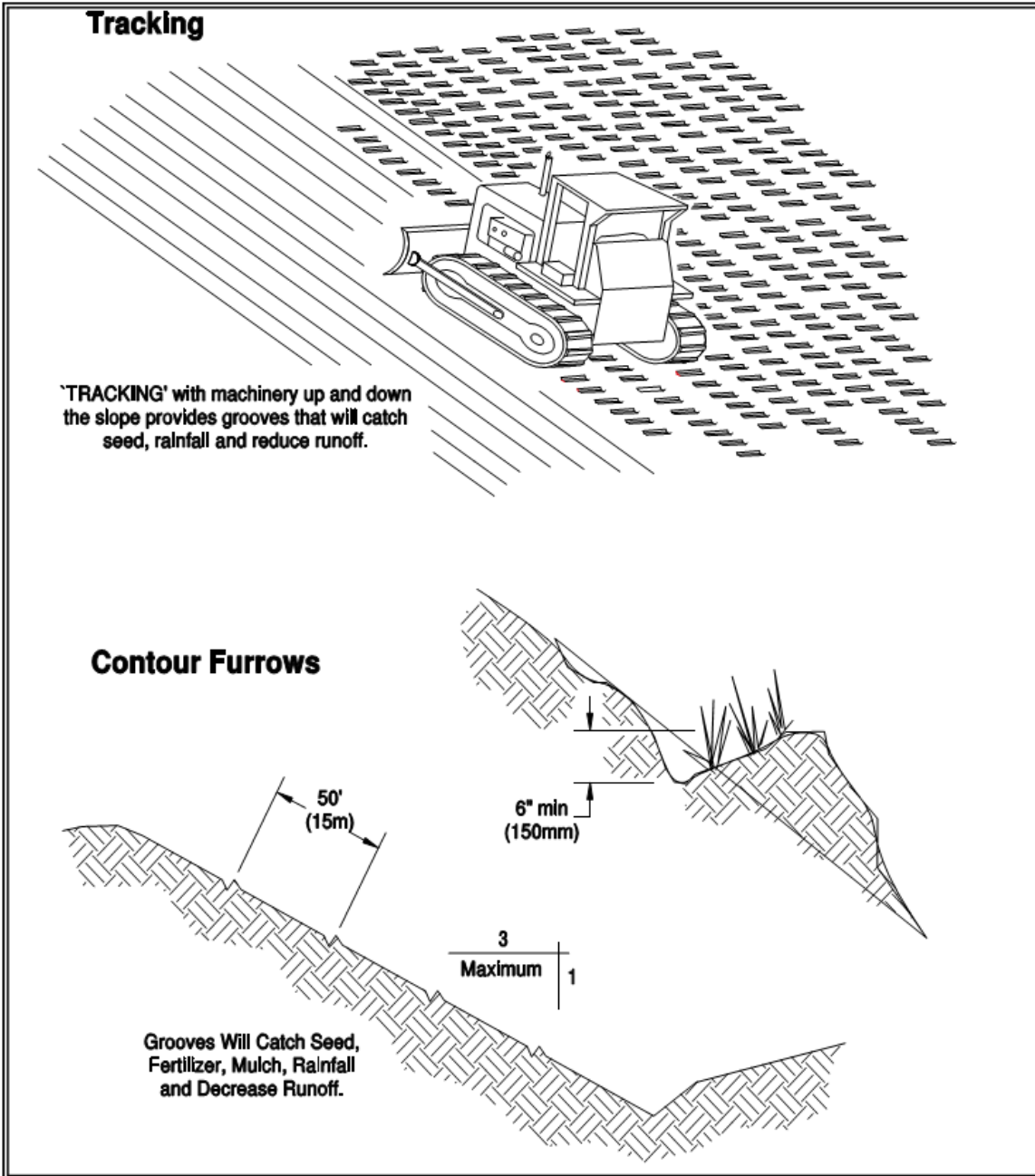


Figure II - 3.2 Surface Roughening by Tracking and Contour Furrows

- Graded areas with slopes greater than 3:1 but less than 2:1 shall be roughened before seeding. This can be accomplished in a variety of ways, including "track walking," or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.
- Tracking is done by operating equipment up and down the slope to leave horizontal depressions in the soil.

Maintenance Standards

- Areas that are surfaced roughened should be seeded as quickly as possible.
- Regular inspections should be made of the area. If rills appear, re-roughen and re-seed immediately.

BMP C131: Gradient Terraces

Purpose

To reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a non-erosive velocity.

Conditions of Use

Gradient terraces normally are limited to denuded land having a water erosion problem. They should not be constructed on deep sands or on soils that are too stony, steep, or shallow to permit practical and economical installation and maintenance. Gradient terraces may be used only where suitable outlets are or will be made available. See Figure II - 3.3 for gradient terraces.

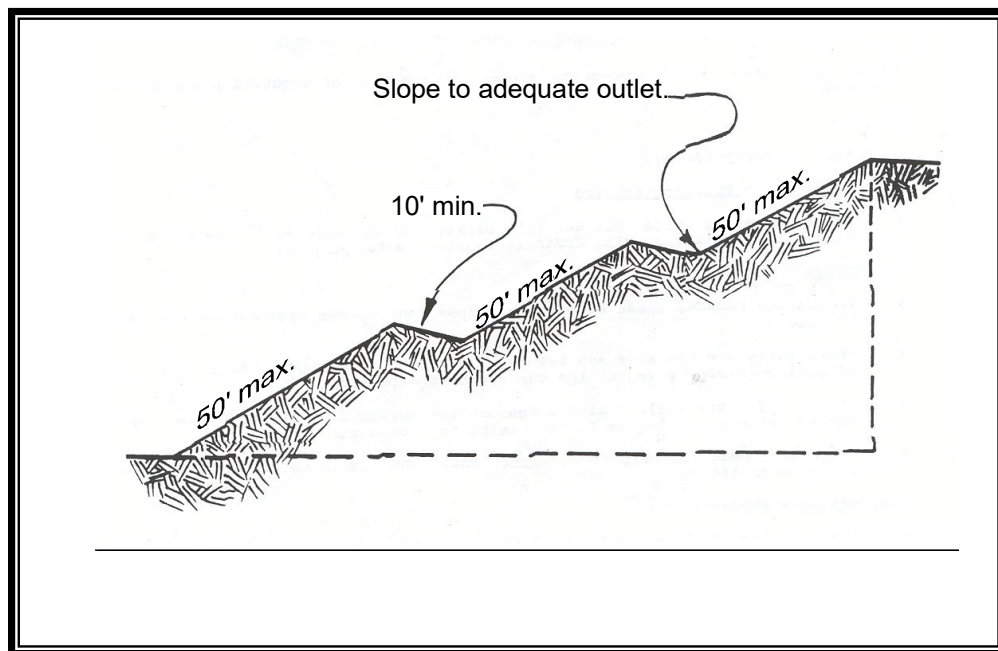


Figure II - 3.3 Gradient Terraces

Design and Installation Specifications

- Determine the maximum spacing of gradient terraces using the following formula:

$$VI = (0.8)s + y$$

Where:

VI = vertical interval in feet

S = land rise per 100 feet, expressed in feet

y = a soil and cover variable with values from 1.0 to 4.0

Values of “y” are influenced by soil erodibility and cover practices. The lower values are applicable to erosive soils where little to no residue is left on the surface. The higher value is applicable only to erosion-resistant soils where a large amount of residue (1-1/2 tons of straw/acre equivalent) is on the surface.

- The minimum constructed cross-section shall meet the design dimensions.
- The top of the constructed ridge shall not be lower at any point than the design elevation plus the specified overfill for settlement. The opening at the outlet end of the terrace shall have a cross-section equal to that specified for the terrace channel.
- Channel grades may be either uniform or variable with a maximum grade of 0.6 feet per 100 feet length (0.6%). For short distances, terrace grades may be increased to improve alignment. The channel velocity shall not exceed that which is non-erosive for the soil type with the planned treatment.
- All gradient terraces shall have adequate outlets. Such an outlet may be a grassed waterway, vegetated area, or tile outlet. In all cases the outlet must convey runoff from the terrace or terrace system to a point where the outflow will not cause damage. Use vegetative cover in the outlet channel.
- The design elevation of the water surface of the terrace shall not be lower than the design elevation of the water surface in the outlet at their junction, when both are operating at design flow.
- Vertical spacing determined by the above methods may be increased as much as 0.5 feet or 10 percent, whichever is greater, to provide better alignment or location, to avoid obstacles, to adjust for equipment size, or to reach a satisfactory outlet. The drainage area above the terrace shall not exceed the area that would be drained by a terrace with normal spacing.
- The terrace shall have enough capacity to handle the peak runoff expected from a 2-year, 24-hour design storm without overtopping.
- The terrace cross-section should be proportioned to fit the land slope. The ridge height should include a reasonable settlement factor. The ridge shall have a minimum top width of 3 feet at the design height. The minimum cross-sectional area of the terrace channel shall be 8 square feet for land slopes of 5 percent or less, 7 square feet for slopes from 5 to 8 percent, and 6 square feet for slopes steeper than 8 percent. The terrace can be constructed wide enough to be maintained using a small cat.

Maintenance Standards

Performance maintenance as needed. Terraces should be inspected regularly; at least once a year, and after large storm events.

BMP C140: Dust Control***Purpose***

To prevent wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use

Dust control must be used in areas (including roadways) subject to surface and air movement of dust, where on-site and off-site impacts to roadways, drainage ways or surface waters are likely.

Design and Installation Specifications

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

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

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C150: Materials on Hand***Purpose***

Quantities of erosion prevention and sediment control materials can be kept on the project site at all times for regular maintenance and emergency situations such as unexpected heavy summer rains. Having these materials on-site reduces the time needed to implement BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements. In addition, contractors can save money by buying some materials in bulk and storing them at their office or yard.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible pipe, sandbags, geotextile fabric, and steel “T” posts.
- Materials are stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or developer could keep a stockpile of materials that are available to be used on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum that will cover numerous situations includes:

Table II - 3.10 Materials on Hand

Material	Measure	Quantity
Clear Plastic, 6 mil	100 foot roll	1-2
Drainpipe, 6- or 8-inch diameter	25 foot section	4-6
Sandbags, filled	each	25-50
Straw Bales for mulching,	approx. 50# each	10-20
Quarry Spalls	ton	2-4
Washed Gravel	cubic yard	2-4
Geotextile Fabric	100 foot roll	1-2
Catch Basin Inserts	each	2-4
Steel “T” Posts	each	12-24

Silt fence material	Lineal feet	200
Straw Wattles	Lineal feet	100

Maintenance Standards

- All materials with the exception of the quarry spalls, steel “T” posts, and gravel should be kept covered and out of both sun and rain.
- Re-stock materials used as needed.

BMP C151: Concrete Handling

Purpose

Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. Concrete spillage or concrete discharge to surface waters of the State is prohibited. Use this BMP to minimize and eliminate concrete, concrete process water, and concrete slurry from entering waters of the State.

Conditions of Use

Any time concrete is used; these management practices shall be utilized, since concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water.

Concrete construction projects include, but are not limited to, the following:

- Curbs
- Sidewalks
- Roads
- Bridges
- Foundations
- Floors
- Runways

Disposal options for concrete, in order of preference are:

1. Off-site disposal locations
2. Concrete wash-out areas (see BMP C154: Concrete Washout Area)
3. De minimis washout to formed areas awaiting concrete

Design and Installation Specifications

- Washout concrete truck drums at an approved off-site location or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground (including formed areas awaiting concrete), or into storm drains, open ditches, streets, or streams. Refer to BMP C154 for information on concrete washout areas.

- Unused concrete remaining in the truck and pump shall be returned to the originating batch plant for recycling, as feasible. Do not dump excess concrete on site, except in designated concrete washout areas as allowed in BMP C154.
- Small concrete handling equipment (e.g., hand tools screeds, shovels, rakes, floats, trowels, and wheelbarrows) shall be washed into designated concrete washout areas or into formed areas awaiting concrete pour.
- At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.
- Equipment that cannot be easily moved, such as concrete paving machines, shall only be washed in areas that do not directly drain to natural or constructed stormwater conveyances or potential infiltration areas.
- Do not allow washwater from areas, such as concrete aggregate driveways, to drain directly (without detention or treatment) to natural or constructed stormwater conveyances.
- When no designated concrete washout areas (or formed areas, allowed as described above) are available, contain washwater and leftover product in a lined container. Lining shall be a minimum of 10-mil polyethylene sheeting and shall be free of holes, tears, or other defects that compromise the impermeability of the material. Dispose of contained concrete and concrete washwater (process water) in a manner that does not violate groundwater or surface water quality standards.
- Always use forms or solid barriers for concrete pours, such as pilings, within 15-feet of surface waters.
- Refer to BMPs C252: Treating and Disposing of High pH Water for pH adjustment requirements.
- Refer to the Construction Stormwater General Permit (CSWGP) for pH monitoring requirements if the project involves one of the following activities:
 - Significant concrete work (as defined in the CSWGP).
 - The use of soils amended with (but not limited to) Portland cement-treated base, cement kiln dust or fly ash.
 - Discharging stormwater to segments of water bodies on the 303(d) list (Category 5) for high pH.

Maintenance Standards

Check containers for holes in the liner daily during concrete pours and repaired the same day.

BMP C152: Sawcutting and Surfacing Pollution Prevention***Purpose***

Sawcutting or surfacing operations generate slurry and process water that contains fine particles and high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. Concrete spillage or concrete discharge to surface waters of the State is prohibited. Use this BMP to minimize and eliminate process water and slurry from entering waters of the State.

Conditions of Use

Utilize these management practices anytime sawcutting and surfacing operations take place. Sawcutting and surfacing operations include, but are not limited to, the following:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing

Design and Installation Specifications

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance including stormwater systems. This may require temporarily blocking catch basins.
- Dispose collected slurry and cuttings in a manner that does not violate groundwater or surface water quality standards.
- Do not allow process water that is generated during hydro-demolition, surface roughening or similar operations to drain to any natural or constructed drainage conveyance including stormwater systems and dispose it in a manner that does not violate groundwater or surface water quality standards.
- Handle and dispose cleaning waste material and demolition debris in a manner that does not cause contamination of water. If the area is swept

with a pick-up sweeper, haul the material out of the area to an appropriate disposal site.

Maintenance Standards

Continually monitor operations to determine whether slurry, cuttings, or process water could enter waters of the state. If inspections show that a violation of water quality standards could occur, stop operations and immediately implement preventive measures such as berms, barriers, secondary containment, and/or vacuum trucks.

BMP C153: Material Delivery, Storage and Containment

Purpose

To prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or water courses from material delivery and storage by minimizing on-site hazardous materials storage, storing materials in a designated area, and installing secondary containment.

Conditions of Use

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g., Polyacrylamide)
- Fertilizers, pesticides and herbicides
- Detergents
- Asphalt and concrete compounds
- Hazardous chemicals such as acids, lime, adhesives, paints, solvents and curing compounds
- Any other material that may be detrimental if released to the environment

Design and Installation Specifications

To minimize risk, do the following:

- Locate temporary storage area away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Safety Data Sheets (SDS) should be supplied for all stored materials. Chemicals should be kept in their original labeled containers.
- Minimize on-site hazardous material storage.
- Handle hazardous materials as infrequently as possible.
- During the wet weather season (October 1 – April 30), store materials in a covered area when possible.
- Store materials in secondary containments such as an earthen dike, a horse trough, or even a children's wading pool for non-reactive materials

such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in “bus boy” trays or concrete mixing trays.

- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, in secondary containment.
- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.

Material Storage Areas and Secondary Containment Practices:

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain precipitation from a 25-year, 24-hour storm event, plus 10 percent of the total enclosed container volume of all containers, or 110 percent of the capacity of the largest container within its boundary, whichever is greater.
- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Provide sufficient separation between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (October 1 – April 30), each secondary containment facility shall be covered during non-working days, prior to and during rain events.
- Keep material storage areas clean, organized and equipped with an ample supply of appropriate spill clean-up material (spill kit).
- The spill kit should include, at a minimum:
 - 1-Water Resistant Nylon Bag

- 3-Oil Absorbent Socks 3" x 4'
- 2-Oil Absorbent Socks 3" x 10'
- 12-Oil Absorbent Pads 17" x 19"
- 1-Pair Splash Resistant Goggles
- 3-Pair Nitrile Gloves
- 10-Disposable Bags with Ties
- Instructions.

Maintenance Standards

- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Re-stock spill kit materials as needed.

BMP C154: Concrete Washout Area

Purpose

To prevent or reduce the discharge of pollutants to stormwater from concrete waste by conducting washout off-site or performing on-site washout in a designated area to prevent pollutants from entering surface waters or groundwater.

Conditions of Use

Concrete washout area best management practices are implemented on construction projects where:

- Concrete is used as a construction material
- It is not possible to dispose of all concrete wastewater and washout off-site (ready mix plant, etc.).
- Concrete truck drums are washed on-site.

Note that auxiliary concrete truck components (e.g. chutes and hoses) and small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheelbarrows) may be washed into formed areas awaiting concrete pour. At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.

Design and Installation Specifications

Implementation

The following steps will help reduce stormwater pollution from concrete wastes:

- Perform washout of concrete truck drums at an approved off-site location or in designated concrete washout areas only.
- Do not wash out concrete onto non-formed areas, or into storm drains, open ditches, streets, or streams.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow excess concrete to be dumped on-site, except in designated concrete washout areas as allowed above.
- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures (above-grade or below-grade).

- Prefabricated containers are most resistant to damage and protect against spills and leaks. Companies may offer delivery service and provide regular maintenance and disposal of solid and liquid waste.
- If self-installed concrete washout areas are used, below-grade structures are preferred over above-grade structures because they are less prone to spills and leaks.
- Self-installed above-grade structures should only be used if excavation is not practical.
- Construct and maintain concrete washout areas in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

Education

- Discuss the concrete management techniques described in this BMP with the ready-mix concrete supplier before any deliveries are made.
- Educate employees and subcontractors on the concrete waste management techniques described in this BMP.
- Arrange for contractor's superintendent or Certified Erosion and Sediment Control Lead (CESCL) to oversee and enforce concrete waste management procedures.
- A sign shall be installed adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.

Contracts

Incorporate requirements for concrete waste management into concrete supplier and subcontractor agreements.

Location and Placement

- Locate concrete washout areas at least 50 feet from sensitive areas such as storm drains, open ditches, water bodies, or wetlands.
- Allow convenient access to the concrete washout area for concrete trucks, preferably near the area where the concrete is being poured.
- If trucks need to leave a paved area to access the concrete washout area, prevent track-out with a pad of rock or quarry). These areas should be far

enough away from other construction traffic to reduce the likelihood of accidental damage and spills.

- The number of concrete washout areas you install should depend on the expected demand for storage capacity.
- On large sites with extensive concrete work, concrete washout areas should be placed in multiple locations for ease of use by concrete truck drivers.

Concrete Truck Washout Procedures

- Perform washout of concrete truck drums in designated concrete washout areas only.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated concrete washout areas or properly disposed of off-site.

Concrete Washout Area Installation

- Concrete washout areas should be constructed as shown on the details below, with a recommended minimum length and width of 10 feet, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
- Plastic lining material shall be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
- Lath and flagging should be commercial type.
- Liner seams shall be installed in accordance with manufacturers' recommendations.
- Soil base shall be prepared free of rocks or other debris that may cause tears or holes in the plastic lining material.

Maintenance Standards

Inspection and Maintenance

- Inspect and verify that concrete washout areas are in place prior to the commencement of concrete work. Once concrete wastes are washed into the designated washout area and allowed to harden, the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.

- During periods of concrete work, inspect daily to verify continued performance.
 - Check overall condition and performance.
 - Check remaining capacity (% full).
 - If using self-installed washout facilities, verify plastic liners are intact and sidewalls are not damaged.
 - If using prefabricated containers, check for leaks.
- Concrete washout areas shall be maintained to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Concrete washout areas must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.
- If the concrete washout area is nearing capacity, vacuum and dispose of the waste material in an approved manner.
 - Do not discharge liquid or slurry to waterways, storm drains, or directly onto the ground.
 - Do not use sanitary sewer without local sewer service provider approval.
 - Place a secure, non-collapsing, non-water collecting cover over the concrete washout facility prior to predicted wet weather to prevent accumulation and overflow of precipitation.
 - Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused on-site or hauled away for disposal or recycling.
- When you remove materials from a self-installed concrete washout area, build a new structure; or, if the previous structure is still intact, inspect for signs of weakening or damage, and make any necessary repairs. Re-line the structure with new plastic after each cleaning.

Removal of Concrete Washout Areas

- When concrete washout areas are no longer required for the work, the hardened concrete, slurries and liquids shall be removed and properly disposed of.

- Materials used to construct temporary concrete washout areas shall be removed from the site of the work and disposed of or recycled.
- Holes, depressions or other ground disturbance caused by the removal of the concrete washout areas shall be backfilled, repaired, and stabilized to prevent erosion.

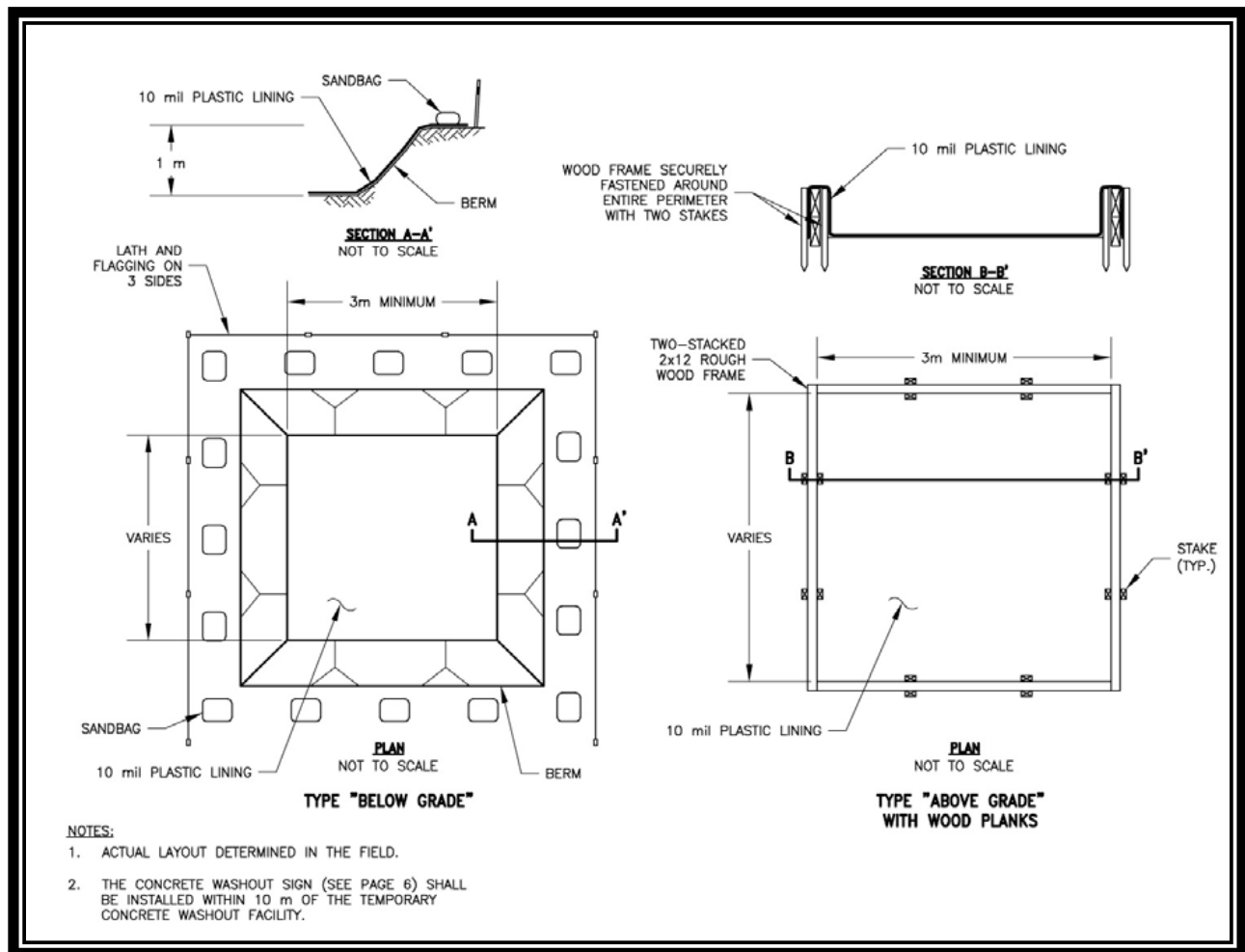


Figure II - 3.4 Concrete Washout Area with Wood Planks

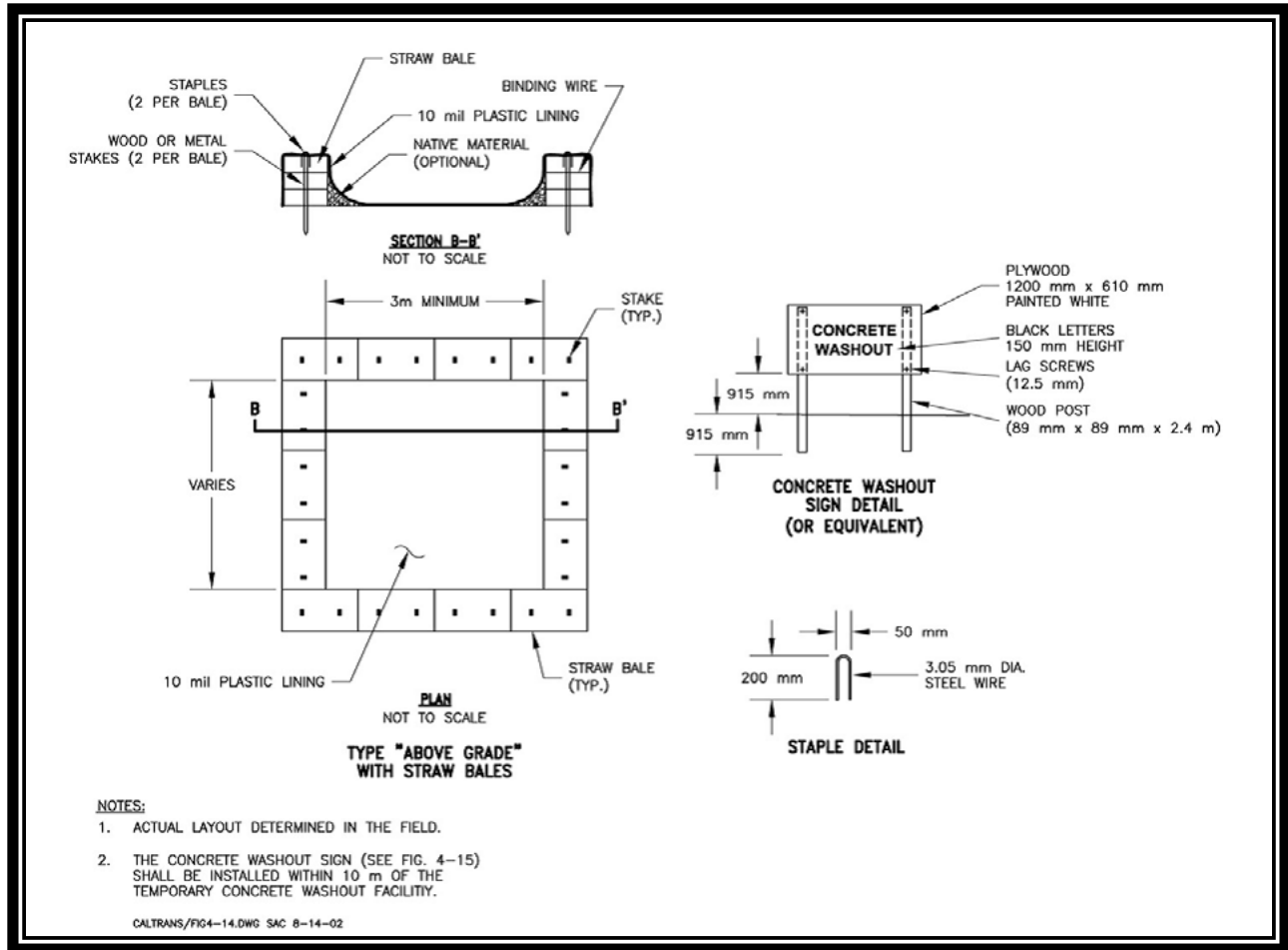


Figure II - 3.5 Concrete Washout Area with Straw Bales

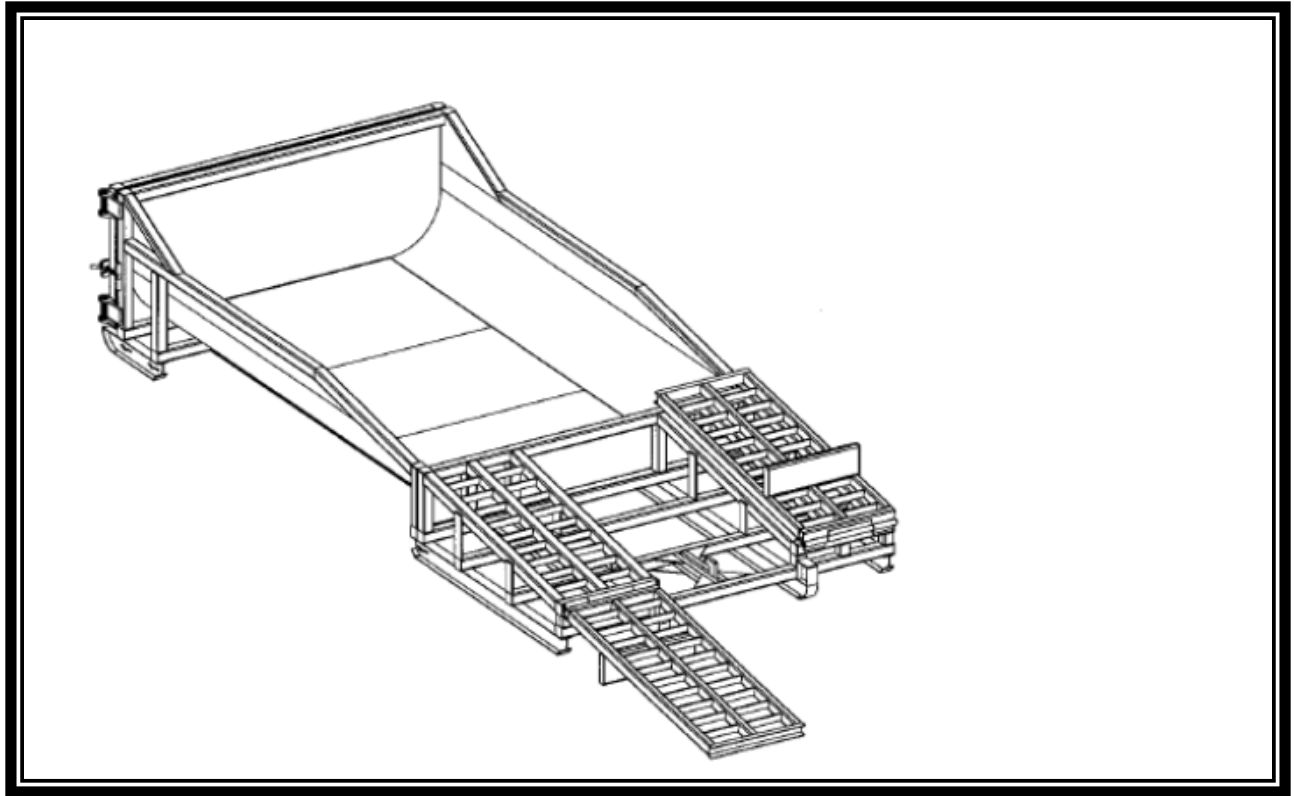


Figure II - 3.6 Prefabricated Concrete Washout Container w/Ramp

BMP C160: Certified Erosion and Sediment Control Lead

Purpose

To ensure compliance with all local, state, and federal erosion and sediment control and water quality requirements by designating at least one person as the responsible representative in charge of erosion and sediment control (ESC), and water quality protection. The designated person shall be the Certified Erosion and Sediment Control Lead (CESCL).

Conditions of Use

A CESCL shall be made available on projects disturbing ground 1 acre or larger and that discharge stormwater to surface waters of the state. Sites less than one acre may have a person without CESCL certification conduct inspections; sampling is not required on sites that disturb less than an acre.

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology (see Ecology's 2012 Stormwater Management Manual for Western Washington for details).

Ecology will maintain a list of ESC training and certification providers at:
<https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Certified-erosion-sediment-control>

OR

- Be a Certified Professional in Erosion and Sediment Control (CPESC); for additional information go to: <http://www.envirocertintl.org/cpesc/>

Specifications

- CESCL certification shall remain valid for 3 years.
- The CESCL shall have authority to act on behalf of the contractor or project proponent and shall be available, or on call, 24 hours per day throughout the period of construction.
- The Construction SWPPP shall include the name, telephone number, fax number, and address of the designated CESCL.
- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region but must be on site whenever earthwork activities are occurring that could generate release of turbid water.

- Duties and responsibilities of the CESCL shall include, but are not limited to the following:
 - Maintaining permit file on site at all times which includes the Construction SWPPP and any associated permits and plans.
 - Directing BMP installation, inspection, maintenance, modification, and removal.
 - Updating all project drawings and the Construction SWPPP with changes made.
 - Completing any sampling requirements including reporting results using electronic Discharge Monitoring Reports (WebDMR). Keeping daily logs, and inspection reports. Inspection reports shall include:
 - Inspection date/time.
 - Weather information; general conditions during inspection and approximate amount of precipitation since the last inspection.
 - A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:
 1. Locations of BMPs inspected
 2. Locations of BMPs that need maintenance
 3. Locations of BMPs that failed to operate as designed or intended
 4. Locations of where additional or different BMPs are required.
- Visual monitoring results, including a description of discharged stormwater. The presence of suspended sediment, turbid water, discoloration, and oil sheen shall be noted, as applicable.
- Any water quality monitoring performed during inspection.
- General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.
- Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.

BMP C162: Scheduling

Purpose

To reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking by sequencing a construction project.

Conditions of Use

The construction sequence schedule is an orderly listing of all major land-disturbing activities together with the necessary erosion and sedimentation control measures planned for the project. This type of schedule guides the contractor on work to be done before other work is started so that serious erosion and sedimentation problems can be avoided.

Following a specified work schedule that coordinates the timing of land-disturbing activities and the installation of control measures is perhaps the most cost-effective way of controlling erosion during construction. The removal of surface ground cover leaves a site vulnerable to accelerated erosion. Construction procedures that limit land clearing, provide timely installation of erosion and sedimentation controls, and restore protective cover quickly can significantly reduce the erosion potential of a site.

Design Considerations

- Avoid construction during rainy periods.
- Schedule projects to disturb only small portions of the site at any one time.
- Complete grading as soon as possible.
- Immediately stabilize the disturbed portion before grading the next portion.
- Practice staged seeding in order to revegetate cut and fill slopes as the work progresses.

3.2 Runoff Conveyance and Treatment BMPs

This section contains the standards and specifications for Runoff Conveyance and Treatment BMPs. Table II - 3.11, below, shows the relationship of the BMPs in Section 3.2 to the Construction Stormwater Pollution Prevention Plan (SWPPP) Elements described in Section 2.3.3.

Table II - 3.11 Runoff Conveyance and Treatment BMPs by SWPPP Element

BMP or Element Name	Element #3 Control Flow Rates	Element #4 Install Sediment Controls	Element #6 Protect Slopes	Element #7 Protect Drain Inlets	Element #8 Stabilize Channels and Outlets	Element #9 Control Pollutants	Element #10 Control De- Watering	Element #13 Protect LID BMPs
BMP C200: Interceptor Dike and Swale			✓					✓
BMP C201: Grass-Lined Channels			✓					✓
BMP C202: Riprap Channel Lining					✓			
BMP C203: Water Bars	✓		✓				✓	
BMP C204: Pipe Slope Drains			✓					
BMP C205: Subsurface Drains			✓					
BMP C206: Level Spreader			✓				✓	
BMP C207: Check Dams	✓		✓		✓			✓
BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)			✓					✓
BMP C209: Outlet Protection	✓				✓			
BMP C220: Storm Drain Inlet Protection				✓				
BMP C231: Brush Barrier		✓						✓
BMP C232: Gravel Filter Berm		✓						
BMP C233: Silt Fence		✓						✓
BMP C234: Vegetated Strip		✓						✓
BMP C235: Wattles	✓	✓						
BMP C236: Vegetative Filtration							✓	
BMP C240: Sediment Trap	✓	✓						
BMP C241: Temporary Sediment Pond	✓	✓						
BMP C250: Construction Stormwater Chemical Treatment		✓				✓		
BMP C251: Construction Stormwater Filtration		✓				✓		
BMP C252: Treating and Disposing of High pH Water						✓		

BMP C207: Check Dams



Purpose

Construction of check dams across a swale or ditch are used to reduce the velocity of concentrated flow and dissipate energy at the check dam.

Conditions of Use

- Use check dams where temporary channels or permanent channels are not yet vegetated, channel lining is infeasible, and velocity checks are required.
- Check dams may not be placed in streams unless approved by the State Department of Fish and Wildlife. Check dams may not be placed in wetlands without approval from Thurston County and/or another applicable permitting agency.
- Do not place check dams below the expected backwater from any salmonid bearing water between October 1 and May 31 to ensure that there is no loss of high flow refuge habitat for overwintering juvenile salmonids and emergent salmonid fry.

Design and Installation Specifications

- Whatever material is used, the dam should form a triangle when viewed from the side. This prevents undercutting as water flows over the face of the dam rather than falling directly onto the ditch bottom.

- Before installing check dams impound and bypass upstream water flow away from the work area. Options for bypassing include pumps, siphons, or temporary channels.
- Check dams in association with sumps work more effectively at slowing flow and retaining sediment than just a check dam alone. Provide a deep sump immediately upstream of the check dam.
- In some cases, if carefully located and designed, check dams can remain as permanent installations with very minor regrading. They may be left as either spillways, in which case accumulated sediment would be graded and seeded, or as check dams to prevent further sediment from leaving the site.
- Construct rock check dams with appropriately sized rock. Place the rock by hand or by mechanical means (no dumping of rock to form dam) to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges. The rock used must be large enough to stay in place given the expected design flow through the channel.
- Check dams may also be constructed of either rock or pea-gravel filled bags. Numerous new products are also available for this purpose. They tend to be re-usable, quick and easy to install, effective, and cost efficient.
- Place check dams perpendicular to the flow of water.
- The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.
- Keep the maximum height at 2 feet at the center of the dam.
- Keep the center of the check dam at least 12 inches lower than the outer edges at natural ground elevation.
- Keep the side slopes of the check dam at 2:1 or flatter.
- Key the stone into the ditch banks and extend it beyond the abutments a minimum of 18 inches to avoid washouts from overflow around the dam.
- Use filter fabric foundation under a rock or sandbag check dam. If a blanket ditch liner is used, this is not necessary. A piece of organic or synthetic blanket cut to fit will also work for this purpose.
- In the case of grass-lined ditches and swales, all check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale – unless the slope of the swale is

greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

- Ensure that channel appurtenances, such as culvert entrances below check dams, are not subject to damage or blockage from displaced stones. Figure II - 3.13 depicts a typical rock check dam.

Maintenance Standards

- Check dams shall be monitored for performance and sediment accumulation during and after each runoff producing rainfall. Sediment shall be removed when it reaches one half the sump depth.
- Anticipate submergence and deposition above the check dam and erosion from high flows around the edges of the dam.
- If significant erosion occurs between dams, install a protective riprap liner in that portion of the channel.

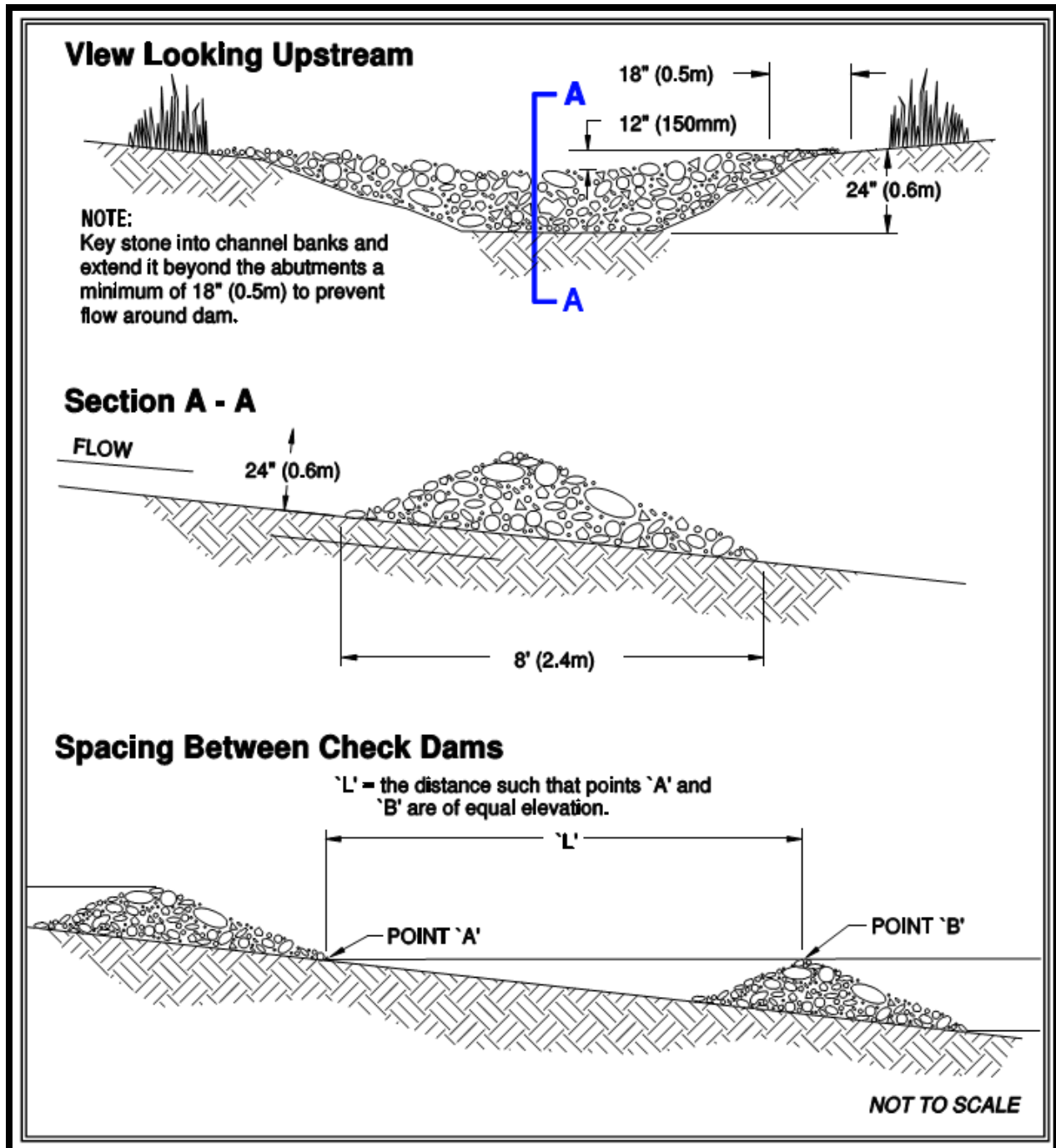


Figure II - 3.13 Check Dams

BMP C220: Storm Drain Inlet Protection***Purpose***

Inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of a disturbed area.

Conditions of Use

Use this BMP where storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless the runoff that enters the catch basin will be conveyed to a sediment trapping BMP. Inlet protection may be used anywhere to protect the drainage system. It is likely that the drainage system will still require cleaning.

Also consider inlet protection for lawn and yard drains on new home construction. These small and numerous drains coupled with lack of gutters in new home construction can add significant amounts of sediment into the roof drain system. If possible delay installing lawn and yard drains until just before landscaping or cap these drains to prevent sediment from entering the system until completion of landscaping. Provide 18-inches of sod around each finished lawn and yard drain.

Table II - 3.14 lists several options for inlet protection. All of the methods for storm drain inlet protection are prone to plugging and require a high frequency of maintenance. Limit contributing drainage areas for an individual inlet to 1 acre or less. If possible, provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

For projects where the final lift of asphalt or concrete will not be completed for a period of time, an asphalt taper shall be constructed around the storm drain inlet frame. Where

weepholes are required, the pipe shall be placed in the center of the catch basin filter and extended beyond the taper.

Table II - 3.14 Storm Drain Inlet Protection

Type of Inlet Protection	Emergency Overflow	Applicable for Paved/Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding will occur	Earthen	Applicable for heavy flows. Easy to maintain. Large Area Requirement: 30' X 30'/acre.
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No		Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with a wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Block and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap			18 month expected life.

Design and Installation Specifications

Excavated Drop Inlet Protection – An excavated impoundment around the storm drain inlet. Sediment settles out of the stormwater prior to entering the storm drain. Design and installation specifications for excavated drop inlet protection include:

- Provide a depth 1 to 2 feet as measured from the crest of the inlet structure.
- Slope sides of excavation no steeper than 2H:1V.
- Minimum volume of excavation 35 cubic yards.
- Shape the excavation to fit site, with longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water problems.
- Clear the area of all debris.
- Grade the approach to the inlet uniformly.

- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- It may be necessary to build a temporary dike to the down slope side of the structure to prevent bypass flow.

Block and Gravel Filter – A barrier formed around the storm drain inlet with standard concrete blocks and gravel. See Figure II - 3.14. Design and installation specifications for block gravel filters include:

- Provide a height of 1 to 2 feet above inlet.
- Recess the first row of blocks 2-inches into the ground for stability.
- Support subsequent courses by placing a 2x4 through the block opening.
- Do not use mortar
- Lay some blocks in the bottom row on their side for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel just below the top of blocks on slopes of 2H:1V or flatter.
- An alternative design is a gravel berm surrounding the inlet, as follows:
 - Provide a slope of 3H:1V on the upstream side of the berm.
 - Provide a slope of 2H:1V on the downstream side of the berm.
 - Provide a 1-foot wide level stone area between the gravel berm and the inlet.
 - Use stones 3 inches in diameter or larger on the upstream slope of the berm.
 - Use gravel ½ - to ¾-inch at a minimum thickness of 1-foot on the downstream slope of the berm.

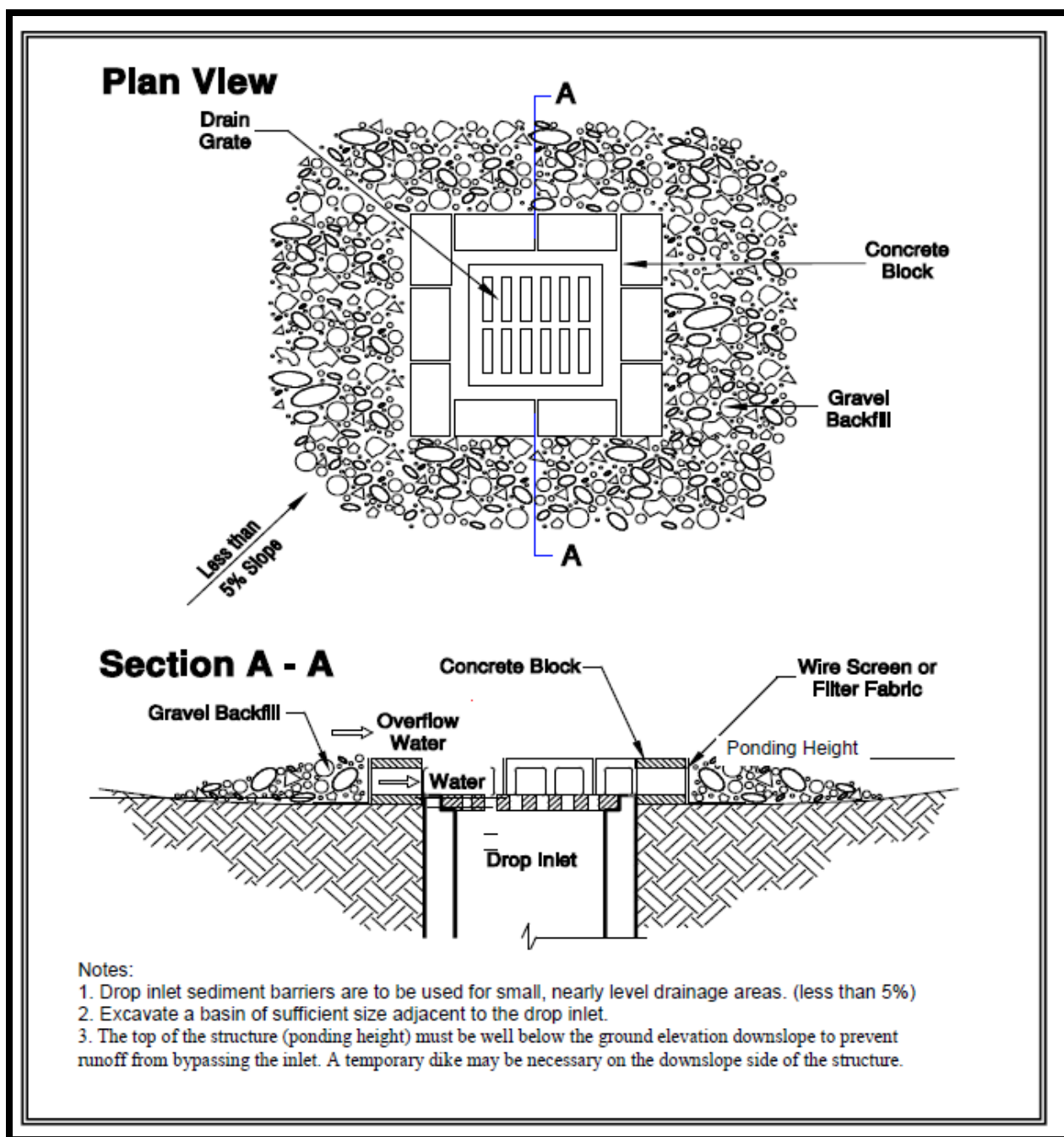


Figure II - 3.14 Block and Gravel Filter

Gravel and Wire Mesh Filter- A gravel barrier placed over the top of the inlet. This method does not provide an overflow. Design and installation specifications for gravel and wire mesh filters include:

- Use a hardware cloth or comparable wire mesh with ½-inch openings.
 - Place wire mesh over the drop inlet so that the wire extends a minimum of 1-foot beyond each side of the inlet structure.

- Overlap the strips if more than one strip of mesh is necessary.
- Place coarse aggregate over the wire mesh.
 - Provide at least a 12-inch depth of coarse aggregate over the entire inlet opening and extend at least 18-inches on all sides.

Catch Basin Filters – Use inserts designed by manufacturers for construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. To reduce maintenance requirements, combine a catch basin filter with another type of inlet protection. This type of inlet protection provides flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way. Design and installation specifications for catch basin filters include:

- Provides 5 cubic feet of storage.
- Requires dewatering provisions.
- Provides a high-flow bypass that will not clog under normal use at a construction site.
- Insert the catch basin filter in the catch basin just below the grating.

Curb Inlet Protection with Wooden Weir – Barrier formed around a curb inlet with a wooden frame and gravel. Design and installation specifications for curb inlet protection with wooden weirs include:

- Use wire mesh with 1/2-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against wire/fabric.
- Place weight on frame anchors.
- See Figure II - 3.15

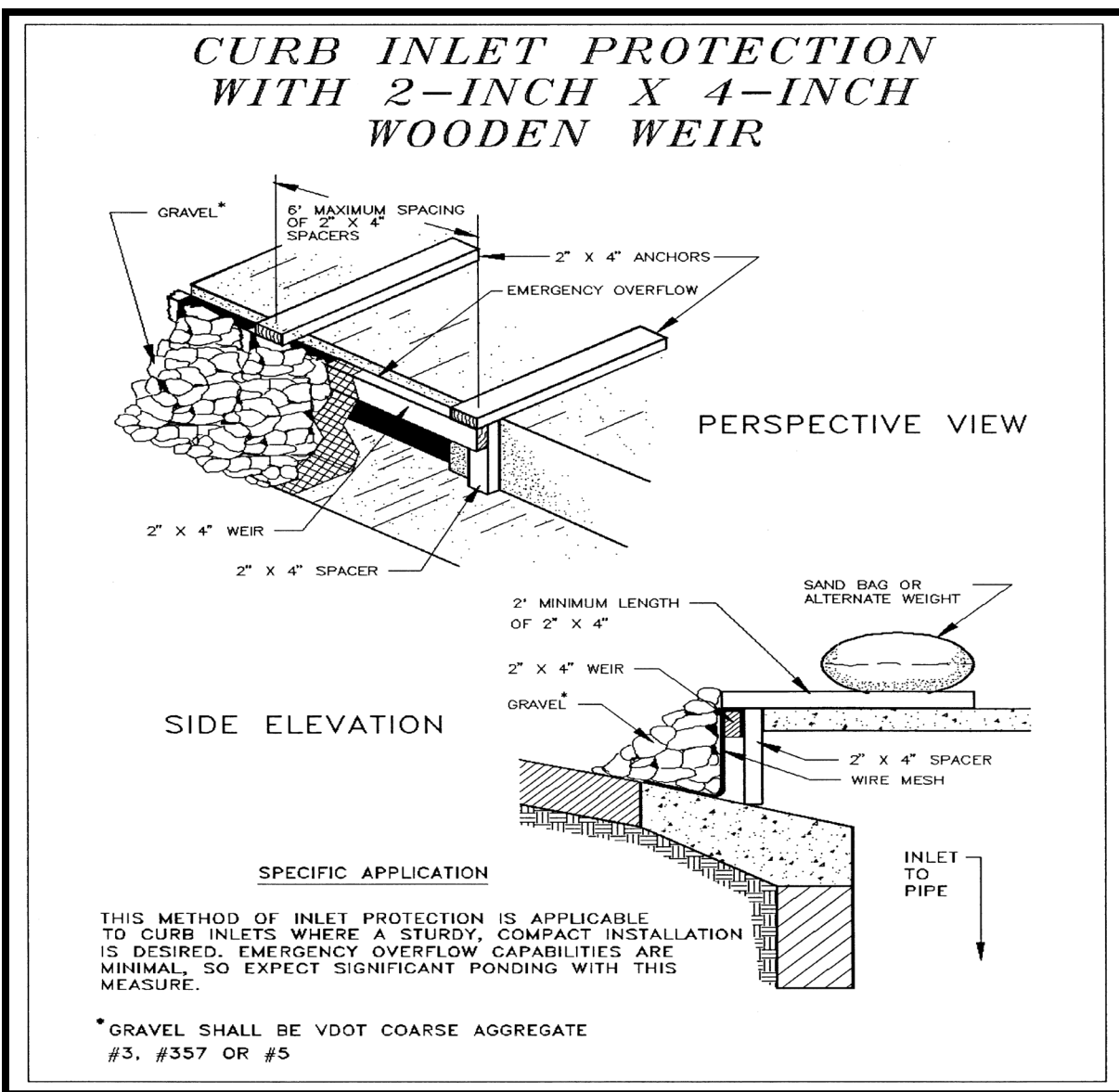


Figure II - 3.15 Curb Inlet with Wooden Weir

(Figure courtesy of Maryland Standards and Specifications for Soil Erosion and Sediment Control)

Block and Gravel Curb Inlet Protection – Barrier formed around a curb inlet with concrete blocks and gravel. See Figure II - 3.16. Design and installation specifications for block and gravel curb inlet protection include:

- Use wire mesh with ½-inch openings.
- Place two concrete blocks on their sides abutting the curb at either side of the inlet opening. These are spacer blocks.
- Place a 2x4 stud through the outer holes of each spacer block to align the front blocks.

- Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
- Place wire mesh over the outside vertical face.
- Pile coarse aggregate against the wire to the top of the barrier.

Curb and Gutter Sediment Barrier – Sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure II - 3.17. Design and installation specifications for curb and gutter sediment barrier include:

- Construct a horseshoe shaped berm, faced with coarse aggregate if using riprap, 3 feet high and 3 feet wide, at least 2 feet from the inlet.
- Construct a horseshoe shaped sedimentation trap on the upstream side of the berm. Size the sediment trap to sediment trap standards for protecting a culvert inlet.

Maintenance Standards

- Inspect all forms of inlet protection frequently, especially after storm events. If the insert becomes clogged, it should be cleaned or replaced.
- For systems using stone filters: If the stone filter becomes clogged with sediment, the stones must be pulled away from the inlet and cleaned or replaced. Since cleaning of gravel at a construction site may be difficult, an alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.
- Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

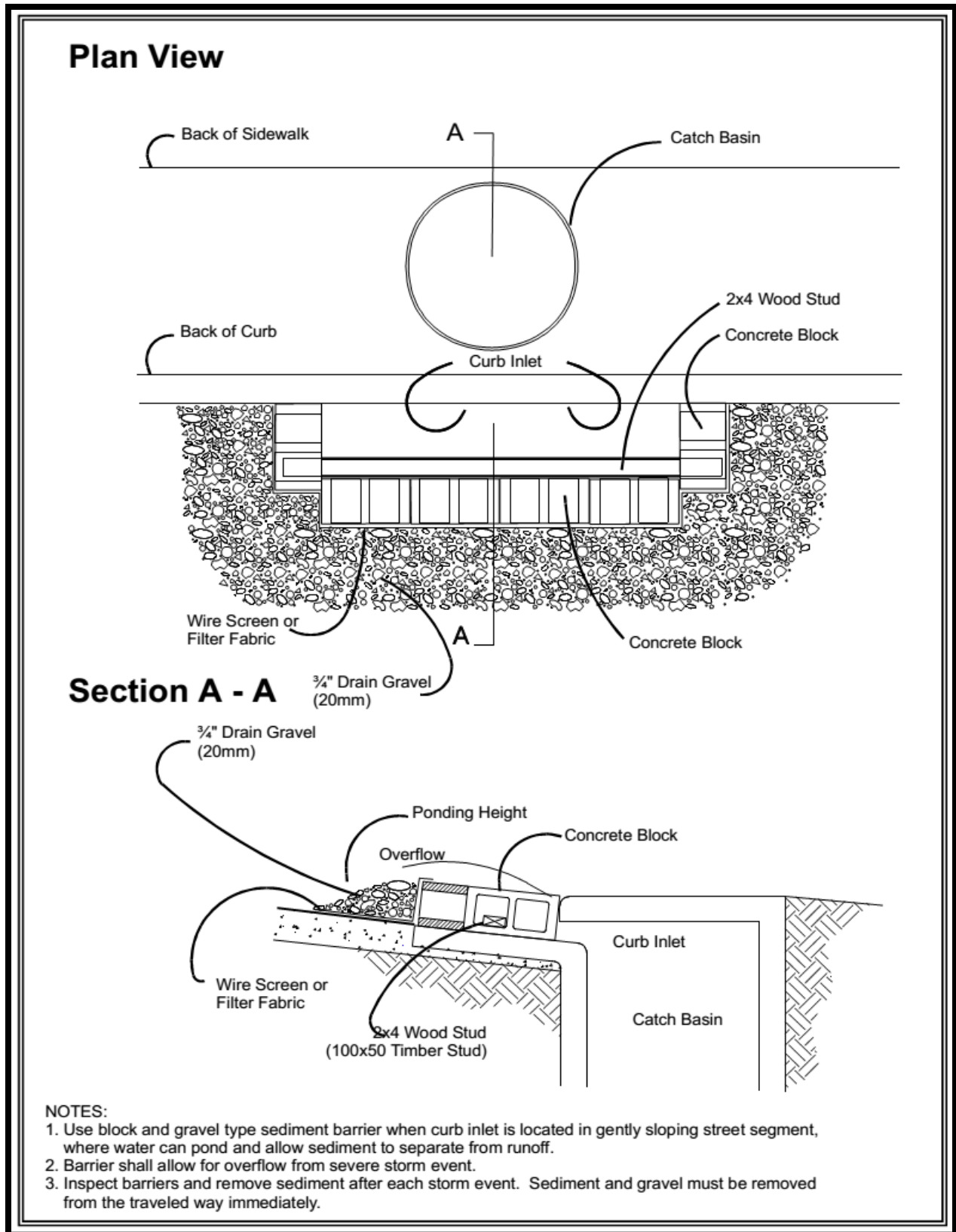


Figure II - 3.16 Block and Gravel Curb Inlet Protection

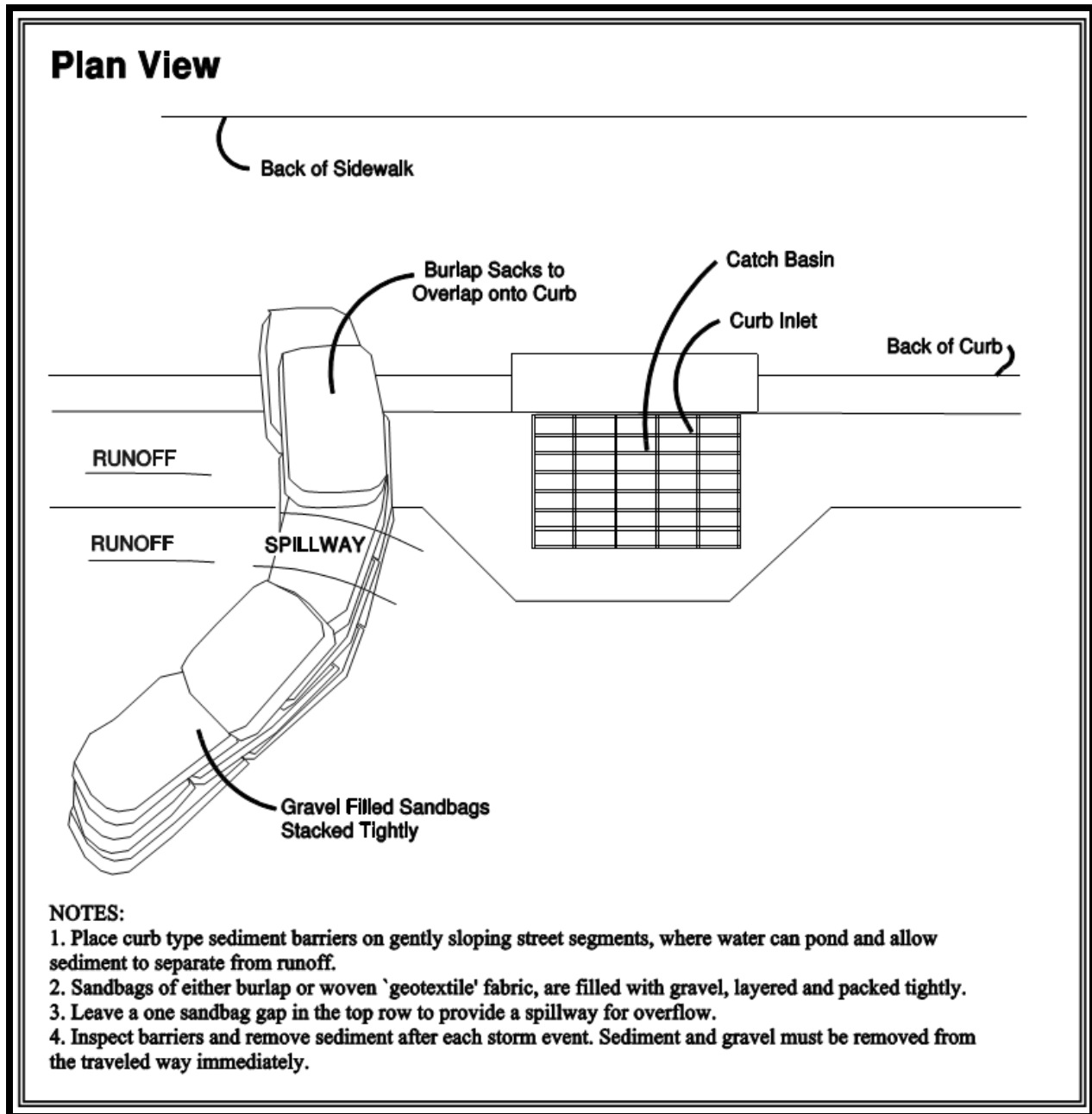


Figure II - 3.17 Curb and Gutter Barrier

BMP C233: Silt Fence

Purpose

To reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow. See Figure II - 3.19 for details on silt fence construction.

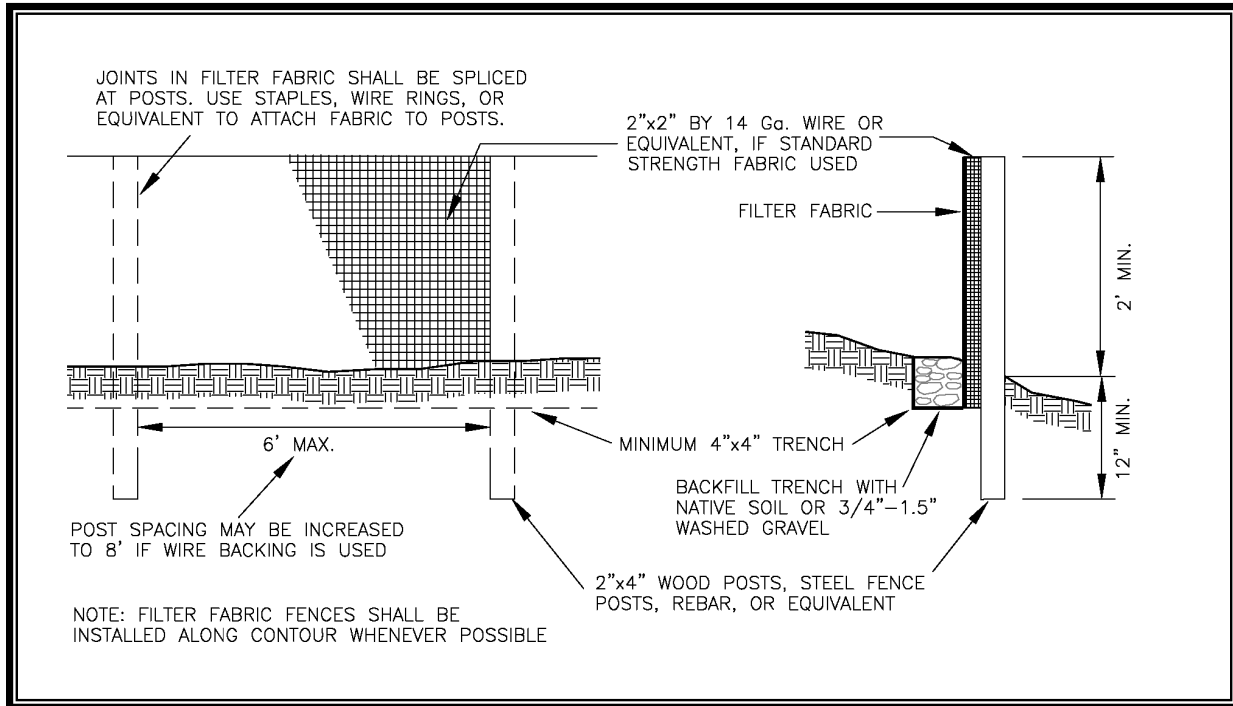


Figure II - 3.19 Silt Fence

Conditions of Use

- Silt fence may be used downslope of all disturbed areas.
- Silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Convey any concentrated flows through the drainage system to a sediment pond.
- Silt fences should not be constructed in streams or use in V-shaped ditches. They are not an adequate method of silt control for anything deeper than sheet or overland flow.

Design and Installation Specifications

- Use in combination with other construction stormwater BMPs.

- Maximum slope steepness (perpendicular to the silt fence line) 1H:1V.
- Maximum sheet or overland flow path length to the silt fence of 100 feet.
- Do not allow flows greater than 0.5 cfs.
- The geotextile used for filter fabric shall meet the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table II - 3.15):

Table II - 3.15 Geotextile Standards

Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film wovens (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec ⁻¹ minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. Minimum for extra strength fabric. 100 lbs minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- Support standard strength fabrics with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the fabric. Silt fence materials are available that have synthetic mesh backing attached.
- Silt fence material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F. to 120°F.
- 100 percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed.
- Include the following Standard Notes for silt fence on construction plans and specifications. Refer to Figure II - 3.19 for standard silt fence details.
 1. The contractor shall install and maintain temporary silt fences at the locations shown in the Plans.
 2. Silt fences shall be constructed in the areas of clearing, grading, or drainage prior to starting those activities.

3. The silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
4. The minimum height of the top of silt fence shall be 2 feet and the maximum height shall be 2-1/2 feet above the original ground surface.
5. The geotextile shall be sewn together at the point of manufacture, or at an approved location as determined by the Engineer, to form geotextile lengths as required. All sewn seams shall be located at a support post. Alternatively, two sections of silt fence can be overlapped, provided the Contractor can demonstrate, to the satisfaction of the Engineer, that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.
6. The geotextile shall be attached on the up-slope side of the posts and support system with staples, wire, or in accordance with the manufacturer's recommendations. The geotextile shall be attached to the posts in a manner that reduces the potential for geotextile tearing at the staples, wire, or other connection device.
7. Silt fence back-up support for the geotextile in the form of a wire or plastic mesh is dependent on the properties of the geotextile selected for use. If wire or plastic back-up mesh is used, the mesh shall be fastened securely to the up-slope side of the posts with the geotextile being up-slope of the mesh back-up support.
8. Mesh support, if used, shall consist of steel wire with a maximum mesh spacing of 2-inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to the same level of ultraviolet radiation as the filter fabric it supports.
9. The geotextile at the bottom of the fence shall be buried in a trench to a minimum depth of 4 inches below the ground surface. The trench shall be backfilled, and the soil tamped in place over the buried portion of the geotextile, such that no flow can pass beneath the fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the trench a minimum of 3 inches.
10. Drive or place the fence posts a minimum of 18 inches into the ground. A minimum depth of 12 inches is allowed if topsoil or other

soft subgrade soil is not present and a minimum depth of 18 inches cannot be reached. Fence post depths shall be increased by 6 inches if the fence is located on slopes of 3H:1V or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.

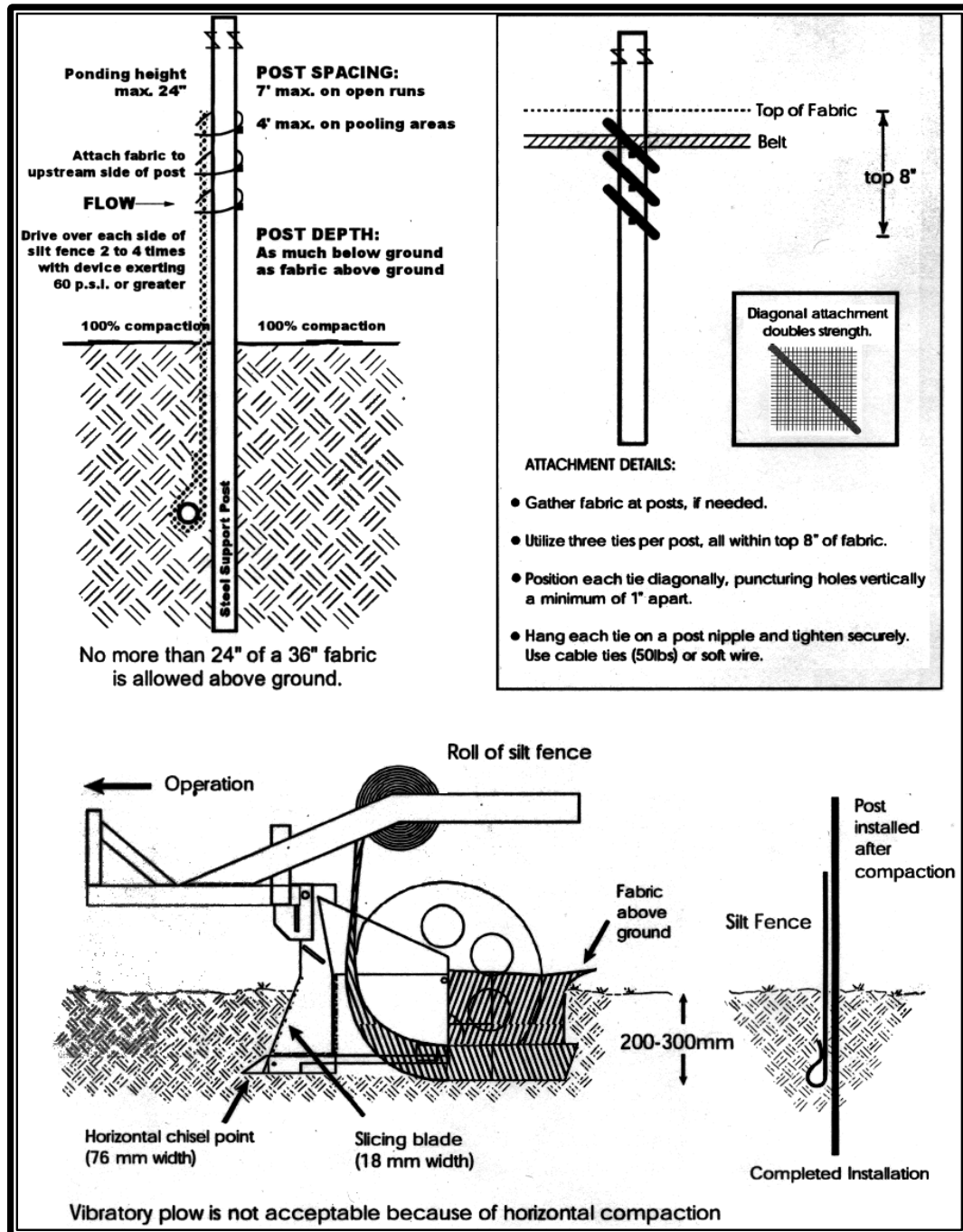
11. Silt fences shall be located on contour as much as possible, except at the ends of the fence, where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.
12. If the fence must cross contours, with the exception of the ends of the fence, check dams placed perpendicular to the back of the fence shall be used to minimize concentrated flow and erosion along the back of the fence. The slope of the fence line where contours must be crossed shall not be steeper than 3:1.
 - The check dams shall be approximately 1 foot deep at the back of the fence. It shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence.
 - The check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. The gravel check dams shall be located every 10 feet along the fence where the fence must cross contours.
13. Wood, steel or equivalent posts shall be used. The spacing of the support posts shall be a maximum of 6-feet. Posts shall consist of either:
 - Wood posts with minimum dimensions of 2 inches by 2 inches and 3 feet minimum length. Wood posts shall be free of defects such as knots, splits, or gouges.
 - No. 6 rebar or larger.
 - ASTM A 120 steel pipe with a minimum diameter of 1 inch.
 - U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft.
 - Other steel posts having equivalent strength and bending resistance to the post sizes listed above.

- Silt fence installation using the slicing method specification details follow. Refer to Figure II – 3.20 for slicing method details.
 1. The base of both end posts must be at least 2 to 4 inches above the top of the silt fence fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.
 2. Install posts 3 to 4 feet apart in critical retention areas and 6 to 7 feet apart in standard applications.
 3. Install posts 24 inches deep on the downstream side of the silt fence, and as close as possible to the fabric, enabling posts to support the fabric from upstream water pressure.
 4. Install posts with the nipples facing away from the silt fence fabric.
 5. Attach the filter fabric to each post with three ties, all spaced within the top 8 inches of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1 inch vertically apart. In addition, position each tie to hang on a post nipple when tightening to prevent sagging.
 6. Wrap approximately 6 inches of fabric around the end posts and secure with three ties.
 7. No more than 24 inches of a 36-inch fabric is allowed above ground level.
 8. Compact the soil immediately next to the silt fence fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips. The installation should be checked and corrected for any deviation before compaction. Use a flat-bladed shovel to tuck fabric deeper into the ground if necessary.

Maintenance Standards

- Any damage shall be repaired immediately.
- If concentrated flows are evident uphill of the fence, they must be intercepted and conveyed to a sediment trapping BMP.
- It is important to check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence and remove the trapped sediment.

- Sediment deposits shall either be removed when the deposit reaches approximately one-third the height of the silt fence, or a second silt fence shall be installed.
- If the filter fabric (geotextile) has deteriorated due to ultraviolet breakdown, it shall be replaced.



BMP C235: Wattles



Purpose

To reduce the velocity and spread the flow of rill and sheet runoff, and to capture and retain sediment.

Wattles are temporary erosion and sediment control barriers consisting of straw, compost, or other material that is wrapped in netting made of natural plant fiber or similar encasing material.

Conditions of Use

- Wattles shall consist of cylinders of plant material such as weed-free straw, coir, wood chips, excelsior, or wood fiber or shavings encased with netting made of natural plant fibers unaltered by synthetic materials.
- Use Wattles:
 1. In disturbed areas that require immediate erosion protection.
 2. On exposed soils during the period of short construction delays, or over winter months.
 3. On slopes requiring stabilization until permanent vegetation can be established.
- The material used dictates the effectiveness period of the wattle. Wattles are typically effective for one to two wet seasons.

- If conditions are appropriate, wattles can be staked to the ground using willow cuttings for added revegetation.
- Prevent rilling beneath wattles by properly entrenching and abutting wattles together to prevent water from passing between them.

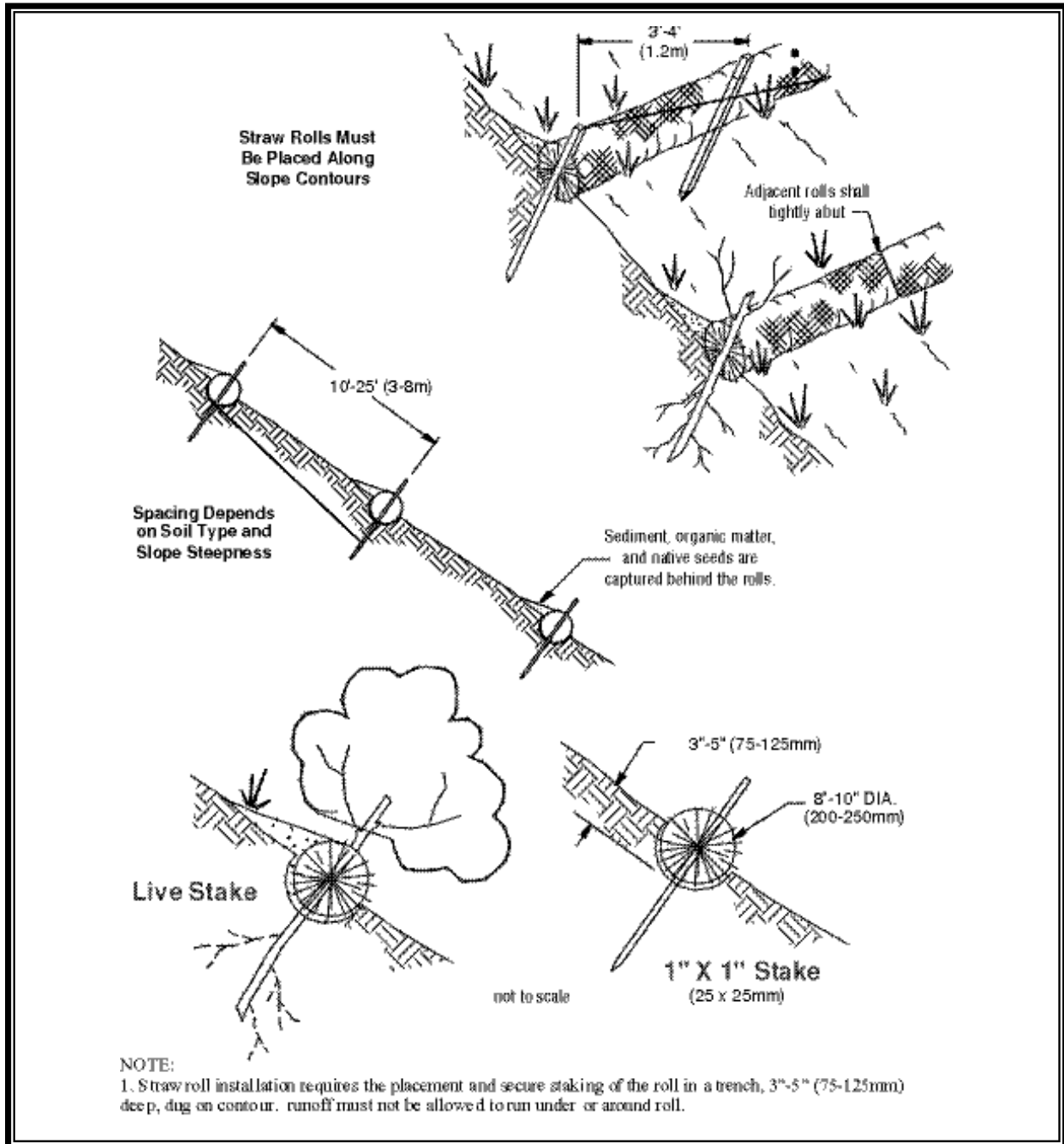


Figure II - 3.21 Straw Wattles

Design Criteria

- See Figure II - 3.23 for typical construction details. WSDOT Standard Plan I-30.30-00 also provides information on Wattles (<http://www.wsdot.wa.gov/Design/Standards/Plans.htm#SectionI>)
- Wattles are typically 8 to 10 inches in diameter and 25 to 30 feet in length.
- Install wattles perpendicular to the flow direction and parallel to the slope contour.
- Place wattles in narrow trenches, staked along the contour of disturbed or newly constructed slopes (on contour) to a depth of 3 to 5 inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, the trenches should be dug to a depth of 5 to 7 inches, or 1/2 to 2/3 of the thickness of the wattle.
- Start building trenches and installing wattles from the base of the slope and work up. Spread excavated material evenly along the uphill slope and compact using hand tamping or other methods.
- Construct trenches at intervals of 10 to 25-feet depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the trenches need to be. See Table II – 3.17 for spacing information.
- Install the wattles snugly into the trenches and abut tightly end to end. Do not overlap the ends.
- Install stakes at each end of the wattle, and at 4-foot centers along entire length of wattle.
- If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.
- Wooden stakes shall be approximately 3/4 x 3/4 x 24 inches. Willow cuttings or 3/8-inch rebar can also be used for stakes.
- Stakes should be driven through the middle of the wattle, leaving 2 to 3-inches of the stake protruding above the wattle.

Table II – 3.17 Wattle Spacing Table

8" Diameter Wattle Spacing Table	
Slope	Maximum Spacing
1H:1V	10'-0"
2H:1V	20'-0"
3H:1V	30'-0"
4H:1V	40'-0"

Maintenance Standards

- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall on steep sandy soils.
- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted, or water has scoured beneath the wattles.

APPENDIX 5

SOURCE CONTROL PLAN

After recording return to:
Thurston County Public Works
Stormwater Utility
9605 Tilley Rd S, Ste C
Olympia, WA 98512

THURSTON COUNTY, WASHINGTON COMMERCIAL STORMWATER POLLUTION PREVENTION SOURCE
CONTROL PLAN FOR:

GRANTOR: RJ DEVELOPMENT

GRANTEE: RJ DEVELOPMENT

LEGAL DESCRIPTION (abbreviated form, i.e., lot, block, plat or section, township, range, quarter/quarter):

PARCEL A OF BOUNDARY LINE ADJUSTMENT NO. BLA-11105686 TC,

AS RECORDED JUNE 30, 2011 UNDER AUDITOR'S FILE NO. 4217456.

ASSESSOR'S PARCEL NUMBER(S): 09750029001

ORGANIZATION: _____

ADDRESS: 2000 24th Ave NW, Olympia WA, 98502

DATE PREPARED/UPDATED: 04/01/2023

RESPONSIBLE PERSON: Caleb Perkins

PHONE/E-MAIL: caleb@rjdevelopment.com

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ATTACHMENT C – SPILL CONTROL PLAN

ATTACHMENT D – INTEGRATED PEST MANAGEMENT PLAN

ATTACHMENT E – ANNUAL REPORT CHECKLIST

ATTACHMENT F – QUICK REFERENCE PHONE NUMBERS AND WEB SITES

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1.0 Introduction

1.1 OBJECTIVES OF THIS PLAN

1. To implement and maintain best management practices (BMPs) that identify, reduce, eliminate and/or prevent the discharge of stormwater pollutants.
2. To prevent violations of surface water quality, groundwater quality, and sediment management standards.
3. To eliminate the discharges of un-permitted process wastewater, domestic wastewater, non-contact cooling water and other illicit discharges to stormwater drainage systems.

1.2 INSTRUCTIONS FOR PREPARING PLAN

To customize this plan for your property/business do the following:

1. **Complete the cover page** with information on your information.
2. **Complete the worksheet included in Attachment A** by selecting those activities that apply to your property/business.
3. **Copy and include in Attachment B the applicable activity sheets** based on the activities selected in step 2. Copy the applicable pages of Chapter 4, Volume IV of the *Thurston County Drainage Design and Erosion Control Manual* that address the activities selected in step 2.
4. **Complete Table 2 (Operational Source Control Practices Summary) in Section 4.0** referencing the applicable activity sheets from step 3. Indicate for each activity the required and recommended operational BMPs applicable to your business.
5. **If an Emergency Spill Control Plan (SPC) is required, include it as Attachment C.** This may be required for some business types. Prepare the plan using the appropriate guidance for your business practices (i.e. fueling, chemical handling, etc.).
6. **If an Integrated Pest Management Plan (IPM) is required, include it as Attachment D.** If one of your required BMPs is the use of an Integrated Pest Management Plan, prepare the plan using the appropriate guidance and include it as Attachment D.
7. **Customize the Annual Report checklist included in Attachment E.** This checklist needs to be completed and submitted with the Annual Report required as part of your Stormwater Agreement with Thurston County. If your business/property is not subject to a Stormwater Agreement, this checklist can be used internally to perform routine audits of your source control program.

1.3 ABOUT THIS PLAN

All commercial and industrial properties and activities, including multi-family residential complexes (i.e. apartments, condominiums), non-residential special uses, and government facilities in unincorporated Thurston County that have the potential to contribute pollutants to stormwater runoff or directly to receiving waters are required to implement stormwater pollution prevention source control measures. Stormwater runoff may seep into the ground, drain to a storm drain or a drainage ditch, or flow over the ground. Regardless of the way runoff leaves your site, it ends up in a stream river, lake, wetland, groundwater or Puget Sound.

All known, available and reasonable source control BMPs shall be applied. Source control BMPs shall be selected, designed, and maintained in accordance with Volume IV of the *Thurston County Drainage Design and Erosion Control Manual*.

Many people believe that stormwater runoff is “clean” and does not harm water quality. This perception is understandable since the amount of pollution from any one place is not usually significant by itself. But when all these small amounts are combined, they can cause significant pollution problems. Contaminated stormwater can negatively affect every water body it enters. Therefore, this plan provides detailed information to reduce the contamination of surface water, groundwater, and stormwater from the property and/or business.

The federal Clean Water Act mandates that cities and counties control the quality of stormwater runoff. One way to achieve this is to implement pollution prevention measures on individual properties. By following the “Best Management Practices” for your business as described in this plan you can do your part to protect our streams, groundwater, and Puget Sound.

1.4 BEST MANAGEMENT PRACTICES ... WHAT ARE THEY?

Best Management Practices (BMPs) are a set of activities designed to reduce stormwater pollution. BMPs are separated into two broad categories: *source control* and *treatment*. Applicable BMPs for your business can be selected from the most recent published edition of the *Thurston County Drainage Design and Erosion Control Manual*, Volume IV, “Source Control.”

1.4.1 Source Control BMPs

Source control BMPs prevent contaminants from entering stormwater by controlling them at the source.

Source control BMPs prevent contaminants from entering stormwater runoff by controlling them at the source. Some source control BMPs are operational, such as checking regularly for leaks and drips from equipment and vehicles, covering materials that have potential to add pollutants to surface water if rainwater comes in contact with the materials, and minimizing use of pesticides, fertilizers, and insecticides. Other source control BMPs require use of a structure to prevent rainwater from contacting materials that will contaminate stormwater runoff such as providing a covered area or berm to prevent clean stormwater from entering work or storage areas.

1.4.2 Treatment BMPs

In contrast, **treatments BMPs** are structures that treat stormwater to remove contaminants. Treatment BMPs typically require planning, design and construction. A stormwater treatment pond is an example of a *treatment BMP*. No treatment BMP is capable of removing 100 percent of the contaminants in stormwater and the less contaminants in the stormwater the more effective the treatment BMP is.

Just because there is a stormwater collection system serving your property, it does not necessarily mean that the stormwater is treated. Many sites were developed prior to requirements to treat stormwater. Runoff from your property may go directly or indirectly to a stream or wetland without any treatment.

Keep in mind that runoff from your property may go directly or indirectly to a stream or wetland without any treatment.

This plan focuses on *source control* BMPs applicable to the routine practices of your business.

1.5 WHAT'S IN THIS PLAN?

This plan should be customized for your business. If you are trying to get a building permit you may be required to submit a copy of this plan, or its equivalent as part of your permit application and then record it with the Thurston County Auditor's office prior to receiving final approval of your project.

The plan is divided into sections as follows:

- **Introduction**
- **General Principles of Pollution Prevention**
- **Operational BMPs Applicable to All Facilities**
- **Site/Business Specific BMPs**
- **Attachments**
 - **A – Commercial and Industrial Activities Worksheet**
 - **B – Applicable Facility Activity Sheets**
 - **C – Spill Control Plan (If applicable)**
 - **D – Integrated Pest Management Plan (If applicable)**
 - **E – Annual Report Checklist**
 - **F – Quick Reference Phone Numbers and Web Sites**

2.0 General Principles of Pollution Prevention

There are 15 general principles of pollution prevention that every business owner should consider:

This section describes the 15 general principles of pollution prevention that every business owner should consider. Most of these are common sense, “housekeeping” types of solutions.

1. Avoid the activity or reduce its occurrence

Avoid potentially polluting activity or do it less frequently. Apply lawn care chemicals following directions and only as needed. Do not apply herbicides right before it rains.

2. Move the activity indoors

Move a potentially polluting activity indoors out of the weather. This prevents runoff contamination and provides more control for a cleanup if a spill occurs.

3. Cleanup spills quickly

Promptly contain and cleanup solid and liquid pollutant leaks and spills on exposed soil, vegetation, or paved areas. Use readily available absorbents such as kitty litter to absorb spills and then sweep up the material and dispose of it properly. Repair leaks on vehicles and equipment.

4. Use less material

Don’t buy or use more material than you really need. This not only helps keep potential disposal, storage and pollution problems to a minimum, but will probably save you money.

5. Use the least toxic materials available

Investigate the use of materials that are less toxic. For example, replace a caustic-type detergent or solvent with a more environmentally friendly product. If you do switch to a biodegradable product, remember that only uncontaminated water is allowed to enter the stormwater drainage system.

Only uncontaminated water is allowed to enter the stormwater drainage system.

6. Create and maintain vegetated areas near activity locations

Vegetation can filter pollutants out of stormwater. Route stormwater from parking and work areas through vegetated areas. Remember that wastewater other than stormwater runoff, such as wash water, must be discharged to a wastewater collection system (sewer or septic system).

7. Locate activities as far as possible from surface drainage paths

Locate activities away from storm drains, ditches, streams, and other water bodies to reduce the potential to pollute. It will take longer for material to reach the drainage features providing more time to react to a spill, or “housekeeping” issue and protect local waters long enough to cleanup.

8. Maintain stormwater drainage systems

Pollutants concentrate over time in catch basins, ditches, and storm drains. When a storm event occurs, turbulent runoff can mobilize these pollutants and carry them to receiving waters. Perform regular maintenance on stormwater facilities to prevent this from occurring.

9. Reduce, reuse, and recycle as much as possible

Look for ways to recycle. This saves money and keeps hazardous and non-hazardous materials out of landfills. Contact the Thurston County Solid Waste Division at (360) 357-2491 for more information on recycling opportunities at the Thurston County Waste and Recover Center.

10. Be an advocate for stormwater pollution prevention

Help friends, neighbors, and business associates find ways to reduce stormwater pollution in their activities. Most people want clean water and do not pollute intentionally. Share your ideas and the BMPs in this plan to get them thinking about how their everyday activities affect water quality.

11. Report problems

We all must do our part to protect water, fish, wildlife, and our own health by implementing proper BMPs, and reporting water quality problems that we observe. Call the Thurston County Stormwater Utility at (360) 754-4681 to report dumping to storm drains or ditches.

12. Provide oversight and training

Talk to your employees, or if you are a landlord talk to your tenants, to ensure they understand the pollution prevention source control measures and BMPs described in this plan. If you are a landlord, you are still responsible for the activities of your tenants. Monitor the activities of your tenants to ensure that they are carrying out the principles of this plan.

Do not hose down pollutants from any area to the ground, storm drain, conveyance ditch or any receiving water (stream, wetland, lake, etc.)

13. Dust control

Sweep parking and storage areas regularly to collect and dispose of dust and debris that could contaminate stormwater. Do not hose down pollutants from any area to the ground, storm drain, conveyance ditch or any receiving water (stream, wetland, lake, etc.). Do not use oil or other petroleum products for dust control. Only light watering of dirt or gravel roads or parking areas should be conducted to prevent any runoff of stormwater from the surface.

14. Eliminate illicit connections

Occasionally businesses have internal building drains, sump overflows, sump pumps, outdoor sinks and showers, and even sanitary sewer and septic system pipes that were inadvertently connected to the storm drainage system in the past.

Examine the plumbing system for your business to determine if illicit connections exist. Toilets, sinks, appliances, showers, bathtubs, floor drains, industrial process waters, and other indoor activities found to be connected to the stormwater drainage system must be immediately rerouted to the sanitary sewer or septic system, holding tanks, or process treatment system. For assistance in methods to detect and eliminate illicit connections contact the Thurston County Stormwater Utility at (360) 754-4681.

15. Dispose of waste properly

Every business and residence in Thurston County must dispose of solid and liquid wastes and contaminated stormwater properly. There are generally four options for disposal depending on the type of materials. These options include:

- Sanitary sewer and septic systems.
- Recycling facilities
- Municipal solid waste disposal facilities
- Hazardous waste treatment, storage and disposal facilities.

Do not use oil or other petroleum products for dust control. Only light watering of dirt or gravel roads or parking areas should be conducted to prevent runoff...

3.0 General Source Control BMPs

This section briefly summarizes source control BMPs that are generally applicable to all types of sites. In the next section BMPs specific to your business will be identified. In some cases the Activity Sheet will reference the BMPs in this section. In that case the *Thurston County Drainage Design and Erosion Control Manual*, Volume IV, Chapter 5, should be referenced for more detail on these general source control BMPs.

TABLE 1: GENERAL SOURCE CONTROL BMPs

BMP CATEGORY	DESCRIPTION	√
S.1 Eliminate Illicit Stormwater Drainage System Connections	<ol style="list-style-type: none"> 1. Use building and site plans and examine plumbing systems to determine if illegal connections exist. 2. Consider dye testing to determine where a pipe or structure drains. 3. Consider smoke testing (best done by qualified professional). 4. Contact Thurston County (360) 754-4681 for assistance. 5. Plug, disconnect or reroute to sewer/septic system any drains found connected to the stormwater drainage system. 	✓
S.2 Dispose of Collected Runoff and Waste Materials Properly	<ol style="list-style-type: none"> 1. Discharge liquid wastes and contaminated stormwater to the sanitary sewer – contact LOTT or local sewer provider for restrictions. 2. Use sumps or holding tanks for temporary storage. 3. Consider recycling materials where feasible. 4. Dispose of solid wastes to Thurston County WARC. 5. Dispose of dangerous or hazardous wastes at permitted facility. 6. Contact Thurston County for disposal options (360)754-4581. 	✓
S.3 Connect Process Water Discharges to Sanitary Sewer, Holding Tank, or Water Treatment System	<ol style="list-style-type: none"> 1. Required for all industrial and commercial activities that generate contaminated process wastewater. 2. Discharge to sanitary sewer - contact LOTT or local sewer provider for restrictions. 2. Discharge to sumps or holding tanks for temporary storage – have tanks pumped for proper disposal. 3. Construct wastewater treatment system – contact Ecology for permitting requirements. 4. If activity is conducted outdoors cover the activity and/or construct curbs, dikes or berms to prevent stormwater run-on. 	
S.4 Cover the Activity with a Roof or Awning	<ol style="list-style-type: none"> 1. Construct simple roof or awning to prevent contact with stormwater. 2. Contact Thurston County for information on permits-(360) 786-5490. 3. The area of roof cover should be sufficient to prevent precipitation from reaching the covered materials. 	

BMP CATEGORY	DESCRIPTION	√
S.5 Cover the Activity with an Anchored Tarpaulin or Plastic Sheet	<ol style="list-style-type: none"> 1. Use where raw materials are stockpiled outdoors. 2. Use weights such as bricks, tires, or sandbags to anchor the cover. 3. Use pins or stakes to anchor tarpaulin to the ground. 4. Locate stockpile to provide wind protection (leeward side of buildings, landscaping, etc.) 5. Inspect daily. 	
S.6 Pave the Activity Area and Slope to a Sump or Holding Tank	<ol style="list-style-type: none"> 1. Apply to activities that cannot be covered adequately but that may be susceptible to spills such as chemical storage areas. 2. Enclose area within a dike, curb or berm. 3. Provide a sump or holding tank to contain spills until the liquids can be pumped out and disposed properly. 4. Ensure paving is compatible with stored material, e.g. gasoline can breakdown asphalt – use concrete paving. 	
S.7 Surround the Activity Area with a Curb, Dike, or Berm or elevate the Activity	<ol style="list-style-type: none"> 1. Containment is most applicable to spill control situations. 2. If used to prevent run-on to a covered activity area place the berm underneath the covering so rain water will not pond inside it. 3. Size containment area for 6-month storm unless other containment sizing restrictions apply. 4. Install a valve in storm drainage line from area so that excess clean stormwater can be drained from area. 5. For storage of small items, consider a tub, wading pool, or specially manufactured containment systems. 6. For spill control the volume of the containment should be the greater of either 110% of the volume of the largest tank, or 10% of the volume of all tanks if there are multiple tanks. 	
S.8 Implement Integrated Pest Management Measures	<ol style="list-style-type: none"> 1. IPM may be required by Thurston County Code. 2. Commercial, agricultural, municipal and other large scale pesticide users should adhere to integrated pest management principles. 3. Guidance information is available from Thurston County Environmental Health, the Washington State Department of Agriculture and Washington State University Extension Service. 4. If an IPM plan is required, include as Attachment D. 	✓
S.9 Clean Catch Basins	<ol style="list-style-type: none"> 1. Catch basins should be cleaned regularly. 2. Several companies offer catch basin cleaning services; check the yellow pages under “sewer cleaning equipment and supplies.” A list of local service providers is available at: https://www.thurstoncountywa.gov/sw/Pages/rs-contractor.aspx 3. Do not flush catch basin sumps into the catch basin outlet pipe. 4. Check your stormwater Maintenance Plan for additional information on catch basin cleaning frequency and inspection requirements. 	✓

BMP CATEGORY	DESCRIPTION	√
S.10 Labeling Storm Drain Inlets On Your Property	1. Install storm drain markers at all storm drain inlets. Contact the Thurston County Water Resources Division at (360) 754-4681 for information on how to obtain approved markers. 2. Stencil or apply storm drain markers adjacent to storm drain inlets. Or use a storm drain grate stamped with warning against pollution. 3. Place the marker in clear site facing toward anyone approaching the inlet from either side. 4. Use a brief statement and/or graphical icons to discourage illegal dumping. 5. Maintain the legibility of markers and signs. 5. When painting stencils or installing markers, temporarily block the storm drain inlet.	✓
S.11 Color Events	1. Create a map of the event and pollution prevention plan, contract with a commercial street sweeping firm, obtain the dye product's Safety Data Sheet, and provide names and contact information of the event official for both during and after the event. This information should be provided to Thurston County Water Resources Division at least two weeks prior to the scheduled event. 2. Protect storm drains. 3. Set up color stations and prohibit participants from throwing dye at least 100 feet away from any surface water or open stormwater feature. Route, start, finish, and color application stations must be at least 100 feet away from any permeable pavement or the permeable pavement must be completely covered. 4. Use brooms or street sweepers to clean up paved areas. If it is necessary to use water to clean surfaces, collect and dispose of wash water to the sanitary sewer system with approval from the local sewer agency. 5. Properly dispose of all waste materials. 6. All cleanup must be done within 24 hours of the race event. 7. Call the Thurston County spill response hotline immediately (24/7) at (360) 867-2099 if any colored water enters a storm drain or waterbody.	
S.12 Goose Waste	1. If possible, pick up goose waste using shovels, brooms, rakes, power sweepers, and trash cans. Properly dispose of goose waste in garbage. 2. Do not blow, sweep, or wash goose waste into waterways or storm drain systems. 3. Regularly clean goose waste from areas of chronic deposition where deterrence measures are impractical. 4. Do not feed wild geese or any other wild animals.	

4.0 Site / Business Specific BMPS

Every business in Thurston County is required to use the BMPs described in the Thurston County Drainage Manual to control stormwater pollution.

Table 2 (following pages) should be completed and include a list of all activities identified on the worksheet (Attachment A). Review the applicable Activity Sheet (should be included in Attachment B) and summarize those required and suggested BMPs or actions that are appropriate for your property/business. This table should be posted in an appropriate location for employees to see.

RJ DEVELOPMENT

TABLE 2 – OPERATIONAL SOURCE CONTROL PRACTICES SUMMARY

ACTIVITY	SOURCE CONTROL BMPS (SEE ACTIVITY SHEET IN ATTACHMENT B FOR MORE INFORMATION)	√
A3.2 Concrete Pouring, Concrete Cutting, and Asphalt Application at Temporary Sites	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. Loose aggregate chunks must be swept or shoveled and collected (not hosed down a storm drain) for recycling or disposal. 2. Storm drain covers must be placed over all nearby drains each day 3. Exposed aggregate washing must be done with a mechanism for containment. 4. Cleaning of concrete equipment must be done in a designated area <p>Suggested Practices:</p> <ol style="list-style-type: none"> 1. Avoid the activity when rain is occurring or expected 2. If possible, portable asphalt mixing equipment should be covered by an awning or similar structure to avoid rain. 3. Recycle broken concrete and asphalt 	
A3.6 Landscaping and Lawn/ Vegetation Management	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas. 2. Select the right plants for the planting location based on proposed use and conditions. 3. Ensure plants selected for planting are not on the noxious weed list. 4. Select appropriate turfgrass mixture for the climate and soil type. <p>Suggested Practices:</p> <ol style="list-style-type: none"> 1. Conduct mulch-mowing whenever practicable 2. Use native plants in landscaping 3. Use mulch or other erosion control measures on soils exposed for more than one week during the dry season or two days during the rainy season. 	
A3.7 Painting, Finishing, and Coating of Vehicles, Boats, Buildings, and Equipment	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. Do not conduct spraying, blasting, or sanding activities over open water or where wind may blow paint or waste into water. 2. Wipe up spills with rags and other absorbent materials immediately. 3. Use protective device for paint mixing and tool cleaning where spills can contaminate stormwater. 4. Store toxic materials under cover during precipitation events. <p>Suggested Practices:</p> <ol style="list-style-type: none"> 1. Recycle paint, paint thinner, solvents, pressure washwater, and any other recyclable materials. 2. Use efficient spray equipment such as electrostatic, air-atomized, high volume/low pressure, or gravity fed spray equipment. 3. Purchase recycled paints, paint thinner, solvents, and other products if feasible. 	

ACTIVITY	SOURCE CONTROL BMPS (SEE ACTIVITY SHEET IN ATTACHMENT B FOR MORE INFORMATION)	√
A4.4 Storage of Solid Wastes and Food Wastes	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. All solid and food wastes must be stored in suitable containers. 2. Storage containers must be checked for leaks and replaced if they are leaking, corroded, or otherwise deteriorating. 3. The waste storage area must be swept or otherwise cleaned frequently to collect all loose solids for proper disposal in a storage container. <p>Suggested Practices:</p> <ol style="list-style-type: none"> 1. If the amount of waste accumulated appears to frequently exceed the capacity of the storage container, then another storage container should be obtained and utilized. 2. Store containers such that wind will not be able to knock them over. 3. Designate a storage area and ensure it is sloped to prevent stormwater run-on or run-off. 	
A7.12 Maintenance of Public and Utility Corridors and Facilities	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. Within utility corridors, prepare maintenance procedures and an implementation schedule that provides for vegetative, gravel, or equivalent cover that minimizes bare ground surfaces and prevents erosion. 2. Maintain ditches and culverts at an appropriate frequency to ensure that plugging and flooding across the roadbed, with resulting overflow erosion, does not occur. <p>Suggested Practices:</p> <ol style="list-style-type: none"> 1. Implement temporary erosion and sediment control in areas cleared of trees and vegetation and during the construction of new roads. 	
A7.14 Maintenance of Stormwater Drainage and Treatment Facilities	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine whether improvements or maintenance are needed. 2. Promptly repair any deterioration threatening the structural integrity of stormwater facilities. 3. Regularly remove debris and sludge from BMPs used for flow control, treatment, etc. and truck to an appropriate local or state government disposal site. 4. Clear woody debris in a catch basin as frequently as needed. 5. Eliminate illicit connections to the stormwater drainage system. 	
A7.16 Streets and Highways	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. Cover and contain nearby storm drains to keep runoff from entering the drainage system. 2. Use drip pans or absorbents wherever concrete, asphalt, paint, and drips are likely to spill. 3. Collect and contain all solids, slurry, and rinse water. 4. Sweep areas as frequently as needed <p>Suggested Practices:</p> <ol style="list-style-type: none"> 1. Intensify roadway and drainage structure cleaning in early spring to help remove particles from road surfaces. 2. Where feasible, use roadway deicing chemicals that cause the least adverse environmental impact. 	

ACTIVITY	SOURCE CONTROL BMPS (SEE ACTIVITY SHEET IN ATTACHMENT B FOR MORE INFORMATION)	√
S.1 Eliminate Illicit Stormwater Drainage System Connections	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. If wastes cannot be legally discharged to a sanitary sewer or septic system, one of the other three disposal options must be used. Sumps or holding tanks may be useful for storing liquid wastes temporarily. The contents must be disposed of in the sanitary sewer or at a dangerous waste facility depending on the nature of the waste. 2. Dangerous and hazardous wastes must be properly transported to an appropriate hazardous waste treatment, storage, and disposal facility. 	
S.2 Dispose of Collected Runoff and Waste Materials Properly	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. If wastes cannot be legally discharged to a sanitary sewer or septic system, one of the other three disposal options must be used. Sumps or holding tanks may be useful for storing liquid wastes temporarily. The contents must be disposed of in the sanitary sewer or at a dangerous waste facility depending on the nature of the waste. 2. Dangerous and hazardous wastes must be properly transported to an appropriate hazardous waste treatment, storage, and disposal facility. 	
S.9 Clean Catch Basins	<p>Required Practices:</p> <ol style="list-style-type: none"> 1. All of the solids and stagnant water collected from catch basin sumps must be disposed of properly. None of the sump contents can be flushed into the catch basin outflow pipe. Depending on the nature of the pollutants in the sump, and the associated types of activities taking place on site, the sump contents may need to be disposed of as hazardous waste. Contractors who perform catch basin cleanout services will be required to follow specified disposal requirements. 	

ATTACHMENT A

COMMERCIAL AND INDUSTRIAL ACTIVITIES WORKSHEET

This worksheet and the associated BMPs are organized by business activity. The goal of BMPs is to ensure that **only uncontaminated stormwater is discharged** into any stormwater drainage system.

Complete the entire worksheet by checking the appropriate boxes for all activities that occur at your work place. If you checked off any of the activities **that are being performed outdoors or can drain to the stormwater drainage system**, use the activity code on the worksheet to find the BMPs recommended for you in Chapter 4 of Volume IV of the *Thurston County Drainage Design and Erosion Control Manual*. If you perform an activity indoors and control all discharges from the activity (e.g., process water, washwater, lubricants, solvents, fugitive dust, granular material, blow down waste) so that no stormwater exposure occurs, you do not have to institute BMPs for that activity.

If you have questions, please contact the Thurston County Stormwater Utility at (360) 754-4681. They can provide assistance over the phone and also at your business site.

Activity Code	Type of Activity	Check if You Are Involved in This	
		Indoor	Outdoor
A1.1	Cleaning or Washing of Tools, Engines, and Manufacturing Equipment <ul style="list-style-type: none">Includes parts washers and all types of manufactured equipment components.		
A1.2	Cleaning or Washing of Cooking Equipment <ul style="list-style-type: none">Includes vents, filters, pots and pans, grills, and related items.		
A1.3	Washing, Pressure Washing, and Steam Cleaning of Vehicles/Equipment/Building Structures <ul style="list-style-type: none">Includes cleaning and washing at all types of establishments, including fleet vehicle yards, car dealerships, car washes, and maintenance facilities.		
A1.4	Collection and Disposal of Wastewater from Mobile Interior Washing Operations <ul style="list-style-type: none">Includes carpet cleaners, upholstery cleaners, and drapery cleaners.		
A1.5	Dock Washing <ul style="list-style-type: none">Includes wharves, piers, floats, and boat ramps.		
A1.6	Potable Water Line Flushing, Water Tank Maintenance, and Hydrant Testing		
A2.1	Loading and Unloading Areas for Liquid or Solid Material <ul style="list-style-type: none">Includes raw materials, intermediate products, finished products, waste, or fuel.		

Activity Code	Type of Activity	Check if You Are Involved in This	
		Indoor	Outdoor
A2.2	Fueling at Dedicated Stations <ul style="list-style-type: none"> Includes gas stations, pumps at fleet vehicle yards or shops, and other privately owned pumps. 		
A2.3	Engine Repair and Maintenance <ul style="list-style-type: none"> This covers oil changes and other engine fluids. 		
A2.4	Mobile Fueling of Vehicles and Heavy Equipment <ul style="list-style-type: none"> Includes fleet fueling, wet fueling, and wet hosing. 		
A2.5	In-Water and Over-Water Fueling <ul style="list-style-type: none"> Applies to transferring of fuels to vehicles or equipment in water. 		
A3.1	Concrete and Asphalt Mixing and Production at Stationary Sites <ul style="list-style-type: none"> Applies to mixing of raw materials on site to produce concrete or asphalt. 		
A3.2	Concrete Pouring, Concrete Cutting, and Asphalt Application at Temporary Sites <ul style="list-style-type: none"> Includes construction sites, and driveway and parking lot resurfacing. 		✓
A3.3	Manufacturing and Post-processing of Metal Products <ul style="list-style-type: none"> Includes machining, grinding, soldering, cutting, welding, quenching, rinsing, etc. 		
A3.4	Wood Treatment Areas <ul style="list-style-type: none"> Includes wood treatment using pressure processes or by dipping or spraying. 		
A3.5	Commercial Composting <ul style="list-style-type: none"> Includes commercial composting facilities operating outside. 		
A3.6	Landscaping and Vegetation Management Activities <ul style="list-style-type: none"> Includes businesses involved in landscaping and managing vegetation. 		✓
A3.7	Painting, Finishing, and Coating of Vehicles, Boats, Buildings, and Equipment <ul style="list-style-type: none"> Includes surface preparation and the applications of paints, finishes, and/or coatings. 		✓
A3.8	Commercial Printing Operations <ul style="list-style-type: none"> Includes materials used in the printing process. 		
A3.9	Manufacturing Activities – Outside <ul style="list-style-type: none"> Includes outdoor manufacturing areas. 		
A3.10	Agricultural Crop Production <ul style="list-style-type: none"> Includes commercial scale farming. 		
A3.11	Pesticides and Integrated Pest Management Program <ul style="list-style-type: none"> Includes moss removal and outdoor insect extermination. 		

Activity Code	Type of Activity	Check if You Are Involved in This	
		Indoor	Outdoor
A3.12	Nurseries and Greenhouses <ul style="list-style-type: none"> Applies to commercial container plant, greenhouse grown, and cut foliage production operations. 		
A3.13	Irrigation <ul style="list-style-type: none"> Includes businesses involved in landscaping and managing vegetation. 		
A3.14	Fertilizer Application <ul style="list-style-type: none"> Includes businesses involved in landscaping, applying fertilizers, and managing vegetation. 		
A4.1	Storage or Transfer (Outside) of Solid Raw Materials, By-products, or Finished Products		
A4.2	Storage and Treatment of Contaminated Soils <ul style="list-style-type: none"> This applies to contaminated soils that are excavated and left on site. 		
A4.3	Temporary Storage or Processing of Fruits or Vegetables <ul style="list-style-type: none"> Includes processing activities at wineries, fresh and frozen juice makers, and other food and beverage processing operations. 		
A4.4	Storage of Solid Wastes and Food Wastes <ul style="list-style-type: none"> Includes regular garbage and all other discarded non-liquid items. 		✓
A4.5	Recyclers and Scrap Yards <ul style="list-style-type: none"> Includes scrapped equipment, vehicles, empty metal drums, and assorted recyclables. 		✓
A4.6	Treatment, Storage, or Disposal of Dangerous Wastes <ul style="list-style-type: none"> Refer to Ecology and the Thurston County Health Department for more information, see Chapter 7. 		
A4.7	Storage of Liquid, Food Waste, or Dangerous Waste Containers <ul style="list-style-type: none"> Includes containers located outside a building and used for temporary storage. 		
A4.8	Storage of Liquids in Permanent Aboveground Tanks <ul style="list-style-type: none"> Includes all liquids in aboveground tanks. 		
A4.9	Parking and Storage for Vehicles and Equipment <ul style="list-style-type: none"> Includes public and commercial parking lots 		
A4.10	Storage of Pesticides, Fertilizers, or other products that can leach pollutants		
A5.1	Demolition of Buildings <ul style="list-style-type: none"> Applies to removal of existing buildings and subsequent clearing of the rubble. 		
A5.2	Building Repair, Remodeling, and Construction <ul style="list-style-type: none"> Applies to construction of buildings, general exterior building repair work and remodeling of buildings. 		
A6.1	Dust Control at Disturbed Land Areas and Unpaved Roadways and Parking Lots		

Activity Code	Type of Activity	Check if You Are Involved in This	
		Indoor	Outdoor
A6.2	Dust Control at Manufacturing Sites <ul style="list-style-type: none"> Includes grain dust, sawdust, coal, gravel, crushed rock, cement, and boiler fly ash. 		
A6.3	Soil Erosion and Sediment Control (ESC) at Industrial Sites <ul style="list-style-type: none"> Includes industrial activities that take place on soil. 		
A7.1	Commercial Animal Handling Areas <ul style="list-style-type: none"> Includes kennels, fenced pens, veterinarians, and businesses that board animals. 		
A7.2	Keeping Livestock in Stables, Pens, Pastures or Fields <ul style="list-style-type: none"> Applies to all types of livestock. 		
A7.3	Log Sorting and Handling <ul style="list-style-type: none"> Applies to log yards typically located at sawmills, ports, and pulp mills. 		
A7.4	Boat Building, Mooring, Maintenance, and Repair <ul style="list-style-type: none"> Includes all types of maintenance, repair, and building operations. 		
A7.5	Logging <ul style="list-style-type: none"> Applies to logging activities that fall under Class IV general forest practices. 		
A7.6	Mining and Quarrying of Sand, Gravel, Rock, Minerals, Peat, Clay, and Other Materials <ul style="list-style-type: none"> This does not include excavation at construction sites. 		
A7.7	Swimming Pool and Spa Cleaning and Maintenance <ul style="list-style-type: none"> Includes every swimming pool and spa not at a single family residence. Commercial pool cleaners are included here for all pools. 		
A7.8	De-icing and Anti-icing Operations for Airports <ul style="list-style-type: none"> Includes aircraft, runways, and taxiways. 		
A7.9	Roof and Building Drains at Manufacturing and Commercial Buildings <ul style="list-style-type: none"> These sites will be referred to ORCAA. 		
A7.10	Urban Streets <ul style="list-style-type: none"> BMPs for addressing pollutants found on paved surfaces, including street sweeping. 		
A7.11	Railroad Yards		
A7.12	Maintenance of Public and Private Utility Corridors and Facilities <ul style="list-style-type: none"> Includes public and private utility maintenance activities. 		✓
A7.13	Maintenance of Roadside Ditches		
A7.14	Maintenance of Stormwater Drainage and Treatment Facilities		✓
A7.15	Spills of Oil and Hazardous Substances		
A7.16	Streets and Highways <ul style="list-style-type: none"> Includes maintenance and deicing/anti-icing of streets and highways. 		✓

Activity Code	Type of Activity	Check if You Are Involved in This	
		Indoor	Outdoor
A7.17	Maintenance and Repair of Vehicles and Equipment		
A7.18	Well, Utility, Directional and Geotechnical Drilling <ul style="list-style-type: none"> Includes drilling water wells and utilities, environmental protection and monitoring wells, and geotechnical borings using machinery. 		
A7.19	Roof Vents <ul style="list-style-type: none"> Includes processes that vent emissions to the roof . 		

ATTACHMENT B

ACTIVITY SHEETS

Best Management Practices for Commercial and Industrial Activities

This Attachment coordinates with the worksheet in Attachment A. That worksheet and the BMPs are organized by the different activities that businesses perform. If you checked the column for activities performed outdoors, match the number from the worksheet to the activities listed in Volume IV, Chapter 4 of the *Thurston County Drainage Design and Erosion Control Manual* to find the suggested BMPs you should implement. Make photocopies of the applicable Activity Sheets and insert them in this section. Use the Activity Sheets to prepare a summary of the applicable required and suggested BMPs for inclusion in Table 2 (Section 4).

Explanation of Required BMPs

Every business in Thurston County is required to use the BMPs described in the *Thurston County Drainage Design and Erosion Control Manual* to control stormwater pollution. In some instances, there are BMPs mandated by various federal, state, or county laws. If you are subject to those laws and regulations via another permit or formal regulatory approval, you are encouraged, but not required to use additional BMPs to further protect water quality.

The BMPs outlined in this section are focused on source control: that is, methods to prevent pollution from reaching stormwater in the first place. The use of source control BMPs is always the first line of defense in stormwater pollution prevention.

A3.2 Concrete Pouring, Concrete Cutting, and Asphalt Application at Temporary Sites

Description of Pollutant Sources: This activity applies to businesses and public agencies that apply asphalt or pour or cut concrete for building construction and remodeling, road construction, sidewalk, curb and gutter repairs and construction, sealing of driveways and roofs, and other applications. These activities are typically done on a temporary site-to-site basis where permanent BMP measures do not apply. Concrete pouring activities can severely alter the pH of receiving waters and slurry from aggregate washing can harden in storm pipes, reducing capacity and creating flooding problems. Concrete cutting uses water for cooling and the fine particulates suspended in the resulting slurry are particularly hard to treat.

Pollutants of concern include toxic hydrocarbons, toxic organic compounds, oils and greases, heavy metals, suspended solids, and pH.

Pollutant Control Approach: Train employees on proper procedures, sweep or shovel aggregate chunks, collect accumulated runoff and solids, and wash equipment in designated areas.

Required BMPs

The following BMPs or equivalent measures are required of all businesses and agencies doing concrete pouring and asphalt application at temporary sites:

- Employees must be educated on the pollution hazards of concrete and asphalt application and cutting.
- Loose aggregate chunks and dust must be swept or shoveled and collected (not hosed down a storm drain) for recycling or proper disposal at the end of each workday, especially at work sites such as streets, driveways, parking lots, sidewalks, curbs, and gutters where rain can readily pick up the loose material and carry it to the nearest stormwater conveyance. Small amounts of excess concrete, grout, and mortar can be disposed of in the trash.
- Storm drain covers or similarly effective containment devices must be placed over all nearby drains at the beginning of each day. Shovel or vacuum slurry and remove from the site. All accumulated runoff and solids must be collected and properly disposed of (see BMP S.2 in Chapter 5 for disposal options) at the end of each workday, or more often if necessary.
- Exposed aggregate washing (where the top layer of unhardened concrete is hosed or scraped off to leave a rough finish) must be done with a mechanism for containment and collection of the discarded concrete slurry.

- Cleaning of concrete application and mixing equipment or concrete vehicles must be done in a designated area where the rinse water is controlled and properly disposed. See Volume II, Section 3.1, BMP C154 for more information.

The use of any treatment BMP must not result in the violation of groundwater or surface water quality standards.

Suggested BMPs

- Avoid the activity when rain is occurring or expected.
- If possible, portable asphalt mixing equipment should be covered by an awning, a lean-to, or another simple structure to avoid contact with rain. See BMP S.4 in Chapter 5 for further details on cover structures.
- Recycle broken concrete and asphalt.

A3.6 Landscaping and Lawn/Vegetation Management

Description of Pollutant Sources: Landscaping can include grading, soil transfer, vegetation planting, and vegetation removal. Examples include weed control on golf course lawns, access roads, and utility corridors and during landscaping; and residential lawn/plant care. Proper management of vegetation can minimize excess nutrients and pesticides.

Pollutant Control Approach: Maintain appropriate vegetation to control erosion and discharge of stormwater pollutants. Prevent debris contamination of stormwater. Where practicable, grow plant species appropriate for the site, or adjust the soil properties of the site to grow desired plant species.

Required BMPs

- Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
- Select the right plants for the planting location based on proposed use, available maintenance, soil conditions, sun exposure, water availability, height, sight factors, and space available.
- Ensure that plants selected for planting are not on the noxious weed list. For example, butterfly bush often gets planted as an ornamental but is actually on the noxious weed list.

The Washington State Noxious Weed List can be found at the following webpage: <https://www.nwcb.wa.gov/printable-noxious-weed-list>

- Do not dispose of grass clippings and other collected vegetation into waterways or stormwater drainage systems.
- Do not blow vegetation or other debris into the drainage system.
- Dispose of collected vegetation such as grass clippings, leaves, sticks by composting or recycling.
- Remove, bag, and dispose of noxious weeds in the garbage immediately.
- Do not compost noxious weeds as it may lead to spreading through seed or fragment if the composting process is not hot enough.
- Use manual and/or mechanical methods of vegetation removal (pincer-type weeding tools, flame weeders, or hot water weeders as appropriate) rather than applying herbicides, where practical.
- Use at least an eight-inch “topsoil” layer with at least 8 percent organic matter to provide a sufficient vegetation-growing medium.
 - Organic matter is the least water-soluble form of nutrients that can be added to the soil. Composed organic matter generally releases

only between 2 and 10 percent of its total nitrogen annually, and this release corresponds closely to the plant growth cycle. Return natural plant debris and mulch to the soil, to continue recycling nutrients indefinitely.

- Select the appropriate turfgrass mixture for the climate and soil type.
 - Certain tall fescues and rye grasses resist insect attack because the symbiotic endophytic fungi naturally in their tissues repel or kill common leaf and stem-eating lawn insects.
 - The fungus causes no known adverse effects to the host plant or to humans.
 - Tall fescues and rye grasses do not repel root-feeding lawn pests such as Crane Fly larvae.
 - Tall fescues and rye grasses are toxic to ruminants such as cattle and sheep.
 - Endophytic grasses are commercially available; use them in areas such as parks or golf courses where grazing does not occur.
 - Local agricultural or gardening resources such as Washington State University Extension office can offer advice on which types of grass are best suited to the area and soil type.
- Use the following seeding and planting BMPs, or equivalent BMPs, to obtain information on grass mixtures, temporary and permanent seeding procedures, maintenance of a recently planted area, and fertilizer application rates: BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, BMP C123: Plastic Covering, and BMP C124: Sodding.
- Adjusting the soil properties of the subject site can assist in selection of desired plant species. Consult a soil restoration specialist for site-specific conditions.

Suggested BMPs

- Conduct mulch-mowing whenever practicable.
- Use native plants in landscaping. Native plants do not require extensive fertilizer or pesticide applications. Native plants may also require less watering.
- Use mulch or other erosion control measures on soils exposed for more than one week during the dry season (May 1 to September 30) or two days during the rainy season (October 1 to April 30).

- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Apply an annual topdressing application of 3/8" compost. Amending existing landscapes and turf systems by increasing the percent organic matter and depth of topsoil can:
 - Substantially improve the permeability of the soil.
 - Increase the disease and drought resistance of the vegetation.
 - Reduces the demand for fertilizers and pesticides.
- Disinfect gardening tools after pruning diseased plants to prevent the spread of disease.
- Prune trees in a manner appropriate for each species.
- If specific plants have a high mortality rate, assess the cause and replace with another more appropriate species.
- When working around and below mature trees, follow the most current American National Standards Institute (ANSI) ANSI A300 standards and International Society of Arboriculture BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil).
- Monitor tree support systems (stakes, guys, etc.).
 - Repair and adjust as needed to provide support and prevent tree damage.
 - Remove tree supports after one growing season or maximum of 1 year.
 - Backfill stake holes after removal.
- When continued, regular pruning (more than one time during the growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location.
- Make reasonable attempts to remove and dispose of class C noxious weeds.
- Re-seed bare turf areas until the vegetation fully covers the ground surface.
- Watch for and respond to new occurrences of especially aggressive weeds such as Himalayan blackberry, Japanese knotweed, morning glory, English ivy, and reed canary grass to avoid invasions.

- Plant and protect tree per BMP LID.14: Tree Planting and Tree Retention.
- Aerate lawns regularly in areas of heavy use, where the soil tends to become compacted. Conduct aeration while the grasses in the lawn are growing most vigorously. Remove layers of thatch greater than 0.75 inches deep.
- Set the mowing height at the highest acceptable level and mow at times and intervals designed to minimize stress on the turf. Generally, mowing only one-third of the grass blade height will prevent stressing the turf.
 - Mowing is a stress-creating activity for turfgrass.
 - Grass decreases its productivity when mown too short and there is less growth of roots and rhizomes. The turf becomes less tolerant of environmental stresses, more disease prone, and more reliant on outside means such as pesticides, fertilizers, and irrigation to remain healthy.

A3.7 Painting, Finishing, and Coating of Vehicles, Boats, Buildings, and Equipment

Description of Pollutant Sources: Surface preparation and the application of paints, finishes, and/or coatings to vehicles, boats, buildings, and/or equipment outdoors can be sources of pollutants. Potential pollutants include organic compounds, oils and greases, heavy metals, and suspended solids.

Pollutant Control Approach: Cover and contain painting and sanding operations and apply good housekeeping and preventive maintenance practices to prevent the contamination of stormwater with painting over sprays and grit from sanding.

Required BMPs

- Train employees in the careful application of paints, finishes, and coatings to reduce misuse and overspray. Use ground or drop cloths underneath outdoor painting, scraping, sandblasting work, and properly clean and temporarily store collected debris daily.
- Do not conduct spraying, blasting, or sanding activities over open water or where wind may blow paint or waste into water.
- Wipe up spills with rags and other absorbent materials immediately. Do not hose down the area to a storm drain, conveyance ditch, or to a receiving water.
- On dock areas, sweep rather than hose down debris. Collect any hose water generated and convey to appropriate treatment and disposal.
- Use an effective runoff control device if dust, grit, washwater, or other pollutants may escape the work area and enter a catch basin. The containment device(s) must be in place at the beginning of the workday. Collect contaminated runoff and solids and properly dispose of such wastes before removing the containment device(s) at the end of the workday.
- Use a ground cloth, pail, drum, drip pan, tarpaulin, or other protective device for activities such as outdoor paint mixing and tool cleaning or where spills can contaminate stormwater.
- Properly dispose of all wastes and prevent all uncontrolled releases to the air, ground, or water.
- Clean brushes and tools covered with non-water-based paints, finishes, or other materials in a manner that allows collection of used solvents, turpentine, or paint thinners for recycling or proper disposal.
- Store toxic materials under cover (tarpaulin, etc.) during precipitation events and when not in use to prevent contact with stormwater.

- Enclose or contain all work while using a spray gun or conducting sand blasting and in compliance with applicable Olympic Region Clean Air Agency (ORCAA), Occupational Safety and Health Administration (OSHA), and Washington Industrial Safety and Health Act (WISHA) requirements. Do not conduct outside spraying, grit blasting, or sanding activities during windy conditions that render containment ineffective.

Suggested BMPs

- Recycle paint, paint thinner, solvents, pressure washwater, and any other recyclable materials.
- Use efficient spray equipment such as electrostatic, air-atomized, high volume/low pressure, or gravity feed spray equipment.
- Purchase recycled paints, paint thinner, solvents, and other products, if feasible.

A4.4 Storage of Solid Wastes and Food Wastes

Description of Pollutant Sources: This activity applies to businesses and public agencies that store solid wastes and food wastes outdoors. This includes ordinary garbage. If improperly stored, these wastes can contribute a variety of different pollutants to stormwater. Requirements for handling and storing solid waste may include a permit from the Thurston County Public Health and Social Services Department. For more information, call the Waste Management Section at (360) 867-2664

NOTE: Dangerous solid wastes must be stored and handled under special guidelines. Businesses and agencies that store dangerous wastes must follow specific regulations outlined by Ecology and, in some cases, the county health department. Ecology regulations are outlined in Chapter 7. Please contact Ecology at (360) 407-6300 and the Thurston County Public Health and Social Services Department at (360) 867-2664 for the specific requirements and permitting information.

Pollutants of concern include toxic organic compounds, oils and greases, heavy metals, nutrients, suspended solids, and oxygen demanding substances (i.e., BOD and COD).

Pollutant Control Approach: Store wastes in suitable containers with leak-proof lids. Sweep or shovel loose solids. Educate employees about the need to check for and replace leaking containers.

Required BMPs

The following BMPs are required of all businesses and public agencies engaged in storage of non-dangerous solid wastes or food wastes:

- All solid and food wastes must be stored in suitable containers. Piling of wastes without any cover is not acceptable.
- Storage containers must be checked for leaks and replaced if they are leaking, corroded, or otherwise deteriorating.
- Storage containers must have leak-proof lids or be covered by some other means (Figure IV - 4.14). Lids must be kept closed at all times. This is especially important for dumpsters, as birds can pick out garbage and drop it, promoting rodent, health, and stormwater problems.

OR

- If lids cannot be provided for the waste containers, or they cannot otherwise be covered, there is another option: a designated waste storage area must be provided with a containment berm, dike, or curb, and the designated area must drain to a sanitary sewer (contact LOTT Alliance Industrial Pretreatment Program at (360) 528-5708 or your local sewer service provider prior to any connections) or holding tank for further treatment. See BMP S.7 and S.3 in Chapter 5 for more information.



Figure IV - 4.14 Solid Waste Dumpsters with Properly Sealed Lids.

- Employees must be trained to frequently check storage containers for leaks and to ensure that the lids are on tightly.
- The waste storage area must be swept or otherwise cleaned frequently to collect all loose solids for proper disposal in a storage container. Do not hose the area to collect or clean solids.
- If you clean your containers, all rinse water from cleaning must be disposed of in a sanitary sewer or septic system.
- Clean out catch basins on your property that receive drainage from your waste storage area. See BMP S.9 in Chapter 5 for details on catch basin cleaning.

Suggested BMPs

- If the amount of waste accumulated appears to frequently exceed the capacity of the storage container, then another storage container should be obtained and utilized.
- Store containers such that wind will not be able to knock them over.
- Designate a storage area, pave the area, and slope the drainage to a holding tank to prevent stormwater run-on or run-off. If a holding tank is used, the contents must be pumped out before the tank is full and properly disposed of. See BMP S.2 in Chapter 5 for more information on disposal options.
- Compost appropriate wastes. Contact Thurston County Solid Waste at (360) 867-2300 for more information on composting.

- Recycle your solid wastes. The Industrial Materials Exchange program facilitates the transfer of excess materials and wastes to those who can use them. Industrial Materials Exchange can be reached at (206) 296-4899, toll free 1-888-TRY-IMEX or on the Web at: <http://www.hazwastehelp.org/imex/>.

A4.5 Recyclers and Scrap Yards

Description of Pollutant Sources: Includes businesses and public agencies that reclaim various materials for resale or for scrap, such as vehicles and vehicle/equipment parts, construction materials, metals, papers, and beverage containers.

Potential sources of pollutants include paper, plastic, metal scrap debris, engines, transmissions, radiators, batteries, and other contaminated materials or that contain fluids. Other pollutant sources include leachate from metal components, contaminated soil, and the erosion of soil. Activities that can generate pollutants include the transfer, dismantling, and crushing of vehicles and scrap metal; the transfer and removal of fluids; maintenance and cleaning of vehicles, parts, and equipment; and storage of fluids, parts for resale, solid wastes, scrap parts, and materials, equipment and vehicles that contain fluids, generally in uncovered areas.

Potential pollutants typically found vehicle recycle and scrap yards include, polychlorinated biphenyls (PCBs), heavy metals, oils and greases, total suspended solids, BOD, ethylene and propylene glycol, and acidic pH.

Required BMPs

- For facilities subject to Ecology's industrial stormwater general permit refer to Ecology Document No. 94-146, *Vehicle and Metal Recyclers: A Guide for Implementing the Industrial Stormwater General National Pollutant Discharge Elimination System (NPDES) Permit Requirements*. Apply the BMPs in that guidance document to scrap material recycling facilities depending on the pollutant sources existing at those facilities.
- Check incoming scrap materials, vehicles, and equipment for potential fluid contents and batteries.
- Drain and transfer fluids from vehicles and other equipment only in a designated area with a waste collection system or over drip pans.
- Remove batteries and store on the ground in a leak-proof container and under cover.
- Cover and raise any materials that may contaminate stormwater. A tarp and pallet are acceptable.
- Cover and contain any stockpiles of any material that has the potential to contaminate stormwater runoff.
- All containers used to store fluids must comply with federal, state, and/or local secondary containment requirements. Storage of flammable and combustible materials must comply with the appropriate fire codes.

Required Routine Maintenance

- Inspect storage areas regularly and promptly clean up any leaks, spills, or contamination.
- Sweep scrap storage areas as needed. Do not hose down anything to a storm drain.
- Keep spill cleanup materials in a location known to all. Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.

Suggested BMPs

- Install catch basin inserts to collect excess sediment and debris if necessary. Inspect and maintain catch basin inserts to ensure they are working correctly.
- Conduct automobile/vehicle metal-shredding inside enclosed building with HEPA air filtration systems to prevent the fugitive release of heavy metals and other potentially hazardous materials into the air.

A7.12 Maintenance of Public and Utility Corridors and Facilities

Description of Pollutant Sources: Corridors and facilities at petroleum product, natural gas, and water pipelines and electrical power transmission corridors and rights-of-way can be sources of pollutants, such as herbicides used for vegetation management and eroded soil particles from unpaved access roads. At pump stations, waste materials generated during maintenance activities may be temporarily stored outside. Additional potential pollutant sources include the leaching of preservatives from wood utility poles, PCBs in older transformers, water that is removed from underground transformer vaults, and leaks/spills from petroleum pipelines. The following are potential pollutants: oil and grease, total suspended solids, BOD organics, PCBs, pesticides, and heavy metals.

Pollutant Control Approach: Implementation of spill control plans as well as control of fertilizer and pesticide applications, soil erosion, and site debris that can contaminate stormwater.

Required BMPs

- Implement BMPs included in Chapter 4, A.6 Landscaping and Lawn/Vegetation Management and in Chapter 7, Section 7.2, R.6 Pesticide Regulations.
- When removing water or sediments from electric transformer vaults, determine the presence of contaminants before disposing of the water and sediments. This includes inspecting for the presence of oil or sheen, and determining from records or testing if the transformers contain PCBs. If records or tests indicate that the sediment or water are contaminated above applicable levels, manage these media in accordance with applicable federal and state regulations, including the federal PCB rules (40 CFR 761) and the state MTCA cleanup regulations (Chapter 173-340 WAC). Water removed from the vaults can be discharged in accordance with the federal 40 CFR 761.79, and state regulations (Chapter 173-201A WAC and Chapter 173-200 WAC), or via the sanitary sewer if the requirements, including applicable permits, for such a discharge are met. (See also Chapter 7, Section 7.2-R2.)
- Within utility corridors, prepare maintenance procedures and an implementation schedule that provides for vegetative, gravel, or equivalent cover that minimizes bare or thinly vegetated ground surfaces within the corridor to prevent the erosion of soil.
- Provide maintenance practices to prevent stormwater from accumulating and draining across and/or onto roadways. Convey stormwater through roadside ditches and culverts. The road should be crowned, outsloped, water barred, or otherwise left in a condition not conducive to erosion. Appropriately maintaining grassy roadside ditches discharging to surface

waters is an effective way of removing many pollutants associated with sediments carried by stormwater.

- Maintain ditches and culverts at an appropriate frequency to ensure that plugging and flooding across the roadbed, with resulting overflow erosion, does not occur.
- Apply the appropriate BMPs from Section A4 of this volume, Storage Activities, for the storage of waste materials that can contaminate stormwater.

Suggested BMPs

- When selecting utility poles for a specific location, consider the potential environmental effects of the pole or poles during storage, handling, and end-use, as well as its cost, safety, efficacy, and expected life. Use wood products treated with chemical preservatives made in accordance with generally accepted industry standards such as the American Wood Preservers Association Standards. Consider alternative materials or technologies if placing poles in or near an environmentally sensitive area, such as a wetland or a drinking water well. Alternative technologies include poles constructed with material(s) other than wood, such as fiberglass composites, metal, or concrete. Consider other technologies and materials, such as sleeves or caissons for wood poles, when they are determined to be practicable and available.
- As soon as practicable, remove all litter from wire cutting/replacing operations,
- Implement temporary erosion and sediment control in areas cleared of trees and vegetation and during the construction of new roads.

A7.14 Maintenance of Stormwater Drainage and Treatment Facilities

Description of Pollutant Sources: Facilities include roadside catch basins on arterials and within residential areas, conveyance systems, detention facilities such as ponds and vaults, oil and water separators, bioretention, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems presented in Volume V. Oil and grease, hydrocarbons, debris, heavy metals, sediments, and contaminated water are found in catch basins, oil and water separators, settling basins, etc.

Pollutant Control Approach: Provide maintenance and cleaning of debris, sediments, and oil from stormwater collection, conveyance, and treatment systems to obtain proper operation.

Required BMPs

Maintain stormwater treatment facilities per the operations and maintenance (O&M) procedures presented in Volume V, Appendix V-C, in addition to the following BMPs:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins (Figure IV - 4.23) as needed, and determine whether improvements or maintenance are needed.
- Promptly repair any deterioration threatening the structural integrity of stormwater facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spillways.
- Ensure adequacy of storm sewer capacities and prevent heavy sediment discharges to the storm sewer system, by methods like those found in C-220, Storm Drain Inlet Protection.
- Regularly remove debris and sludge from BMPs used for flow control, treatment, etc. and truck to an appropriate local or state government approved disposal site.
- Clean catch basins in accordance with the information provided in Volume V, Appendix V-C. Additional information is also included in Chapter 5 of this volume, BMP S.9 Cleaning Catch Basins.
- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.
- Install monuments on storm drain inlet rims that state: "Dump No Waste - Drains to Groundwater," "Streams," "Lakes," where possible (Figure IV - 4.24).



Figure IV - 4.23 Catch Basin Cleaning with a Vacuum Truck.



Figure IV - 4.24 "No Dumping" Storm Drain Button.

- Disposal of sediments and liquids from the catch basins must comply with "Recommendations for Management of Road maintenance materials" described in Appendix IV-C of this volume.

- Eliminate illicit connections to the stormwater drainage system. See BMP S.1 in Chapter 5 for details on detecting and eliminating these connections.
- Select additional applicable BMPs from this chapter depending on the pollutant sources and activities conducted at the facility. Those BMPs include:
 - [A4.7](#) – Storage of Liquid, Food Waste, or Dangerous Waste Containers
 - [A6.3](#) – Soil ESC at Industrial Sites
 - [A7.10](#) – Urban Streets
 - [A7.15](#) – Spills of Oil and Hazardous Substances.

absorbent and/or used absorbent. Deploy spill kits in a manner that allows rapid access and use by employees.

A7.16 Streets and Highways

Description of Pollutant Sources: These BMPs apply to the maintenance and deicing/anti-icing of streets and highways. Deicing products can be conveyed during storm events to inlets/catch basins or to receiving waters after application. Leaks and spills of these products can also occur during their handling and storage. Equipment and processes used during maintenance can contribute pollutants such as oil and grease, suspended solids, turbidity, high pH, and metals.

Pollutant Control Approach: Apply good housekeeping practices, preventative maintenance, properly train employees, and use materials that cause less adverse effects on the environment.

Required BMPs

Deicing and Anti-Icing Operations

- Adhere to manufacturer's guidelines and industry standards of use and application.
- Store and transfer de and anti-icing materials on impervious containment pads, or an equivalent spill/leak containment area in accordance with A4.1 Storage or Transfer (Outside) of Solid Raw Materials, By-Products, or Finished Products in this volume.
- Sweep/cleanup accumulated de-icing and anti-icing materials and grit from roads as soon as possible after the road surface clears.
- Minimize use in areas where runoff or spray from the roadway immediately enters sensitive areas such as fish-bearing streams.

Maintenance Operations

- Use drip pans or absorbents wherever concrete, asphalt, asphalt emulsion, paint product, and drips are likely to spill, such as beneath discharge points from equipment.
- Cover and contain nearby storm drains to keep runoff from entering the drainage system.
- Collect and contain all solids, slurry, and rinse water. Do not allow these to enter gutters, storm drains, or drainage ditches or onto the paved surface of a roadway or driveway.

- Designate all fueling equipment in accordance with A2.4 Mobile Fueling of Vehicles and Heavy Equipment.
- Do not use diesel fuel for cleaning or prepping asphalt tools and equipment.
- Sweep areas frequently as needed. Collect all loose aggregate and dust for disposal. Do not hose down areas into storm drains.
- Store all fuel, paint, and other products in secondary containment.
- Conduct paint striping operations during dry weather.

Suggested BMPs

- Where feasible and practicable, use roadway deicing chemicals that cause the least adverse environmental impact. Apply only as needed using minimum quantities. Consider the Pacific Northwest Snowfighters Qualified Products List when selecting roadway deicers and anti-icers.
- Intensify roadway and drainage structure cleaning in early spring to help remove particles from road surfaces.
- Include limits on toxic metals in the specifications for de/anti-icers.
- Install catch basin inserts to collect excess sediment and debris as necessary. Inspect and maintain catch basin inserts to ensure they are working correctly.
- Research mixtures (e.g. corrosion inhibitors, surfactants) to determine what additional pollutants may be an issue. Verify with Thurston County Water Resources Division at 360-754-4681 if there are any restrictions on admixtures.

A7.17 Maintenance and Repair of Vehicles and Equipment

Description of Pollutant Sources: Pollutant sources include parts/vehicle cleaning, spills/leaks of fuel and other liquids, replacement of liquids, outdoor storage of batteries/liquids/parts, and vehicle parking.

Pollutant Control Approach: Control of leaks and spills of fluids using good housekeeping and cover and containment BMPs.

Required BMPs

- Inspect all incoming vehicles, parts, and equipment stored temporarily outside for leaks.

Suggested BMPs

- Store damaged vehicles inside a building or other covered containment, until successfully removing all liquids.
- Clean parts with aqueous detergent based solutions or non-chlorinated solvents such as kerosene or high flash mineral spirits, and/or use wire brushing or sandblasting whenever practicable. Avoid using toxic liquid cleaners such as methylene chloride, 1, 1, 1-trichloroethane, trichloroethylene or similar chlorinated solvents. Choose cleaning agents that can be recycled.
- Inspect all BMPs regularly, particularly after a significant storm. Identify and correct deficiencies to ensure that the BMPs are functioning as intended.
- Avoid hosing down work areas. Use dry methods for cleaning leaked fluids.
- Recycle greases, used oil, oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic fluids, transmission fluids, and engine oils. Contact Ecology's Hazardous Waste & Toxics Reduction Program for recommendations on recycling or disposal of waste materials.
- Do not mix dissimilar or incompatible waste liquids stored for recycling.

A7.18 Well, Utility, Directional and Geotechnical Drilling

Description of Pollutant Source: This activity applies to drilling water wells and utilities, environmental protection and monitoring wells, and geotechnical borings that use machinery in the drilling. It does not apply to the use of devices such as hand augers, or for large structural drilling such as drilled shafts.

Drilling activities can expose soil and contaminated soil. These activities may cause the discharge of stormwater contaminated with sediments and other contaminants. This risk increases when drilling in areas with contaminated soils.

Pollutant Control Approach: Reduce sediment runoff from drilling operations.

Required BMPs

- When drilling in areas of known or suspected soil contamination, test and characterize soil cuttings and accumulated sediment to determine proper management and disposal methods. If applicable, generator knowledge may be used to characterize the soil cuttings and accumulated sediment.
- Obtain permits for drilling activities and for clearing and grading the access routes and the work site.

- Protect environmentally sensitive areas (streams, wetlands, floodplains, floodways, erosion hazards, and landslide hazards) within the area of influence of the work site.
- Mitigate potential impacts to surrounding areas and/or the drainage system.
- For horizontal directional drilling, take measures to capture and contain drilling fluids and slurry.
- Equip the driller to quickly respond to unusual conditions that may arise.
- Locate and prepare access roadways to minimize the amount of excavation and the potential for erosion.
- Contain accumulated uncontaminated water and sediment on site and pump into a storage tank or direct through a geotextile filtration system (or equivalent system) before discharging to the surrounding ground surface. Contaminants may include, but are not limited to, hydraulic fluids, contaminants in the soil and/or groundwater, polymers, and other drilling fluid additives.
- Keep all sediment-laden water out of storm drains and surface waters. If sediment-laden water does escape from the immediate drilling location, block flow to any nearby waterways or catch basins using fabric, inlet protections, sandbags, erosion fences, or other similar methods. Immediately notify Ecology and the Thurston County Water Resources Division if sediment-laden water impacts the storm sewer system or surface waters.
- Divert any concentrated flows of water into the site using sandbags or check dams up-slope from the site.
- Dispose of soil cuttings and accumulated sediment appropriately. If cuttings or other soils disturbed in the drilling process are to be temporarily stockpiled on site, they must be covered and surrounded by a berm or filter device. See A4.1 Storage or Transfer (Outside) of Solid Raw materials, Byproducts, or Finished Products.
- Stabilize exposed soils at the end of the job using mulch or other erosion control measures. See A6.3 Soil Erosion and Sediment Control at Industrial Sites.
- Contain spent drilling slurry on site and allow it to dewater, or haul to an appropriate, approved disposal site.
- Restore disturbed areas with mulch (see BMP C121: Mulching) and seeding or hydroseeding (see BMP C120: Temporary and Permanent Seeding).

1.2 Source Control BMPs

S.1 Eliminate Illicit Storm Drain Connections

Many businesses and residences hooked internal building drains, sump overflows, process wastewater discharges, and even sanitary sewer and septic system pipes to the storm drain in the past, allowing a variety of pollutants to flow directly to receiving waters instead of the sanitary sewer or septic system. Frequently, these connections are unknown to the current owner, and do not appear on any plans for the site.

Because of the pollution potential these connections represent, the Environmental Protection Agency, under the mandate of the NPDES stormwater permits, has made elimination of illegal connections a top priority.

All businesses and residences in Thurston County must examine their plumbing systems to identify any potential illicit connections. Start with an examination of the site plans, to better understand what piping systems were initially installed, making piping that does not appear on the plan a priority for investigation. Wherever toilets, sinks, appliances, showers and bathtubs, floor drains, industrial process waters, or other indoor activities are connected to the stormwater drainage system, immediately reroute them to the sanitary or septic system, holding tanks, or process treatment system.

Industries and businesses that have been issued an NPDES Baseline General Permit by Ecology, and are allowed specific discharges under that permit are exceptions to this requirement. Please refer to R.4 in Chapter 7 to determine if your type of business is required to have a NPDES permit.

If sanitary facilities (such as toilets) are connected to the stormwater drainage system, you must obtain a permit from your local sewer utility and reroute them to the sanitary sewer. If sanitary service is not available, contact the Thurston County Public Health and Social Services Department at (360) 867-2673 for septic permits.

Dye testing with a non-toxic dye is one way to determine where a pipe or structure drains if not obvious by observations or on plans. The dye is put into the structure and flushed with some water. Observations are then made at ends-of-pipes, drainage ditches, catch basins, and manholes to look for the color coming through. Contact Thurston County Department of Resource Stewardship, Water Resources Division (360) 754-4681 if you need assistance in locating structures adjacent to your property.

Smoke testing can also help detect illegal connections and is best done by qualified personnel. To conduct smoke testing, shut off all indoor discharges, place a smoke bomb or other smoke-generating device in a storm drain manhole, and force air in after it. Station personnel at each suspect drain location to observe if smoke is coming out. Identify smoking drains for future rerouting.

Drains which are found to connect to the stormwater drainage system must either be permanently plugged or disconnected and rerouted as soon as possible. Plug unused drains with concrete or similar permanent materials. If a drain pipe is to be rerouted and

a sanitary sewer services the property, then the local sewer provider must be contacted. Restrictions on certain types of discharges, particularly industrial process waters, may require pretreatment of discharges before entering the sanitary sewer. It is the responsibility of the property owner or business operator to follow through on rerouting illicit storm drainage connections to the sanitary sewer.

If the property is not served by a sanitary sewer, alternate measures will be necessary. If the discharge is simply domestic waste, a septic system may be feasible. If it is necessary to install a septic system, the proper permits will need to be obtained from the Thurston County Public Health and Social Services Department at (360) 867-2673. If the discharge is anything other than domestic waste, then a holding tank or on-site treatment will be necessary. Contact LOTT Alliance Industrial Pretreatment Program at (360) 528-5708 or your local sewer service provider for specific directions for installation and disposal.

S.2 Dispose of Collected Runoff and Waste Materials Properly

Every business and residence in Thurston County must dispose of solid and liquid wastes and contaminated stormwater properly. There are generally four options for disposal depending on the type of materials. These options include:

- Sanitary sewer and septic systems
- Recycling facilities
- Municipal solid waste disposal facilities
- Hazardous waste treatment, storage, and disposal facilities.

Many liquid wastes and contaminated stormwater (depending on the pollutants and associated concentrations present) may be put into the sanitary sewer, subject to approval by the LOTT Alliance Industrial Pretreatment Program at (360) 528-5708 or your local sewer service provider.

If wastes cannot be legally discharged to a sanitary sewer or septic system, one of the other three disposal options must be used. Sumps or holding tanks may be useful for storing liquid wastes temporarily. The contents must be disposed of in the sanitary sewer or at a dangerous waste facility depending on the nature of the waste.

Recycling facilities are a recommended option for many commercial and household items, including used oils, used batteries, old equipment, glass, some plastics, metal scrap materials, solvents, paints, wood and land clearing wastes, and various other solid wastes. Solid wastes that cannot be recycled and that are not hazardous must be disposed of at a licensed municipal solid waste disposal facility. The list in Chapter 8 of this volume has the phone numbers and addresses of these facilities in Thurston County.

Dangerous and hazardous wastes must be properly transported to an appropriate hazardous waste treatment, storage, and disposal facility. Included in Chapter 8 is a list of companies dealing in these activities.

Costs of disposal vary considerably from option to option. Especially in the case of dangerous wastes, different types of wastes should be kept segregated. Disposal costs are usually determined by the most hazardous or difficult to dispose of waste present, so you can keep your costs down by not mixing wastes. The Thurston County Department of Public Works (360) 867-2300 can help you determine the best disposal options for your waste.

S.3 Connect Process Water Discharges to a Sanitary Sewer, Holding Tank, or Wastewater Treatment System

This BMP is a core requirement for all industrial and commercial activities that generate contaminated process wastewater, such as washing activities, composting activities, and production and processing activities. The water used in these activities cannot drain to surface waters or groundwater untreated. Process water must drain to a sanitary sewer, holding tank, or wastewater treatment system, or it can be recycled.

The first priority for these businesses is discharge of process water to a sanitary sewer via a new or existing plumbing connection. In order to connect to the sewer, you must contact LOTT Alliance Industrial Pretreatment Program at (360) 528-5708 or your local sewer service provider for information on permits for the connection. Pretreatment of industrial wastewaters will often be necessary before it is allowed to discharge to the sewer, and more information can be obtained by calling the number above.

If a sanitary sewer is not available, or if it is determined that a discharge connection is not allowed, the only remaining options are holding tanks or an on-site wastewater treatment facility. Consideration should be given to using a holding tank for used process water if the volume of process water generated by the activity is not excessive. The contents of the holding tank must be pumped out or drained before the tank is full and disposed of properly (see BMP S.2 in this chapter for information on disposal options). If a sanitary sewer connection cannot be made and a holding tank is not used, a wastewater treatment facility must be constructed on the site. This treatment facility must be designed to receive and effectively treat all discharges of process water from the business. Ecology must be contacted for approval of such a facility, since discharges from the treatment facility will enter surface waters or be spread on land. See Chapter 7 for Ecology's requirements for discharges of process waters.

For all types of process water discharges the following measures are required if the activity is to remain uncovered. Define a designated area for the activity and provide a mechanism for prevention of stormwater run-on into the activity area. This can be a curb, dike, or berm (see BMP S.7 in this chapter for more information) or similar effective means to prevent run-on. In this manner, only the precipitation that falls within the activity area is discharged and/or treated along with the activity process water. The designated area should be paved and sloped to a central collection drain. The collection drain must connect to the sanitary sewer (with pretreatment if required), the on-site holding tank, or the on-site treatment facility, whichever method is selected.

This process water BMP can be made more effective if the activity is covered, thus reducing the total amount of water to be treated.

S.4 Cover the Activity with a Roof or Awning

Not every activity can or needs to be located inside a building. In many cases, a simple roof or awning will protect the activity from coming into contact with stormwater, and usually at a lower cost than a complete building. If you do decide to build one of these structures, you will need to obtain permits from Thurston County Development Services

S.9 Cleaning Catch Basins

Cleaning catch basins regularly (Figure IV - 5.8) is one of the most important stormwater source control measures that a business can take as they are a last line of defense before runoff enters the stormwater conveyance system.



IV - Figure IV - 5.8 Catch Basin Cleaning with a Vacuum Truck.

Catch basins are typically located under low spots in parking lots, along curbs and road edges, and where storm drain pipes combine flows. Catch basins on the surface collect runoff for storm drains that are typically located directly underneath them. Most catch basins have some storage in the bottom that never drains to an outflow pipe. This permanent storage area is intended to trap sediments, debris, and other particles that can settle out of stormwater, thus preventing clogging of downstream pipes and washing of these solids into receiving waters.

Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than 6 inches clearance from the debris surface to the invert of the lowest pipe. Some catch basins (for example, WSDOT Type 1L basins) may have as little as 12 inches sediment storage below the invert. These catch basins will need more frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach. For additional information on the maintenance of catch basins, refer to Volume V, Appendix V-C.

Several companies offer catch basin cleaning services. Pertinent equipment dealers and cleaning services can be found in the telephone Yellow Pages under headings like “Sewer Cleaning Equipment and Supplies” and “Sewer Contractors”. A list of operators

that offer catch basin cleaning services (as well as maintenance for other stormwater BMPs) can be found at <http://www.co.thurston.wa.us/stormwater/facilities/facilities-contractors.html>

All of the solids and stagnant water collected from catch basin sumps must be disposed of properly. None of the sump contents can be flushed into the catch basin outflow pipe. Depending on the nature of the pollutants in the sump, and the associated types of activities taking place on the site, the sump contents may need to be disposed of as hazardous waste. Contractors who perform catch basin cleanout services will be required to follow specified disposal requirements.

The use of other BMPs, such as frequent sweeping of activity areas, covering activity areas, reducing activity occurrence, and containing runoff from activity areas will help reduce catch basin cleaning frequency, thus saving time and money. All businesses and agencies should set up maintenance schedules for all of their BMPs so that coordinated BMP maintenance efforts result in reduced catch basin cleaning frequencies.

S.10 Labeling Storm Drain Inlets On Your Property

Description of Pollutant Sources: Waste materials dumped into storm drain inlets can have severe impacts on receiving waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Pollutant Control Approach: The stencil, affixed sign, or metal grate contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Required BMPs

- Label storm drain inlets in residential, commercial, industrial areas, and any other areas where contributions or dumping to storm drains is likely.
- Stencil or apply storm drain markers adjacent to storm drain inlets to help prevent the improper disposal of pollutants. Or, use a storm drain grate stamped with warnings against pollution.
- Place the marker in clear site facing toward anyone approaching the inlet from either side.
- Use a brief statement and/or graphical icons to discourage illegal dumping. Examples include:
 - “No Dumping – Drains to Stream”

- “No Pollutants – Drains to Puget Sound”
- “Dump No Waste – Drains to Lake”
- “No Dumping – Puget Sound Starts Here”
- Thurston County requires the installation of storm drain markers at all storm drain inlets. Contact the Thurston County Water Resources Division at 360-754-4681 for information on how to obtain approved markers.
- Maintain the legibility of markers and signs. Signage on top of curbs tends to weather and fade. Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.
- When painting stencils or installing markers, temporarily block the storm drain inlet so that no pollutants are discharged from the labeling activities.

S.11 Color Events

Description of Pollutant Source: Color events are charity, religious, or commercial events that involve the use of powdered (typically cornstarch-based) and/or liquid dyes. Because they typically occur outside, there is a high likelihood of the color material entering drainage systems and surface water unless measures are taken to prevent these illicit discharges from occurring.

“Biodegradable” and “non-toxic” do NOT mean a substance can go into storm drains or water bodies. The dye material can harm aquatic organisms by altering water quality and chemistry. State and Federal environmental laws require the county to prohibit non-stormwater discharges to storm drains. Dye material and any wash water are prohibited discharges

Pollutant Control Approach: Plan for the event. Control the application areas for the powder or liquid dyes. Block off storm drain inlets prior to the event. Clean up the areas immediately after the event.

Required BMPs

Pre-Event:

- Create a map of your event that includes the following:
 - Event route.
 - Nearby streams, lakes, and ponds.
 - Start and finish areas.

ATTACHMENT D

INTEGRATED PEST MANAGEMENT PLAN

INTEGRATED PEST MANAGEMENT GUIDANCE

Integrated Pest and Vegetation Management (IPM) is a natural, long-term, ecologically-based systems approach to controlling pest populations. IPM is used to reduce pest populations, maintain them at levels below those causing health concerns or economic damage. The goals of IPM are to both encourage optimal selective pesticide use (away from prophylactic, broad spectrum use), and to maximize natural controls to minimize environmental side effects.

Thurston County requires Integrated Pest Management Plans for certain land use projects located in Category I or II Aquifer Recharge Areas, where drinking water sources are vulnerable to contamination. These include:

1. Subdivisions of 10 lots or greater (excluding large lots).
2. Any land use project that incorporates maintained open space totally more than five acres.
3. All land use projects located within a delineated wellhead capture zone for a Group A public water supply.

For more information on Thurston County's IPM policy, visit the County web site at:

<http://www.co.thurston.wa.us/health/ehipm/index.html>

Introduction

True integrated pest and vegetation management is a powerful approach that anticipates and prevents most problems through appropriate cultural practices and careful observation. Knowledge of the life cycles of host plants and both beneficial and pest organisms is also important. The integrated pest management section of this guidance is adapted from *Least Toxic Pest Management for Lawns* by Sheila Daar. Following the integrated pest management process gives you the information you need to minimize damage by weeds, diseases, and pests and to treat those problems with the least toxic approaches.

The IPM Process

Step One: Correctly identify problem pests and understand their life cycle.

Learn more about the pest. Observe it and pay attention to any damage that may be occurring. Learn about the life cycle. Many pests are only a problem during certain seasons, or can only be treated effectively in certain phases of the life cycle.

Step Two: Establish tolerance thresholds for pests.

Every landscape has a population of some pest insects, weeds, and diseases. This is good because it supports a population of beneficial species that keep pest numbers in check. Beneficial organisms may compete with, eat, or parasitize disease or pest organisms. Decide on the level of infestation that must be exceeded before treatment needs to be considered. Pest populations under this threshold should be monitored but don't need treatment. For instance, European crane flies usually don't do serious damage to a lawn unless there are 25 to 40 larvae per square foot feeding on the turf in February (in normal weather years). Also, most people consider a lawn healthy and well maintained even with up to 20 percent weed cover, so treatment, other than continuing good maintenance practices, is generally unnecessary.

Step Three: Monitor to detect and prevent pest problems.

Regular monitoring is a key practice to anticipate and prevent major pest outbreaks. It begins with a visual evaluation of the lawn or landscape's condition. Take a few minutes before mowing to walk around and look for problems. Keep a notebook, record when and where a problem occurs, then monitor for it at about the same time in future years. Specific monitoring techniques can be used in the appropriate season for some potential problem pests, such as European crane fly.

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

A healthy landscape is resistant to most pest problems. Lawn aeration and over-seeding along with proper mowing height, fertilization, and irrigation will help the grass out-compete weeds. Correcting drainage problems and letting soil dry out between waterings in the summer may reduce the number of crane-fly larvae that survive.

Step Five: If pests exceed the tolerance thresholds ...

Use cultural, physical, mechanical, or biological controls first. If those prove insufficient, use the chemical controls described below that have the least non-target impact. When a pest outbreak strikes (or monitoring shows one is imminent), implement integrated pest management then consider control options that are the least toxic, or have the least non-target impact. Here are two examples of an integrated pest management approach:

1. **Red thread disease** is most likely under low nitrogen fertility conditions and most severe during slow growth conditions. Mow and bag the clippings to remove diseased blades. Fertilize lightly to help the grass recover, then begin grasscycling and change to fall fertilization with a slow-release or natural-organic fertilizer to provide an even supply of nutrients. Chemical fungicides are not recommended because red thread cannot kill the lawn.
2. **Crane fly damage** is most prevalent on lawns that stay wet in the winter and are irrigated in the summer. Correct the winter drainage and/or allow the soil to dry between irrigation cycles; larvae are susceptible to drying out, so these changes can reduce their numbers. It may also be possible to reduce crane fly larvae numbers by using a power de-thatcher on a cool, cloudy day when feeding is occurring close to the surface. Studies are being conducted using beneficial nematodes that parasitize the crane fly larvae; this type of treatment may eventually be a reasonable alternative.

Only after trying suitable non-chemical control methods or determining that the pest outbreak is causing too much serious damage, should chemical controls be considered. If chemical controls prove necessary, determine what products are available and choose a product that is the least toxic and has the least non-target impact. Refer to the operational BMPs for the use of pesticides below for guidelines on choosing, storing, and using lawn and garden chemicals.

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

Keep records! Note when, where, and what symptoms occurred, or when monitoring revealed a potential pest problem. Note what controls were applied and when, and the effectiveness of the control. Monitor next year for the same problems. Review your landscape maintenance and cultural practices to see if they can be modified to prevent or reduce the problem.

A comprehensive integrated pest management program should also include the proper use of pesticides as a last resort, and vegetation/fertilizer management to eliminate or minimize the contamination of stormwater.

INTEGRATED PEST MANAGEMENT PLAN

for

WEST OLYMPIA DEVELOPMENT
THURSTON COUNTY, WASHINGTON

March, 2024

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1.0 Introduction

This Integrated Pest Management Plan (IPMP) describes pest control methods and ongoing management guidelines to be employed by residents, owners and/or managers, employees and landscape professionals within the West Olympia Development in Thurston County, Washington. The residents, owners and management of the buildings within the West Olympia Development are responsible for the continued implementation and oversight of this plan because the facilities are located in a group A wellhead protection area.

The intent of the IPMP is to provide residents, owners and managers with guidelines to govern pest control methods within the development. The major goals of the IPMP are two-fold: to provide a structured process for pest management and to minimize the amount of chemical application within the West Olympia Development properties by emphasizing prevention and encouraging non-chemical methods of pest control in an effort to protect the Group A wellhead. This approach will aid in minimizing adverse environmental impacts, primarily groundwater contamination of the water system.

Effective pest management attempts to keep properly identified pest populations below a certain population or damage level, starting with the safest control methods. Successful implementation of the IPMP will require ongoing communication and cooperation between residents, owners, managers, employees and trained professionals. All employees will be given a copy of the IPMP for the West Olympia Development, and management will also provide educational materials to inform employees on various aspects of pest management. The appropriate professional consultant(s) shall be retained when necessary to provide assistance in implementing the plan.

2.0 Pests

Within this IPMP, a pest is defined as an unwanted plant, animal, disease, or organism intrusion into the development that is desired or required to be removed or controlled by the owners, management or Thurston County.

3.0 Existing Site Location and Features

The West Olympia Development consists of dividing an 11.28-acre parcel into thirty single family lots, one four-unit townhome, one three-unit townhome, and one two-unit townhome. The site is located in the Olympia UGA of Thurston County off of 24th Ave NW.

According to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), the on-site soils are characterized to be Alderwood gravelly sandy loam, 0 to 20 percent slopes. These soils are part of hydrologic soil group C and have an infiltration rate of 0.6 to 2.6 inches/hour. A full geotechnical report has been provided in the Drainage Report as Appendix 6.

The proposed West Olympia Development will create both treatment and flow control facilities. In the northern middle portion of the proposed development, a Modular Wetland System will collect and treat most of the stormwater runoff generated from the pollution generating hard surfaces and will discharge into the wetland buffer using an

energy dissipator. On the southeastern side of the wetland, a second Modular Wetland System will collect and treat the rest of the PGHS runoff and will discharge into the buffer via a flow dispersal trench. The roof runoff from majority of the lots will be tightlined and discharged to a rock-lined protection outfall into the buffer. The roof runoff from the eastern lots will be tightlined to an infiltration trench on each lot where the stormwater will fully infiltrate.

4.0 Management Area Objectives

From the standpoint of an IPMP, there will be one management area for the parcel. Landscape professionals will likely be hired and along with the residents will maintain all areas within the West Olympia Development and provide pest inspections to ensure that these tasks are being performed regularly and thoroughly.

5.0 Control Methods

There are five main methods for controlling pest populations:

- | | |
|--------------------------------|--|
| 1. <i>Cultural Controls:</i> | Methods that require an understanding of the culture of individual plant species or turfgrasses. Adequate site preparation, efficient use of water, need for aeration, and timing, selection, and efficient use of fertilizers are all examples of cultural control methods. |
| 2. <i>Mechanical Controls:</i> | Methods that require labor-intensive actions such as mowing, hoeing, and hand weeding. |
| 3. <i>Physical Controls:</i> | Methods that alter the site to prevent insect damage such as manual removal and destruction of pests, traps, and barriers. |
| 4. <i>Biological Controls:</i> | Methods include naturally occurring organisms such as predators and parasitoids, as well as naturally occurring and introduced microbial products. |
| 5. <i>Chemical Controls:</i> | Include insecticides, fungicides, herbicides, and other chemicals intended to control, prevent, or repel pests if used properly. |

The overlying theme of the IPMP is emphasis on prevention as the best and most efficient means of pest control. Prevention of potential pest problems is best accomplished through use of cultural controls. Mechanical and physical controls also aid in prevention by removing potential pests before populations can increase and spread. Chemical and biological control methods should be used as the last line of defense, and should only be considered after other control methods have been exhausted. Oftentimes, chemical and biological controls do more harm than good by reducing both pest and beneficial organisms in the control process.

Combinations of these methods can also prove useful depending upon the specific situation. It is important to state that this Integrated Pest Management Program does not attempt to eradicate a pest, since in most instances it is desirable to allow the pest to survive in lower numbers in order to maintain the presence of natural predators.

6.0 Implementation Strategies

An IPMP is by nature dynamic and should change over time as specific control strategies within the community are implemented and evaluated. Ongoing development of an IPMP should involve periodic review of five principal components:

1. Prevention
2. Identification
3. Inspection
4. Thresholds for Control
5. Appropriate Control Actions

These steps are further described below.

6.1 Prevention

Prevention provides the best line of defense against potential pest problems and is the least costly. Many pest problems in landscapes can be avoided by selecting plants with known pest resistance and avoiding those plants that are known to be susceptible. To minimize the use of pesticides and fertilizers, at least 75% native species and/or drought tolerant plants shall be planted. Selecting indigenous plants provides the owner with an additional line of defense against pests, since most of these plants are resistant to local pest populations. The Thurston County Local Hazardous Waste Program has prepared a native and drought tolerant plant list that is available at the Thurston County courthouse and the WSU Cooperative Extension Office (360) 867-2189.

Other elements such as proper soil preparation, planting, irrigation, and mulching techniques discourage the presence of pest populations. Many symptoms resulting from inadequate prevention measures are incorrectly attributed to the presence of pests. This can result in needless chemical applications that fail to address the actual problem and contribute to groundwater contamination.

6.2 Identification

Proper identification of the pest or symptom affecting a given plant or plants is an essential step before determining the proper control action. Owners and managers should take responsibility to familiarize themselves with common indicators of pest problems and/or consult with a professional. There are several professional resources within the community to aid in the identification of pests. Landscape contractors such as ecoPro Certified Sustainable Landscape Professionals, nursery professionals, and the Master Gardeners at the WSU Cooperative Extension Office are all valuable resources that can identify pests and recommend appropriate control methods based upon their expertise. Although they should not be relied upon alone, reference books also provide another valuable resource in diagnosing or identifying a potential pest problem.

Before applying any control methods, the owner, manager or professional must determine whether action is needed or is likely to be effective. Affected plants should be evaluated in terms of their value in the landscape. It is possible that the value of the plant is much less important and could be replaced with less effort than chemical application. It may be too late for a control to be effective, or the problem may be minor. In some situations, no action may be the best alternative. If action is needed, control methods can be used individually or in combination. Priority should always be given to non-chemical control methods.

6.3 *Inspection*

Owners and managers should establish a schedule for systematically surveying their landscape for pests and damage evidence. This is an important activity and should be performed on a regular basis. By performing regular inspections, potential pest problems are controlled much easier than if the given pest has time to propagate and spread to other locations. It is recommended that a landscape professional be hired to regularly inspect landscape areas throughout the properties. Inspections should be more frequent in Spring and Summer months, which are the principal times for pest activity.

6.4 *Thresholds for Control*

Many pests do not actually kill plants, but simply make them unsightly. Landscaped areas will be maintained by a professional with the ability to provide an assessment of the existing state of the area and recommend management practices for the future. Such professional can recommend the point at which some level of control should be taken. Knowing when a plant is approaching such a threshold may influence its treatment as well, since the problems are best treated at a particular time of year, or by a particular combination of controls.

6.5 *Appropriate Control Actions*

Determining the success of a given treatment is essential in any modification of the IPMP. Comprehensive records shall be kept by the chosen professional. Complete records shall be kept for all treatment strategies in order to evaluate both short and long term success. Information to be recorded will include:

- Identification of the pest
- Location and size of affected areas
- Recent weather including rainfall and temperature
- Previous control methods
- Control method to be implemented
- Dates of implementation
- Observed changes in condition after treatment

Such detailed record-keeping will aid subsequent landscape professionals in fine-tuning treatment strategies.

7.0 *Recommended BMPS*

Adequate site preparation is essential for the successful implementation of the IPMP. Upper layers of topsoil should be removed from foundation and road areas and

stockpiled. This topsoil may then be reapplied to landscape areas as needed. In areas with little or no topsoil, soil amendments such as compost or well-aged manure should be added in a layer between 6 and 12 inches thick. This organic material should then be tilled into the soil thoroughly. The added organic material will serve to enrich the nutrient value of the soil, retain moisture, and filter impurities. After landscape is installed, the beds will be covered with 2-4" of compost. It is suggested that the beds receive additional compost or bark annually to retain soil moisture, provide nutrients, and help prevent weed growth.

In areas with existing noxious weed species such as Scotch broom and Himalayan blackberry, plants will be removed to an off-site dump. These plants will be mechanically pulled prior to excavation to remove as much of the below ground root system as possible. Contractors conducting site work should be mindful of cleaning their equipment prior to completing their work to avoid the spread of noxious weeds from site to site.

8.0 Irrigation Practices

Excess watering accelerates the movement of fertilizers and chemical residues through the soil before plants can fully benefit and can contribute to the presence of pests. Water requirements vary due to a variety of factors. After a watering schedule has been established, it is useful to remove a shovel full of soil between waterings and inspect the depth of watering being achieved. Soils that are excessively wet beyond plant root zones could benefit from less water and soils that remain excessively dry following watering may benefit from adding organic material that absorbs water. As a rule of thumb, watering schedules should be less frequent but with longer run times.

- Irrigation systems should be properly adjusted to water plants exclusively at a rate of 1" per week and adjusted to include rainfall.
- Watering should occur during early morning hours to reduce evaporative losses and minimize fungal problems in turfgrasses.
- During extreme drought conditions, watering will be restricted to priority plantings such as trees and shrubs.

Irrigation systems must be well adjusted in applying water only to plants, not to pavement. After plants are established, readjust the irrigation system watering frequency to account for deeper root systems.

9.0 Fertilizing Options

All plants need a supply of nutrients in addition to light, air and water for proper growth and development. Three main elements are responsible for proper plant development: nitrogen, phosphorus and potassium.

Nitrogen

Nitrogen is the element needed in the greatest quantity by plants. All nitrogen used by plants comes from combinations of organic matter, air, and commercial fertilizers and is responsible for most of the visible growth of plants. Nitrogen is found in forms that are either immediately available to plants (soluble or quick release forms) or not immediately available to plants (insoluble or slow release).

Due to the chemical nature of nitrogen, it is leached quickly and readily from the soil.

Phosphorus

Phosphorus is associated with root development in plants. The most effective method of applying a fertilizer containing phosphate is to concentrate it within the root zone. It is less mobile in most soils than nitrogen, but should be used sparingly to avoid overloading the soil or water with excess nutrients. In Washington State, phosphorus is not permitted in lawn fertilizer due to water pollution concerns (RCW 15.54.500).

Potassium

Potassium is an element also commonly referred to as potash. Potassium aids in the flowering and fruiting of appropriate plants and aids in a plant's ability to withstand stress. Potassium can also be leached from the soil like nitrogen and phosphorus.

Both organic mulches and commercial fertilizers contain these elements, as well as several trace elements required by plants in much smaller quantities. Excess irrigation and high rainfall can leach these nutrients from the soil.

9.1 Organic Mulches

Organic mulches such as barks and composts provide several advantages when compared to commercial fertilizers. The first advantage is that organic mulches provide a well-rounded nutrient source for most plant material and take the guesswork out of using the "right" combination of synthetic fertilizers. These mulches can be applied in the Fall and/or Spring and release nutrients slowly to plants as they break down. This provides most plants with a year-round nutrient source. As organic mulches decompose, they add structure to soils and provide greater moisture retention and help to regulate temperature extremes within the soil. The other benefit is that organic mulches slow the movement of water through the soil by their ability to absorb and retain water. For these reasons, organic mulches are the most preferable means of increasing nutrient levels within soil.

9.2 Fertilizers

Regardless of the specific types, fertilizers should only be applied when it becomes evident that a nutrient deficiency exists. Thurston Conservation District offers soil testing services and can recommend fertilizing rates and timing. Organic mulches will provide adequate quantities of nutrients to plants in the majority of situations and should be applied before fertilizers are considered. Fertilizer applications should not be used during the high rainfall winter season. Of the commonly applied fertilizers, application of excess soluble nitrogen constitutes the most serious risk to groundwater supplies.

Commercial fertilizers come in a variety of formulas and forms. These fertilizers usually come in dry or liquid forms that are applied directly to the surface of the soil. These fertilizers are available in quick and slow-release formulas. Slow-release fertilizers are less likely to cause water pollution problems, an important consideration due to the site location in a wellhead protection area. Quick release fertilizers contain forms of nitrogen

phosphorus and potassium that are readily available to plants. The advantage of this type of fertilizer is that a known nutrient deficiency can be corrected relatively quickly. However, quick release fertilizers should be used only in situations where a specific plant nutrient deficiency is evident. These types of fertilizers migrate quickly through the soil and provide little or no benefit to the plant if excess water is applied. Groundwater supplies may be contaminated by readily leached nutrients. It is recommended that quick release formulas be applied during periods of active plant growth and only when a nutrient deficiency can be determined.

In contrast, slow release fertilizers are applied as infrequently as once a year, ideally at the end of the rainy season. These fertilizers continuously break down, providing nutrients to plants year round. For this reason, it is much more difficult for slow release fertilizers to migrate through soil into the groundwater.

9.3 *Application Guidelines*

The following guidelines should be utilized when considering use of commercial fertilizers:

- Avoid needless applications of fertilizer. For lawns, mulching mowers return cut grass to the ground and can provide up to one-third of the entire nitrogen requirement of the lawn. When fertilizing is appropriate, avoid heavy applications of quick release fertilizers, especially in lawn areas. Rather, consider the use of a natural lawn fertilizer. Natural lawn fertilizers are slow-release, require fewer applications, and provide more uniform growth.
- In lawn areas, apply lighter rates of fertilizer more often. This practice is much more effective than applying heavy rates less often. As an example, one pound of soluble nitrogen per 1,000 square feet applied once a month poses less risk to groundwater than two pounds of soluble nitrogen per 1,000 square feet applied every two months.
- To fertilize a lawn properly, it is important to first determine the square footage of the lawn area to be fertilized. Once the square footage of lawn areas has been established, a good rule of thumb is to apply one- to four pounds of nitrogen per 1,000 square feet of lawn per year. It is recommended that lawn fertilizing be applied four times a year during the months of April, June, September and November. As a guideline, no more than one-half pound of soluble nitrogen per 1,000 square feet should be applied in any single application.
- It is possible to maintain a healthy lawn by using a natural lawn fertilizer once a year in September. If fertilizing twice a year, an additional application should be made in May.
- Avoid over-watering lawns immediately after applying fertilizer. A preferred alternative is to irrigate the lawn thoroughly a day or two before fertilizing

and water briefly after application – just enough to wash the fertilizer off the leaves and into the soil.

- Do not use “weed and feed” type fertilizers, which contain pre-emergent herbicides, on lawn areas.

10.0 Weed Control

Mechanical and cultural control methods are the preferred means of weed control within the West Olympia Development. These methods include combinations of hand pulling, tilling, installation of weed barriers, and application of organic mulch. These control methods are preferable to using herbicides, since herbicides may harm desirable plants and contaminate groundwater supplies. Chemical weed control is appropriate only in situations where mechanical and cultural means of control have been proven ineffective. If chemical weed control becomes appropriate, the following guidelines should be followed:

- Use www.GrowSmartGrowSafe.org to help select the least hazardous pesticide if needed. Do not use products rated high and moderate hazard for water pollution due to the location in a wellhead protection area. Products that are effective and environmentally friendly should be selected.
- Applications should be timed to provide for best results. Product label directions must be followed.
- Applications should be made during windless periods at least four hours before probable rainfall, and early in the morning before the day heats up.
- “Weed and feed” type fertilizers which contain pre-emergent herbicides shall not be used on lawn areas.
- Use of herbicides must be recommended and applied by a licensed professional.

11.0 Fungicides

Most fungi occupy areas with very specific environmental conditions. The progression of their life cycles is also very specific. For these reasons, fungicides should not be applied to vegetation until a professional has diagnosed the presence of a fungal infestation. The timing of watering can reduce many fungal infestations of plant foliage. Watering in the early morning will allow water standing on leaf surfaces to evaporate during the day and prevents the propagation of many leaf fungi. Careful attention to soil moisture levels can reduce the presence of fungi in the soil. Like other plant care chemicals, fungicides can also contribute to groundwater contamination. Once a professional has identified a fungus is present, a recommended treatment program, which may or may not involve fungicides, can be implemented and evaluated for effectiveness. Any use of chemicals shall be documented.

12.0 Insecticides

Insecticides should only be used when the level of infestation poses a threat to the life of the plant. Proper identification of the insect is the first step in controlling the problem. There are many beneficial insects which can help with pest control. See pictures of beneficial insects and strategies to help them to thrive in your landscape at www.GrowSmartGrowSafe.org. By identifying the insect, the professional can explore cultural means of controlling the insect by modifying the environment that may favor its presence. If insecticide application is recommended, it should begin with less toxic products. Use www.GrowSmartGrowSafe.org to help select the least hazardous pesticide if needed. Do not use products rated high and moderate hazard for water pollution due to the location in a wellhead protection area. Most insecticides are not specific. When applied, these insecticides don't distinguish between a pest and a beneficial insect, and, for this reason, often do more harm than good. Insecticidal soaps are effective against a variety of insects and should be used carefully and sparingly for the same reason. The advantage of insecticidal soaps is that they are safer for the environment when compared to their counterparts.

13.0 Chemical Application Practice

Any outbreaks of fungal disease or insect infestation should be recorded and subsequently monitored to see if the outbreak increases. A period of three weeks should be allowed after any pesticide application to monitor the effect of the application. Pesticide applications should not be made at a higher frequency than once every three weeks. Treated areas will be posted to notify residents of the application of pesticides. Any professional consultant or employee who applies pesticides shall be licensed by Washington State Department of Agriculture as a Public Pesticide Operator or Public Pest Control Consultant.

14.0 Products to Avoid

All recommendations in this IPMP regarding use of chemicals must also be followed by landscape professionals working within the West Olympia Development. Professionals will be required to adhere to this IPMP regardless of their possession of a state pesticide applicator's license with legal ability to handle restricted pesticides. Landscape contractors will avoid materials described herein when working within the West Olympia Development. A number of pesticides listed in the EPA National Pesticide Survey's *Leach List* (1998) are unrestricted chemicals. These have high potential for leaching into groundwater.

The use of the following common pesticides on the EPA list, and the use of any other "leacher" is not permitted in the community. Product labels should be consulted to determine whether these chemicals are present:

- Acephate
- Amitrol
- Altrazine
- Baygon
- Bentazon
- Carbaryl
- Chloropyrifos

- 2,4-D
- DDDVP
- Diazinon
- 1,2-Dichloropropene
- Cis-1,3-Dichloropropene
- Trans-1,3-Dichloropropene
- Dieldrin
- Dicamba
- Picloram
- Pramitol
- Simazine
- 2,4,5-T
- Triclopyramine

15.0 Storage and Handling of Chemicals

Generally, all landscape maintenance chemicals are toxic and should be handled with care. All label requirements must be followed and only those chemicals recommended and approved for controlling the pest should be used. The following policies shall be followed in the community:

- Wear protective clothing when mixing and applying chemicals.
- Store chemicals in a dry place inaccessible to children, pets, or desirable organisms.
- Keep containers well marked and tightly closed.
- Save empty containers for disposal at a hazardous waste collection center.

16.0 Hazardous Material Use, Storage and Disposal

Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).

Maintenance and repair of heavy equipment and vehicles involving 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 must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Spills should be reported to 911. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations shall be followed for application rates and procedures.

Employees and residents are advised to avoid skin contact with hazardous materials such as oil, pesticides and household solvents and to wear gloves and use kitty litter or sawdust to absorb spills. All hazardous materials must be stored in water-tight

containers and taken to the Hazo House at the Thurston County Waste and Recovery Center at 2418 Hogum Bay Road NE in Lacey. Hazo House is open daily from 8:00 a.m. – 4:45 p.m. and is free for Thurston County residents, businesses must register and pay a fee.

17.0 Monitoring

As noted above, detailed record keeping is valuable in assessing the success of a particular IPMP treatment. Landscape professionals working at the West Olympia Development are required by law to keep careful records of chemical use.

Records of pesticide applications are required to be kept for a minimum of 20 years and will include:

- Date and time of pesticide application;
- Specific location of application;
- Purpose of application (target species);
- Material, lot number, EPA registration number, amount, rate, and concentration used;
- Method of application;
- Temperature, wind speed and direction, weather conditions;
- Applicator's name and operator's license number;
- Evaluation of results.

18.0 IPMP Amendments

Since a management plan can only be as effective as its constituent elements, it may be necessary to modify those elements as environmental factors or site specific conditions dictate. Such changes may be necessary to better direct pest management efforts as well as modify procedural directives identified in the IPMP. Any proposed changes to the IPMP will be submitted to Thurston County for review and approval prior to implementation.

ATTACHMENT E

ANNUAL REPORT CHECKLIST

SOURCE CONTROL ANNUAL REPORT CHECKLIST

Your stormwater pollution prevention plan should be reviewed at least annually and updated as required. The following checklist should be completed and submitted to Thurston County along with the annual report required as part of your Stormwater Maintenance Agreement with Thurston County. If your project did not require a Stormwater Maintenance Agreement and Maintenance Plan then submittal of this annual report is not required. If submittal is required it should be mailed or hand delivered to: Thurston County Stormwater Utility; 9605 Tilley Rd S, Ste. C; Olympia, Washington 98512.

BUSINESS NAME: _____

ADDRESS: _____

ASSESSOR'S PARCEL NUMBER: _____

COMPLETED BY: _____

SIGNATURE: _____

DATE: _____

√	ACTIVITY	NOTES
	Review Activity Checklist (Attachment A) – Verify still current. List any new activities.	
	Review and Update Attachment B if new activities are identified.	
	Review and Update Table 2 for New Activities	

√	ACTIVITY	NOTES
	Was any employee training held? If so describe.	
	Review Table 2 and verify compliance. Attach copy indicating each item has been checked.	
	Describe any significant events such as spills, illicit discharges detected/fixed, etc.	
	Was catch basin cleaning conducted? If so when, and by what company.	
	Conduct visual inspection of property for evidence of leaks, improper operations, etc. Note any items requiring attention.	
	Is a copy of Table 2 posted where visible to employees?	

√	ACTIVITY	NOTES
	Have any additional structural or treatment BMPs been implemented on the site since the last annual report was submitted? If so describe.	
	Any other items related to stormwater source control not noted above? Describe.	
	Do you desire any technical assistance from Thurston County related to stormwater issues? If so, indicate contact person and phone number.	

ATTACHMENT F

QUICK REFERENCE PHONE NUMBERS AND WEB SITES

PHONE NUMBERS

Environmental Protection Agency (U.S. EPA) – Region X	800-424-4372
Thurston County:	
Water Resources Division, Stormwater Utility	360-754-4681
Department of Public Works	360-867-2300
After-hours water and sewer emergencies (paging service)	800-926-7761
Thurston County Waste Line (automated information)	360-786-5494
LOTT Alliance Industrial Pretreatment Program	360-528-5708
Development Services – Permits	360-786-5490
Weed Control/ Noxious Chemical Use	360-786-5576
Thurston County Public Health and Social Services Department:	
On-Site Sewage	360-867-2673
Asbestos Removal	360-867-2664
Hazardous Waste Section	360-867-2664
Solid Waste	360-867-2664
University of Washington Center for Urban Water Resources	253-254-7030
Washington State Department of Agriculture	360-902-2010 877-301-4555
Washington State Department of Ecology	360-407-6000
Southwest Regional Office	360-407-6300
Dangerous/Hazardous Waste	360-407-6300
NPDES Stormwater or Wastewater Permits	360-407-6400
Spill Reporting	800-424-8802
Recycling	800-732-9253
Groundwater Quality and Protection	360-407-6400
Underground and Aboveground Storage Tanks	360-407-7170
Washington State University/Thurston County Cooperative Extension	360-867-2151
Industrial Materials Exchange	206-263-8899
Nisqually Tribe	360-456-5221
Confederated Tribes of the Chehalis	360-273-5911
Olympic Region Clean Air Agency (ORCAA)	800-422-5623
Underground Utility Locate “Call Before You Dig”	800-424-5555

WEB PAGES

Washington State Departments:

Washington State Department of Ecology - Stormwater Home Page
<http://www.ecy.wa.gov/programs/wq/stormwater/index.html>

Washington State Department of Health
<http://www.doh.wa.gov/>

Washington Department of Fish and Wildlife
<http://wdfw.wa.gov/>

Washington State Government Information and Services
<http://www.access.wa.gov/>

Washington State Department of Ecology – Flood Information
<http://www.ecy.wa.gov/programs/sea/floods/>

Washington State Department of Ecology - Digital Coastal Atlas
<http://fortress.wa.gov/ecy/coastalatlas>

Federal Departments:

Federal Emergency Management Agency (FEMA)
<http://fema.gov/>

U.S. EPA Office of Water, Academy 2000
<http://epa.gov/watertrain/>

U.S. Geological Survey (USGS) Departments:

USGS Historical Water Resource Data
<http://wa.water.usgs.gov/realtime/historical.html>

USGS National Water Information System (NWISWeb)
<http://water.usgs.gov/nwis/>

Water Quality and NPDES:

Natural Resources Conservation Service (NRCS) and U.S. Department of Agriculture (USDA)
<http://www.nrcs.usda.gov/>

National Climatic Data Center Data Archive

<http://www.ncdc.noaa.gov/>

National Weather Service Hydrologic Forecasts (River Flooding)

<http://water.weather.gov/ahps/>

USGS Real Time Gauging Info

<http://wa.water.usgs.gov/realtime/current.html>

U.S. Army Corps of Engineers Real Time Gauge Info

<http://rivergages.mvr.usace.army.mil/WaterControl/new/layout.cfm>

The Central Puget Sound Water Suppliers' Forum

<http://www.ci.seattle.wa.us/Forum>

Thurston County:

Thurston County Homepage

<http://www.co.thurston.wa.us/home/index.asp>

Thurston County Stormwater Utility (Public Works)

<https://www.thurstoncountywa.gov/sw>

Thurston County Water Planning (Community Planning & Economic Development)

<https://www.thurstoncountywa.gov/planning/Pages/water-gateway.aspx>

Thurston County Mapping

<http://www.geodata.org>

Thurston Conservation District

<http://www.thurstoncd.com/>

Other Agencies:

Thurston County Public Health and Social Services

<http://www.co.thurston.wa.us/health/ehadm/index.html>

NWS River Forecast Center - Flood Outlook

<http://www.nwrfc.noaa.gov/river/fop.cgi>

NOAA Tide and Current Predictions

https://tidesandcurrents.noaa.gov/tide_predictions.html

APPENDIX 6

SOILS REPORT



March 3, 2023

RJ Development
401 Central St SE
Olympia, Washington 98501
Attention: Caleb Perkins

Report
Geotechnical and Stormwater Investigation
Proposed Multi-Family Development
2000 24th Avenue NW
Olympia, Washington
Project No. 901-003-01

INTRODUCTION

Insight Geologic is pleased to present our report on the subsurface conditions as they pertain to geotechnical properties and the infiltration of stormwater at the site of your proposed multi-family residential development to be located at 2000-24th Avenue NW in unincorporated Thurston County, Washington. The location of the site is shown relative to surrounding physical features in the Vicinity Map, Figure 1.

We understand that the project site consists of a single parcel of property totaling approximately 11 acres. The site is wooded in the western portion and used for pasture and livestock holding in the eastern portion. The eastern portion also contains a single-family residence.

SCOPE OF SERVICES

The purpose of our services was to evaluate subsurface conditions as they pertain to stormwater infiltration and geotechnical parameters for the proposed project. The specific tasks conducted are as follows:

Stormwater Investigation

1. Provide for the location of subsurface utilities on the site. We performed this task by notifying the "One Call" system.
2. Drilled four borings across the site to evaluate depth to groundwater using a track-mounted drilling rig. The borings were extended to a depth of about 16 feet or until the underlying glacial till was encountered.
3. Installed four 1-inch diameter monitoring wells constructed of PVC casing. The wells were finished inside locking steel covers installed flush with the surrounding grade.
4. Collected soil samples continuously during drilling to the full depth of the borings.

5. Maintained logs of the soils encountered in the boreholes and provided well construction details. Soils were described in general accordance with the Unified Soil Classification System and presented on the field logs.
6. Conducted laboratory testing on selected soil samples for determination of a design stormwater infiltration rate for the site.
7. Conducted an evaluation of stormwater infiltration rates using the detailed method outlined in the 2022 Thurston County Drainage Design and Erosion Control Manual and provide a design infiltration rate for stormwater infiltration.

Geotechnical Investigation

8. Excavated a series of eight exploratory test pits across the site using a small, track-mounted excavator. The test pits were excavated to a depth of between 4 to 9 feet below ground surface and backfilled with the excavated soil.
9. Logged the soils encountered in the test pits in general accordance with the Unified Soil Classification System and presented on the field logs.
10. Obtained representative soil samples from the test pits for laboratory testing.
11. Conducted laboratory testing on selected soil samples. We performed grain size analysis and moisture content to evaluate geotechnical parameters of the soil.
12. Prepared a report summarizing our field activities and providing our recommendations as to clearing activities, suitability of onsite soil for use as fill, Seismic Class, bearing capacity, foundation recommendations, retaining wall recommendations, infiltration rates and paving recommendations.

FINDINGS

Surface Conditions

The project site consists of a single rectangular parcel of land with an area of approximately 11.28 acres. The site is situated at an elevation of approximately 212 to 226 feet above mean sea level and the east half of the site is developed with a residential structure, barns, associated outbuildings, and fenced paddocks for sheep and goats. The west half of the site is undeveloped woodland and wetland. The site is accessed by 24th Avenue NW along the southeast corner of the parcel. Other residential properties abut the subject property on all sides. The site is gently sloping from elevated areas on the east half and west edge of the site to a low area near the central portion of the site containing a mapped wetland.

Geology

Based on our review of available published geologic maps, Vashon age glacial till underlie the project site and surrounding area. The glacial till consists of an unsorted mixture of silt, sands, and gravel that was deposited at the base of the advancing glacier, and was subsequently glacially compacted.

Subsurface Explorations

We explored subsurface conditions at the site on January 6 and February 3, 2023, by excavating eight test pits and advancing four borings in the locations as shown on the Site Plan, Figure 2. The test pits

were excavated using a track-mounted excavator. The exploratory borings were completed by Standard Environmental Probe using a track-mounted, direct-push drill rig. A geologist from Insight Geologic monitored the explorations and maintained a log of the conditions encountered. The test pits were completed at depths of between 4.5 and 9 feet bgs and the borings were completed to a depth of between 8 and 16 feet bgs. Test pits completed prior to reaching a depth of 8 feet bgs and borings completed prior to a depth of 10 feet were terminated after encountering underlying glacial till or after encountering shallow groundwater at the site. The soils were visually classified in general accordance with the system described in ASTM D2487-06. A copy of the explorations is contained in Attachment A.

Monitoring wells, consisting of a 1-inch diameter casing and screen, were installed in each of the four borings to a depth of between 8 to 15 feet bgs. The monitoring wells were completed within locking, tamper-resistant steel covers, and installed flush with the surrounding grade. The monitoring well construction details are included in Attachment A. For the purposes of this report, groundwater elevations were based on estimated ground surface elevations obtained from the Thurston County Geodata website digital elevation model.

Soil Conditions

Soil conditions encountered within the explorations were generally consistent across the site. Underlying approximately 6 inches of sod or forest duff, we encountered 1.5 to 3 feet of brown to red-brown silty sand and gravel with roots (SM) in a medium dense and moist condition overlying approximately 0.5 to 4 feet of brown well- to poorly graded gravel with fine to coarse sand (GP, GW) in a medium dense and moist condition. In general, this gravel unit was thicker on the east half of the site. Underlying these upper units, we encountered either gray-brown poorly graded sand with gravel with silt or poorly graded sand with gravel (SP-SM, SP) in a medium dense to dense and moist to wet condition. We identified this sand with silt unit as the underlying glacial till which was encountered in test pits TP-1, TP-4, and TP-8. One exception to this general description was noted. Test pit TP-7 encountered 3 feet of silt in a medium stiff and moist condition instead of the gravel unit at a depth of 2 feet bgs.

The surficial soils encountered are consistent with Alderwood gravelly sandy loam, which is mapped for the area. This soil is generally formed on glacial drift or glacial outwash and generally has restrictive layers occurring at 2 to 3 feet below grade. Percolation is generally moderately low to very low, according to the U.S. Department of Agriculture Soil Survey.

Groundwater Conditions

Groundwater was encountered in test pits TP-5 to TP-7 completed on the site. These test pits are located closest to the mapped wetland at the site. Due to the relatively shallow glacial till at the site, perched water likely develops on the till surface at least briefly during the winter months. Additional groundwater monitoring in the infiltration areas will likely be needed to further define the existence of perched groundwater.

Laboratory Testing

We selected ten soil samples for gradation analyses in general accordance with ASTM D422 to define soil class and obtain parameters for stormwater infiltration calculations. Our geotechnical laboratory tests are presented in Attachment B.

STORMWATER INFILTRATION

We completed a stormwater infiltration rate evaluation in general accordance with the 2022 Thurston County Drainage Design and Erosion Control Manual (2022 Manual). The 2022 Manual uses a detailed method that utilizes the relationship between the D_{10} , D_{60} , and D_{90} results of the ASTM grain-size distribution analyses, along with site-specific correction factors to estimate long-term design infiltration rates.

Based on our analyses, the shallow glacial till and/or groundwater identified will present a significant restriction to the majority of infiltration systems that can be used at the site as there is limited room to allow for the required separation from the base of most infiltration systems. Based on our gradation analyses, we estimate that the initial long-term design infiltration rate (F_{design}) for the proposed stormwater infiltration galleries is 0.6 to 2.6 inches per hour, after applying the appropriate correction factors. Our calculations assume that the stormwater infiltration will occur within stormwater galleries at a depth of approximately 4 to 5 feet bgs. We further assumed that the underlying glacial till units are relatively impermeable. This preliminary infiltration rate takes into account the glacial till horizon encountered at the site, but does not account for perched groundwater that may develop during the winter months. The results of our stormwater infiltration evaluation are presented in Table 1.

Table 2. Design Infiltration Rates – Grain Size Analysis Method

Exploration Location	Unit	Depth Range (feet)	D_{10} Value	D_{60} Value	D_{90} Value	Design Infiltration Rate (inches per hour)
TP-2	GP	2.5 – 9.0	0.28	11.5	19.0	2.6
TP-5	SP	4.0 – 8.0	0.12	0.43	19.0	0.7
TP-6	SP	4.0 – 7.0	0.18	2.1	27.5	0.6

SEISMIC DESIGN CONSIDERATIONS

General

We understand that seismic design will likely be performed using the 2018 IBC standards. The following parameters may be used in computing seismic base shear forces:

Table 3. 2018 IBC Seismic Design Parameters

Spectral Response Accel. at Short Periods (S_s) = 1.428
Spectral Response Accel. at 1 Second Periods (S_1) = 0.53
Site Class = D
Site Coefficient (F_A) = 1.0
Site Coefficient (F_V) = 1.77

Ground Rupture

Because of the location of the site with respect to the nearest known active crustal faults, and the presence of a relatively thick layer of glacial till deposits, it is our opinion that the risk of ground rupture at the site due to surface faulting is low.

Soil Liquefaction

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in the development of excess pore water pressures in saturated soils, and a subsequent loss of stiffness in the soil occurs. Liquefaction also causes a temporary reduction of soil shear strength and bearing capacity, which can cause settlement of the ground surface above the liquefied soil layers. In general, soils that are most susceptible to liquefaction include saturated, loose to medium dense, clean to silty sands, and non-plastic silts within 50 feet of the ground surface.

Based on our review of the *Liquefaction Susceptibility Map of Thurston County (Palmer, 2004)*, the project site is identified to have a low potential risk for soil liquefaction. Based on our experience with detailed seismic studies in the Olympia area, including areas that are mapped within the same glacial outwash and till soil deposits as the project site, we concur with the reviewed map. It is our opinion that there is a low risk for soil liquefaction at the site. Additional investigation and evaluation would be needed to further define this risk.

Seismic Compression

Seismic compression is defined as the accrual of contractive volumetric strains in unsaturated soils during strong shaking from earthquakes (Stewart et al., 2004). Loose to medium-dense clean sands and non-plastic silts are particularly prone to seismic compression settlement. Seismic compression settlement is most prevalent on slopes, but it can also occur on flat ground. It is our opinion that the site has a low risk for seismic compression settlement.

Seismic Settlement Discussion

Based on the materials encountered in our explorations, it is our preliminary opinion that seismic settlements (liquefaction-induced plus seismic compression) could potentially total a few inches at the site as the result of an IBC design-level earthquake. We are available upon request to perform deep subsurface explorations and detailed seismic settlement estimates during the design phase.

Lateral Spreading

Lateral spreading involves the lateral displacement of surficial blocks of non-liquefied soil when an underlying soil layer liquefies. Lateral spreading generally develops in areas where sloping ground or large grade changes are present. Based on our understanding of the subsurface conditions along the minimal slope, it is our opinion that there could be a low risk for the development of lateral spreading as a result of an IBC design-level earthquake.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our subsurface explorations and engineering analyses, it is our opinion that the proposed development is feasible from a geotechnical standpoint. We recommend that the proposed structures be supported on shallow concrete foundations that are designed using an allowable soil-bearing capacity of 2,500 pounds per square foot (psf).

The soils encountered in our explorations are typically in a medium-dense condition near the ground surface. To limit the potential for structural settlement, we recommend that shallow foundations and slabs-on-grade be established on a minimum 1-foot thick layer of structural fill. Depending on the final grading plans and the time of year earthwork is performed; it may be possible to reuse the on-site soils as structural fill under the foundations/slabs.

Based on the result of our study, it appears that soils have a limited capacity for stormwater infiltration at the site. Our evaluations based on the 2022 Manual indicated an infiltration rate of between 0.6 and 2.6 inches per hour for the soils located above the glacial till unit. This does not take into account the potential for perched groundwater which may develop above the till unit during the winter months, and the potential mounding of the stormwater on the water table. In addition, the shallow depth of the glacial till soils may represent an additional restriction to most infiltration methods. It may be prudent to investigate the use of low-impact development (LID) methods such as pervious pavement or other shallow infiltration options as a part of this project.

Earthwork

General

We anticipate that site development earthwork will include removing the vegetation and existing hardscape, stripping sod/topsoil materials, preparing subgrades, excavating for utility trenches, and placing and compacting structural fill. We expect that the majority of site grading can be accomplished with conventional earthmoving equipment in proper working order.

Our explorations did not encounter appreciable amounts of debris or unsuitable soils associated with past site development other than the existing asphalt located on-site. Still, it is possible that additional concrete slabs, abandoned utility lines or other development features from the existing development could be encountered during construction. The contractor should be prepared to deal with these conditions.

Clearing and Stripping

Clearing and stripping should consist of removing surface and subsurface deleterious materials including sod/topsoil, asphalt, trees, brush, debris, and other unsuitable loose/soft or organic materials. Stripping and clearing should extend at least 5 feet beyond all structures and areas to receive structural fill.

We estimate that a stripping depth of about 0.5 feet will be required to remove the vegetation encountered in several of our explorations. Deeper stripping depths may be required if additional unsuitable soils are exposed during stripping operations. We recommend that trees be removed by

overturning so that the majority of roots are also removed. Depressions created by tree or stump removal should be backfilled with structural fill and properly compacted.

Subgrade Preparation

After stripping and excavating to the proposed subgrade elevation, and before placing structural fill or foundation concrete, the exposed subgrade should be thoroughly compacted to a firm and unyielding condition. The exposed subgrade should then be proof-rolled using loaded, rubber-tired heavy equipment. We recommend that Insight Geologic be retained to observe the proof-rolling prior to the placement of structural fill or foundation concrete. Areas of limited access that cannot be proof-rolled can be evaluated using a steel probe rod. If soft or otherwise unsuitable areas are revealed during proof-rolling or probing, that cannot be compacted to a stable and uniformly firm condition, we generally recommend that: 1) the subgrade soils be scarified (e.g., with a ripper or farmer's disc), aerated and recompacted; or 2) the unsuitable soils be overexcavated and replaced with structural fill.

Temporary Excavations and Groundwater Handling

Excavations deeper than 4 feet should be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, "Excavation, Trenching and Shoring." Regardless of the soil type encountered in the excavation, shoring, trench boxes or sloped sidewalls were required under the Washington Industrial Safety and Health Act (WISHA). The contract documents should specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety and providing shoring, as required, to protect personnel and structures.

In general, temporary cut slopes should be inclined no steeper than about 1.5H:1V (horizontal: vertical). This guideline assumes that all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope, and that significant seepage is not present on the slope face. Flatter cut slopes were necessary where significant seepage occurs or if large voids are created during excavation. Some sloughing and raveling of cut slopes should be expected. Temporary covering with heavy plastic sheeting should be used to protect slopes during periods of wet weather.

We anticipate that if perched groundwater is encountered during construction can be handled adequately with sumps, pumps, and/or diversion ditches. Groundwater handling needs will generally be lower during the late summer and early fall months. We recommend that the contractor performing the work be made responsible for controlling and collecting groundwater encountered during construction.

Permanent Slopes

We do not anticipate that permanent slopes will be utilized for the proposed project. If permanent slopes are necessary, we recommend the slopes be constructed at a maximum inclination of 2H:1V. Where 2H:1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

To achieve uniform compaction, we recommend that fill slopes be overbuilt and subsequently cut back to expose well-compacted fill. Fill placement on slopes should be benched into the slope face and include keyways. The configuration of the bench and keyway depends on the equipment being used. Bench excavations should be level and extend into the slope face. We recommend that a vertical cut of about 3 feet be maintained for benched excavations. Keyways should be about 1-1/2 times the width of the equipment used for grading or compaction.

Erosion Control

We anticipate that erosion control measures such as silt fences, straw bales and sandbags will generally be adequate during development. Temporary erosion control should be provided during construction activities and until permanent erosion control measures are functional. Surface water runoff should be properly contained and channeled using drainage ditches, berms, swales, and tightlines, and should not discharge onto sloped areas. Any disturbed sloped areas should be protected with a temporary covering until new vegetation can take effect. Jute or coconut fiber matting, excelsior matting or clear plastic sheeting is suitable for this purpose. Graded or disturbed slopes should be tracked in-place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion. Ultimately, erosion control measures should be in accordance with local regulations and should be clearly described on project plans.

Wet Weather Earthwork

Some of the near-surface soils contain up to about 35 percent fines. When the moisture content of the soil is more than a few percent above the optimum moisture content, the soil will become unstable and it may become difficult or impossible to meet the required compaction criteria. Disturbance of near-surface soils should be expected if earthwork is completed during periods of wet weather.

The wet weather season in this area generally begins in October and continues through May. However, periods of wet weather may occur during any month of the year. If wet weather earthwork is unavoidable, we recommend that:

- The ground surface is sloped so that surface water is collected and directed away from the work area to an approved collection/dispersion point.
- Earthwork activities not take place during periods of heavy precipitation.
- Slopes with exposed soil are covered with plastic sheeting or otherwise protected from erosion.
- Measures are taken to prevent on-site soil and soil stockpiles from becoming wet or unstable. Sealing the surficial soil by rolling with a smooth-drum roller prior to periods of precipitation should reduce the extent that the soil becomes wet or unstable.
- Construction traffic is restricted to specific areas of the site, preferably areas that are surfaced with materials not susceptible to wet weather disturbance.
- A minimum 1-foot thick layer of 4- to 6-inch quarry spalls is used in high traffic areas of the site to protect the subgrade soil from disturbance.
- Contingencies are included in the project schedule and budget to allow for the above elements.

Structural Fill Materials

General

Material used for structural fill should be free of debris, organic material and rock fragments larger than 3 inches. The workability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines increases, soil becomes increasingly more sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve.

On-Site Soil

We anticipate that the majority of the on-site soils encountered during construction will consist of silty sand, located at or near the surface of the site. It is our opinion, that this material may be a suitable source for structural fill during an extremely limited portion of the year. However, we anticipate that thin lifts (6 inches thick or less) will likely be needed to obtain structural fill compaction specifications. During the winter season, these materials may be over-optimum moisture and will require drying back to obtain suitable compaction. On-site materials used as structural fill should be free of roots, organic matter, and other deleterious materials and particles larger than 3 inches in diameter.

Select Granular Fill

Select granular fill should consist of imported, well-graded sand and gravel or crushed rock with a maximum particle size of 3 inches and less than 5 percent passing a U.S. Standard No. 200 sieve based on the minus ¾-inch fraction. Organic matter, debris or other deleterious material should not be present. In our experience, “gravel borrow” as described in Section 9-03.14(1) of the 2022 WSDOT Standard Specifications is typically a suitable source for select granular fill during periods of wet weather, provided that the percent passing a U.S. Standard No. 200 sieve is less than 5 percent based on the minus ¾-inch fraction.

Structural Fill Placement and Compaction

General

Structural fill should be placed on an approved subgrade that consists of uniformly firm and unyielding inorganic native soils or compacted structural fill. Structural fill should be compacted at a moisture content near optimum. The optimum moisture content varies with the soil gradation and should be evaluated during construction.

Structural fill should be placed in uniform, horizontal lifts and uniformly densified with vibratory compaction equipment. The maximum lift thickness will vary depending on the material and compaction equipment used but should generally not exceed the loose thicknesses provided in Table 4. Structural fill materials should be compacted in accordance with the compaction criteria provided in Table 5.

Table 4. Recommended Uncompacted Lift Thickness

Compaction Equipment	Recommended Uncompacted Fill Thickness (inches)	
	Granular Materials Maximum Particle Size $\leq 1\frac{1}{2}$ inch	Granular Materials Maximum Particle Size $> 1\frac{1}{2}$ inch
Hand Tools (Plate Compactors and Jumping Jacks)	4 – 8	Not Recommended
Rubber-tire Equipment	10 – 12	6 – 8
Light Roller	10 – 12	8 – 10
Heavy Roller	12 – 18	12 – 16
Hoe Pack Equipment	18 – 24	12 – 16

Note: The above table is intended to serve as a guideline and should not be included in the project specifications.

Table 5. Recommended Compaction Criteria in Structural Fill Zones

Fill Type	Percent Maximum Dry Density Determined by ASTM Test Method D 1557 at $\pm 3\%$ of Optimum Moisture		
	0 to 2 Feet Below Subgrade	> 2 Feet Below Subgrade	Pipe Zone
Imported or On-site Granular, Maximum Particle Size $< 1\frac{1}{4}$ -inch	95	95	-----
Imported or On-site Granular, Maximum Particle Size $> 1\frac{1}{4}$ -inch	N/A (Proof-roll)	N/A (Proof-roll)	-----
Trench Backfill ¹	95	92	90

Note: ¹Trench backfill above the pipe zone in nonstructural areas should be compacted to at least 85 percent.

Shallow Foundation Support

General

We recommend that the proposed structures be founded on continuous wall or isolated column footings, bearing on a minimum 1-foot thick overexcavation and replacement with compacted structural fill where underlying soils are not able to be compacted as structural fill. The structural fill zone should extend to a horizontal distance equal to the overexcavation depth on each side of the footing. The actual overexcavation depth will vary, depending on the conditions encountered.

We recommend that a representative from Insight Geologic observe the foundation surfaces before overexcavation, and before placing structural fill in overexcavations. This representative should confirm that adequate bearing surfaces have been prepared and that the soil conditions are as anticipated. Unsuitable foundation bearing soils should be recompacted or removed and replaced with compacted structural fill, as recommended by the geotechnical engineer.

Bearing Capacity and Footing Dimensions

We recommend an allowable soil bearing pressure of 2,500 psf for shallow foundations that are supported as recommended. This allowable bearing pressure applies to long-term dead and live loads exclusive of the weight of the footing and any overlying backfill. The allowable soil bearing pressure

can be increased by one-third when considering total loads, including transient loads such as those induced by wind and seismic forces. If higher bearing values are required, we should be consulted to evaluate appropriate methods to increase bearing in the subsurface.

We recommend a minimum width of 18 inches for continuous wall footings and 2 feet for isolated column footings. For settlement considerations, we have assumed a maximum width of 4 feet for continuous wall footings and 6 feet for isolated column footings.

Perimeter footings should be embedded at least 12 inches below the lowest adjacent grade where the ground is flat. Interior footings should be embedded a minimum of 6 inches below the nearest adjacent grade.

Settlement

We estimate that the total settlement of footings that are designed and constructed as recommended should be less than 1 inch. We estimate that differential settlement should be ½ inch or less between comparably loaded isolated footings or along 50 feet of continuous footing. We anticipate that the settlement will occur essentially as loads are applied during construction.

Lateral Load Resistance

Lateral loads on shallow foundation elements may be resisted by passive resistance on the sides of footings and by friction on the base of footings. Passive resistance may be estimated using an equivalent fluid density of 303 pounds per cubic foot (pcf), assuming that the footings are backfilled with structural fill. Frictional resistance may be estimated using 0.2 for the coefficient of base friction.

The lateral resistance values provided above incorporate a factor of safety of 1.5. The passive earth pressure and friction components can be combined, provided that the passive component does not exceed two-thirds of the total. The top foot of soil should be neglected when calculating passive resistance unless the foundation perimeter area is covered by a slab-on-grade or pavement.

Slabs-On-Grade

Slabs-on-grade should be established on a minimum 1-foot thick section of structural fill extending to an approved bearing surface. A modulus of vertical subgrade reaction (subgrade modulus) can be used to design slabs-on-grade. The subgrade modulus varies based on the dimensions of the slab and the magnitude of applied loads on the slab surface; slabs with larger dimensions and loads are influenced by soils to a greater depth. We recommend a modulus value of 200 pounds per cubic inch (pci) for the design of on-grade floor slabs with floor loads up to 500 psf. We are available to provide alternate subgrade modulus recommendations during design, based on specific loading information.

We recommend that slabs-on-grade in interior spaces be underlain by a minimum 4-inch thick capillary break layer to reduce the potential for moisture migration into the slab. The capillary break material should consist of well-graded sand and gravel or crushed rock containing less than 5 percent fines based on the fraction passing the ¾-inch sieve. The 4-inch thick capillary break layer can be included when calculating the minimum 1-foot thick structural fill section beneath the slab. If dry slabs are

required (e.g., where adhesives are used to anchor carpet or tile to the slab), a waterproofing liner should be placed below the slab to act as a vapor barrier.

Subsurface Drainage

It is our opinion that foundation footing drains are necessary for the proposed structures. The site soils are underlain by shallow glacial till which are generally poorly draining. Footing drains should be routed to existing on-site or planned storm drainage.

Conventional Retaining Walls

General

We do not anticipate that retaining walls will be utilized for the proposed project. We should be contacted during the design phase to review retaining wall plans and provide supplemental recommendations, if needed.

Drainage

Positive drainage is imperative behind any retaining structure. This can be accomplished by using a zone of free-draining material behind the wall with perforated pipes to collect water seepage. The drainage material should consist of coarse sand and gravel containing less than 5 percent fines based on the fraction of material passing the $\frac{3}{4}$ -inch sieve. The wall drainage zone should extend horizontally at least 12 inches from the back of the wall. If a stacked block wall is constructed, we recommend that a barrier such as a non-woven geotextile filter fabric be placed against the back of the wall to prevent loss of the drainage material through the wall joints.

A perforated smooth-walled rigid PVC pipe, having a minimum diameter of 4 inches, should be placed at the bottom of the drainage zone along the entire length of the wall. Drainpipes should discharge to a tightline leading to an appropriate collection and disposal system. An adequate number of cleanouts should be incorporated into the design of the drains in order to provide access for regular maintenance. Roof downspouts, perimeter drains or other types of drainage systems should not be connected to retaining wall drain systems.

Design Parameters

We recommend an active lateral earth pressure of 31 pcf (equivalent fluid density) for a level backfill condition. This assumes that the top of the wall is not structurally restrained and is free to rotate. For restrained walls that are fixed against rotation (at-rest condition), an equivalent fluid density of 45 pcf can be used for the level backfill condition. For seismic conditions, we recommend a uniform lateral pressure of $14H$ psf (where H is the height of the wall) be added to the lateral pressures. This seismic pressure assumes a peak ground acceleration of 0.32 g. Note that if the retaining system is designed as a braced system but is expected to yield a small amount during a seismic event, the active earth pressure condition may be assumed and combined with the seismic surcharge.

The recommended earth pressure values do not include the effects of surcharges from surface loads or structures. If vehicles were operated within one-half of the height of the wall, a traffic surcharge should be added to the wall pressure. The traffic surcharge can be approximated by the equivalent

weight of an additional 2 feet of backfill behind the wall. Other surcharge loads, such as construction equipment, staging areas, and stockpiled fill, should be considered on a case-by-case basis.

Pavement Design Recommendations

The recommended pavement section for parking and drive areas consists of 6 inches of compacted granular base course, 2 inches of compacted crushed rock top course, and 2 compacted inches of asphalt concrete pavement. High traffic and driveway areas should have a minimum of 8 inches of compacted granular subbase, 2 inches of compacted crushed rock top course, and 3 inches of asphalt concrete pavement. Native soils are appropriate for use as granular fill subbase if properly compacted. Recommended Pavement Sections: The following table presents our recommended asphalt pavement sections.

Recommended Asphalt Pavement Sections*

Service Level	Base Course (in)	Top Course (in)	Asphalt (in)
Light-duty	6	2	2
Heavy-duty	8	2	3

It should be realized that asphaltic pavements are not maintenance-free. Our recommended pavement section represents our minimum recommendation for an average level of performance during a 20-year design life; therefore, an average level of maintenance will likely be required. A 20-year pavement life typically assumes that an overlay will be placed after about 12 years. Thicker asphalt, base, and subbase courses would offer better long-term performance but would cost more initially. Conversely, thinner courses would be more susceptible to “alligator” cracking and other failure modes. As such, pavement design can be considered a compromise between a high initial cost and low maintenance costs versus a low initial cost and higher maintenance costs.

The native subgrade soils are anticipated to consist mostly of sands with gravel. Based on our experience with similar soil types, our analysis is based on a California Bearing Ratio (CBR) value of 30 percent. These values assume the upper foot of subgrade soils will be compacted to a minimum of 95 percent of the modified proctor maximum dry density or a firm or unyielding condition.

We recommend the following regarding asphalt pavement materials and pavement construction:

- Subgrade Preparation: Upper 12 inches of pavement subgrade should be proof-rolled and inspected for deflection. Areas showing more than ½-inch deflection during proof rolling should be over-excavated and replaced with gravel base.
- Base Course: We recommend that the base conforms to Section 9-03.10, Gravel Base, of the 2022 WSDOT/APWA Standard Specifications for Road, Bridge and Municipal Construction (Standard Specifications). The gravel base shall be placed and compacted in accordance with Section 4-02 of the Standard Specifications.
- Crushed Surfacing Top Course: We recommend that the crushed aggregate top course conforms to Section 9-03.9(3), CSTC of the WSDOT Standard Specifications. The CSTC shall be placed and compacted in accordance with Section 4-04 of the Standard Specifications.

- **Asphalt Concrete:** We recommend that the asphalt concrete conforms to Section 9-02.1(4) for PG 58-22 or PG 64-22 Performance Graded Asphalt Binder as presented in the 2022 WSDOT Standard Specifications. We also recommend that the gradation of the asphalt aggregate conform to the aggregate gradation control points for ½-inch mixes as presented in Section 9-03.8(6), HMA Proportions of Materials. We also recommend that the Commercial Asphalt be placed and compacted in accordance with Section 5-04 of the Standard Specifications.
- **Compaction:** All base material should be compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D1557 or a firm and unyielding condition. We recommend that asphalt be compacted to a minimum of 92 percent of the Rice (theoretical maximum) density or 96 percent of Marshall (maximum laboratory) density.

DOCUMENT REVIEW AND CONSTRUCTION OBSERVATION

We recommend that we are retained to review the portions of the plans and specifications that pertain to earthwork construction and stormwater infiltration. We recommend that monitoring, testing and consultation be performed during construction to confirm that the conditions encountered are consistent with our explorations and our stated design assumptions. Insight Geologic would be pleased to provide these services upon request.

REFERENCES

International Code Council, International Building Code, 2018.

Seismic Compression of As-compacted Fill Soils with Variable Levels of Fines Content and Fines Plasticity, Department of Civil and Environmental Engineering, University of California, Los Angeles, July 2004.

Thurston County, Drainage Design and Erosion Control Manual, 2022.

Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge and Municipal Construction Manual, 2022.

LIMITATIONS

We have prepared this geotechnical and stormwater evaluation report for the exclusive use of RJ Development and their authorized agents, for the proposed development located at 2000 24th Avenue NW in unincorporated Thurston County, Washington.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

Please refer to Attachment C titled "Report Limitations and Guidelines for Use" for additional information pertaining to the use of this report.

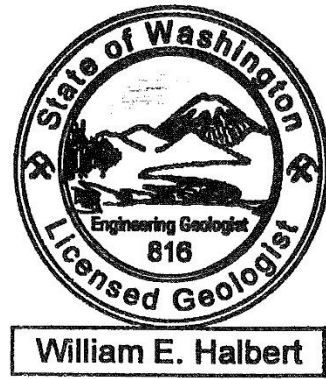
————— ◀ ▶ —————

We appreciate the opportunity to be of service to you on this project. Please contact us if you have any questions or require additional information.

Respectfully Submitted,
INSIGHT GEOLOGIC, INC.

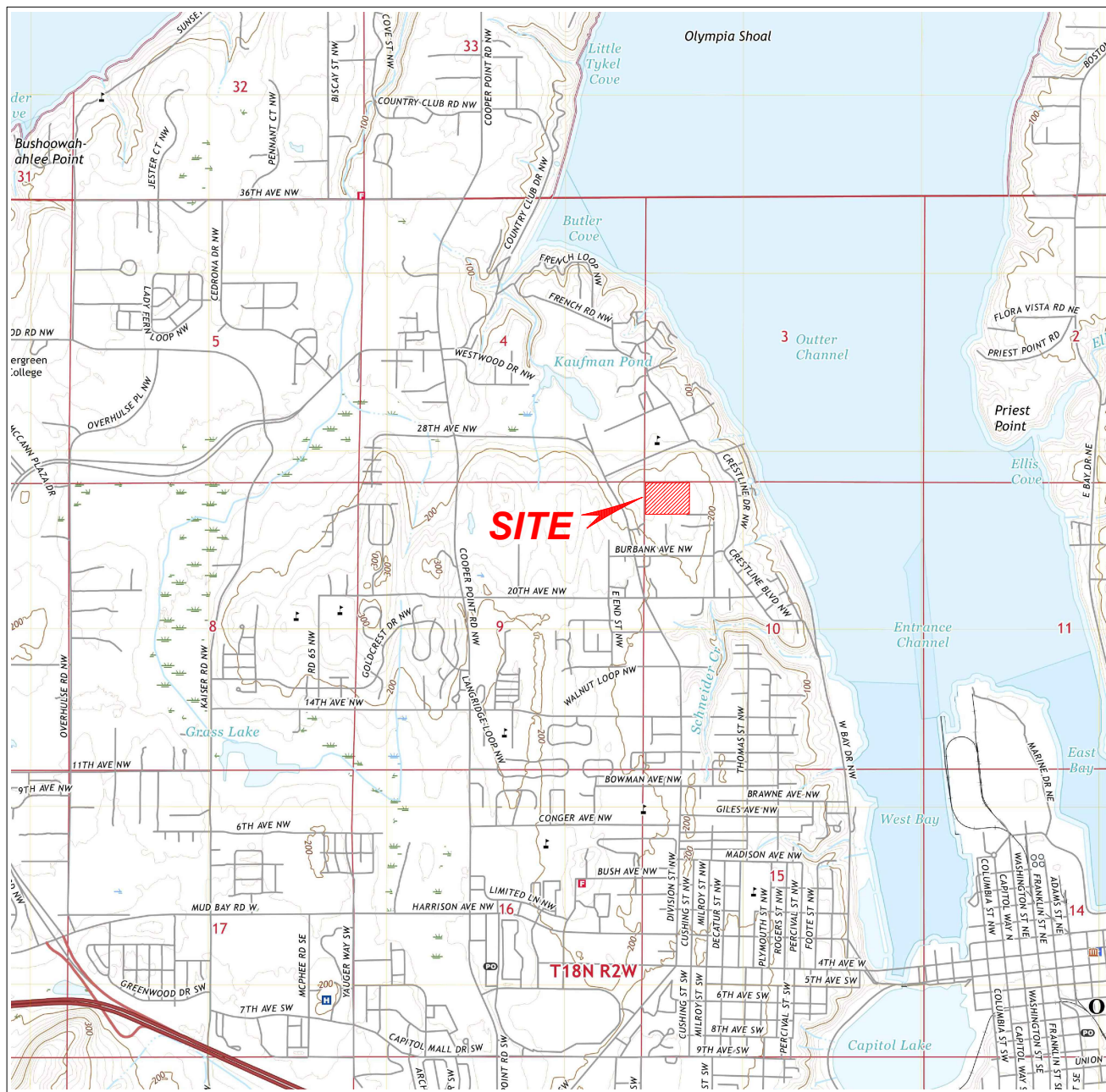


William E. Halbert, L.E.G., L.HG.
Principal



Attachments

FIGURES



Source: USGS (c) 2020

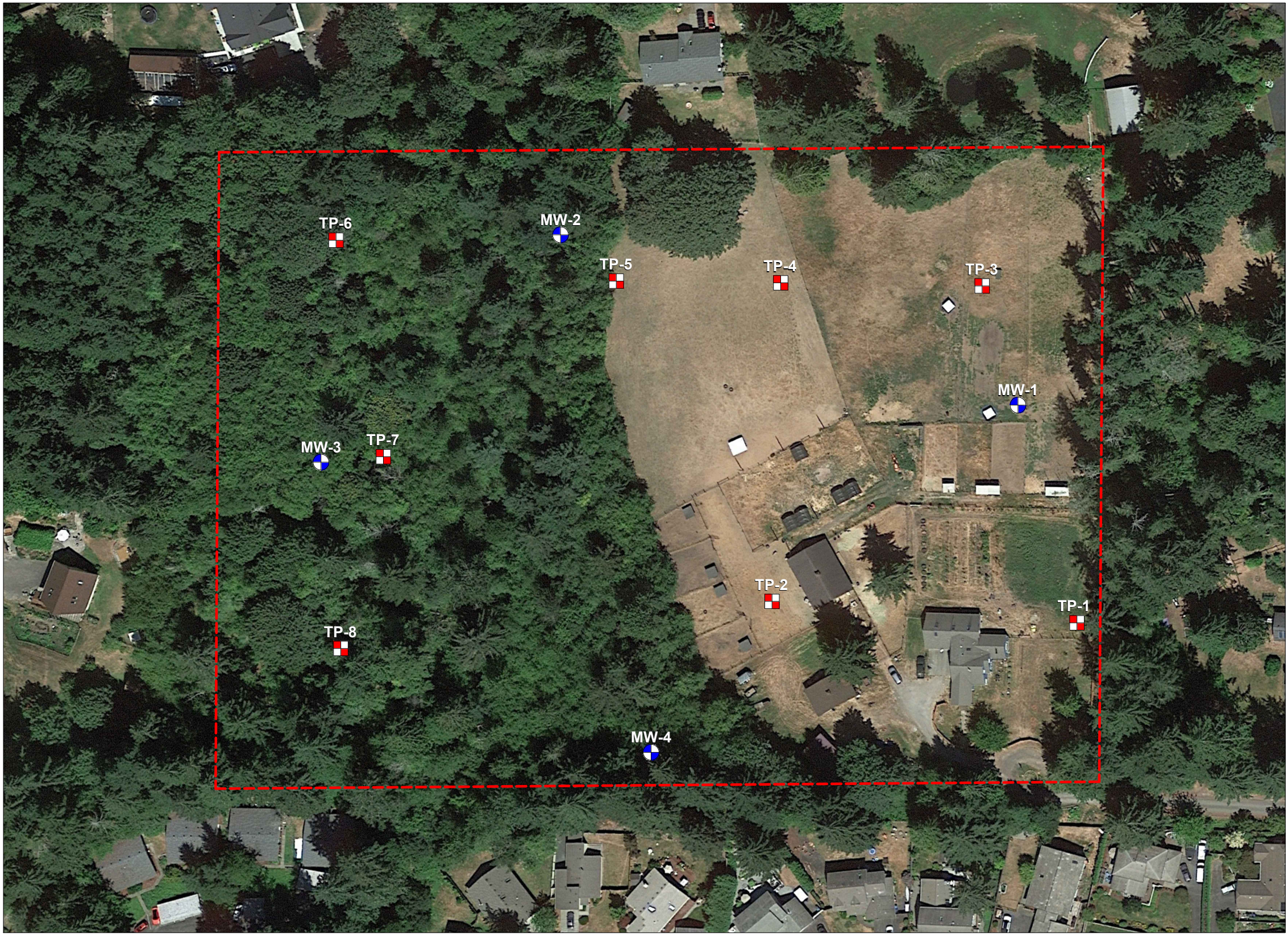
TUMWATER QUADRANGLE
WASHINGTON - THURSTON COUNTY
7.5-MINUTE SERIES
Year 2020

SCALE: 1" = 3000'

2000 24th AVENUE NW
OLYMPIA, WASHINGTON



Figure 1
Vicinity Map

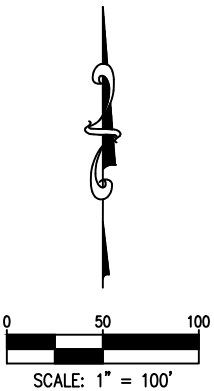


Source: kpff Consulting Engineers



LEGEND:

- APPROXIMATE PROJECT BOUNDARY
- TP-1 APPROXIMATE TEST PIT LOCATION
- MW-1 APPROXIMATE MONITORING WELL LOCATION


















2000 24th AVENUE NW
OLYMPIA, WASHINGTON

Figure 2
SITE PLAN

ATTACHMENT A
EXPLORATION LOGS

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		GROUP NAME
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL <5% FINES		GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
				GP	POORLY GRADED GRAVEL
		GRAVEL WITH FINES >12% FINES		GM	SILTY GRAVEL
				GC	CLAYEY GRAVEL
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND <5% FINES		SW	WELL-GRADED SAND, FINE TO COARSE SAND
				SP	POORLY GRADED SAND
		SAND WITH FINES >12% FINES		SM	SILTY SAND
				SC	CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	INORGANIC		ML	SILT
				CL	CLAY
		ORGANIC		OL	ORGANIC SILT, ORGANIC CLAY
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE	INORGANIC		MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
				CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC		OH	ORGANIC CLAY, ORGANIC SILT
			HIGHLY ORGANIC SOILS		

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS	TYPICAL DESCRIPTION	
	CC	CEMENT CONCRETE
	AC	ASPHALT CONCRETE
	CR	CRUSHED ROCK / QUARRY SPALLS
	TS	TOPSOIL / FOREST DUFF / SOD

GROUNDWATER EXPLORATION SYMBOLS

- MEASURED GROUNDWATER LEVEL IN EXPLORATION, WELL, OR PIEZOMETER
- GROUNDWATER OBSERVED AT TIME OF EXPLORATION
- PERCHED WATER OBSERVED AT TIME OF EXPLORATION
- MEASURED FREE PRODUCT IN WELL OR PIEZOMETER

STRATIGRAPHIC CONTACT

- DISTINCT CONTACT BETWEEN SOIL STRATA OR GEOLOGIC UNITS
- GRADUAL CHANGE BETWEEN SOIL STRATA OR GEOLOGIC UNITS
- APPROXIMATE LOCATION OF SOIL STRATA CHANGE WITHIN GEOLOGIC SOIL UNIT

LABORATORY / FIELD TEST CLASSIFICATIONS

- | | |
|--------------------------------------|--|
| %F PERCENT FINES | MD MOISTURE CONTENT AND DRY DENSITY |
| AL ATTERBERG LIMITS | OC ORGANIC COMPOUND |
| CA CHEMICAL ANALYSIS | PM PERMEABILITY OR HYDRAULIC CONDUCTIVITY |
| CP LABORATORY COMPACTION TEST | PP POCKET PENETROMETER |
| CS CONSOLIDATION TEST | SA SIEVE ANALYSIS |
| DS DIRECT SHEAR | TX TRIAXIAL COMPRESSION |
| HA HYDROMETER ANALYSIS | UC UNCONFINED COMPRESSION |
| MC MOISTURE CONTENT | VS VANE SHEAR |

SAMPLER SYMBOLS

- | | |
|----------------------------|--------------|
| 2.4 INCH I.D. SPLIT BARREL | SHELBY TUBE |
| DIRECT-PUSH | PISTON |
| STANDARD PENETRATION TEST | BULK OR GRAB |

SHEEN CLASSIFICATIONS

- NS** NO VISIBLE SHEEN
- SS** SLIGHT SHEEN
- MS** MODERATE SHEEN
- HS** HEAVY SHEEN
- NT** NOT TESTED

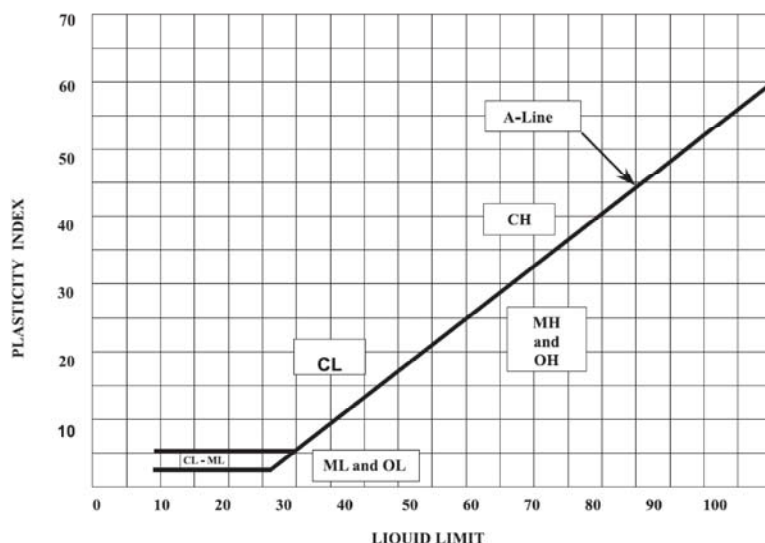


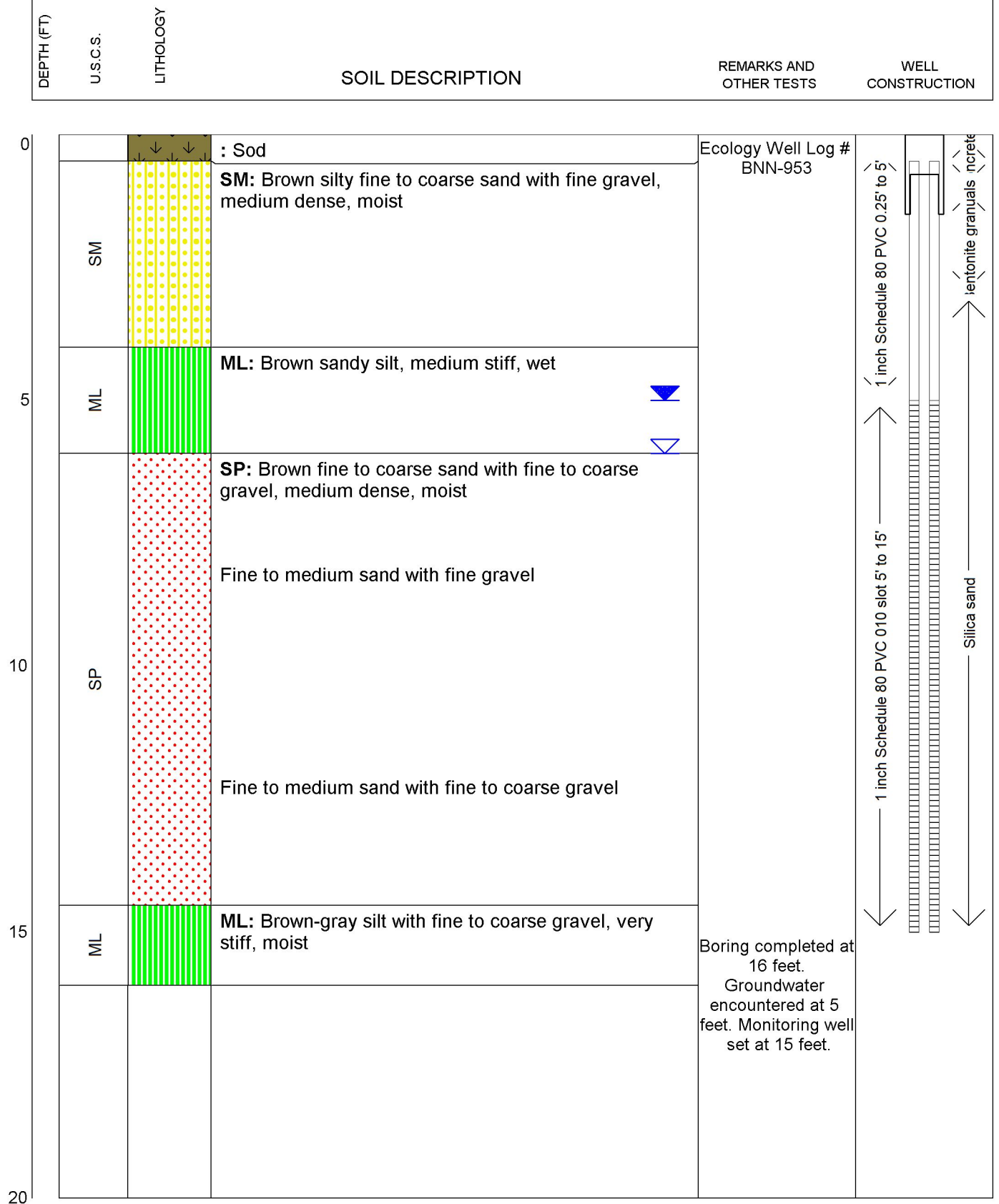
Figure A-1
Key to Exploration Logs

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

DATE: January 6, 2023

MW-1

TOTAL DEPTH: 16



Drilling Contractor: **Standard**
 Drilling Equipment: **Geoprobe 54 LT**
 Logged By: **Neal Graham**

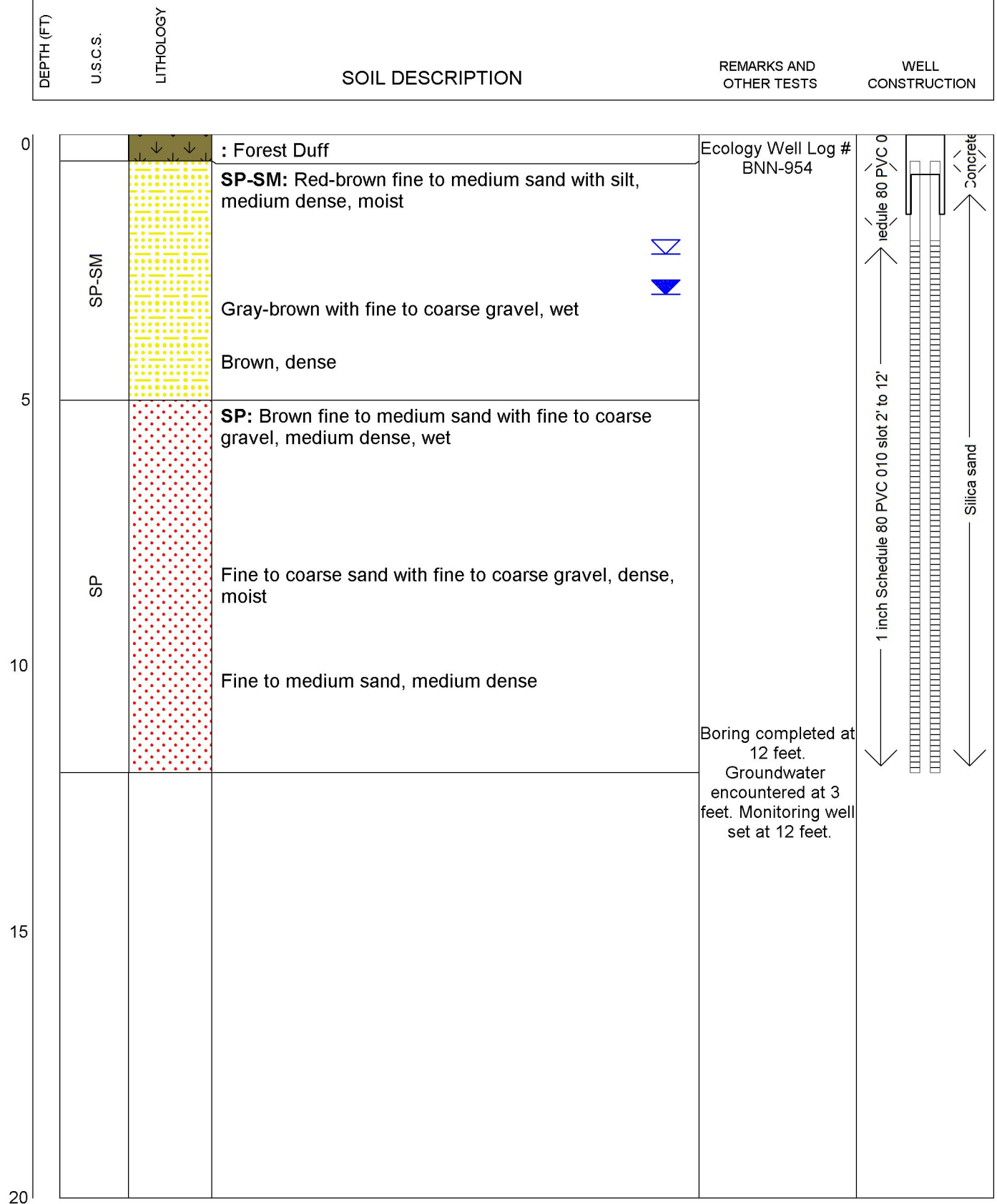
Figure A-2

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

MW-2

DATE: January 6, 2023

TOTAL DEPTH: 12



Drilling Contractor: **Standard**
 Drilling Equipment: **Geoprobe 54 LT**
 Logged By: **Neal Graham**

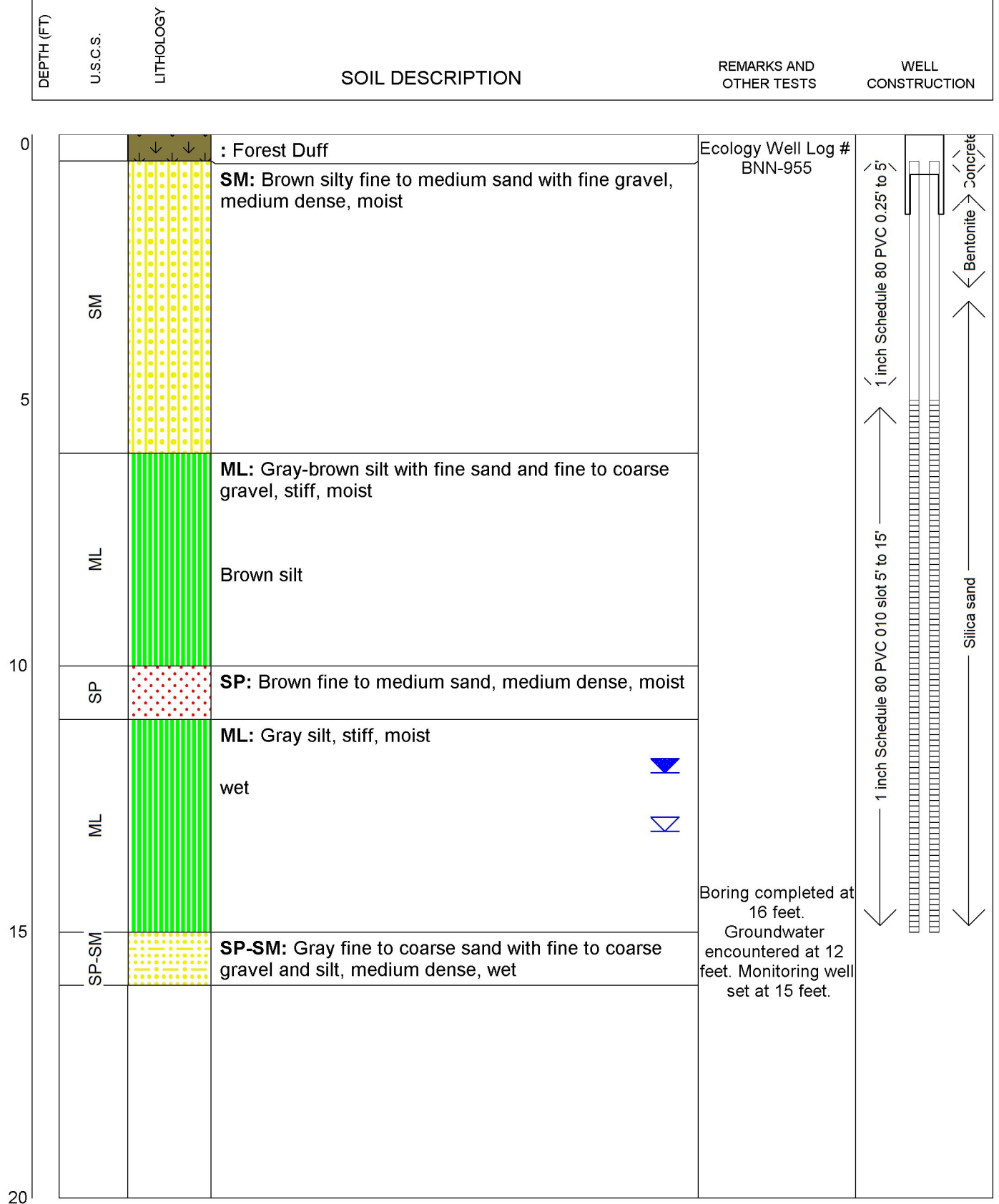
Figure A-3

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

MW-3

DATE: January 6, 2023

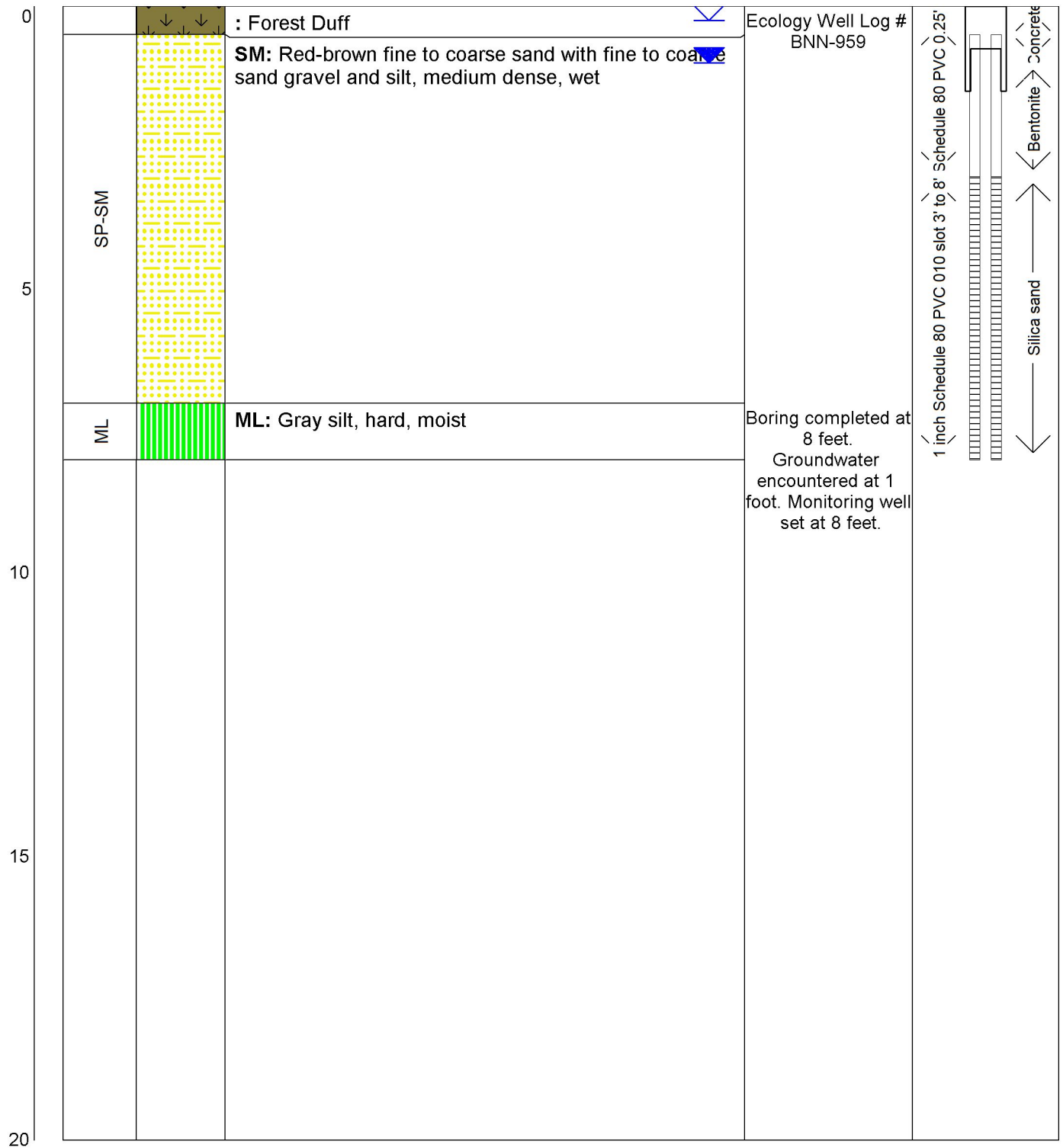
TOTAL DEPTH: 16



Drilling Contractor: **Standard**
 Drilling Equipment: **Geoprobe 54 LT**
 Logged By: **Neal Graham**

Figure A-4

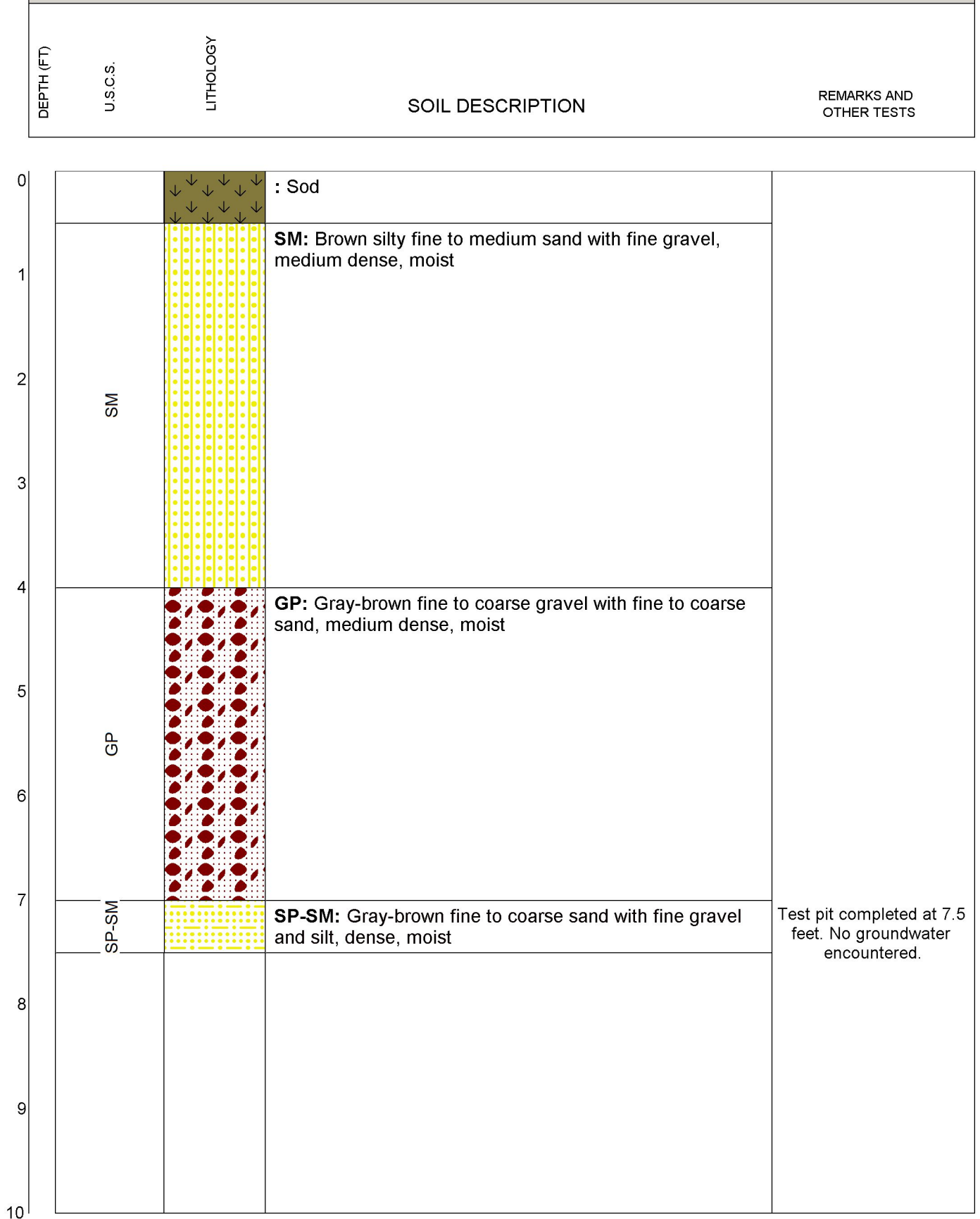
PROJECT: 2000 24th Avenue NW			DATE: January 6, 2023		
PROJECT NO.: 901-003-01			MW-4		
LOCATION: Thurston County, Washington					
			TOTAL DEPTH: 8		
DEPTH (FT)	U.S.C.S.	LITHOLOGY			
			SOIL DESCRIPTION	REMARKS AND OTHER TESTS	WELL CONSTRUCTION



PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

TP-1

DATE: February 3, 2023
 TOTAL DEPTH: 7.5



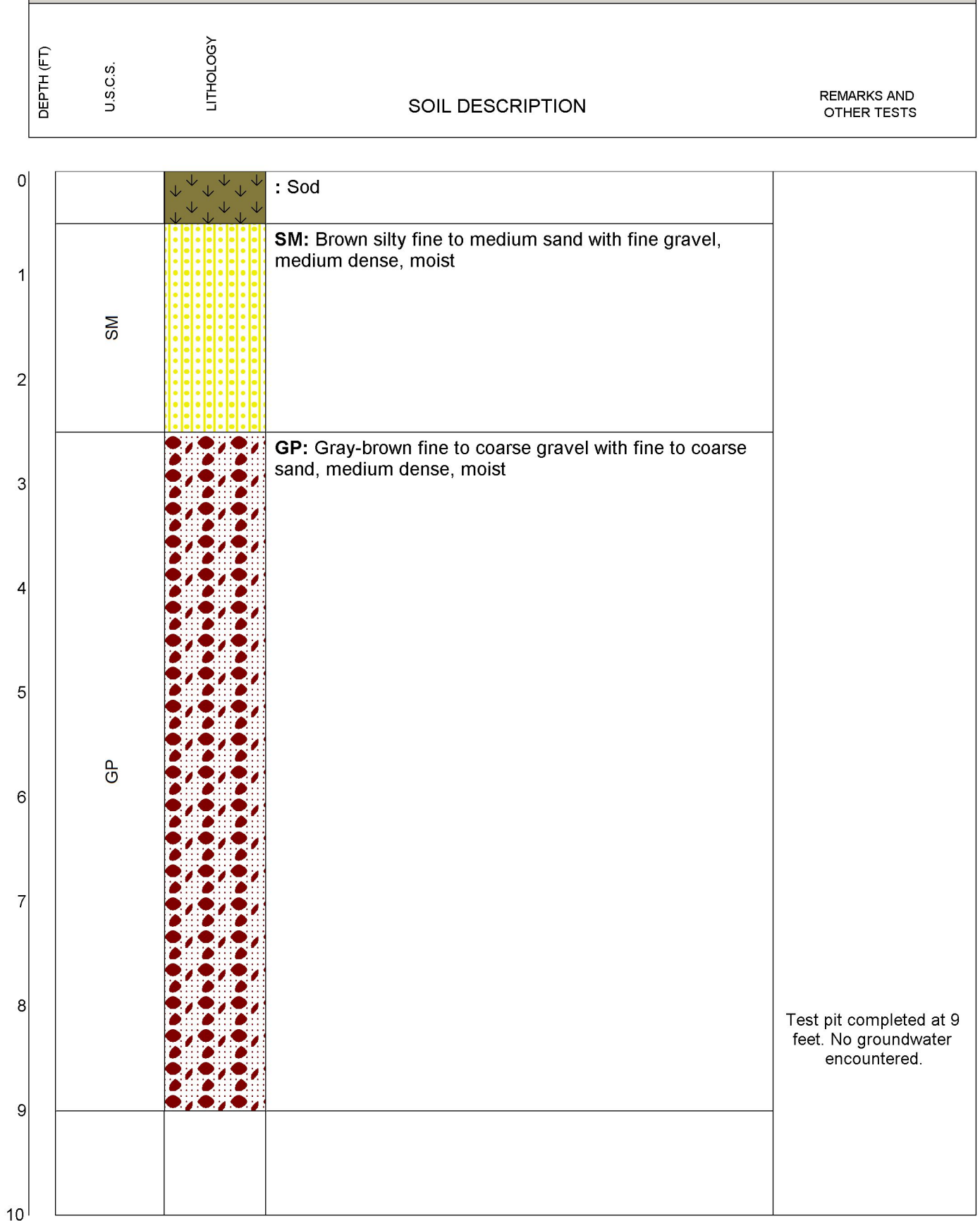
Operator: **Neal Graham**
 Equipment: **Yanmar 35C**
 Logged By: **Neal Graham**

Figure A-6

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

TP-2

DATE: February 3, 2023
 TOTAL DEPTH: 9



Operator: **Neal Graham**
 Equipment: **Yanmar 35C**
 Logged By: **Neal Graham**

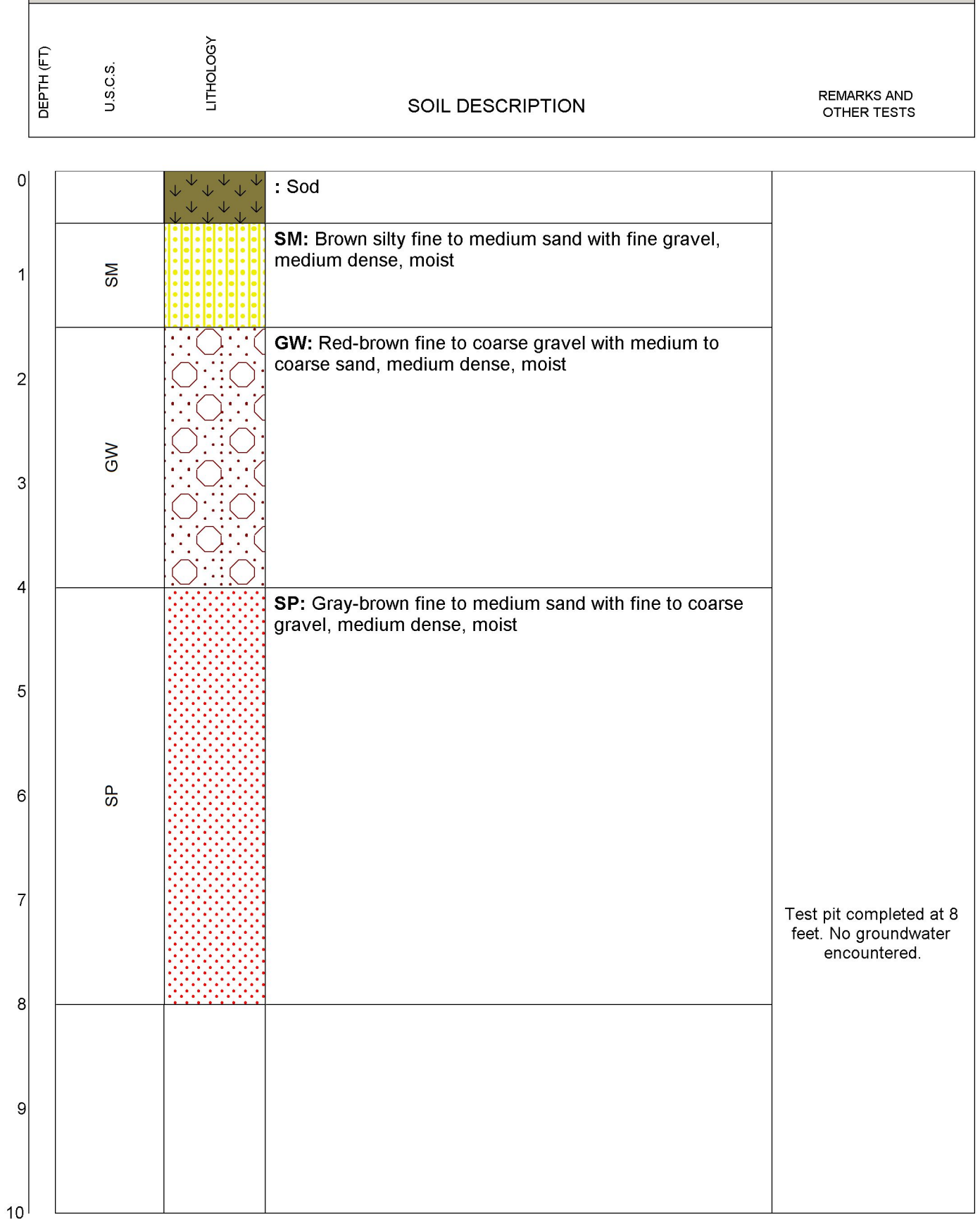
Figure A-7

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

TP-3

DATE: February 3, 2023

TOTAL DEPTH: 8



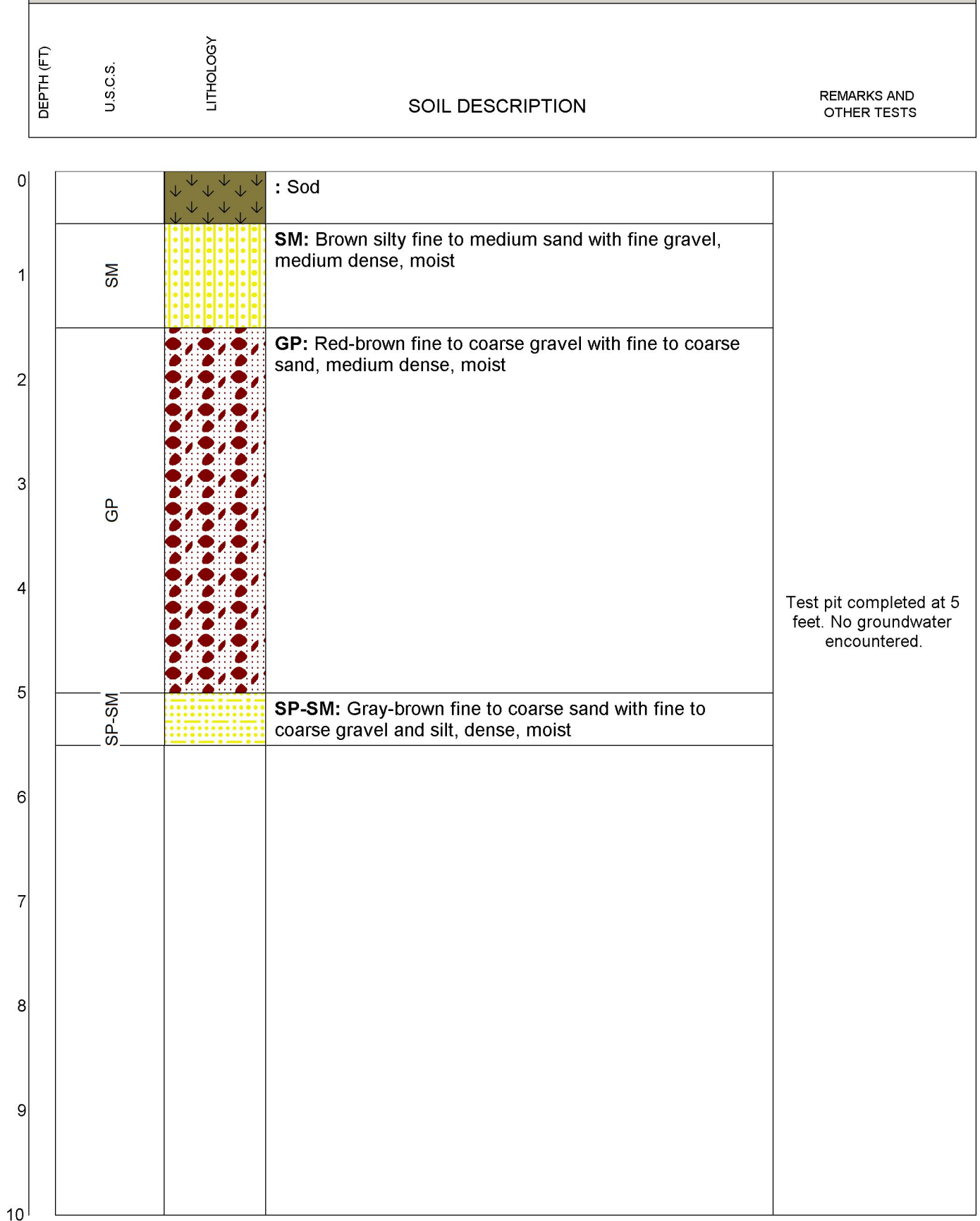
Operator: **Neal Graham**
 Equipment: **Yanmar 35C**
 Logged By: **Neal Graham**

Figure A-8

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

TP-4

DATE: February 3, 2023
 TOTAL DEPTH: 5.5



Operator: **Neal Graham**
 Equipment: **Yanmar 35C**
 Logged By: **Neal Graham**

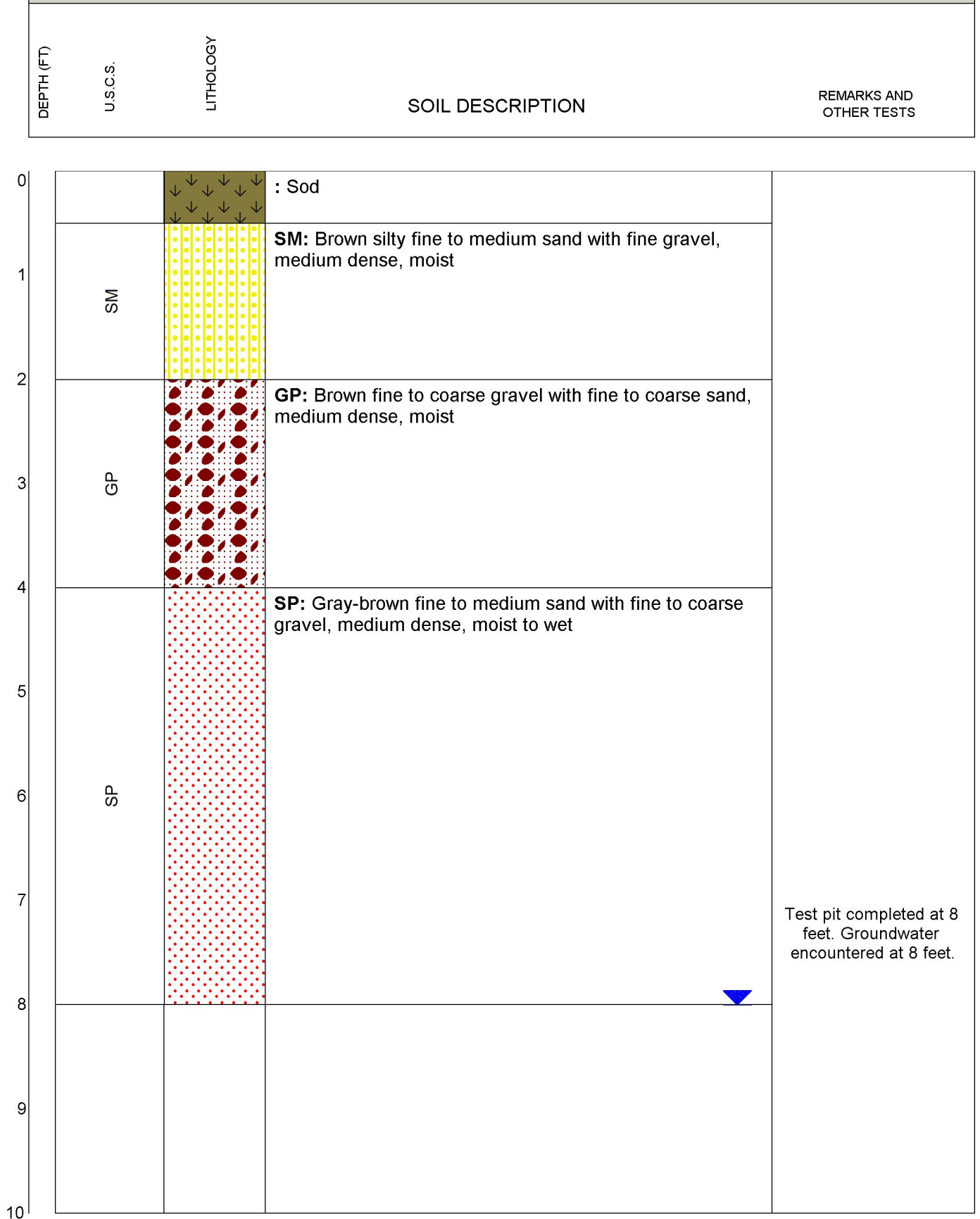
Figure A-9

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

TP-5

DATE: February 3, 2023

TOTAL DEPTH: 8



Operator: **Neal Graham**
 Equipment: **Yanmar 35C**
 Logged By: **Neal Graham**

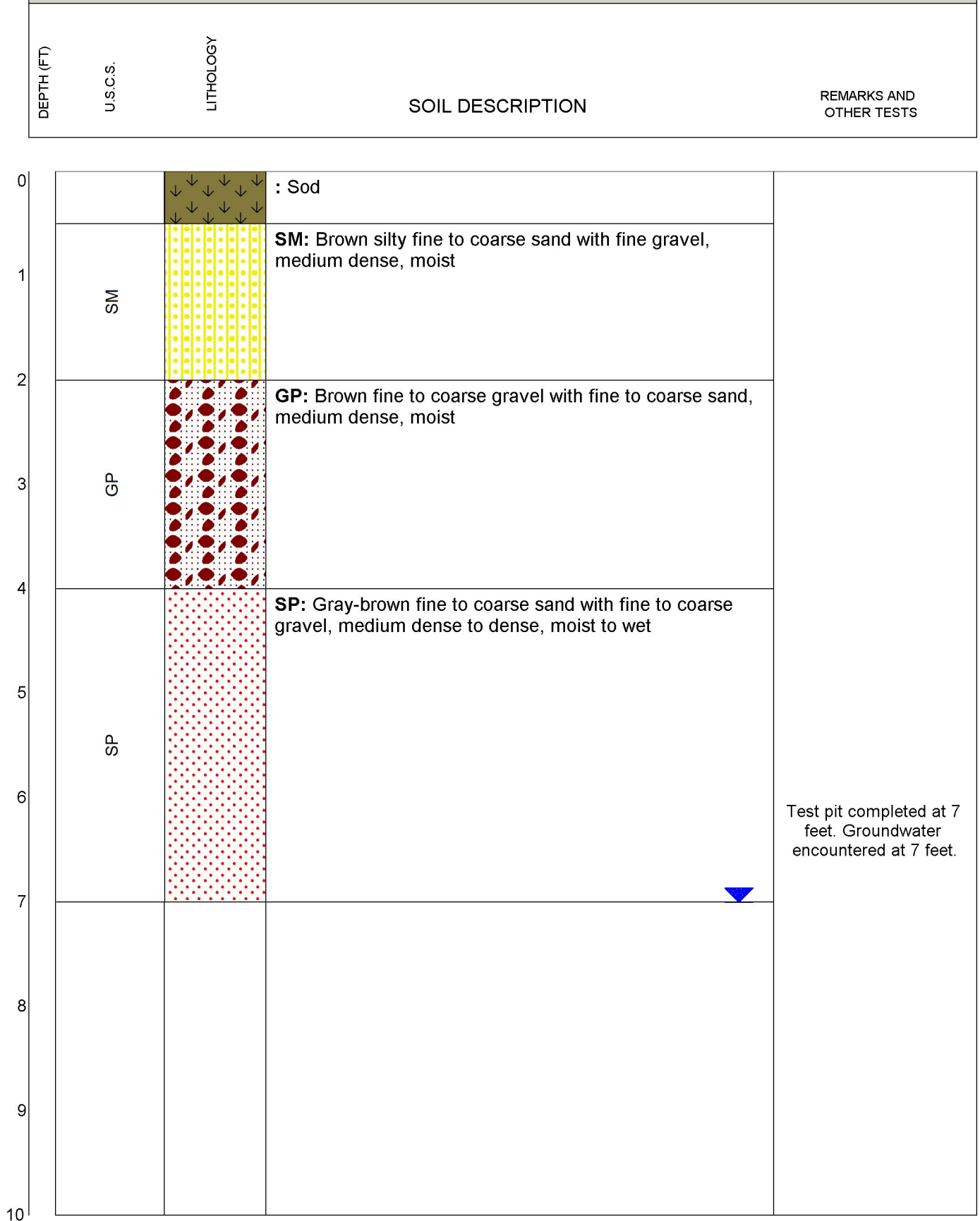
Figure A-10

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

TP-6

DATE: February 3, 2023

TOTAL DEPTH: 7



Operator: **Neal Graham**
 Equipment: **Yanmar 35C**
 Logged By: **Neal Graham**

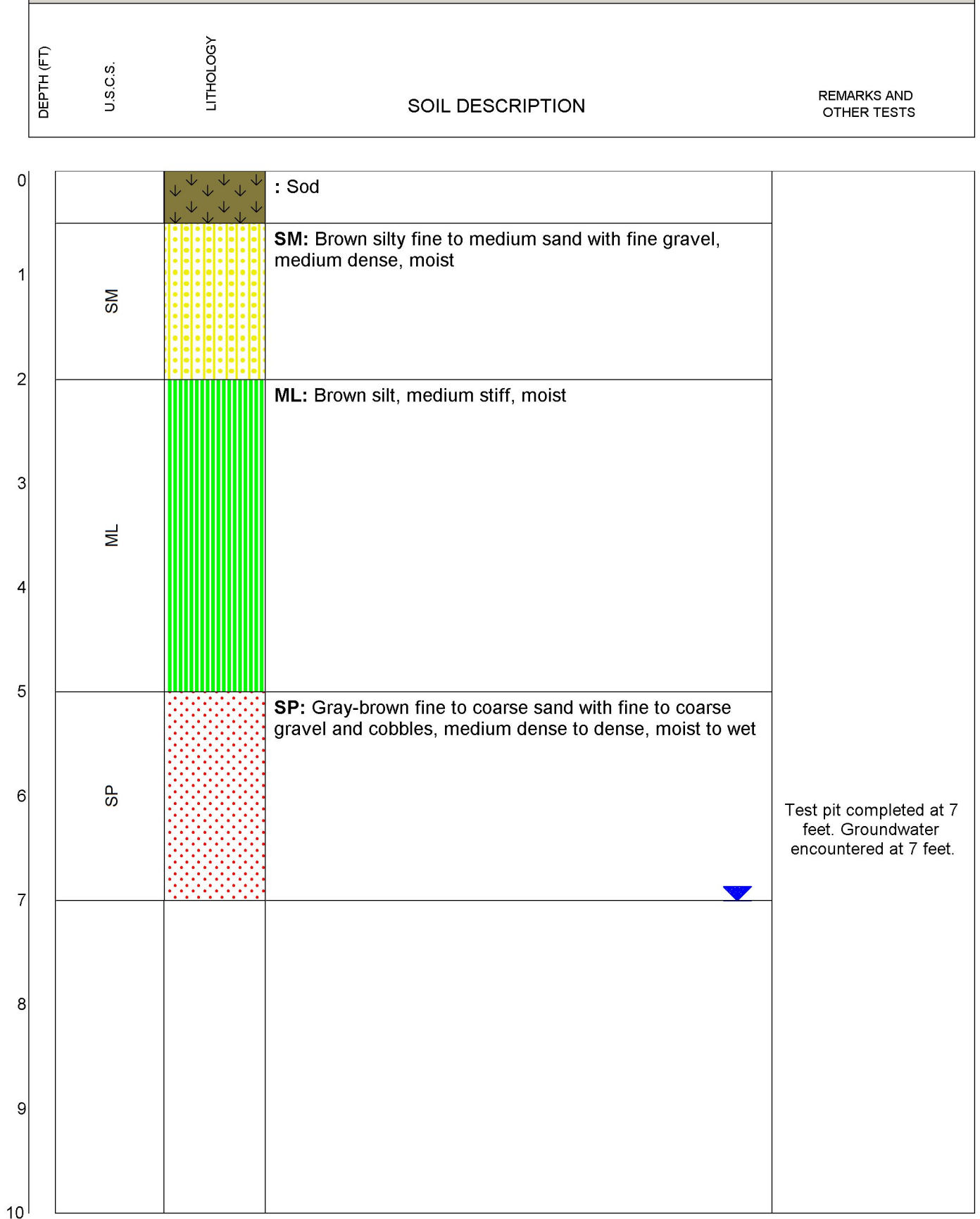
Figure A-11

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

TP-7

DATE: February 3, 2023

TOTAL DEPTH: 7



Operator: **Neal Graham**
 Equipment: **Yanmar 35C**
 Logged By: **Neal Graham**


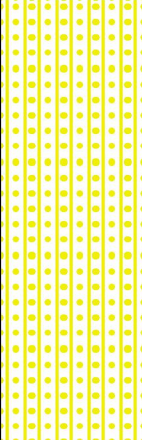

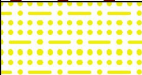
Figure A-12

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

TP-8

DATE: February 3, 2023

TOTAL DEPTH: 4.5

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0			: Sod	Test pit completed at 4.5 feet. No groundwater encountered.
1			SM: Brown silty fine to medium sand with fine gravel, medium dense, moist	
2	SM			
3				
4	GP		GP: Gray-brown fine to coarse gravel with fine to coarse sand, medium dense, moist	
	SP-SM		SP-SM: Gray-brown fine to coarse sand with fine to coarse gravel and silt, dense, moist	
5				
6				
7				
8				
9				
10				



Operator: **Neal Graham**
 Equipment: **Yanmar 35C**
 Logged By: **Neal Graham**

Figure A-13

ATTACHMENT B
LABORATORY ANALYSES RESULTS

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: TP-1
Sample Name: TP-1 0.0' - 4.0'
Depth: 0 - 4 Feet

Moisture Content (%) 21.7%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	0.0
1.5 in. (37.5)	100.0	Fine Gravel	28.9
3/4 in. (19.0)	100.0		
3/8 in. (9.5-mm)	81.8	Coarse Sand	9.5
No. 4 (4.75-mm)	71.1	Medium Sand	13.1
No. 10 (2.00-mm)	61.6	Fine Sand	18.0
No. 20 (.850-mm)	54.7		
No. 40 (.425-mm)	48.5	Fines	30.5
No. 60 (.250-mm)	43.4	Total	100.0
No. 100 (.150-mm)	39.5		
No. 200 (.075-mm)	30.5		

LL --

PL --

PI --

D₁₀ 0.00

D₃₀ 0.07

D₆₀ 1.75

D₉₀ 14.00

Cc --

Cu --

ASTM Classification
Group Name: **Silty Sand with Gravel**
Symbol: **SM**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: TP-2
Sample Name: TP-2 2.5' - 9.0'
Depth: 2.5 - 9 Feet

Moisture Content (%) 8.9%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	10.1
1.5 in. (37.5)	100.0	Fine Gravel	49.7
3/4 in. (19.0)	89.9		
3/8 in. (9.5-mm)	51.0	Coarse Sand	5.0
No. 4 (4.75-mm)	40.3	Medium Sand	16.4
No. 10 (2.00-mm)	35.3	Fine Sand	17.3
No. 20 (.850-mm)	29.4		
No. 40 (.425-mm)	18.8	Fines	1.5
No. 60 (.250-mm)	8.5	Total	100.0
No. 100 (.150-mm)	3.5		
No. 200 (.075-mm)	1.5		

LL --

PL --

PI --

D₁₀ 0.28

D₃₀ 0.86

D₆₀ 11.50

D₉₀ 19.00

Cc 0.23

Cu 41.82

ASTM Classification

Group Name: **Poorly Graded Gravel with Sand**

Symbol: **GP**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: TP-3
Sample Name: TP-3 1.5' - 4.0'
Depth: 1.5 - 4 Feet

Moisture Content (%) 2.9%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	21.3
1.5 in. (37.5)	100.0	Fine Gravel	38.4
3/4 in. (19.0)	78.7		
3/8 in. (9.5-mm)	63.0	Coarse Sand	21.9
No. 4 (4.75-mm)	40.3	Medium Sand	15.3
No. 10 (2.00-mm)	18.5	Fine Sand	2.1
No. 20 (.850-mm)	7.8		
No. 40 (.425-mm)	3.1	Fines	1.1
No. 60 (.250-mm)	1.8	Total	100.0
No. 100 (.150-mm)	1.5		
No. 200 (.075-mm)	1.1		

LL --

PL --

PI --

D₁₀ 1.10

D₃₀ 3.20

D₆₀ 8.50

D₉₀ 28.00

Cc 1.10

Cu 7.73

ASTM Classification
Group Name: **Well Graded Gravel with Sand**
Symbol: **GW**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: TP-4
Sample Name: TP-4 1.5' - 5.0'
Depth: 1.5 - 5 Feet

Moisture Content (%) 5.5%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	23.3
1.5 in. (37.5)	100.0	Fine Gravel	34.9
3/4 in. (19.0)	76.7		
3/8 in. (9.5-mm)	56.3	Coarse Sand	11.7
No. 4 (4.75-mm)	41.8	Medium Sand	19.8
No. 10 (2.00-mm)	30.1	Fine Sand	7.4
No. 20 (.850-mm)	18.9		
No. 40 (.425-mm)	10.3	Fines	2.9
No. 60 (.250-mm)	6.0	Total	100.0
No. 100 (.150-mm)	4.3		
No. 200 (.075-mm)	2.9		

LL --

PL --

PI --

D₁₀ 0.42

D₃₀ 2.00

D₆₀ 11.00

D₉₀ 28.00

Cc 0.87

Cu 26.19

ASTM Classification

Group Name: **Poorly Graded Gravel with Sand**

Symbol: **GP**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: TP-5
Sample Name: TP-5 4.0' - 8.0'
Depth: 4 - 8 Feet

Moisture Content (%) 14.9%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	10.0
1.5 in. (37.5)	100.0	Fine Gravel	8.2
3/4 in. (19.0)	90.0		
3/8 in. (9.5-mm)	86.6	Coarse Sand	5.7
No. 4 (4.75-mm)	81.9	Medium Sand	17.0
No. 10 (2.00-mm)	76.2	Fine Sand	54.6
No. 20 (.850-mm)	72.0		
No. 40 (.425-mm)	59.2	Fines	4.6
No. 60 (.250-mm)	35.4	Total	100.0
No. 100 (.150-mm)	14.1		
No. 200 (.075-mm)	4.6		

LL --

PL --

PI --

D₁₀ 0.12

D₃₀ 0.21

D₆₀ 0.43

D₉₀ 19.00

Cc 0.85

Cu 3.58

ASTM Classification

Group Name: **Poorly Graded Sand with Gravel**

Symbol: **SP**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: TP-6
Sample Name: TP-6 0.0' - 2.0'
Depth: 0 - 2 Feet

Moisture Content (%) 26.1%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	0.0
1.5 in. (37.5)	100.0	Fine Gravel	11.6
3/4 in. (19.0)	100.0		
3/8 in. (9.5-mm)	91.4	Coarse Sand	6.3
No. 4 (4.75-mm)	88.4	Medium Sand	13.7
No. 10 (2.00-mm)	82.1	Fine Sand	33.6
No. 20 (.850-mm)	76.7		
No. 40 (.425-mm)	68.4	Fines	34.7
No. 60 (.250-mm)	61.3	Total	100.0
No. 100 (.150-mm)	54.6		
No. 200 (.075-mm)	34.7		

LL --
PL --
PI --

D₁₀ 0.00
D₃₀ 0.07
D₆₀ 0.23
D₉₀ 6.75

Cc --
Cu --

ASTM Classification
 Group Name: **Silty Sand**
 Symbol: **SM**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: TP-6
Sample Name: TP-6 4.0' - 7.0'
Depth: 4 - 7 Feet

Moisture Content (%) 13.6%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	20.7
1.5 in. (37.5)	100.0	Fine Gravel	14.6
3/4 in. (19.0)	79.3		
3/8 in. (9.5-mm)	70.0	Coarse Sand	5.4
No. 4 (4.75-mm)	64.8	Medium Sand	19.4
No. 10 (2.00-mm)	59.4	Fine Sand	36.4
No. 20 (.850-mm)	55.1		
No. 40 (.425-mm)	40.0	Fines	3.5
No. 60 (.250-mm)	17.5	Total	100.0
No. 100 (.150-mm)	7.5		
No. 200 (.075-mm)	3.5		

LL - -
PL - -
PI - -

D₁₀ 0.18
D₃₀ 0.32
D₆₀ 2.10
D₉₀ 27.50

Cc 0.27
Cu 11.67

ASTM Classification
Group Name: **Poorly Graded Sand with Gravel**
Symbol: **SP**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: MW-1
Sample Name: MW-1 4.0' - 6.0'
Depth: 4 - 6 Feet

Moisture Content (%) 29.3%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	0.0
1.5 in. (37.5)	100.0	Fine Gravel	7.0
3/4 in. (19.0)	100.0		
3/8 in. (9.5-mm)	96.0	Coarse Sand	4.7
No. 4 (4.75-mm)	93.0	Medium Sand	7.1
No. 10 (2.00-mm)	88.3	Fine Sand	16.9
No. 20 (.850-mm)	84.6		
No. 40 (.425-mm)	81.2	Fines	64.3
No. 60 (.250-mm)	78.2	Total	100.0
No. 100 (.150-mm)	75.4		
No. 200 (.075-mm)	64.3		

LL --
PL --
PI --

D₁₀ 0.00
D₃₀ 0.00
D₆₀ 0.06
D₉₀ 2.80

Cc --
Cu --

ASTM Classification
Group Name: **Sandy Silt**
Symbol: **ML**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: MW-2
Sample Name: MW-2 2.0' - 4.0'
Depth: 2 - 4 Feet

Moisture Content (%) 16.8%

Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	11.6
1.5 in. (37.5)	100.0	Fine Gravel	8.9
3/4 in. (19.0)	88.4		
3/8 in. (9.5-mm)	83.3	Coarse Sand	4.2
No. 4 (4.75-mm)	79.5	Medium Sand	35.6
No. 10 (2.00-mm)	75.3	Fine Sand	32.1
No. 20 (.850-mm)	68.8		
No. 40 (.425-mm)	39.7	Fines	7.6
No. 60 (.250-mm)	19.2	Total	100.0
No. 100 (.150-mm)	13.3		
No. 200 (.075-mm)	7.6		

LL - -
PL - -
PI - -

D₁₀ 0.10
D₃₀ 0.32
D₆₀ 0.65
D₉₀ 21.00

Cc 1.58
Cu 6.50

ASTM Classification
Group Name: **Poorly Graded Sand with Gravel and Silt**
Symbol: **SP-SM**

Gradation Analysis Summary Data

Job Name: 2000 24th Ave NW
Job Number: 901-003-01
Date Tested: 2/9/23
Tested By: Andrew Johnson

Sample Location: MW-3
Sample Name: MW-3 4.0' - 6.0'
Depth: 4 - 6 Feet

Moisture Content (%) 13.6%

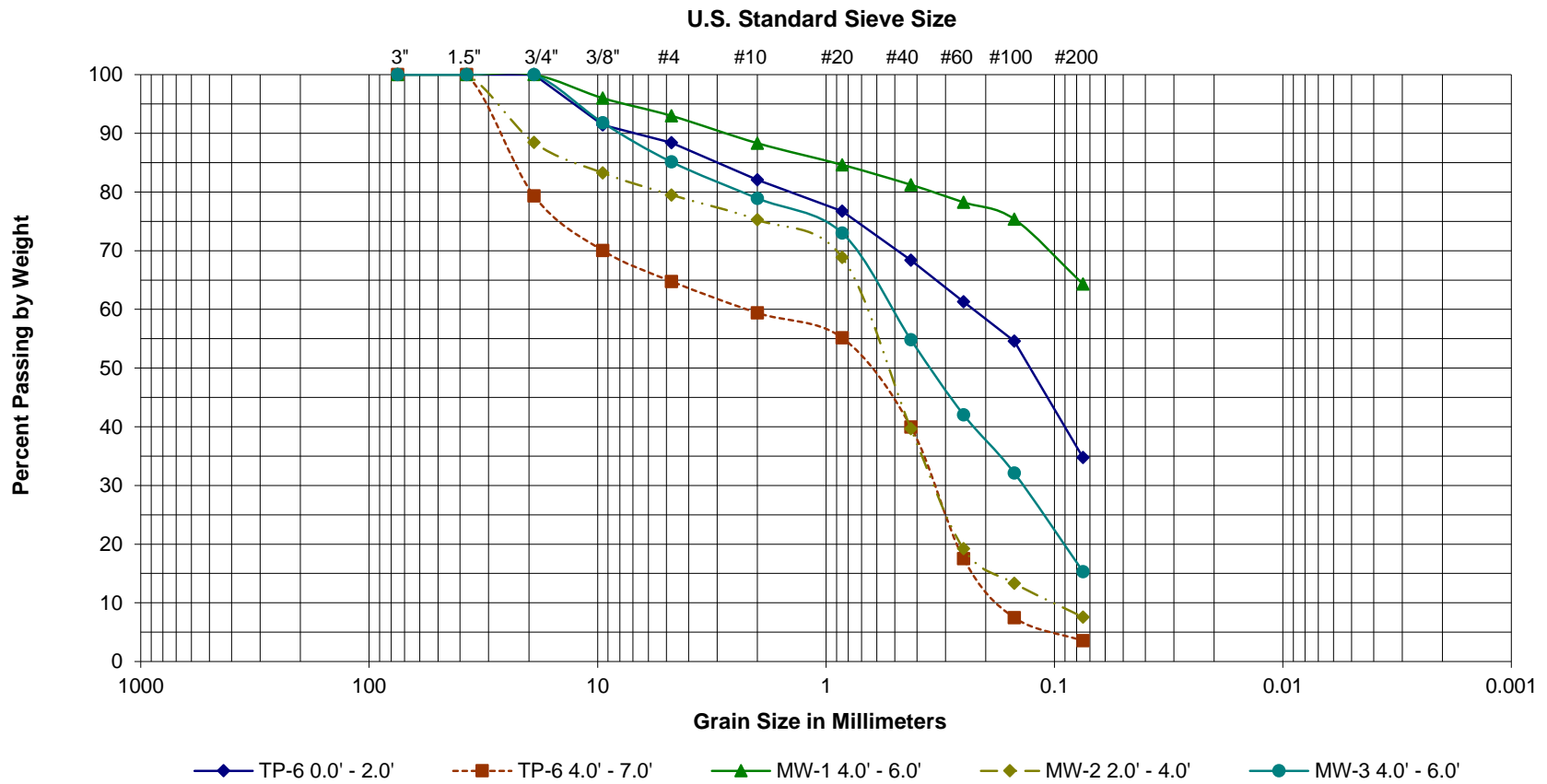
Sieve Size	Percent Passing	Size Fraction	Percent by Weight
3.0 in. (75.0)	100.0	Coarse Gravel	0.0
1.5 in. (37.5)	100.0	Fine Gravel	14.9
3/4 in. (19.0)	100.0		
3/8 in. (9.5-mm)	91.8	Coarse Sand	6.2
No. 4 (4.75-mm)	85.1	Medium Sand	24.1
No. 10 (2.00-mm)	78.9	Fine Sand	39.5
No. 20 (.850-mm)	73.0		
No. 40 (.425-mm)	54.8	Fines	15.3
No. 60 (.250-mm)	42.0	Total	100.0
No. 100 (.150-mm)	32.1		
No. 200 (.075-mm)	15.3		

LL - -
PL - -
PI - -

D₁₀ 0.06
D₃₀ 0.14
D₆₀ 0.50
D₉₀ 8.00

Cc 0.64
Cu 8.20

ASTM Classification
Group Name: **Silty Sand**
Symbol: **SM**



2000 24TH AVENUE NW

OLYMPIA, WASHINGTON



Graph 2
Gratation Analysis Results

ATTACHMENT C
REPORT LIMITATIONS AND GUIDELINES FOR USE

ATTACHMENT C

REPORT LIMITATIONS AND GUIDELINES FOR USE¹

This attachment provides information to help you manage your risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report has been prepared for the exclusive use by RJ Development (Client) and their authorized agents. This report may be made available to regulatory agencies for review. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

Insight Geologic Inc. structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared. This report should not be applied for any purpose or project except the one originally contemplated.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Insight Geologic, Inc. considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless Insight Geologic specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

If important changes are made after the date of this report, Insight Geologic should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

¹ Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org .

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or ground water fluctuations. Always contact Insight Geologic before applying a report to determine if it remains applicable.

MOST GEOTECHNICAL AND GEOLOGIC FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Insight Geologic reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

GEOTECHNICAL ENGINEERING REPORT RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the preliminary construction recommendations included in this report. These recommendations are not final, because they were developed principally from Insight Geologic's professional judgment and opinion. Insight Geologic's recommendations can be finalized only by observing actual subsurface conditions revealed during construction. Insight Geologic cannot assume responsibility or liability for this report's recommendations if we do not perform construction observation.

Sufficient monitoring, testing and consultation by Insight Geologic should be provided during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork activities are completed in accordance with our recommendations. Retaining Insight Geologic for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT COULD BE SUBJECT TO MISINTERPRETATION

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Insight Geologic confer with appropriate members of the design team after submitting the report. Also retain Insight Geologic to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having Insight Geologic participate in pre-bid and pre-construction conferences, and by providing construction observation.

DO NOT REDRAW THE EXPLORATION LOGS

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a

geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering or geologic report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with Insight Geologic and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might an owner be in a position to give contractors the best information available, while requiring them to at least share the financial responsibilities stemming from unanticipated conditions. Further, a contingency for unanticipated conditions should be included in your project budget and schedule.

CONTRACTORS ARE RESPONSIBLE FOR SITE SAFETY ON THEIR OWN CONSTRUCTION PROJECTS

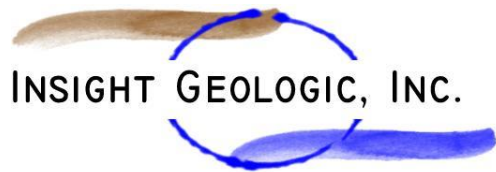
Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and to adjacent properties.

READ THESE PROVISIONS CLOSELY

Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. Insight Geologic includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with Insight Geologic if you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or site.

GEOTECHNICAL, GEOLOGIC AND ENVIRONMENTAL REPORTS SHOULD NOT BE INTERCHANGED

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



June 5, 2023

RJ Development
401 Central St SE
Olympia, Washington 98501
Attention: Caleb Perkins

Report
Winter Groundwater Monitoring
Proposed Multi-Family Development
2000 24th Avenue NW
Olympia, Washington
Project No. 901-003-01

INTRODUCTION

Insight Geologic, Inc. is pleased to provide our report for winter groundwater monitoring at the location of the proposed multi-family residential development to be located at 2000-24th Avenue NW in unincorporated Thurston County, Washington. The location of the site is shown relative to surrounding physical features in the Vicinity Map, Figure 1.

We understand that the project site consists of a single parcel of property totaling approximately 11 acres. The site is wooded in the western portion and used for pasture and livestock holding in the eastern portion. The eastern portion also contains a single-family residence. Insight Geologic recently completed a geotechnical and stormwater investigation at the site.

SCOPE OF SERVICES

The purpose of our services was to evaluate groundwater conditions as they pertain to stormwater infiltration. The specific tasks performed are outlined below:

1. Monitored the depth to groundwater in the wells on a weekly basis for a period of four months, including two months between December and March, in accordance with the 2022 Manual. Water level measurements were made to the nearest 0.01 foot.
2. Prepared a report for review summarizing our monitoring well installation activities, groundwater monitoring data, estimated high groundwater elevations, and any appropriate changes to the stormwater infiltration rate presented in our initial report titled "*Report - Geotechnical and Stormwater Investigation – Proposed Multi-Family Development*," dated March 3, 2023.

FINDINGS

Monitoring Wells

Insight Geologic installed four groundwater monitoring wells at the site on January 6, 2023. The monitoring wells were completed by Standard Environmental Probe using a Geoprobe 54 LT direct

push sampling rig. The approximate location of the wells is shown on the Site Plan, Figure 2. A geologist from Insight Geologic monitored the explorations and maintained a log of the conditions encountered. The borings were completed to depths of between 8 and 16 feet below ground surface (bgs). The soils were visually classified in general accordance with the system described in ASTM D2487-06. The exploration logs are contained in Attachment A.

Monitoring wells, consisting of a 1-inch diameter casing and screen, were installed in each of the borings (MW-1 to MW-4) on-site to the depth of 15, 12, 15, and 8 feet bgs, respectively. Each monitoring well was completed with a locking, tamper-resistant steel cover, installed flush with the surrounding grade. The monitoring well construction details are included in Attachment A. For the purposes of this report, groundwater elevations were based on estimated ground surface elevation obtained from the Thurston County GeoData elevation contour data layer.

Datalogging pressure transducers were installed in the wells and were programmed to collect groundwater readings at 6-hour intervals during the monitoring period. The transducers recorded groundwater readings from January 9, 2023, to May 1, 2023. Unfortunately, the transducers for MW-1 and MW-3 failed during the monitoring period and only partial transducer data was recovered for these two wells. Manual groundwater measurements were collected on a weekly basis during the monitoring period starting January 9, 2023. Groundwater monitoring data for both the manual measurements and the transducer data are contained in Attachment B. The groundwater hydrographs for the monitoring wells are shown in Figures 3 to 6.

Groundwater Conditions

Groundwater was present in each of the four monitoring wells throughout the monitoring period. We measured the initial depth of groundwater in the wells at between 0.87 and 8.74 feet below the top of the well casing at the beginning of the manual monitoring period on January 9, 2023.

Groundwater elevations in the monitoring well network were generally within 6 feet between each monitoring well at any given measurement. Generally, groundwater elevations were between 211 and 218 feet above mean sea level, and wells fluctuated between 0.74 feet in MW-4 and 3.13 feet in MW-1. At its highest point, which occurred mid-January 2023, high groundwater ranged from about 0.55 feet below ground surface in well MW-4 to 6.69 feet below ground surface in MW-1. A summary of groundwater measurements is shown in Table 1.

Table 1. Summary of Measured Groundwater Levels

Well Number	Depth to Groundwater (feet below ground surface)		Groundwater Elevation (feet above mean sea level)	
	Low	High	Low	High
MW - 1	9.37	6.69	215.63	218.31
MW - 2	3.01	1.69	210.99	212.31
MW - 3	8.74	5.61	211.26	214.39
MW - 4	1.29	0.55	211.71	212.45

OPINION

We have performed an evaluation of groundwater conditions at the property located at 2000 24th Avenue NW in unincorporated Thurston County, Washington. Groundwater elevations beneath the site were monitored for the period between January 9, 2023, to May 1, 2023. The high groundwater elevation measured in the monitoring well network was about 218.31 feet above the mean sea level in MW-1 near the east edge of the project site. The shallowest depth to groundwater was 0.55 feet below the ground surface in MW-4 just east of the wetland near the southern edge of the project site.

Based on the 2022 Thurston County Drainage Design and Erosion Control Manual, we recommended a design infiltration rate of 0.6 to 2.6 inches per hour for the proposed stormwater infiltration area as described in our previous report titled “*Report - Geotechnical and Stormwater Investigation – Proposed Multi-Family Development*,” dated March 3, 2023. The results of our winter groundwater monitoring services indicate that high groundwater is approximately 2 to 3 feet higher than previously anticipated. Based on the 2022 manual, a reduction to 0.3 inches per hour is recommended on the west side of the site and a reduction to 1.5 inches per hour is recommended on the east side.

In areas where stormwater is within 3 feet of the ground surface, such as areas identified near the wetland and monitoring well MW-2 and MW-4, rain garden-type stormwater disposal areas may be appropriate, or other engineering solutions. Thurston County will likely require a groundwater mounding analysis for the proposed site stormwater improvements based on the shallow depths of groundwater. Insight Geologic will be pleased to provide these services as needed.

LIMITATIONS

We have prepared this report for use by RJ Development and their authorized agents. This report may be made available to regulatory agencies.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Please refer to Attachment C titled “Report Limitations and Guidelines for Use” for additional information pertaining to use of this report.

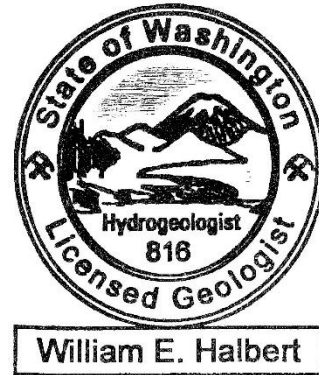


We appreciate the opportunity to be of service to you on this project. Please contact us if you have questions or require additional information.

Respectfully Submitted,
INSIGHT GEOLOGIC, INC.



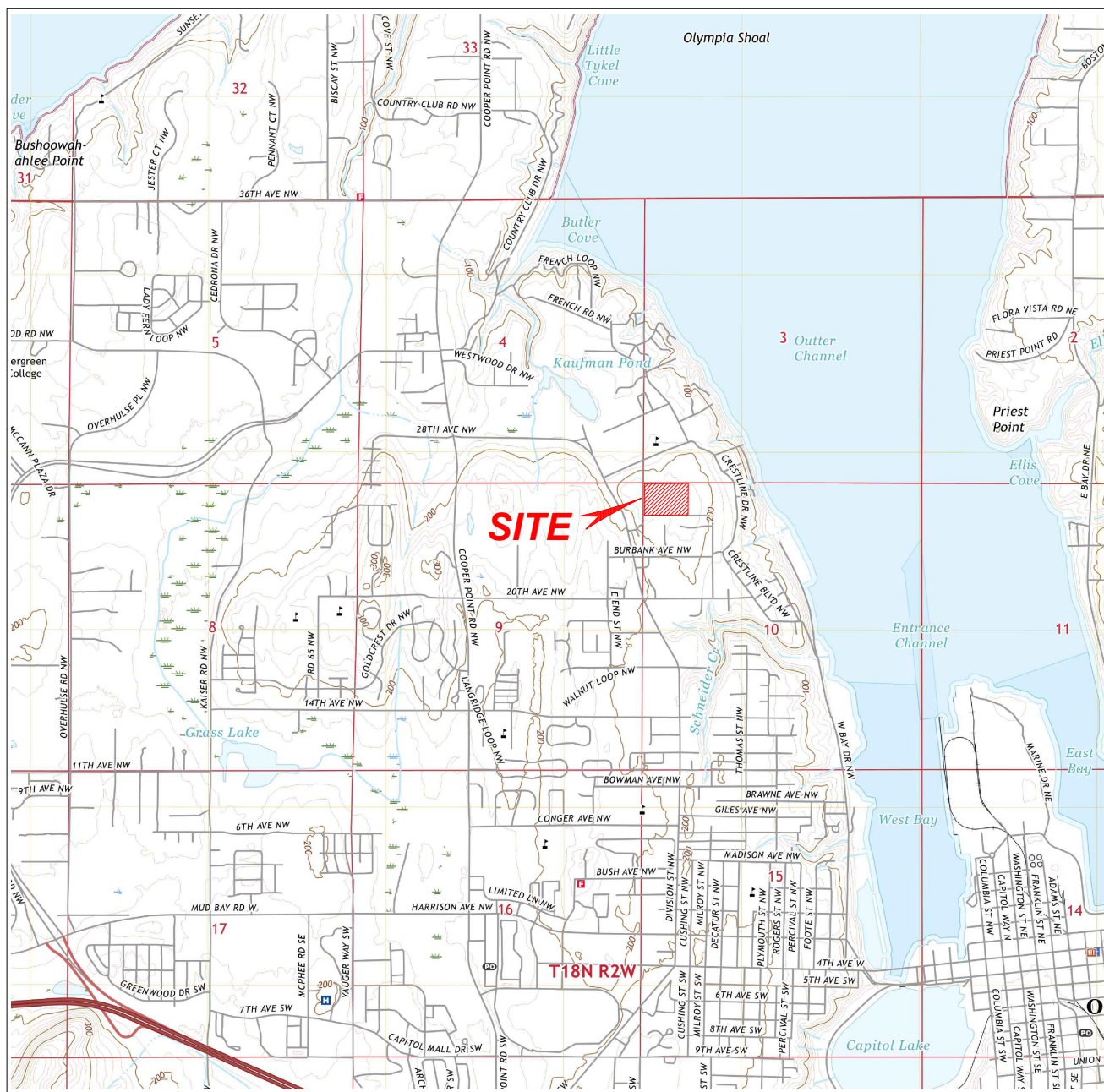
William E. Halbert, L.E.G., L.HG.
Principal



Attachments

FIGURES





Source: USGS (c) 2020

TUMWATER QUADRANGLE
WASHINGTON - THURSTON COUNTY
7.5-MINUTE SERIES
Year 2020

SCALE: 1" = 3000'

2000 24th AVENUE NW
OLYMPIA, WASHINGTON

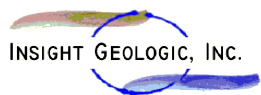
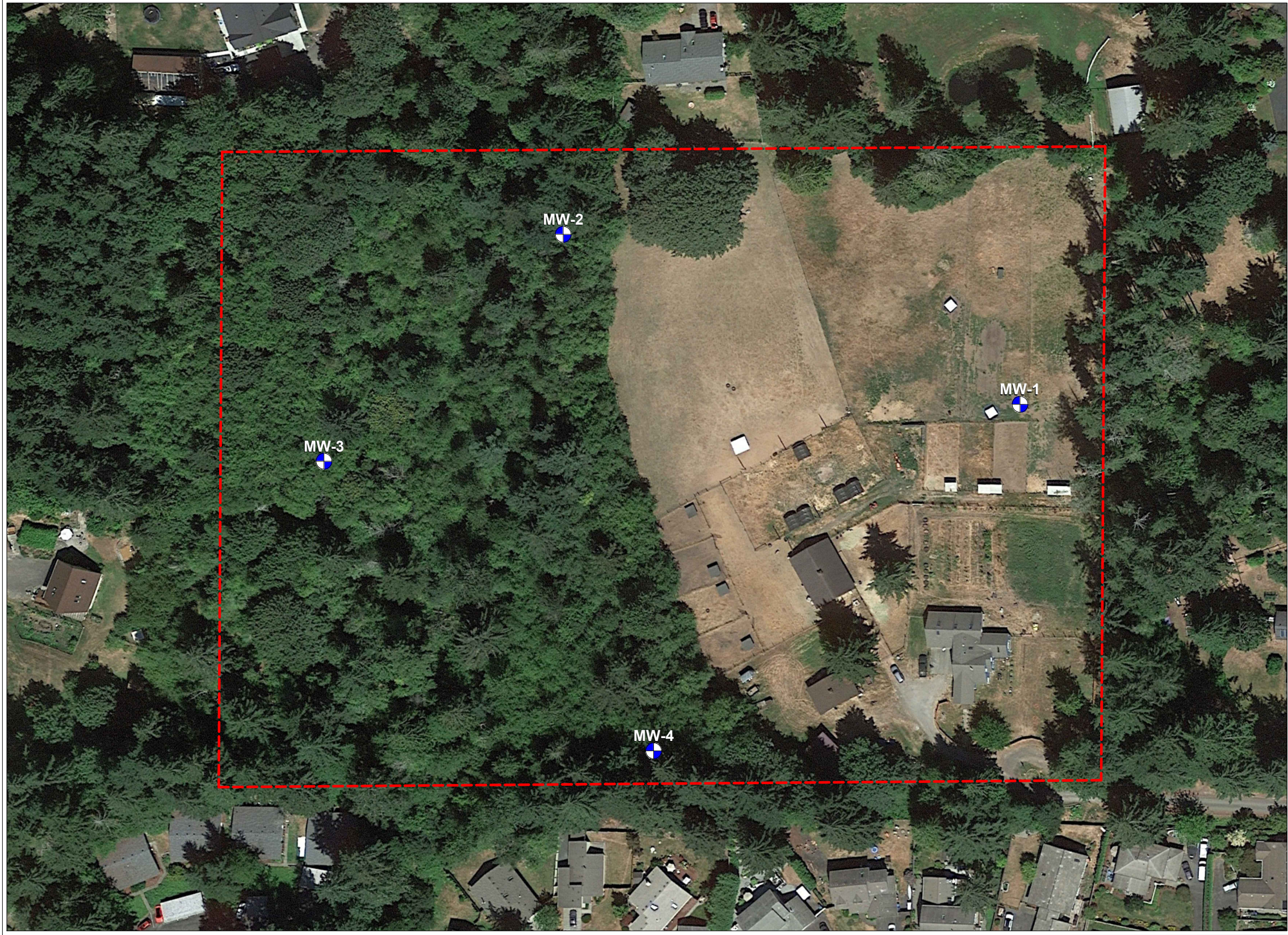

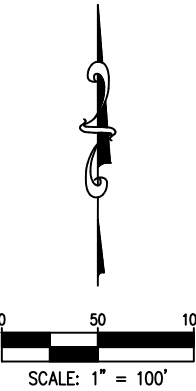


Figure 1
Vicinity Map



LEGEND:

- APPROXIMATE PROJECT BOUNDARY
-  **MW-1** APPROXIMATE MONITORING WELL LOCATION



2000 24th AVENUE NW
OLYMPIA, WASHINGTON

Source: kpff Consulting Engineers

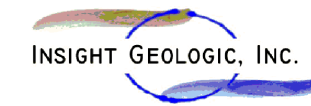


Figure 2
SITE PLAN

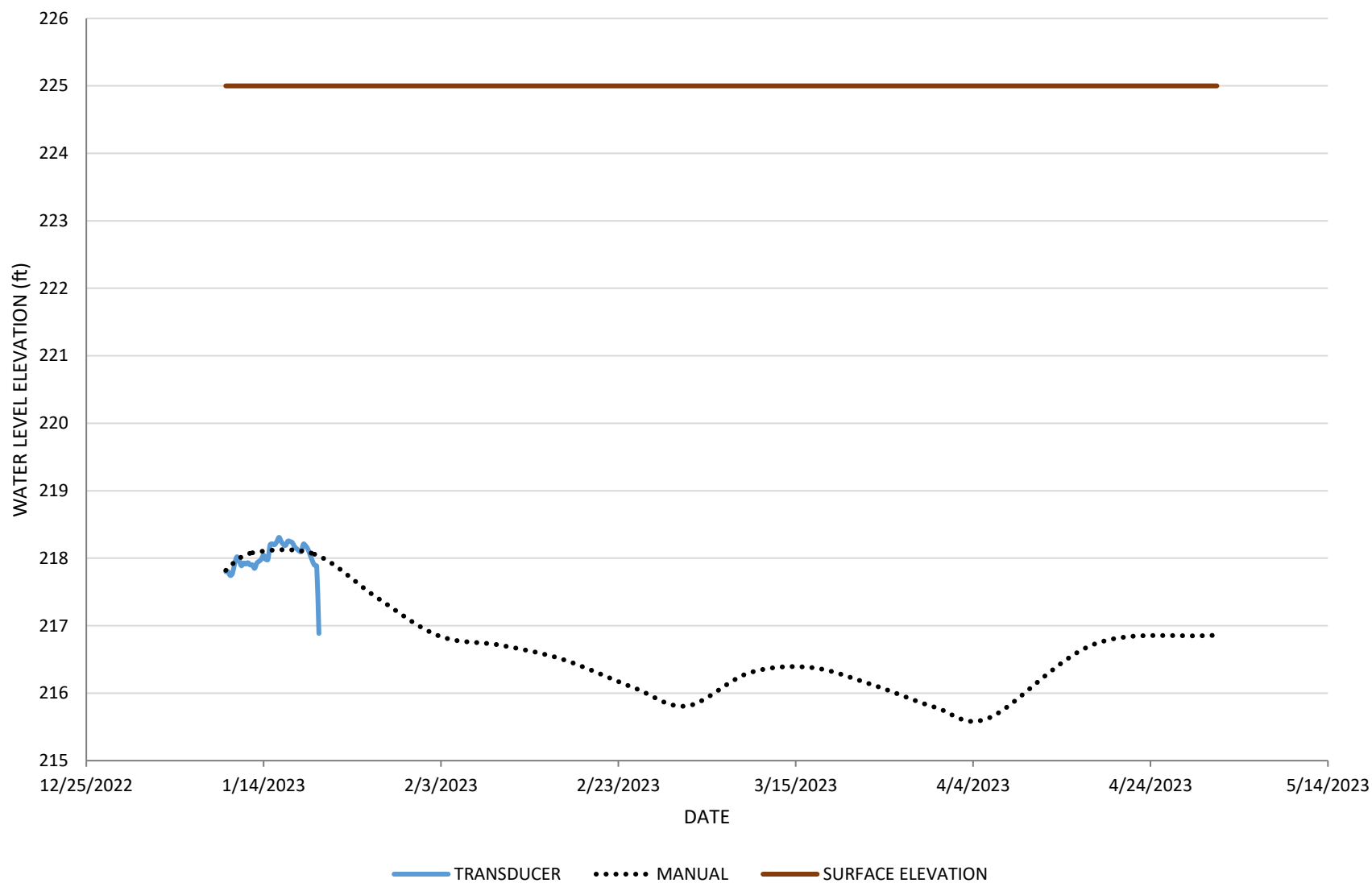


FIGURE 3
HYDROGRAPH MW-I

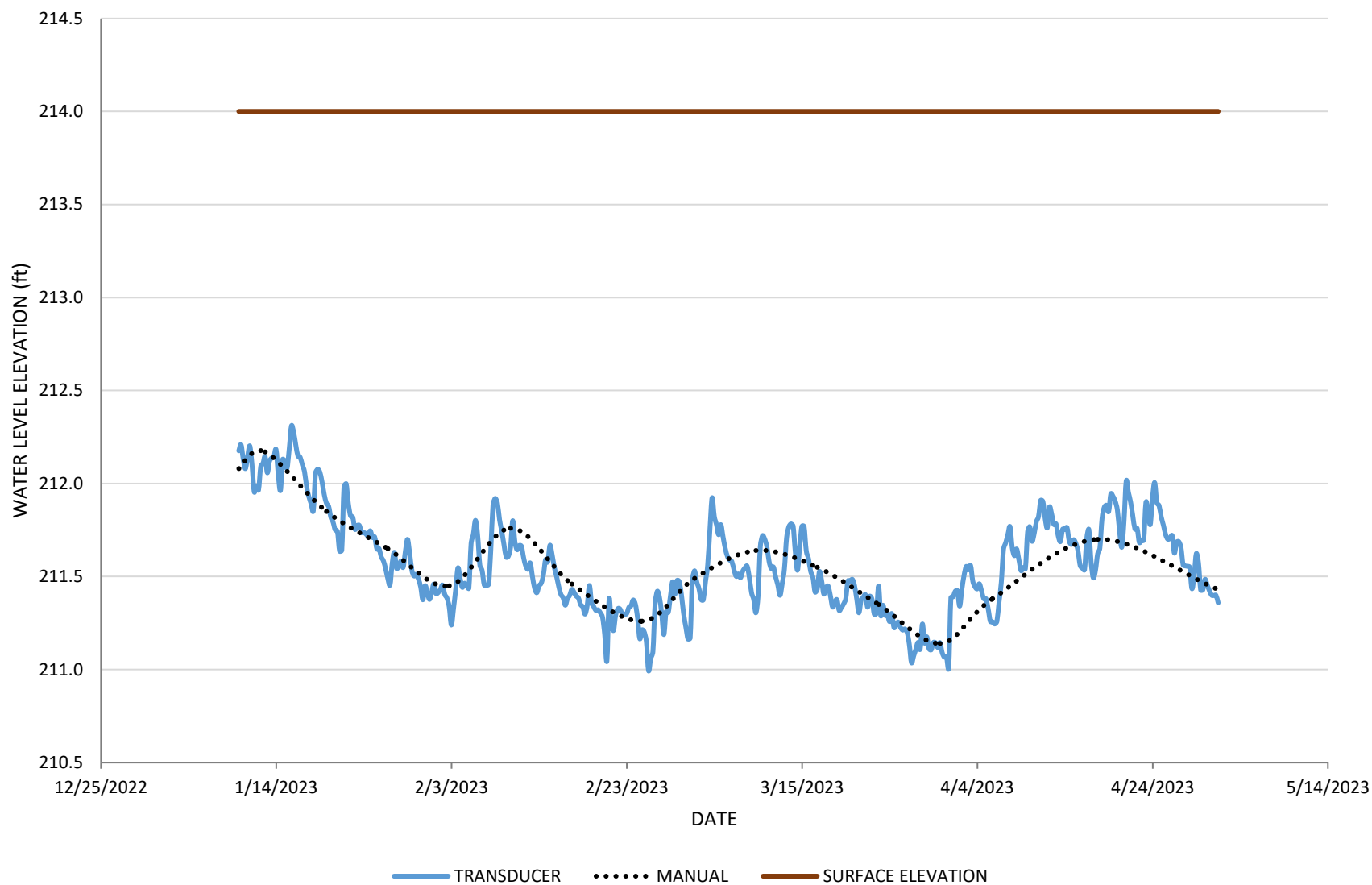


FIGURE 4
HYDROGRAPH MW-2

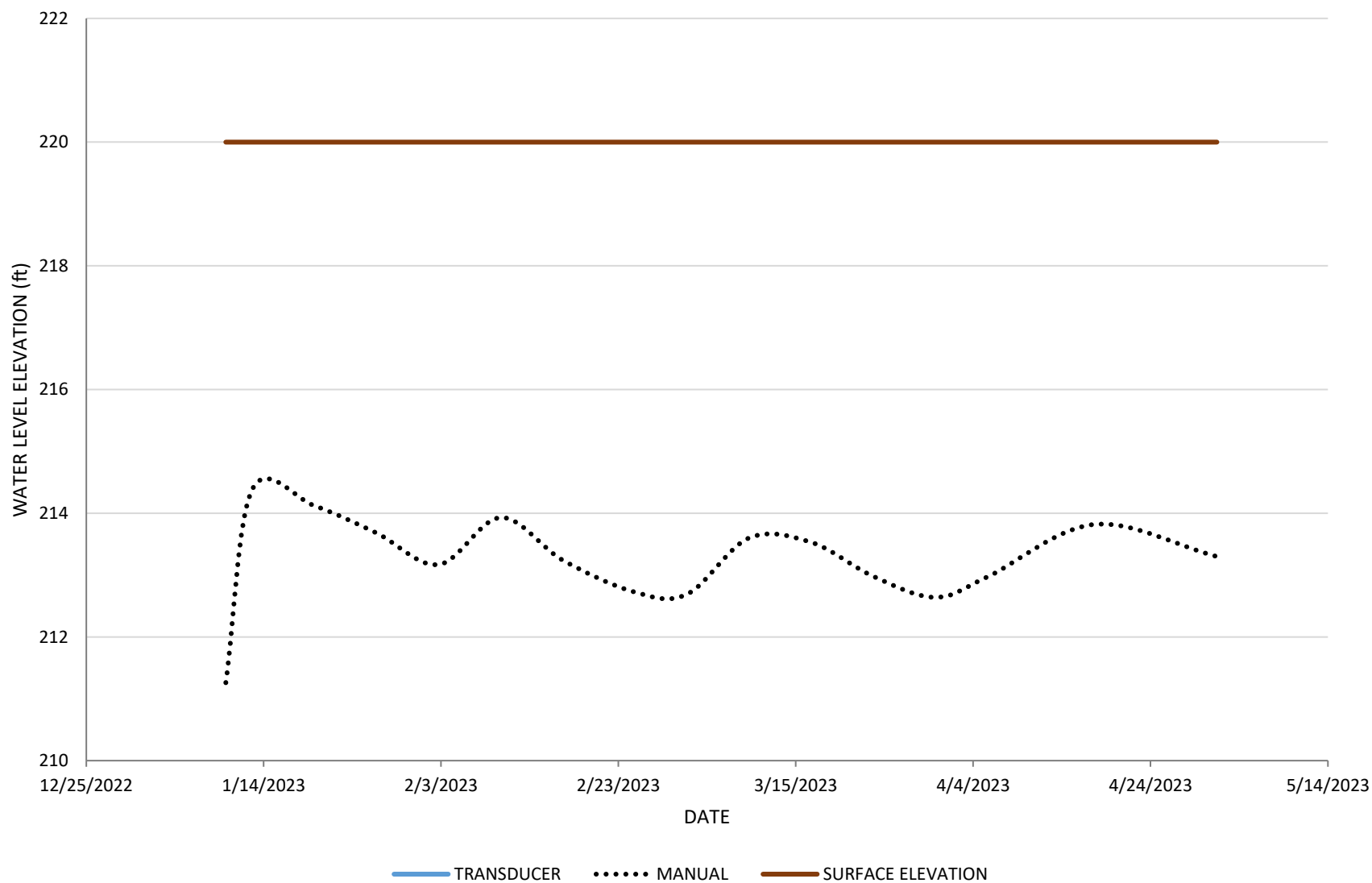
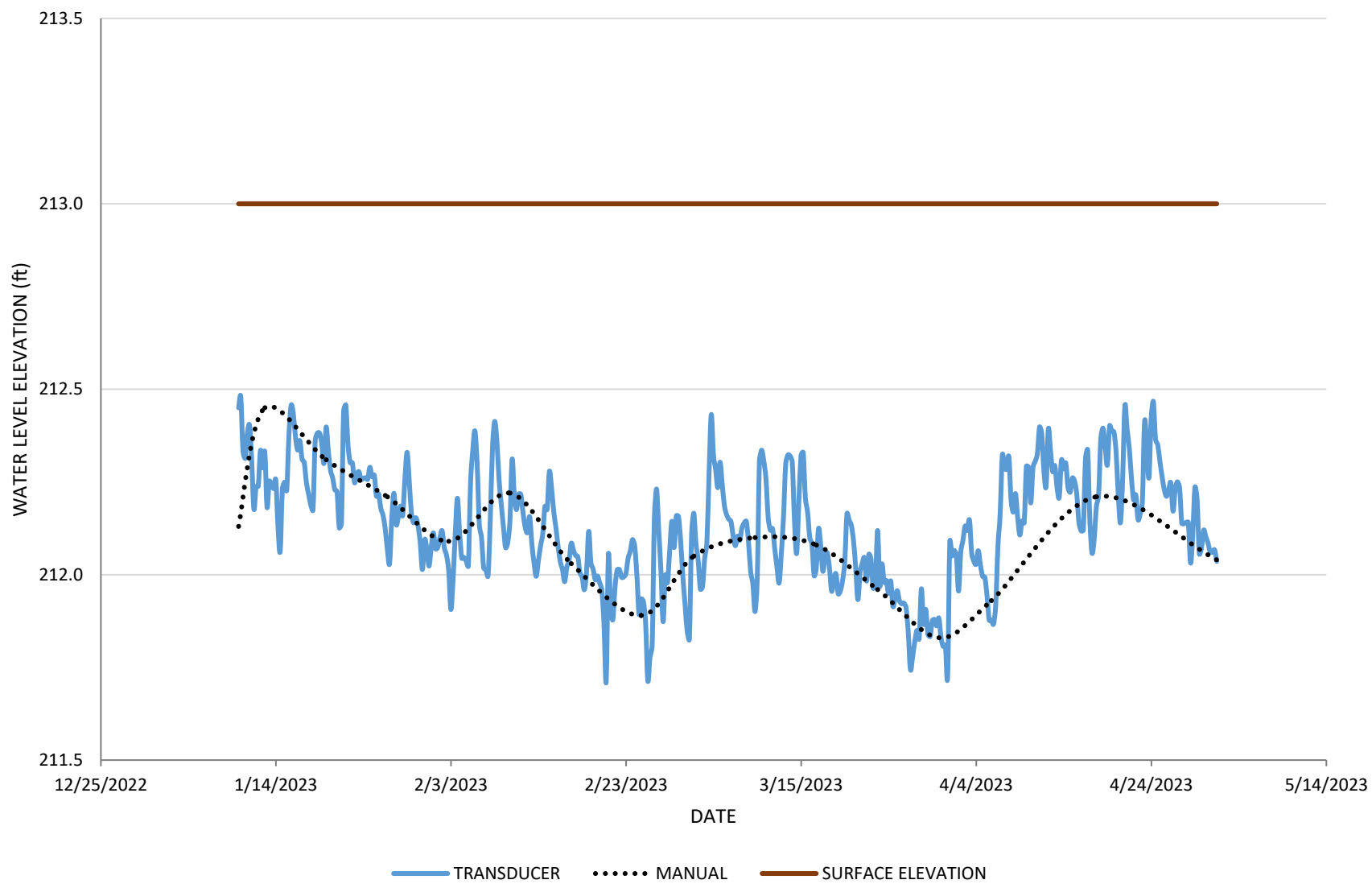
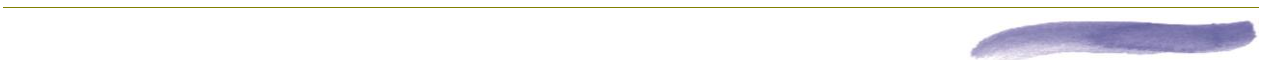

















FIGURE 5
HYDROGRAPH MW-3



ATTACHMENT A
EXPLORATION LOGS



SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		GROUP NAME
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL <5% FINES		GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
				GP	POORLY GRADED GRAVEL
		GRAVEL WITH FINES >12% FINES		GM	SILTY GRAVEL
				GC	CLAYEY GRAVEL
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND <5% FINES		SW	WELL-GRADED SAND, FINE TO COARSE SAND
				SP	POORLY GRADED SAND
		SAND WITH FINES >12% FINES		SM	SILTY SAND
				SC	CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	INORGANIC		ML	SILT
				CL	CLAY
		ORGANIC		OL	ORGANIC SILT, ORGANIC CLAY
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE	INORGANIC		MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
				CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC		OH	ORGANIC CLAY, ORGANIC SILT
			HIGHLY ORGANIC SOILS		

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS	TYPICAL DESCRIPTION	
	CC	CEMENT CONCRETE
	AC	ASPHALT CONCRETE
	CR	CRUSHED ROCK / QUARRY SPALLS
	TS	TOPSOIL / FOREST DUFF / SOD

GROUNDWATER EXPLORATION SYMBOLS

- MEASURED GROUNDWATER LEVEL IN EXPLORATION, WELL, OR PIEZOMETER
- GROUNDWATER OBSERVED AT TIME OF EXPLORATION
- PERCHED WATER OBSERVED AT TIME OF EXPLORATION
- MEASURED FREE PRODUCT IN WELL OR PIEZOMETER

STRATIGRAPHIC CONTACT

- DISTINCT CONTACT BETWEEN SOIL STRATA OR GEOLOGIC UNITS
- GRADUAL CHANGE BETWEEN SOIL STRATA OR GEOLOGIC UNITS
- APPROXIMATE LOCATION OF SOIL STRATA CHANGE WITHIN GEOLOGIC SOIL UNIT

LABORATORY / FIELD TEST CLASSIFICATIONS

- | | |
|--------------------------------------|--|
| %F PERCENT FINES | MD MOISTURE CONTENT AND DRY DENSITY |
| AL ATTERBERG LIMITS | OC ORGANIC COMPOUND |
| CA CHEMICAL ANALYSIS | PM PERMEABILITY OR HYDRAULIC CONDUCTIVITY |
| CP LABORATORY COMPACTION TEST | PP POCKET PENETROMETER |
| CS CONSOLIDATION TEST | SA SIEVE ANALYSIS |
| DS DIRECT SHEAR | TX TRIAXIAL COMPRESSION |
| HA HYDROMETER ANALYSIS | UC UNCONFINED COMPRESSION |
| MC MOISTURE CONTENT | VS VANE SHEAR |

SAMPLER SYMBOLS

- | | |
|----------------------------|--------------|
| 2.4 INCH I.D. SPLIT BARREL | SHELBY TUBE |
| DIRECT-PUSH | PISTON |
| STANDARD PENETRATION TEST | BULK OR GRAB |

SHEEN CLASSIFICATIONS

- NS** NO VISIBLE SHEEN
- SS** SLIGHT SHEEN
- MS** MODERATE SHEEN
- HS** HEAVY SHEEN
- NT** NOT TESTED

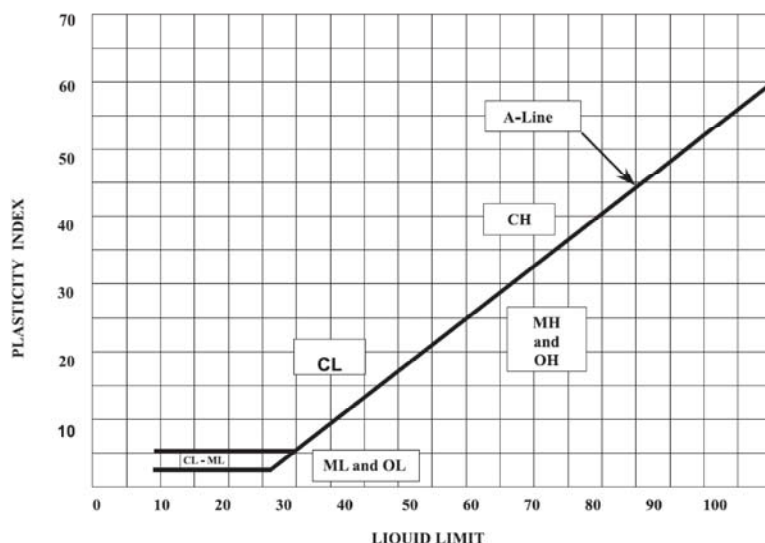


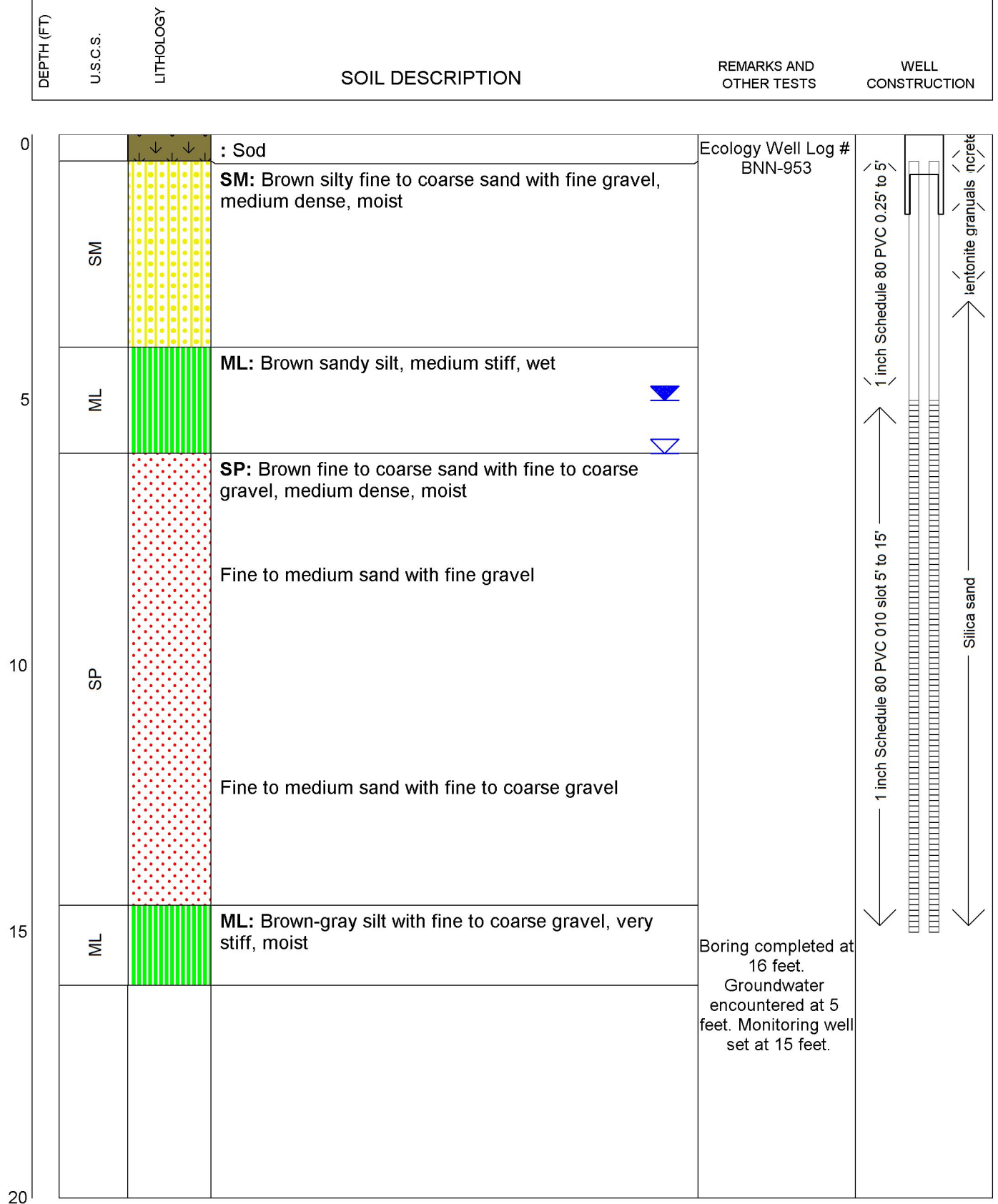
Figure A-1
Key to Exploration Logs

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

DATE: January 6, 2023

MW-1

TOTAL DEPTH: 16



Drilling Contractor: **Standard**
 Drilling Equipment: **Geoprobe 54 LT**
 Logged By: **Neal Graham**

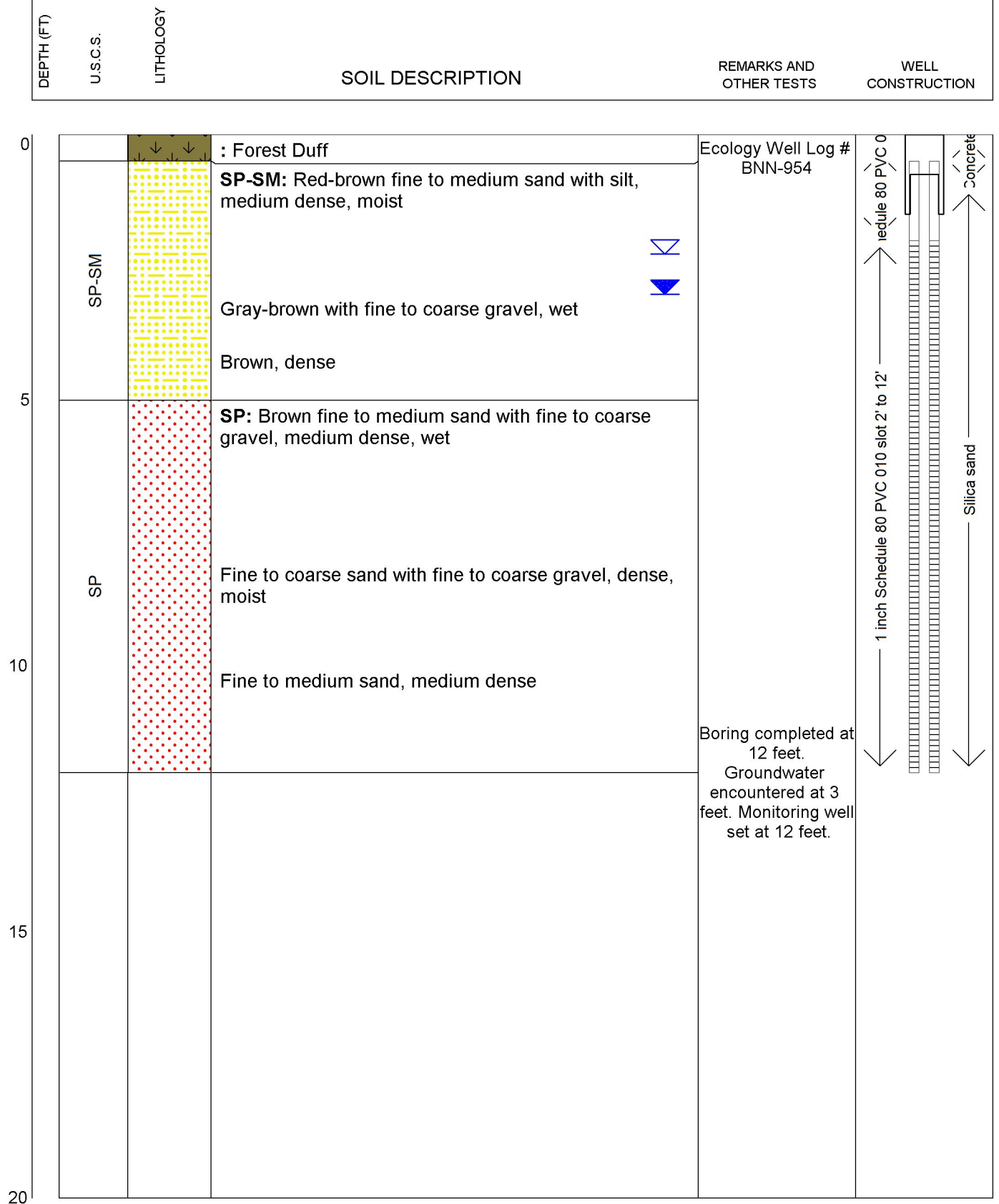
Figure A-2

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

DATE: January 6, 2023

MW-2

TOTAL DEPTH: 12



Drilling Contractor: **Standard**
 Drilling Equipment: **Geoprobe 54 LT**
 Logged By: **Neal Graham**

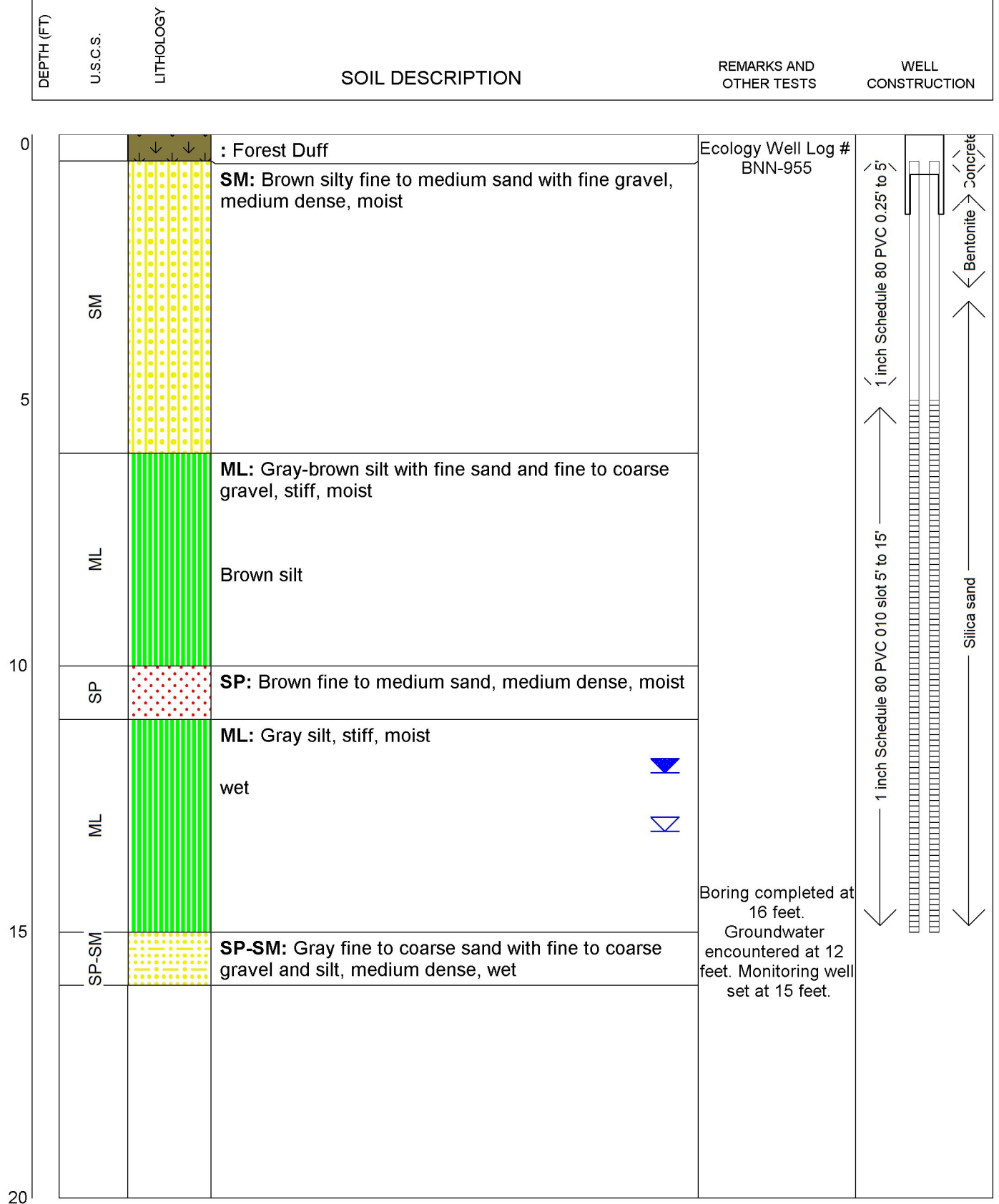
Figure A-3

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

MW-3

DATE: January 6, 2023

TOTAL DEPTH: 16



Drilling Contractor: Standard
 Drilling Equipment: Geoprobe 54 LT
 Logged By: Neal Graham

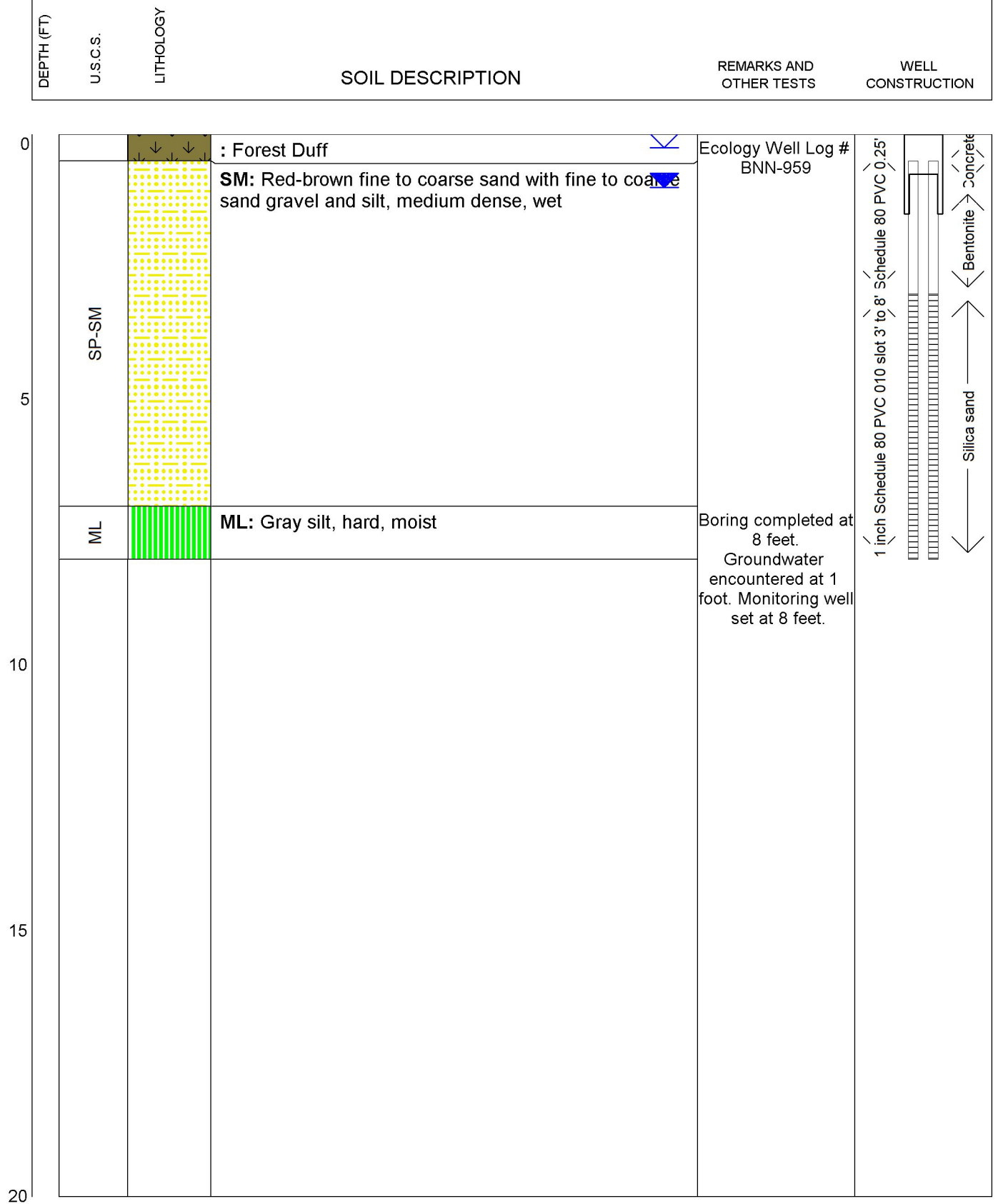
Figure A-4

PROJECT: 2000 24th Avenue NW
 PROJECT NO.: 901-003-01
 LOCATION: Thurston County, Washington

MW-4

DATE: January 6, 2023

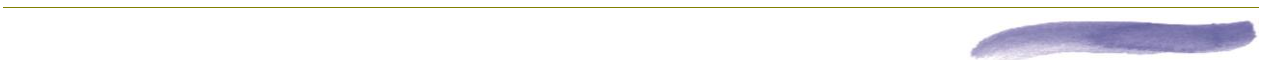
TOTAL DEPTH: 8



Drilling Contractor: **Standard**
 Drilling Equipment: **Geoprobe 54 LT**
 Logged By: **Neal Graham**

Figure A-5

ATTACHMENT B
GROUNDWATER MONITORING DATA



MW-1

RJ Development

2400 24th Avenue NW, Olympia, WA

LEVEL

UNIT: ft

TEMPERATURE

UNIT: °F

Approximate Ground Surface = 225 feet

Based on Thurston County elevation data

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
1/9/2023	17:26:00	6.9002	7.18	225	14.1	217.8002	217.82
1/9/2023	23:26:00	6.9009		225	14.1	217.8009	
1/10/2023	5:26:00	6.843		225	14.1	217.743	
1/10/2023	11:26:00	6.8738		225	14.1	217.7738	
1/10/2023	17:26:00	7.0207		225	14.1	217.9207	
1/10/2023	23:26:00	7.1201		225	14.1	218.0201	
1/11/2023	5:26:00	7.0685		225	14.1	217.9685	
1/11/2023	11:26:00	6.9884		225	14.1	217.8884	
1/11/2023	17:26:00	7.0292		225	14.1	217.9292	
1/11/2023	23:26:00	7.0133		225	14.1	217.9133	
1/12/2023	5:26:00	7.034		225	14.1	217.934	
1/12/2023	11:26:00	6.9993		225	14.1	217.8993	
1/12/2023	17:26:00	7.0016	6.92	225	14.1	217.9016	218.08
1/12/2023	23:26:00	6.9492		225	14.1	217.8492	
1/13/2023	5:26:00	7.0273		225	14.1	217.9273	
1/13/2023	11:26:00	7.0551		225	14.1	217.9551	
1/13/2023	17:26:00	7.0831		225	14.1	217.9831	
1/13/2023	23:26:00	7.1469		225	14.1	218.0469	
1/14/2023	5:26:00	7.0827		225	14.1	217.9827	
1/14/2023	11:26:00	7.0813		225	14.1	217.9813	
1/14/2023	17:26:00	7.2997		225	14.1	218.1997	
1/14/2023	23:26:00	7.3117		225	14.1	218.2117	
1/15/2023	5:26:00	7.3001		225	14.1	218.2001	
1/15/2023	11:26:00	7.3445		225	14.1	218.2445	
1/15/2023	17:26:00	7.409		225	14.1	218.309	
1/15/2023	23:26:00	7.3501		225	14.1	218.2501	
1/16/2023	5:26:00	7.3019		225	14.1	218.2019	
1/16/2023	11:26:00	7.2915		225	14.1	218.1915	
1/16/2023	17:26:00	7.3531		225	14.1	218.2531	
1/16/2023	23:26:00	7.3471		225	14.1	218.2471	
1/17/2023	5:26:00	7.3312		225	14.1	218.2312	
1/17/2023	11:26:00	7.2715		225	14.1	218.1715	
1/17/2023	17:26:00	7.2402		225	14.1	218.1402	
1/17/2023	23:26:00	7.2095		225	14.1	218.1095	
1/18/2023	5:26:00	7.1976		225	14.1	218.0976	
1/18/2023	11:26:00	7.309		225	14.1	218.209	
1/18/2023	17:26:00	7.2842		225	14.1	218.1842	
1/18/2023	23:26:00	7.2362		225	14.1	218.1362	
1/19/2023	5:26:00	7.1515		225	14.1	218.0515	
1/19/2023	11:26:00	7.0666		225	14.1	217.9666	
1/19/2023	17:26:00	6.9956	6.94	225	14.1	217.8956	218.06
1/19/2023	23:26:00	6.9809		225	14.1	217.8809	

MW-1

RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
1/20/2023	5:26:00	5.9857		225	14.1	216.8857	
1/26/2023	17:27:06	--	7.58	225	14.1	--	217.42
2/2/2023	17:27:06	--	8.15	225	14.1	--	216.85
2/9/2023	17:27:06	--	8.29	225	14.1	--	216.71
2/16/2023	17:27:06	--	8.5	225	14.1	--	216.5
2/24/2023	17:27:06	--	8.92	225	14.1	--	216.08
3/2/2023	17:27:06	--	9.19	225	14.1	--	215.81
3/9/2023	17:27:06	--	8.7	225	14.1	--	216.3
3/16/2023	17:27:06	--	8.62	225	14.1	--	216.38
3/23/2023	17:27:06	--	8.88	225	14.1	--	216.12
3/30/2023	17:27:06	--	9.21	225	14.1	--	215.79
4/5/2023	17:27:06	--	9.37	225	14.1	--	215.63
4/17/2023	17:27:06	--	8.27	225	14.1	--	216.73
5/1/2023	11:27:06	--	8.14	225	14.1	--	216.86

*Note: The transducer for MW-1 failed on January 20, 2023

MW-2

RJ Development

2400 24th Avenue NW, Olympia, WA

LEVEL

UNIT: ft

TEMPERATURE

UNIT: °F

Approximate Ground Surface = 214 feet

Based on Thurston County elevation data

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
1/9/2023	17:27:06	8.616	1.92	214	10.44	212.176	212.08
1/9/2023	23:27:06	8.649		214	10.44	212.209	
1/10/2023	5:27:06	8.572		214	10.44	212.132	
1/10/2023	11:27:06	8.52		214	10.44	212.08	
1/10/2023	17:27:06	8.585		214	10.44	212.145	
1/10/2023	23:27:06	8.642		214	10.44	212.202	
1/11/2023	5:27:06	8.543		214	10.44	212.103	
1/11/2023	11:27:06	8.396		214	10.44	211.956	
1/11/2023	17:27:06	8.428		214	10.44	211.988	
1/11/2023	23:27:06	8.406		214	10.44	211.966	
1/12/2023	5:27:06	8.532		214	10.44	212.092	
1/12/2023	11:27:06	8.547		214	10.44	212.107	
1/12/2023	17:27:06	8.585	1.83	214	10.44	212.145	212.17
1/12/2023	23:27:06	8.498		214	10.44	212.058	
1/13/2023	5:27:06	8.56		214	10.44	212.12	
1/13/2023	11:27:06	8.577		214	10.44	212.137	
1/13/2023	17:27:06	8.585		214	10.44	212.145	
1/13/2023	23:27:06	8.622		214	10.44	212.182	
1/14/2023	5:27:06	8.486		214	10.44	212.046	
1/14/2023	11:27:06	8.403		214	10.44	211.963	
1/14/2023	17:27:06	8.569		214	10.44	212.129	
1/14/2023	23:27:06	8.561		214	10.44	212.121	
1/15/2023	5:27:06	8.522		214	10.44	212.082	
1/15/2023	11:27:06	8.626		214	10.44	212.186	
1/15/2023	17:27:06	8.749		214	10.44	212.309	
1/15/2023	23:27:06	8.717		214	10.44	212.277	
1/16/2023	5:27:06	8.647		214	10.44	212.207	
1/16/2023	11:27:06	8.587		214	10.44	212.147	
1/16/2023	17:27:06	8.581		214	10.44	212.141	
1/16/2023	23:27:06	8.54		214	10.44	212.1	
1/17/2023	5:27:06	8.503		214	10.44	212.063	
1/17/2023	11:27:06	8.419		214	10.44	211.979	
1/17/2023	17:27:06	8.368		214	10.44	211.928	
1/17/2023	23:27:06	8.331		214	10.44	211.891	
1/18/2023	5:27:06	8.293		214	10.44	211.853	
1/18/2023	11:27:06	8.496		214	10.44	212.056	
1/18/2023	17:27:06	8.517		214	10.44	212.077	
1/18/2023	23:27:06	8.501		214	10.44	212.061	
1/19/2023	5:27:06	8.448		214	10.44	212.008	
1/19/2023	11:27:06	8.38		214	10.44	211.94	
1/19/2023	17:27:06	8.334	2.15	214	10.44	211.894	211.85
1/19/2023	23:27:06	8.317		214	10.44	211.877	

MW-2

RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
1/20/2023	5:27:06	8.259		214	10.44	211.819	
1/20/2023	11:27:06	8.233		214	10.44	211.793	
1/20/2023	17:27:06	8.19		214	10.44	211.75	
1/20/2023	23:27:06	8.183		214	10.44	211.743	
1/21/2023	5:27:06	8.076		214	10.44	211.636	
1/21/2023	11:27:06	8.081		214	10.44	211.641	
1/21/2023	17:27:06	8.422		214	10.44	211.982	
1/21/2023	23:27:06	8.439		214	10.44	211.999	
1/22/2023	5:27:06	8.332		214	10.44	211.892	
1/22/2023	11:27:06	8.266		214	10.44	211.826	
1/22/2023	17:27:06	8.259		214	10.44	211.819	
1/22/2023	23:27:06	8.194		214	10.44	211.754	
1/23/2023	5:27:06	8.213		214	10.44	211.773	
1/23/2023	11:27:06	8.215		214	10.44	211.775	
1/23/2023	17:27:06	8.177		214	10.44	211.737	
1/23/2023	23:27:06	8.178		214	10.44	211.738	
1/24/2023	5:27:06	8.169		214	10.44	211.729	
1/24/2023	11:27:06	8.159		214	10.44	211.719	
1/24/2023	17:27:06	8.186		214	10.44	211.746	
1/24/2023	23:27:06	8.15		214	10.44	211.71	
1/25/2023	5:27:06	8.153		214	10.44	211.713	
1/25/2023	11:27:06	8.088		214	10.44	211.648	
1/25/2023	17:27:06	8.09		214	10.44	211.65	
1/25/2023	23:27:06	8.046		214	10.44	211.606	
1/26/2023	5:27:06	8.024		214	10.44	211.584	
1/26/2023	11:27:06	7.982		214	10.44	211.542	
1/26/2023	17:27:06	7.929	2.35	214	10.44	211.489	211.65
1/26/2023	23:27:06	7.895		214	10.44	211.455	
1/27/2023	5:27:06	8.011		214	10.44	211.571	
1/27/2023	11:27:06	8.07		214	10.44	211.63	
1/27/2023	17:27:06	7.984		214	10.44	211.544	
1/27/2023	23:27:06	7.993		214	10.44	211.553	
1/28/2023	5:27:06	8.023		214	10.44	211.583	
1/28/2023	11:27:06	7.989		214	10.44	211.549	
1/28/2023	17:27:06	8.074		214	10.44	211.634	
1/28/2023	23:27:06	8.14		214	10.44	211.7	
1/29/2023	5:27:06	8.063		214	10.44	211.623	
1/29/2023	11:27:06	7.972		214	10.44	211.532	
1/29/2023	17:27:06	7.943		214	10.44	211.503	
1/29/2023	23:27:06	7.952		214	10.44	211.512	
1/30/2023	5:27:06	7.925		214	10.44	211.485	
1/30/2023	11:27:06	7.884		214	10.44	211.444	
1/30/2023	17:27:06	7.815		214	10.44	211.375	
1/30/2023	23:27:06	7.89		214	10.44	211.45	
1/31/2023	5:27:06	7.857		214	10.44	211.417	
1/31/2023	11:27:06	7.817		214	10.44	211.377	
1/31/2023	17:27:06	7.854		214	10.44	211.414	

MW-2

RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
1/31/2023	23:27:06	7.9		214	10.44	211.46	
2/1/2023	5:27:06	7.849		214	10.44	211.409	
2/1/2023	11:27:06	7.854		214	10.44	211.414	
2/1/2023	17:27:06	7.871		214	10.44	211.431	
2/1/2023	23:27:06	7.894		214	10.44	211.454	
2/2/2023	5:27:06	7.844		214	10.44	211.404	
2/2/2023	11:27:06	7.824		214	10.44	211.384	
2/2/2023	17:27:06	7.778	2.55	214	10.44	211.338	211.45
2/2/2023	23:27:06	7.679		214	10.44	211.239	
2/3/2023	5:27:06	7.769		214	10.44	211.329	
2/3/2023	11:27:06	7.873		214	10.44	211.433	
2/3/2023	17:27:06	7.986		214	10.44	211.546	
2/3/2023	23:27:06	7.931		214	10.44	211.491	
2/4/2023	5:27:06	7.882		214	10.44	211.442	
2/4/2023	11:27:06	7.904		214	10.44	211.464	
2/4/2023	17:27:06	7.891		214	10.44	211.451	
2/4/2023	23:27:06	7.877		214	10.44	211.437	
2/5/2023	5:27:06	8.116		214	10.44	211.676	
2/5/2023	11:27:06	8.165		214	10.44	211.725	
2/5/2023	17:27:06	8.242		214	10.44	211.802	
2/5/2023	23:27:06	8.161		214	10.44	211.721	
2/6/2023	5:27:06	8.002		214	10.44	211.562	
2/6/2023	11:27:06	7.974		214	10.44	211.534	
2/6/2023	17:27:06	7.895		214	10.44	211.455	
2/6/2023	23:27:06	7.893		214	10.44	211.453	
2/7/2023	5:27:06	7.898		214	10.44	211.458	
2/7/2023	11:27:06	8.083		214	10.44	211.643	
2/7/2023	17:27:06	8.325		214	10.44	211.885	
2/7/2023	23:27:06	8.36		214	10.44	211.92	
2/8/2023	5:27:06	8.336		214	10.44	211.896	
2/8/2023	11:27:06	8.245		214	10.44	211.805	
2/8/2023	17:27:06	8.183		214	10.44	211.743	
2/8/2023	23:27:06	8.112		214	10.44	211.672	
2/9/2023	5:27:06	8.045		214	10.44	211.605	
2/9/2023	11:27:06	8.049		214	10.44	211.609	
2/9/2023	17:27:06	8.097	2.24	214	10.44	211.657	211.76
2/9/2023	23:27:06	8.24		214	10.44	211.8	
2/10/2023	5:27:06	8.126		214	10.44	211.686	
2/10/2023	11:27:06	8.084		214	10.44	211.644	
2/10/2023	17:27:06	8.107		214	10.44	211.667	
2/10/2023	23:27:06	8.103		214	10.44	211.663	
2/11/2023	5:27:06	8.04		214	10.44	211.6	
2/11/2023	11:27:06	7.995		214	10.44	211.555	
2/11/2023	17:27:06	7.979		214	10.44	211.539	
2/11/2023	23:27:06	8.013		214	10.44	211.573	
2/12/2023	5:27:06	7.94		214	10.44	211.5	
2/12/2023	11:27:06	7.877		214	10.44	211.437	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
2/12/2023	17:27:06	7.853		214	10.44	211.413	
2/12/2023	23:27:06	7.89		214	10.44	211.45	
2/13/2023	5:27:06	7.904		214	10.44	211.464	
2/13/2023	11:27:06	7.948		214	10.44	211.508	
2/13/2023	17:27:06	8.031		214	10.44	211.591	
2/13/2023	23:27:06	8.018		214	10.44	211.578	
2/14/2023	5:27:06	8.108		214	10.44	211.668	
2/14/2023	11:27:06	8.057		214	10.44	211.617	
2/14/2023	17:27:06	7.989		214	10.44	211.549	
2/14/2023	23:27:06	7.942		214	10.44	211.502	
2/15/2023	5:27:06	7.887		214	10.44	211.447	
2/15/2023	11:27:06	7.844		214	10.44	211.404	
2/15/2023	17:27:06	7.826		214	10.44	211.386	
2/15/2023	23:27:06	7.786		214	10.44	211.346	
2/16/2023	5:27:06	7.821		214	10.44	211.381	
2/16/2023	11:27:06	7.839		214	10.44	211.399	
2/16/2023	17:27:06	7.871	2.54	214	10.44	211.431	211.46
2/16/2023	23:27:06	7.855		214	10.44	211.415	
2/17/2023	5:27:06	7.835		214	10.44	211.395	
2/17/2023	11:27:06	7.825		214	10.44	211.385	
2/17/2023	17:27:06	7.789		214	10.44	211.349	
2/17/2023	23:27:06	7.777		214	10.44	211.337	
2/18/2023	5:27:06	7.738		214	10.44	211.298	
2/18/2023	11:27:06	7.784		214	10.44	211.344	
2/18/2023	17:27:06	7.892		214	10.44	211.452	
2/18/2023	23:27:06	7.799		214	10.44	211.359	
2/19/2023	5:27:06	7.778		214	10.44	211.338	
2/19/2023	11:27:06	7.757		214	10.44	211.317	
2/19/2023	17:27:06	7.761		214	10.44	211.321	
2/19/2023	23:27:06	7.745		214	10.44	211.305	
2/20/2023	5:27:06	7.721		214	10.44	211.281	
2/20/2023	11:27:06	7.627		214	10.44	211.187	
2/20/2023	17:27:06	7.487		214	10.44	211.047	
2/20/2023	23:27:06	7.82		214	10.44	211.38	
2/21/2023	5:27:06	7.676		214	10.44	211.236	
2/21/2023	11:27:06	7.65		214	10.44	211.21	
2/21/2023	17:27:06	7.733		214	10.44	211.293	
2/21/2023	23:27:06	7.767		214	10.44	211.327	
2/22/2023	5:27:06	7.765		214	10.44	211.325	
2/22/2023	11:27:06	7.739		214	10.44	211.299	
2/22/2023	17:27:06	7.738		214	10.44	211.298	
2/22/2023	23:27:06	7.74		214	10.44	211.3	
2/23/2023	5:27:06	7.774		214	10.44	211.334	
2/23/2023	11:27:06	7.783		214	10.44	211.343	
2/23/2023	17:27:06	7.814		214	10.44	211.374	
2/23/2023	23:27:06	7.791		214	10.44	211.351	
2/24/2023	5:27:06	7.717		214	10.44	211.277	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
2/24/2023	11:27:06	7.606		214	10.44	211.166	
2/24/2023	17:27:06	7.653	2.74	214	10.44	211.213	211.26
2/24/2023	23:27:06	7.643		214	10.44	211.203	
2/25/2023	5:27:06	7.591		214	10.44	211.151	
2/25/2023	11:27:06	7.434		214	10.44	210.994	
2/25/2023	17:27:06	7.5		214	10.44	211.06	
2/25/2023	23:27:06	7.537		214	10.44	211.097	
2/26/2023	5:27:06	7.796		214	10.44	211.356	
2/26/2023	11:27:06	7.861		214	10.44	211.421	
2/26/2023	17:27:06	7.828		214	10.44	211.388	
2/26/2023	23:27:06	7.74		214	10.44	211.3	
2/27/2023	5:27:06	7.628		214	10.44	211.188	
2/27/2023	11:27:06	7.751		214	10.44	211.311	
2/27/2023	17:27:06	7.747		214	10.44	211.307	
2/27/2023	23:27:06	7.835		214	10.44	211.395	
2/28/2023	5:27:06	7.912		214	10.44	211.472	
2/28/2023	11:27:06	7.844		214	10.44	211.404	
2/28/2023	17:27:06	7.918		214	10.44	211.478	
2/28/2023	23:27:06	7.913		214	10.44	211.473	
3/1/2023	5:27:06	7.844		214	10.44	211.404	
3/1/2023	11:27:06	7.742		214	10.44	211.302	
3/1/2023	17:27:06	7.67		214	10.44	211.23	
3/1/2023	23:27:06	7.604		214	10.44	211.164	
3/2/2023	5:27:06	7.609		214	10.44	211.169	
3/2/2023	11:27:06	7.919		214	10.44	211.479	
3/2/2023	17:27:06	7.971	2.51	214	10.44	211.531	211.49
3/2/2023	23:27:06	7.912		214	10.44	211.472	
3/3/2023	5:27:06	7.876		214	10.44	211.436	
3/3/2023	11:27:06	7.816		214	10.44	211.376	
3/3/2023	17:27:06	7.815		214	10.44	211.375	
3/3/2023	23:27:06	7.913		214	10.44	211.473	
3/4/2023	5:27:06	8.002		214	10.44	211.562	
3/4/2023	11:27:06	8.191		214	10.44	211.751	
3/4/2023	17:27:06	8.363		214	10.44	211.923	
3/4/2023	23:27:06	8.264		214	10.44	211.824	
3/5/2023	5:27:06	8.22		214	10.44	211.78	
3/5/2023	11:27:06	8.165		214	10.44	211.725	
3/5/2023	17:27:06	8.219		214	10.44	211.779	
3/5/2023	23:27:06	8.154		214	10.44	211.714	
3/6/2023	5:27:06	8.092		214	10.44	211.652	
3/6/2023	11:27:06	8.049		214	10.44	211.609	
3/6/2023	17:27:06	8.029		214	10.44	211.589	
3/6/2023	23:27:06	8.021		214	10.44	211.581	
3/7/2023	5:27:06	7.976		214	10.44	211.536	
3/7/2023	11:27:06	7.941		214	10.44	211.501	
3/7/2023	17:27:06	7.954		214	10.44	211.514	
3/7/2023	23:27:06	7.934		214	10.44	211.494	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
3/8/2023	5:27:06	7.969		214	10.44	211.529	
3/8/2023	11:27:06	7.986		214	10.44	211.546	
3/8/2023	17:27:06	7.996		214	10.44	211.556	
3/8/2023	23:27:06	7.936		214	10.44	211.496	
3/9/2023	5:27:06	7.854		214	10.44	211.414	
3/9/2023	11:27:06	7.817		214	10.44	211.377	
3/9/2023	17:27:06	7.745	2.36	214	10.44	211.305	211.64
3/9/2023	23:27:06	7.836		214	10.44	211.396	
3/10/2023	5:27:06	8.1		214	10.44	211.66	
3/10/2023	11:27:06	8.159		214	10.44	211.719	
3/10/2023	17:27:06	8.142		214	10.44	211.702	
3/10/2023	23:27:06	8.101		214	10.44	211.661	
3/11/2023	5:27:06	8.022		214	10.44	211.582	
3/11/2023	11:27:06	7.983		214	10.44	211.543	
3/11/2023	17:27:06	7.991		214	10.44	211.551	
3/11/2023	23:27:06	7.938		214	10.44	211.498	
3/12/2023	5:27:06	7.895		214	10.44	211.455	
3/12/2023	11:27:06	7.839		214	10.44	211.399	
3/12/2023	17:27:06	7.901		214	10.44	211.461	
3/12/2023	23:27:06	7.98		214	10.44	211.54	
3/13/2023	5:27:06	8.148		214	10.44	211.708	
3/13/2023	11:27:06	8.206		214	10.44	211.766	
3/13/2023	17:27:06	8.223		214	10.44	211.783	
3/13/2023	23:27:06	8.211		214	10.44	211.771	
3/14/2023	5:27:06	8.07		214	10.44	211.63	
3/14/2023	11:27:06	7.974		214	10.44	211.534	
3/14/2023	17:27:06	8.101		214	10.44	211.661	
3/14/2023	23:27:06	8.21		214	10.44	211.77	
3/15/2023	5:27:06	8.209		214	10.44	211.769	
3/15/2023	11:27:06	8.078		214	10.44	211.638	
3/15/2023	17:27:06	8.037		214	10.44	211.597	
3/15/2023	23:27:06	7.968		214	10.44	211.528	
3/16/2023	5:27:06	7.937		214	10.44	211.497	
3/16/2023	11:27:06	7.857		214	10.44	211.417	
3/16/2023	17:27:06	7.872	2.45	214	10.44	211.432	211.55
3/16/2023	23:27:06	7.967		214	10.44	211.527	
3/17/2023	5:27:06	7.918		214	10.44	211.478	
3/17/2023	11:27:06	7.846		214	10.44	211.406	
3/17/2023	17:27:06	7.88		214	10.44	211.44	
3/17/2023	23:27:06	7.888		214	10.44	211.448	
3/18/2023	5:27:06	7.837		214	10.44	211.397	
3/18/2023	11:27:06	7.776		214	10.44	211.336	
3/18/2023	17:27:06	7.802		214	10.44	211.362	
3/18/2023	23:27:06	7.815		214	10.44	211.375	
3/19/2023	5:27:06	7.758		214	10.44	211.318	
3/19/2023	11:27:06	7.773		214	10.44	211.333	
3/19/2023	17:27:06	7.792		214	10.44	211.352	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
3/19/2023	23:27:06	7.821		214	10.44	211.381	
3/20/2023	5:27:06	7.917		214	10.44	211.477	
3/20/2023	11:27:06	7.913		214	10.44	211.473	
3/20/2023	17:27:06	7.925		214	10.44	211.485	
3/20/2023	23:27:06	7.892		214	10.44	211.452	
3/21/2023	5:27:06	7.821		214	10.44	211.381	
3/21/2023	11:27:06	7.745		214	10.44	211.305	
3/21/2023	17:27:06	7.812		214	10.44	211.372	
3/21/2023	23:27:06	7.829		214	10.44	211.389	
3/22/2023	5:27:06	7.842		214	10.44	211.402	
3/22/2023	11:27:06	7.775		214	10.44	211.335	
3/22/2023	17:27:06	7.834		214	10.44	211.394	
3/22/2023	23:27:06	7.817		214	10.44	211.377	
3/23/2023	5:27:06	7.738		214	10.44	211.298	
3/23/2023	11:27:06	7.742		214	10.44	211.302	
3/23/2023	17:27:06	7.889	2.65	214	10.44	211.449	211.35
3/23/2023	23:27:06	7.73		214	10.44	211.29	
3/24/2023	5:27:06	7.786		214	10.44	211.346	
3/24/2023	11:27:06	7.732		214	10.44	211.292	
3/24/2023	17:27:06	7.738		214	10.44	211.298	
3/24/2023	23:27:06	7.698		214	10.44	211.258	
3/25/2023	5:27:06	7.741		214	10.44	211.301	
3/25/2023	11:27:06	7.666		214	10.44	211.226	
3/25/2023	17:27:06	7.682		214	10.44	211.242	
3/25/2023	23:27:06	7.695		214	10.44	211.255	
3/26/2023	5:27:06	7.666		214	10.44	211.226	
3/26/2023	11:27:06	7.652		214	10.44	211.212	
3/26/2023	17:27:06	7.658		214	10.44	211.218	
3/26/2023	23:27:06	7.641		214	10.44	211.201	
3/27/2023	5:27:06	7.577		214	10.44	211.137	
3/27/2023	11:27:06	7.477		214	10.44	211.037	
3/27/2023	17:27:06	7.513		214	10.44	211.073	
3/27/2023	23:27:06	7.549		214	10.44	211.109	
3/28/2023	5:27:06	7.586		214	10.44	211.146	
3/28/2023	11:27:06	7.55		214	10.44	211.11	
3/28/2023	17:27:06	7.685		214	10.44	211.245	
3/28/2023	23:27:06	7.583		214	10.44	211.143	
3/29/2023	5:27:06	7.616		214	10.44	211.176	
3/29/2023	11:27:06	7.553		214	10.44	211.113	
3/29/2023	17:27:06	7.546		214	10.44	211.106	
3/29/2023	23:27:06	7.585		214	10.44	211.145	
3/30/2023	5:27:06	7.584		214	10.44	211.144	
3/30/2023	11:27:06	7.559		214	10.44	211.119	
3/30/2023	17:27:06	7.585	2.86	214	10.44	211.145	211.14
3/30/2023	23:27:06	7.532		214	10.44	211.092	
3/31/2023	5:27:06	7.507		214	10.44	211.067	
3/31/2023	11:27:06	7.511		214	10.44	211.071	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
3/31/2023	17:27:06	7.448		214	10.44	211.008	
3/31/2023	23:27:06	7.826		214	10.44	211.386	
4/1/2023	5:27:06	7.831		214	10.44	211.391	
4/1/2023	11:27:06	7.861		214	10.44	211.421	
4/1/2023	17:27:06	7.863		214	10.44	211.423	
4/1/2023	23:27:06	7.781		214	10.44	211.341	
4/2/2023	5:27:06	7.87		214	10.44	211.43	
4/2/2023	11:27:06	7.946		214	10.44	211.506	
4/2/2023	17:27:06	7.994		214	10.44	211.554	
4/2/2023	23:27:06	7.976		214	10.44	211.536	
4/3/2023	5:27:06	7.999		214	10.44	211.559	
4/3/2023	11:27:06	7.915		214	10.44	211.475	
4/3/2023	17:27:06	7.885		214	10.44	211.445	
4/3/2023	23:27:06	7.874		214	10.44	211.434	
4/4/2023	5:27:06	7.901		214	10.44	211.461	
4/4/2023	11:27:06	7.863		214	10.44	211.423	
4/4/2023	17:27:06	7.821		214	10.44	211.381	
4/4/2023	23:27:06	7.821		214	10.44	211.381	
4/5/2023	5:27:06	7.767		214	10.44	211.327	
4/5/2023	11:27:06	7.699		214	10.44	211.259	
4/5/2023	17:27:06	7.697	2.62	214	10.44	211.257	211.38
4/5/2023	23:27:06	7.685		214	10.44	211.245	
4/6/2023	5:27:06	7.699		214	10.44	211.259	
4/6/2023	11:27:06	7.806		214	10.44	211.366	
4/6/2023	17:27:06	7.908		214	10.44	211.468	
4/6/2023	23:27:06	8.085		214	10.44	211.645	
4/7/2023	5:27:06	8.121		214	10.44	211.681	
4/7/2023	11:27:06	8.165		214	10.44	211.725	
4/7/2023	17:27:06	8.208		214	10.44	211.768	
4/7/2023	23:27:06	8.095		214	10.44	211.655	
4/8/2023	5:27:06	8.052		214	10.44	211.612	
4/8/2023	11:27:06	8.088		214	10.44	211.648	
4/8/2023	17:27:06	8.032		214	10.44	211.592	
4/8/2023	23:27:06	7.972		214	10.44	211.532	
4/9/2023	5:27:06	7.989		214	10.44	211.549	
4/9/2023	11:27:06	7.982		214	10.44	211.542	
4/9/2023	17:27:06	8.179		214	10.44	211.739	
4/9/2023	23:27:06	8.208		214	10.44	211.768	
4/10/2023	5:27:06	8.13		214	10.44	211.69	
4/10/2023	11:27:06	8.17		214	10.44	211.73	
4/10/2023	17:27:06	8.234		214	10.44	211.794	
4/10/2023	23:27:06	8.263		214	10.44	211.823	
4/11/2023	5:27:06	8.349		214	10.44	211.909	
4/11/2023	11:27:06	8.343		214	10.44	211.903	
4/11/2023	17:27:06	8.254		214	10.44	211.814	
4/11/2023	23:27:06	8.202		214	10.44	211.762	
4/12/2023	5:27:06	8.313		214	10.44	211.873	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
4/12/2023	11:27:06	8.276		214	10.44	211.836	
4/12/2023	17:27:06	8.22		214	10.44	211.78	
4/12/2023	23:27:06	8.223		214	10.44	211.783	
4/13/2023	5:27:06	8.158		214	10.44	211.718	
4/13/2023	11:27:06	8.128		214	10.44	211.688	
4/13/2023	17:27:06	8.194		214	10.44	211.754	
4/13/2023	23:27:06	8.192		214	10.44	211.752	
4/14/2023	5:27:06	8.203		214	10.44	211.763	
4/14/2023	11:27:06	8.131		214	10.44	211.691	
4/14/2023	17:27:06	8.112		214	10.44	211.672	
4/14/2023	23:27:06	8.138		214	10.44	211.698	
4/15/2023	5:27:06	8.119		214	10.44	211.679	
4/15/2023	11:27:06	8.078		214	10.44	211.638	
4/15/2023	17:27:06	7.999		214	10.44	211.559	
4/15/2023	23:27:06	7.985		214	10.44	211.545	
4/16/2023	5:27:06	7.976		214	10.44	211.536	
4/16/2023	11:27:06	8.144		214	10.44	211.704	
4/16/2023	17:27:06	8.192		214	10.44	211.752	
4/16/2023	23:27:06	8.017		214	10.44	211.577	
4/17/2023	5:27:06	7.933		214	10.44	211.493	
4/17/2023	11:27:06	7.973		214	10.44	211.533	
4/17/2023	17:27:06	8.063	2.3	214	10.44	211.623	211.7
4/17/2023	23:27:06	8.093		214	10.44	211.653	
4/18/2023	5:27:06	8.253		214	10.44	211.813	
4/18/2023	11:27:06	8.312		214	10.44	211.872	
4/18/2023	17:27:06	8.323		214	10.44	211.883	
4/18/2023	23:27:06	8.289		214	10.44	211.849	
4/19/2023	5:27:06	8.385		214	10.44	211.945	
4/19/2023	11:27:06	8.371		214	10.44	211.931	
4/19/2023	17:27:06	8.345		214	10.44	211.905	
4/19/2023	23:27:06	8.297		214	10.44	211.857	
4/20/2023	5:27:06	8.181		214	10.44	211.741	
4/20/2023	11:27:06	8.098		214	10.44	211.658	
4/20/2023	17:27:06	8.236		214	10.44	211.796	
4/20/2023	23:27:06	8.452		214	10.44	212.012	
4/21/2023	5:27:06	8.393		214	10.44	211.953	
4/21/2023	11:27:06	8.342		214	10.44	211.902	
4/21/2023	17:27:06	8.268		214	10.44	211.828	
4/21/2023	23:27:06	8.195		214	10.44	211.755	
4/22/2023	5:27:06	8.199		214	10.44	211.759	
4/22/2023	11:27:06	8.123		214	10.44	211.683	
4/22/2023	17:27:06	8.135		214	10.44	211.695	
4/22/2023	23:27:06	8.135		214	10.44	211.695	
4/23/2023	5:27:06	8.337		214	10.44	211.897	
4/23/2023	11:27:06	8.29		214	10.44	211.85	
4/23/2023	17:27:06	8.22		214	10.44	211.78	
4/23/2023	23:27:06	8.363		214	10.44	211.923	

MW-2

RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
4/24/2023	5:27:06	8.445		214	10.44	212.005	
4/24/2023	11:27:06	8.337		214	10.44	211.897	
4/24/2023	17:27:06	8.322		214	10.44	211.882	
4/24/2023	23:27:06	8.26		214	10.44	211.82	
4/25/2023	5:27:06	8.216		214	10.44	211.776	
4/25/2023	11:27:06	8.166		214	10.44	211.726	
4/25/2023	17:27:06	8.141		214	10.44	211.701	
4/25/2023	23:27:06	8.146		214	10.44	211.706	
4/26/2023	5:27:06	8.16		214	10.44	211.72	
4/26/2023	11:27:06	8.066		214	10.44	211.626	
4/26/2023	17:27:06	8.124		214	10.44	211.684	
4/26/2023	23:27:06	8.128		214	10.44	211.688	
4/27/2023	5:27:06	8.098		214	10.44	211.658	
4/27/2023	11:27:06	8.003		214	10.44	211.563	
4/27/2023	17:27:06	7.997		214	10.44	211.557	
4/27/2023	23:27:06	7.995		214	10.44	211.555	
4/28/2023	5:27:06	7.99		214	10.44	211.55	
4/28/2023	11:27:06	7.875		214	10.44	211.435	
4/28/2023	17:27:06	7.943		214	10.44	211.503	
4/28/2023	23:27:06	8.063		214	10.44	211.623	
4/29/2023	5:27:06	8.014		214	10.44	211.574	
4/29/2023	11:27:06	7.868		214	10.44	211.428	
4/29/2023	17:27:06	7.868		214	10.44	211.428	
4/29/2023	23:27:06	7.925		214	10.44	211.485	
4/30/2023	5:27:06	7.894		214	10.44	211.454	
4/30/2023	11:27:06	7.864		214	10.44	211.424	
4/30/2023	17:27:06	7.84		214	10.44	211.4	
4/30/2023	23:27:06	7.838		214	10.44	211.398	
5/1/2023	5:27:06	7.839		214	10.44	211.399	
5/1/2023	11:27:06	7.799	2.57	214	10.44	211.359	211.43

MW-3
 RJ Development
 2400 24th Avenue NW, Olympia, WA

LEVEL
 UNIT: ft
 TEMPERATURE
 UNIT: °F

Approximate Ground Surface = 220 feet
 Based on Thurston County elevation data

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
1/9/2023	17:28:34	--	8.74	220	12.79	--	211.26
1/12/2023	17:28:34	--	5.61	220	12.79	--	214.39
1/19/2023	17:28:34	--	5.88	220	12.79	--	214.12
1/26/2023	17:28:34	--	6.32	220	12.79	--	213.68
2/2/2023	17:28:34	--	6.83	220	12.79	--	213.17
2/9/2023	17:28:34	--	6.07	220	12.79	--	213.93
2/16/2023	17:28:34	--	6.76	220	12.79	--	213.24
2/24/2023	17:28:34	--	7.27	220	12.79	--	212.73
3/2/2023	17:28:34	--	7.31	220	12.79	--	212.69
3/9/2023	17:28:34	--	6.4	220	12.79	--	213.6
3/16/2023	17:28:34	--	6.47	220	12.79	--	213.53
3/23/2023	17:28:34	--	7.02	220	12.79	--	212.98
3/30/2023	17:28:34	--	7.36	220	12.79	--	212.64
4/5/2023	17:28:34	--	7.02	220	12.79	--	212.98
4/17/2023	17:28:34	--	6.18	220	12.79	--	213.82
5/1/2023	11:28:34	--	6.7	220	12.79	--	213.3

*Note: The transducer for MW-3 failed upon deployment. No transducer data was collected for this location.

MW-4

RJ Development

2400 24th Avenue NW, Olympia, WA

LEVEL

UNIT: ft

TEMPERATURE

UNIT: °F

Approximate Ground Surface = 213 feet

Based on Thurston County elevation data

DATE	TRANSDUCER		MANUAL MEASUREMENT (ft)	SURFACE ELEVATION (ft)	WELL DEPTH (ft)	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)				TRANSDUCER	MANUAL
1/9/2023	17:31:40	5.6099	0.87	213	6.16	212.4499	212.13
1/9/2023	23:31:40	5.6402		213	6.16	212.4802	
1/10/2023	5:31:40	5.4942		213	6.16	212.3342	
1/10/2023	11:31:40	5.4737		213	6.16	212.3137	
1/10/2023	17:31:40	5.5417		213	6.16	212.3817	
1/10/2023	23:31:40	5.5632		213	6.16	212.4032	
1/11/2023	5:31:40	5.4661		213	6.16	212.3061	
1/11/2023	11:31:40	5.3367		213	6.16	212.1767	
1/11/2023	17:31:40	5.3975		213	6.16	212.2375	
1/11/2023	23:31:40	5.3988		213	6.16	212.2388	
1/12/2023	5:31:40	5.4951		213	6.16	212.3351	
1/12/2023	11:31:40	5.4481		213	6.16	212.2881	
1/12/2023	17:31:40	5.4909	0.55	213	6.16	212.3309	212.45
1/12/2023	23:31:40	5.342		213	6.16	212.182	
1/13/2023	5:31:40	5.4117		213	6.16	212.2517	
1/13/2023	11:31:40	5.4045		213	6.16	212.2445	
1/13/2023	17:31:40	5.3925		213	6.16	212.2325	
1/13/2023	23:31:40	5.416		213	6.16	212.256	
1/14/2023	5:31:40	5.2905		213	6.16	212.1305	
1/14/2023	11:31:40	5.2226		213	6.16	212.0626	
1/14/2023	17:31:40	5.3906		213	6.16	212.2306	
1/14/2023	23:31:40	5.4095		213	6.16	212.2495	
1/15/2023	5:31:40	5.3878		213	6.16	212.2278	
1/15/2023	11:31:40	5.5354		213	6.16	212.3754	
1/15/2023	17:31:40	5.6166		213	6.16	212.4566	
1/15/2023	23:31:40	5.5946		213	6.16	212.4346	
1/16/2023	5:31:40	5.5313		213	6.16	212.3713	
1/16/2023	11:31:40	5.4959		213	6.16	212.3359	
1/16/2023	17:31:40	5.5216		213	6.16	212.3616	
1/16/2023	23:31:40	5.4718		213	6.16	212.3118	
1/17/2023	5:31:40	5.4624		213	6.16	212.3024	
1/17/2023	11:31:40	5.4079		213	6.16	212.2479	
1/17/2023	17:31:40	5.3773		213	6.16	212.2173	
1/17/2023	23:31:40	5.3476		213	6.16	212.1876	
1/18/2023	5:31:40	5.3341		213	6.16	212.1741	
1/18/2023	11:31:40	5.5208		213	6.16	212.3608	
1/18/2023	17:31:40	5.5417		213	6.16	212.3817	
1/18/2023	23:31:40	5.5419		213	6.16	212.3819	
1/19/2023	5:31:40	5.5137		213	6.16	212.3537	
1/19/2023	11:31:40	5.4602		213	6.16	212.3002	
1/19/2023	17:31:40	5.5579	0.69	213	6.16	212.3979	212.31
1/19/2023	23:31:40	5.4938		213	6.16	212.3338	

MW-4

RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
1/20/2023	5:31:40	5.4419		213	6.16	212.2819	
1/20/2023	11:31:40	5.4205		213	6.16	212.2605	
1/20/2023	17:31:40	5.3886		213	6.16	212.2286	
1/20/2023	23:31:40	5.3838		213	6.16	212.2238	
1/21/2023	5:31:40	5.2858		213	6.16	212.1258	
1/21/2023	11:31:40	5.2981		213	6.16	212.1381	
1/21/2023	17:31:40	5.6005		213	6.16	212.4405	
1/21/2023	23:31:40	5.618		213	6.16	212.458	
1/22/2023	5:31:40	5.5101		213	6.16	212.3501	
1/22/2023	11:31:40	5.4621		213	6.16	212.3021	
1/22/2023	17:31:40	5.4614		213	6.16	212.3014	
1/22/2023	23:31:40	5.408		213	6.16	212.248	
1/23/2023	5:31:40	5.4318		213	6.16	212.2718	
1/23/2023	11:31:40	5.4378		213	6.16	212.2778	
1/23/2023	17:31:40	5.4168		213	6.16	212.2568	
1/23/2023	23:31:40	5.4198		213	6.16	212.2598	
1/24/2023	5:31:40	5.4212		213	6.16	212.2612	
1/24/2023	11:31:40	5.4173		213	6.16	212.2573	
1/24/2023	17:31:40	5.4496		213	6.16	212.2896	
1/24/2023	23:31:40	5.424		213	6.16	212.264	
1/25/2023	5:31:40	5.4285		213	6.16	212.2685	
1/25/2023	11:31:40	5.3718		213	6.16	212.2118	
1/25/2023	17:31:40	5.3783		213	6.16	212.2183	
1/25/2023	23:31:40	5.3388		213	6.16	212.1788	
1/26/2023	5:31:40	5.3204		213	6.16	212.1604	
1/26/2023	11:31:40	5.284		213	6.16	212.124	
1/26/2023	17:31:40	5.2273	0.79	213	6.16	212.0673	212.21
1/26/2023	23:31:40	5.1902		213	6.16	212.0302	
1/27/2023	5:31:40	5.3116		213	6.16	212.1516	
1/27/2023	11:31:40	5.3793		213	6.16	212.2193	
1/27/2023	17:31:40	5.2961		213	6.16	212.1361	
1/27/2023	23:31:40	5.3156		213	6.16	212.1556	
1/28/2023	5:31:40	5.345		213	6.16	212.185	
1/28/2023	11:31:40	5.3203		213	6.16	212.1603	
1/28/2023	17:31:40	5.4182		213	6.16	212.2582	
1/28/2023	23:31:40	5.49		213	6.16	212.33	
1/29/2023	5:31:40	5.4114		213	6.16	212.2514	
1/29/2023	11:31:40	5.3235		213	6.16	212.1635	
1/29/2023	17:31:40	5.2998		213	6.16	212.1398	
1/29/2023	23:31:40	5.3137		213	6.16	212.1537	
1/30/2023	5:31:40	5.2915		213	6.16	212.1315	
1/30/2023	11:31:40	5.2465		213	6.16	212.0865	
1/30/2023	17:31:40	5.1738		213	6.16	212.0138	
1/30/2023	23:31:40	5.2536		213	6.16	212.0936	
1/31/2023	5:31:40	5.2317		213	6.16	212.0717	
1/31/2023	11:31:40	5.1832		213	6.16	212.0232	
1/31/2023	17:31:40	5.2321		213	6.16	212.0721	

MW-4

RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
1/31/2023	23:31:40	5.273		213	6.16	212.113	
2/1/2023	5:31:40	5.23		213	6.16	212.07	
2/1/2023	11:31:40	5.233		213	6.16	212.073	
2/1/2023	17:31:40	5.2596		213	6.16	212.0996	
2/1/2023	23:31:40	5.2786		213	6.16	212.1186	
2/2/2023	5:31:40	5.2323		213	6.16	212.0723	
2/2/2023	11:31:40	5.2128		213	6.16	212.0528	
2/2/2023	17:31:40	5.1722	0.91	213	6.16	212.0122	212.09
2/2/2023	23:31:40	5.0663		213	6.16	211.9063	
2/3/2023	5:31:40	5.1464		213	6.16	211.9864	
2/3/2023	11:31:40	5.2701		213	6.16	212.1101	
2/3/2023	17:31:40	5.3662		213	6.16	212.2062	
2/3/2023	23:31:40	5.2732		213	6.16	212.1132	
2/4/2023	5:31:40	5.2044		213	6.16	212.0444	
2/4/2023	11:31:40	5.2067		213	6.16	212.0467	
2/4/2023	17:31:40	5.1972		213	6.16	212.0372	
2/4/2023	23:31:40	5.1834		213	6.16	212.0234	
2/5/2023	5:31:40	5.4072		213	6.16	212.2472	
2/5/2023	11:31:40	5.4939		213	6.16	212.3339	
2/5/2023	17:31:40	5.5476		213	6.16	212.3876	
2/5/2023	23:31:40	5.4609		213	6.16	212.3009	
2/6/2023	5:31:40	5.2962		213	6.16	212.1362	
2/6/2023	11:31:40	5.2607		213	6.16	212.1007	
2/6/2023	17:31:40	5.1784		213	6.16	212.0184	
2/6/2023	23:31:40	5.1738		213	6.16	212.0138	
2/7/2023	5:31:40	5.1567		213	6.16	211.9967	
2/7/2023	11:31:40	5.3052		213	6.16	212.1452	
2/7/2023	17:31:40	5.4972		213	6.16	212.3372	
2/7/2023	23:31:40	5.5729		213	6.16	212.4129	
2/8/2023	5:31:40	5.5242		213	6.16	212.3642	
2/8/2023	11:31:40	5.4182		213	6.16	212.2582	
2/8/2023	17:31:40	5.3526		213	6.16	212.1926	
2/8/2023	23:31:40	5.2905		213	6.16	212.1305	
2/9/2023	5:31:40	5.2333		213	6.16	212.0733	
2/9/2023	11:31:40	5.2466		213	6.16	212.0866	
2/9/2023	17:31:40	5.3045	0.78	213	6.16	212.1445	212.22
2/9/2023	23:31:40	5.4714		213	6.16	212.3114	
2/10/2023	5:31:40	5.3717		213	6.16	212.2117	
2/10/2023	11:31:40	5.3354		213	6.16	212.1754	
2/10/2023	17:31:40	5.3772		213	6.16	212.2172	
2/10/2023	23:31:40	5.3763		213	6.16	212.2163	
2/11/2023	5:31:40	5.3267		213	6.16	212.1667	
2/11/2023	11:31:40	5.2865		213	6.16	212.1265	
2/11/2023	17:31:40	5.2736		213	6.16	212.1136	
2/11/2023	23:31:40	5.3167		213	6.16	212.1567	
2/12/2023	5:31:40	5.2446		213	6.16	212.0846	
2/12/2023	11:31:40	5.1919		213	6.16	212.0319	

MW-4

RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
2/12/2023	17:31:40	5.1557		213	6.16	211.9957	
2/12/2023	23:31:40	5.1977		213	6.16	212.0377	
2/13/2023	5:31:40	5.2376		213	6.16	212.0776	
2/13/2023	11:31:40	5.271		213	6.16	212.111	
2/13/2023	17:31:40	5.3443		213	6.16	212.1843	
2/13/2023	23:31:40	5.3355		213	6.16	212.1755	
2/14/2023	5:31:40	5.4379		213	6.16	212.2779	
2/14/2023	11:31:40	5.3957		213	6.16	212.2357	
2/14/2023	17:31:40	5.3311		213	6.16	212.1711	
2/14/2023	23:31:40	5.2869		213	6.16	212.1269	
2/15/2023	5:31:40	5.2364		213	6.16	212.0764	
2/15/2023	11:31:40	5.1951		213	6.16	212.0351	
2/15/2023	17:31:40	5.1739		213	6.16	212.0139	
2/15/2023	23:31:40	5.1411		213	6.16	211.9811	
2/16/2023	5:31:40	5.1805		213	6.16	212.0205	
2/16/2023	11:31:40	5.1984		213	6.16	212.0384	
2/16/2023	17:31:40	5.2446	0.97	213	6.16	212.0846	212.03
2/16/2023	23:31:40	5.2263		213	6.16	212.0663	
2/17/2023	5:31:40	5.2115		213	6.16	212.0515	
2/17/2023	11:31:40	5.2087		213	6.16	212.0487	
2/17/2023	17:31:40	5.1647		213	6.16	212.0047	
2/17/2023	23:31:40	5.1536		213	6.16	211.9936	
2/18/2023	5:31:40	5.1193		213	6.16	211.9593	
2/18/2023	11:31:40	5.1673		213	6.16	212.0073	
2/18/2023	17:31:40	5.2768		213	6.16	212.1168	
2/18/2023	23:31:40	5.1917		213	6.16	212.0317	
2/19/2023	5:31:40	5.1753		213	6.16	212.0153	
2/19/2023	11:31:40	5.146		213	6.16	211.986	
2/19/2023	17:31:40	5.1566		213	6.16	211.9966	
2/19/2023	23:31:40	5.138		213	6.16	211.978	
2/20/2023	5:31:40	5.1181		213	6.16	211.9581	
2/20/2023	11:31:40	5.0239		213	6.16	211.8639	
2/20/2023	17:31:40	4.8725		213	6.16	211.7125	
2/20/2023	23:31:40	5.2133		213	6.16	212.0533	
2/21/2023	5:31:40	5.0687		213	6.16	211.9087	
2/21/2023	11:31:40	5.0381		213	6.16	211.8781	
2/21/2023	17:31:40	5.1253		213	6.16	211.9653	
2/21/2023	23:31:40	5.1729		213	6.16	212.0129	
2/22/2023	5:31:40	5.174		213	6.16	212.014	
2/22/2023	11:31:40	5.1532		213	6.16	211.9932	
2/22/2023	17:31:40	5.1539		213	6.16	211.9939	
2/22/2023	23:31:40	5.1629		213	6.16	212.0029	
2/23/2023	5:31:40	5.2042		213	6.16	212.0442	
2/23/2023	11:31:40	5.2236		213	6.16	212.0636	
2/23/2023	17:31:40	5.2546		213	6.16	212.0946	
2/23/2023	23:31:40	5.2378		213	6.16	212.0778	
2/24/2023	5:31:40	5.1594		213	6.16	211.9994	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
2/24/2023	11:31:40	5.0536		213	6.16	211.8936	
2/24/2023	17:31:40	5.0947	1.11	213	6.16	211.9347	211.89
2/24/2023	23:31:40	5.087		213	6.16	211.927	
2/25/2023	5:31:40	5.0298		213	6.16	211.8698	
2/25/2023	11:31:40	4.8739		213	6.16	211.7139	
2/25/2023	17:31:40	4.9384		213	6.16	211.7784	
2/25/2023	23:31:40	4.9705		213	6.16	211.8105	
2/26/2023	5:31:40	5.3111		213	6.16	212.1511	
2/26/2023	11:31:40	5.3912		213	6.16	212.2312	
2/26/2023	17:31:40	5.28		213	6.16	212.12	
2/26/2023	23:31:40	5.1702		213	6.16	212.0102	
2/27/2023	5:31:40	5.0331		213	6.16	211.8731	
2/27/2023	11:31:40	5.1585		213	6.16	211.9985	
2/27/2023	17:31:40	5.1385		213	6.16	211.9785	
2/27/2023	23:31:40	5.2256		213	6.16	212.0656	
2/28/2023	5:31:40	5.3041		213	6.16	212.1441	
2/28/2023	11:31:40	5.2329		213	6.16	212.0729	
2/28/2023	17:31:40	5.3183		213	6.16	212.1583	
2/28/2023	23:31:40	5.3172		213	6.16	212.1572	
3/1/2023	5:31:40	5.2525		213	6.16	212.0925	
3/1/2023	11:31:40	5.1558		213	6.16	211.9958	
3/1/2023	17:31:40	5.0808		213	6.16	211.9208	
3/1/2023	23:31:40	5.0071		213	6.16	211.8471	
3/2/2023	5:31:40	4.9859		213	6.16	211.8259	
3/2/2023	11:31:40	5.2672		213	6.16	212.1072	
3/2/2023	17:31:40	5.3259	0.95	213	6.16	212.1659	212.05
3/2/2023	23:31:40	5.2436		213	6.16	212.0836	
3/3/2023	5:31:40	5.1987		213	6.16	212.0387	
3/3/2023	11:31:40	5.1211		213	6.16	211.9611	
3/3/2023	17:31:40	5.127		213	6.16	211.967	
3/3/2023	23:31:40	5.2054		213	6.16	212.0454	
3/4/2023	5:31:40	5.2474		213	6.16	212.0874	
3/4/2023	11:31:40	5.4337		213	6.16	212.2737	
3/4/2023	17:31:40	5.5916		213	6.16	212.4316	
3/4/2023	23:31:40	5.4825		213	6.16	212.3225	
3/5/2023	5:31:40	5.4441		213	6.16	212.2841	
3/5/2023	11:31:40	5.3947		213	6.16	212.2347	
3/5/2023	17:31:40	5.4635		213	6.16	212.3035	
3/5/2023	23:31:40	5.4045		213	6.16	212.2445	
3/6/2023	5:31:40	5.3462		213	6.16	212.1862	
3/6/2023	11:31:40	5.3221		213	6.16	212.1621	
3/6/2023	17:31:40	5.3097		213	6.16	212.1497	
3/6/2023	23:31:40	5.3033		213	6.16	212.1433	
3/7/2023	5:31:40	5.2645		213	6.16	212.1045	
3/7/2023	11:31:40	5.238		213	6.16	212.078	
3/7/2023	17:31:40	5.2636		213	6.16	212.1036	
3/7/2023	23:31:40	5.2528		213	6.16	212.0928	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
3/8/2023	5:31:40	5.2857		213	6.16	212.1257	
3/8/2023	11:31:40	5.299		213	6.16	212.139	
3/8/2023	17:31:40	5.3039		213	6.16	212.1439	
3/8/2023	23:31:40	5.2498		213	6.16	212.0898	
3/9/2023	5:31:40	5.1682		213	6.16	212.0082	
3/9/2023	11:31:40	5.135		213	6.16	211.975	
3/9/2023	17:31:40	5.0604	0.9	213	6.16	211.9004	212.1
3/9/2023	23:31:40	5.1451		213	6.16	211.9851	
3/10/2023	5:31:40	5.4645		213	6.16	212.3045	
3/10/2023	11:31:40	5.4958		213	6.16	212.3358	
3/10/2023	17:31:40	5.4663		213	6.16	212.3063	
3/10/2023	23:31:40	5.4181		213	6.16	212.2581	
3/11/2023	5:31:40	5.314		213	6.16	212.154	
3/11/2023	11:31:40	5.28		213	6.16	212.12	
3/11/2023	17:31:40	5.2842		213	6.16	212.1242	
3/11/2023	23:31:40	5.2306		213	6.16	212.0706	
3/12/2023	5:31:40	5.1813		213	6.16	212.0213	
3/12/2023	11:31:40	5.1377		213	6.16	211.9777	
3/12/2023	17:31:40	5.2156		213	6.16	212.0556	
3/12/2023	23:31:40	5.3151		213	6.16	212.1551	
3/13/2023	5:31:40	5.4578		213	6.16	212.2978	
3/13/2023	11:31:40	5.4824		213	6.16	212.3224	
3/13/2023	17:31:40	5.48		213	6.16	212.32	
3/13/2023	23:31:40	5.4641		213	6.16	212.3041	
3/14/2023	5:31:40	5.3083		213	6.16	212.1483	
3/14/2023	11:31:40	5.2171		213	6.16	212.0571	
3/14/2023	17:31:40	5.3532		213	6.16	212.1932	
3/14/2023	23:31:40	5.4805		213	6.16	212.3205	
3/15/2023	5:31:40	5.4894		213	6.16	212.3294	
3/15/2023	11:31:40	5.3678		213	6.16	212.2078	
3/15/2023	17:31:40	5.3289		213	6.16	212.1689	
3/15/2023	23:31:40	5.2598		213	6.16	212.0998	
3/16/2023	5:31:40	5.2416		213	6.16	212.0816	
3/16/2023	11:31:40	5.1575		213	6.16	211.9975	
3/16/2023	17:31:40	5.1785	0.92	213	6.16	212.0185	212.08
3/16/2023	23:31:40	5.284		213	6.16	212.124	
3/17/2023	5:31:40	5.2388		213	6.16	212.0788	
3/17/2023	11:31:40	5.1692		213	6.16	212.0092	
3/17/2023	17:31:40	5.2118		213	6.16	212.0518	
3/17/2023	23:31:40	5.219		213	6.16	212.059	
3/18/2023	5:31:40	5.1786		213	6.16	212.0186	
3/18/2023	11:31:40	5.1155		213	6.16	211.9555	
3/18/2023	17:31:40	5.1473		213	6.16	211.9873	
3/18/2023	23:31:40	5.162		213	6.16	212.002	
3/19/2023	5:31:40	5.1087		213	6.16	211.9487	
3/19/2023	11:31:40	5.1164		213	6.16	211.9564	
3/19/2023	17:31:40	5.1441		213	6.16	211.9841	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
3/19/2023	23:31:40	5.1951		213	6.16	212.0351	
3/20/2023	5:31:40	5.3242		213	6.16	212.1642	
3/20/2023	11:31:40	5.3066		213	6.16	212.1466	
3/20/2023	17:31:40	5.2932		213	6.16	212.1332	
3/20/2023	23:31:40	5.2514		213	6.16	212.0914	
3/21/2023	5:31:40	5.1788		213	6.16	212.0188	
3/21/2023	11:31:40	5.0927		213	6.16	211.9327	
3/21/2023	17:31:40	5.1664		213	6.16	212.0064	
3/21/2023	23:31:40	5.1907		213	6.16	212.0307	
3/22/2023	5:31:40	5.205		213	6.16	212.045	
3/22/2023	11:31:40	5.1424		213	6.16	211.9824	
3/22/2023	17:31:40	5.2145		213	6.16	212.0545	
3/22/2023	23:31:40	5.2008		213	6.16	212.0408	
3/23/2023	5:31:40	5.1234		213	6.16	211.9634	
3/23/2023	11:31:40	5.1333		213	6.16	211.9733	
3/23/2023	17:31:40	5.2793	1.04	213	6.16	212.1193	211.96
3/23/2023	23:31:40	5.1301		213	6.16	211.9701	
3/24/2023	5:31:40	5.1894		213	6.16	212.0294	
3/24/2023	11:31:40	5.1396		213	6.16	211.9796	
3/24/2023	17:31:40	5.1444		213	6.16	211.9844	
3/24/2023	23:31:40	5.1095		213	6.16	211.9495	
3/25/2023	5:31:40	5.1432		213	6.16	211.9832	
3/25/2023	11:31:40	5.0746		213	6.16	211.9146	
3/25/2023	17:31:40	5.0969		213	6.16	211.9369	
3/25/2023	23:31:40	5.1169		213	6.16	211.9569	
3/26/2023	5:31:40	5.0892		213	6.16	211.9292	
3/26/2023	11:31:40	5.0817		213	6.16	211.9217	
3/26/2023	17:31:40	5.0835		213	6.16	211.9235	
3/26/2023	23:31:40	5.0714		213	6.16	211.9114	
3/27/2023	5:31:40	5.0056		213	6.16	211.8456	
3/27/2023	11:31:40	4.9043		213	6.16	211.7443	
3/27/2023	17:31:40	4.9381		213	6.16	211.7781	
3/27/2023	23:31:40	4.9799		213	6.16	211.8199	
3/28/2023	5:31:40	5.0099		213	6.16	211.8499	
3/28/2023	11:31:40	4.9876		213	6.16	211.8276	
3/28/2023	17:31:40	5.1216		213	6.16	211.9616	
3/28/2023	23:31:40	5.0265		213	6.16	211.8665	
3/29/2023	5:31:40	5.0664		213	6.16	211.9064	
3/29/2023	11:31:40	4.9997		213	6.16	211.8397	
3/29/2023	17:31:40	4.9934		213	6.16	211.8334	
3/29/2023	23:31:40	5.0359		213	6.16	211.8759	
3/30/2023	5:31:40	5.0392		213	6.16	211.8792	
3/30/2023	11:31:40	5.022		213	6.16	211.862	
3/30/2023	17:31:40	5.0431	1.17	213	6.16	211.8831	211.83
3/30/2023	23:31:40	4.9901		213	6.16	211.8301	
3/31/2023	5:31:40	4.9663		213	6.16	211.8063	
3/31/2023	11:31:40	4.9692		213	6.16	211.8092	

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RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASURMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
3/31/2023	17:31:40	4.8839		213	6.16	211.7239	
3/31/2023	23:31:40	5.2492		213	6.16	212.0892	
4/1/2023	5:31:40	5.2112		213	6.16	212.0512	
4/1/2023	11:31:40	5.2255		213	6.16	212.0655	
4/1/2023	17:31:40	5.2134		213	6.16	212.0534	
4/1/2023	23:31:40	5.1158		213	6.16	211.9558	
4/2/2023	5:31:40	5.2202		213	6.16	212.0602	
4/2/2023	11:31:40	5.2524		213	6.16	212.0924	
4/2/2023	17:31:40	5.291		213	6.16	212.131	
4/2/2023	23:31:40	5.2793		213	6.16	212.1193	
4/3/2023	5:31:40	5.3071		213	6.16	212.1471	
4/3/2023	11:31:40	5.2185		213	6.16	212.0585	
4/3/2023	17:31:40	5.1957		213	6.16	212.0357	
4/3/2023	23:31:40	5.1884		213	6.16	212.0284	
4/4/2023	5:31:40	5.2248		213	6.16	212.0648	
4/4/2023	11:31:40	5.1856		213	6.16	212.0256	
4/4/2023	17:31:40	5.1551		213	6.16	211.9951	
4/4/2023	23:31:40	5.153		213	6.16	211.993	
4/5/2023	5:31:40	5.1038		213	6.16	211.9438	
4/5/2023	11:31:40	5.0372		213	6.16	211.8772	
4/5/2023	17:31:40	5.0378	1.07	213	6.16	211.8778	211.93
4/5/2023	23:31:40	5.0269		213	6.16	211.8669	
4/6/2023	5:31:40	5.0794		213	6.16	211.9194	
4/6/2023	11:31:40	5.2373		213	6.16	212.0773	
4/6/2023	17:31:40	5.3227		213	6.16	212.1627	
4/6/2023	23:31:40	5.4819		213	6.16	212.3219	
4/7/2023	5:31:40	5.4481		213	6.16	212.2881	
4/7/2023	11:31:40	5.4442		213	6.16	212.2842	
4/7/2023	17:31:40	5.4779		213	6.16	212.3179	
4/7/2023	23:31:40	5.3604		213	6.16	212.2004	
4/8/2023	5:31:40	5.3289		213	6.16	212.1689	
4/8/2023	11:31:40	5.3787		213	6.16	212.2187	
4/8/2023	17:31:40	5.3149		213	6.16	212.1549	
4/8/2023	23:31:40	5.267		213	6.16	212.107	
4/9/2023	5:31:40	5.3051		213	6.16	212.1451	
4/9/2023	11:31:40	5.2998		213	6.16	212.1398	
4/9/2023	17:31:40	5.4523		213	6.16	212.2923	
4/9/2023	23:31:40	5.4494		213	6.16	212.2894	
4/10/2023	5:31:40	5.3534		213	6.16	212.1934	
4/10/2023	11:31:40	5.4488		213	6.16	212.2888	
4/10/2023	17:31:40	5.4651		213	6.16	212.3051	
4/10/2023	23:31:40	5.4854		213	6.16	212.3254	
4/11/2023	5:31:40	5.5581		213	6.16	212.3981	
4/11/2023	11:31:40	5.5408		213	6.16	212.3808	
4/11/2023	17:31:40	5.4394		213	6.16	212.2794	
4/11/2023	23:31:40	5.3979		213	6.16	212.2379	
4/12/2023	5:31:40	5.5525		213	6.16	212.3925	

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RJ Development

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DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
4/12/2023	11:31:40	5.4961		213	6.16	212.3361	
4/12/2023	17:31:40	5.438		213	6.16	212.278	
4/12/2023	23:31:40	5.4537		213	6.16	212.2937	
4/13/2023	5:31:40	5.3952		213	6.16	212.2352	
4/13/2023	11:31:40	5.3689		213	6.16	212.2089	
4/13/2023	17:31:40	5.4684		213	6.16	212.3084	
4/13/2023	23:31:40	5.4453		213	6.16	212.2853	
4/14/2023	5:31:40	5.4607		213	6.16	212.3007	
4/14/2023	11:31:40	5.3942		213	6.16	212.2342	
4/14/2023	17:31:40	5.3824		213	6.16	212.2224	
4/14/2023	23:31:40	5.4206		213	6.16	212.2606	
4/15/2023	5:31:40	5.4124		213	6.16	212.2524	
4/15/2023	11:31:40	5.3778		213	6.16	212.2178	
4/15/2023	17:31:40	5.302		213	6.16	212.142	
4/15/2023	23:31:40	5.278		213	6.16	212.118	
4/16/2023	5:31:40	5.2797		213	6.16	212.1197	
4/16/2023	11:31:40	5.4718		213	6.16	212.3118	
4/16/2023	17:31:40	5.4959		213	6.16	212.3359	
4/16/2023	23:31:40	5.3063		213	6.16	212.1463	
4/17/2023	5:31:40	5.2182		213	6.16	212.0582	
4/17/2023	11:31:40	5.2576		213	6.16	212.0976	
4/17/2023	17:31:40	5.3448	0.79	213	6.16	212.1848	212.21
4/17/2023	23:31:40	5.3742		213	6.16	212.2142	
4/18/2023	5:31:40	5.5268		213	6.16	212.3668	
4/18/2023	11:31:40	5.5551		213	6.16	212.3951	
4/18/2023	17:31:40	5.5032		213	6.16	212.3432	
4/18/2023	23:31:40	5.456		213	6.16	212.296	
4/19/2023	5:31:40	5.5611		213	6.16	212.4011	
4/19/2023	11:31:40	5.5478		213	6.16	212.3878	
4/19/2023	17:31:40	5.5448		213	6.16	212.3848	
4/19/2023	23:31:40	5.4903		213	6.16	212.3303	
4/20/2023	5:31:40	5.372		213	6.16	212.212	
4/20/2023	11:31:40	5.3003		213	6.16	212.1403	
4/20/2023	17:31:40	5.422		213	6.16	212.262	
4/20/2023	23:31:40	5.615		213	6.16	212.455	
4/21/2023	5:31:40	5.553		213	6.16	212.393	
4/21/2023	11:31:40	5.5021		213	6.16	212.3421	
4/21/2023	17:31:40	5.4208		213	6.16	212.2608	
4/21/2023	23:31:40	5.3618		213	6.16	212.2018	
4/22/2023	5:31:40	5.375		213	6.16	212.215	
4/22/2023	11:31:40	5.3091		213	6.16	212.1491	
4/22/2023	17:31:40	5.3242		213	6.16	212.1642	
4/22/2023	23:31:40	5.3568		213	6.16	212.1968	
4/23/2023	5:31:40	5.5727		213	6.16	212.4127	
4/23/2023	11:31:40	5.5059		213	6.16	212.3459	
4/23/2023	17:31:40	5.4215		213	6.16	212.2615	
4/23/2023	23:31:40	5.5795		213	6.16	212.4195	

MW-4

RJ Development

2400 24th Avenue NW, Olympia, WA

DATE	TRANSDUCER		MANUAL	SURFACE	WELL	WATER LEVEL ELEVATION (ft)	
	TIME	LEVEL (ft)	MEASUREMENT (ft)	ELEVATION (ft)	DEPTH (ft)	TRANSDUCER	MANUAL
4/24/2023	5:31:40	5.627		213	6.16	212.467	
4/24/2023	11:31:40	5.5252		213	6.16	212.3652	
4/24/2023	17:31:40	5.5107		213	6.16	212.3507	
4/24/2023	23:31:40	5.4657		213	6.16	212.3057	
4/25/2023	5:31:40	5.425		213	6.16	212.265	
4/25/2023	11:31:40	5.3896		213	6.16	212.2296	
4/25/2023	17:31:40	5.3712		213	6.16	212.2112	
4/25/2023	23:31:40	5.3882		213	6.16	212.2282	
4/26/2023	5:31:40	5.4073		213	6.16	212.2473	
4/26/2023	11:31:40	5.3314		213	6.16	212.1714	
4/26/2023	17:31:40	5.391		213	6.16	212.231	
4/26/2023	23:31:40	5.4105		213	6.16	212.2505	
4/27/2023	5:31:40	5.3945		213	6.16	212.2345	
4/27/2023	11:31:40	5.2988		213	6.16	212.1388	
4/27/2023	17:31:40	5.2973		213	6.16	212.1373	
4/27/2023	23:31:40	5.301		213	6.16	212.141	
4/28/2023	5:31:40	5.301		213	6.16	212.141	
4/28/2023	11:31:40	5.1916		213	6.16	212.0316	
4/28/2023	17:31:40	5.2653		213	6.16	212.1053	
4/28/2023	23:31:40	5.3954		213	6.16	212.2354	
4/29/2023	5:31:40	5.3632		213	6.16	212.2032	
4/29/2023	11:31:40	5.2167		213	6.16	212.0567	
4/29/2023	17:31:40	5.2314		213	6.16	212.0714	
4/29/2023	23:31:40	5.2801		213	6.16	212.1201	
4/30/2023	5:31:40	5.2622		213	6.16	212.1022	
4/30/2023	11:31:40	5.2452		213	6.16	212.0852	
4/30/2023	17:31:40	5.2209		213	6.16	212.0609	
4/30/2023	23:31:40	5.221		213	6.16	212.061	
5/1/2023	5:31:40	5.227		213	6.16	212.067	
5/1/2023	11:31:40	5.1959	0.96	213	6.16	212.0359	212.04

ATTACHMENT C
REPORT LIMITATIONS AND GUIDELINES FOR USE



ATTACHMENT C

REPORT LIMITATIONS AND GUIDELINES FOR USE¹

This attachment provides information to help you manage your risks with respect to the use of this report.

HYDROGEOLOGIC SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report has been prepared for the exclusive use of RJ Development (Client) and their authorized agents. This report may be made available to regulatory agencies for review. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

Insight Geologic structures our services to meet the specific needs of our clients. For example, a hydrogeologic or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each hydrogeologic or geologic study is unique, each hydrogeologic or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted hydrogeologic practices in this area at the time this report was prepared. This report should not be applied for any purpose or project except the one originally contemplated.

A HYDROGEOLOGIC OR GEOLOGIC REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Insight Geologic considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless Insight Geologic specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

If important changes are made after the date of this report, Insight Geologic should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

SUBSURFACE CONDITIONS CAN CHANGE

This hydrogeologic or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by

¹ Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or ground water fluctuations. Always contact Insight Geologic before applying a report to determine if it remains applicable.

MOST HYDROGEOLOGIC AND GEOLOGIC FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Insight Geologic reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

HYDROGEOLOGIC REPORT RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the preliminary recommendations included in this report. These recommendations are not final, because they were developed principally from Insight Geologic's professional judgment and opinion. Insight Geologic's recommendations can be finalized only by observing actual subsurface conditions revealed during construction.

A HYDROGEOLOGIC OR GEOLOGIC REPORT COULD BE SUBJECT TO MISINTERPRETATION

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Insight Geologic confer with appropriate members of the design team after submitting the report. Also retain Insight Geologic to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a hydrogeologic engineering or geologic report. Reduce that risk by having Insight Geologic participate in pre-bid and preconstruction conferences, and by providing construction observation.

DO NOT REDRAW THE EXPLORATION LOGS

Hydrogeologic engineers and geologists prepare final boring and test pit logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a hydrogeologic engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

READ THESE PROVISIONS CLOSELY

Some clients, design professionals and contractors may not recognize that the geoscience practices (hydrogeologic engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. Insight Geologic includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with Insight Geologic if you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or site.

HYDROGEOLOGIC, GEOLOGIC AND ENVIRONMENTAL REPORTS SHOULD NOT BE INTERCHANGED

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



1015 East 4th Avenue
Olympia, Washington 98506
Telephone: (360) 754-2128
Fax: (360) 754-9299



William E. Halbert

MEMORANDUM

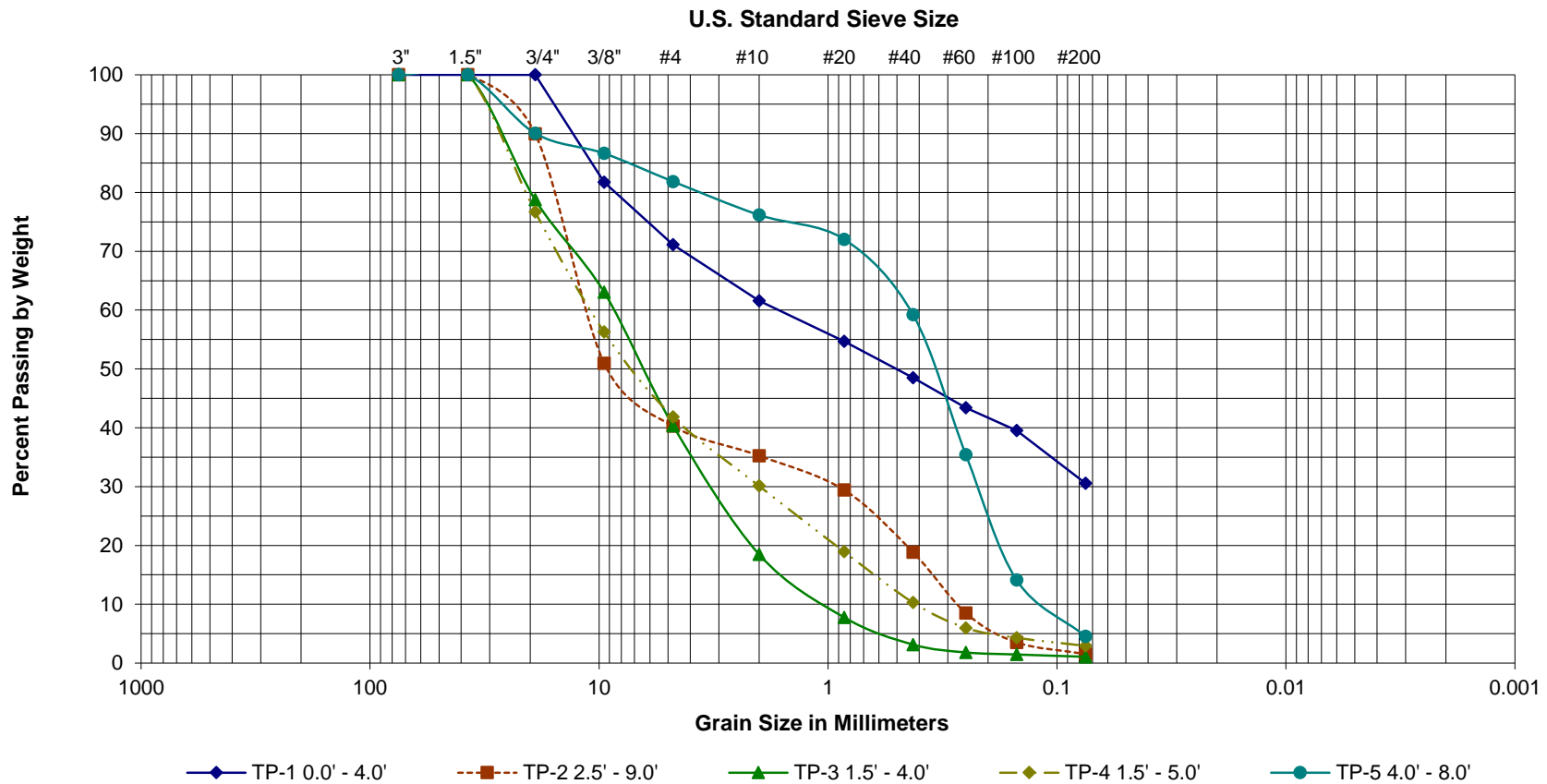
TO: Kyle Herrera
FROM: William Halbert, L.E.G., L.Hg.
DATE: April 2, 2024
PROJECT: West Olympia
SUBJECT: Infiltration on east side of property

We have reviewed the laboratory grain-size distribution results contained in our March 3, 2023 geotechnical report for the property. The grain-size distribution indicates that the soil samples obtained from test pits TP-3 and TP-4 are, in general, coarser than that in TP-2. This would indicate that the infiltration rates for the soils in TP-3 and TP-4 at these depths are at least equal to, if not higher than the 2.6 inches per hour design infiltration rate as calculated for the soils in TP-2.

The grain-size distribution for TP-1 (0 to 4 feet) indicates silty fine to medium sand with relatively lower infiltrative rates. However, below a depth of 4 feet in TP-1, the soil changes to a poorly graded fine to coarse gravel which would have an infiltration rate of at least 2.6 inches per hour.

Roof downspout infiltration trenches should be excavated to a depth of at least 3 feet in the areas of TP-2, TP-3 and TP-4, and should be extended below a depth of 4 feet into the gravelly soils in the area of TP-1 to achieve the design infiltration rates. It may be possible to obtain higher design infiltration rates by conducting a full-scale Pilot Infiltration Test in the gravelly units.

We are including a copy of the graphical grain-size results for these test pits with this memo.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

2000 24TH AVENUE NW

OLYMPIA, WASHINGTON



Graph 1
Gratation Analysis Results

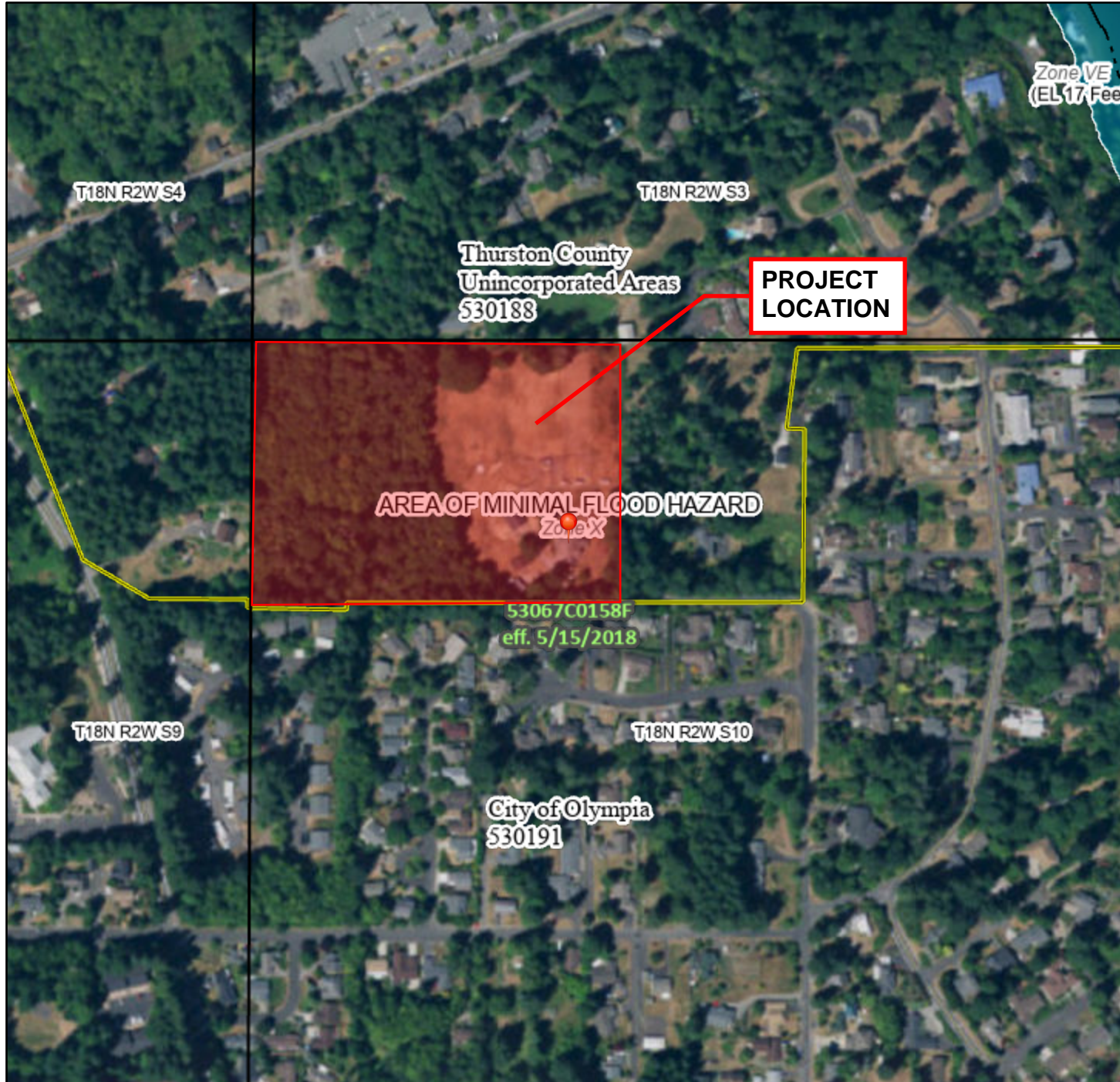
APPENDIX 7

FEMA FLOOD INSURANCE RATE MAP

National Flood Hazard Layer FIRMette



122°55'50"W 47°4'16"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **4/21/2023 at 12:59 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

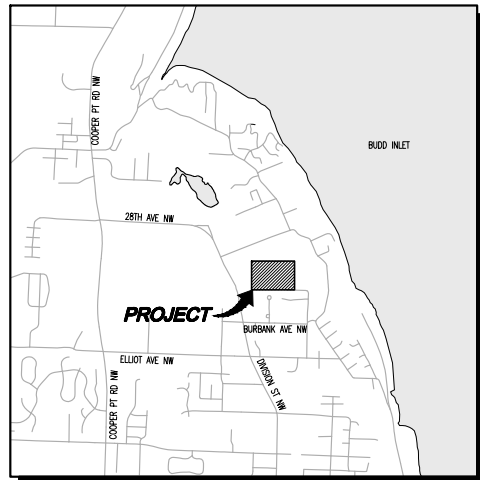
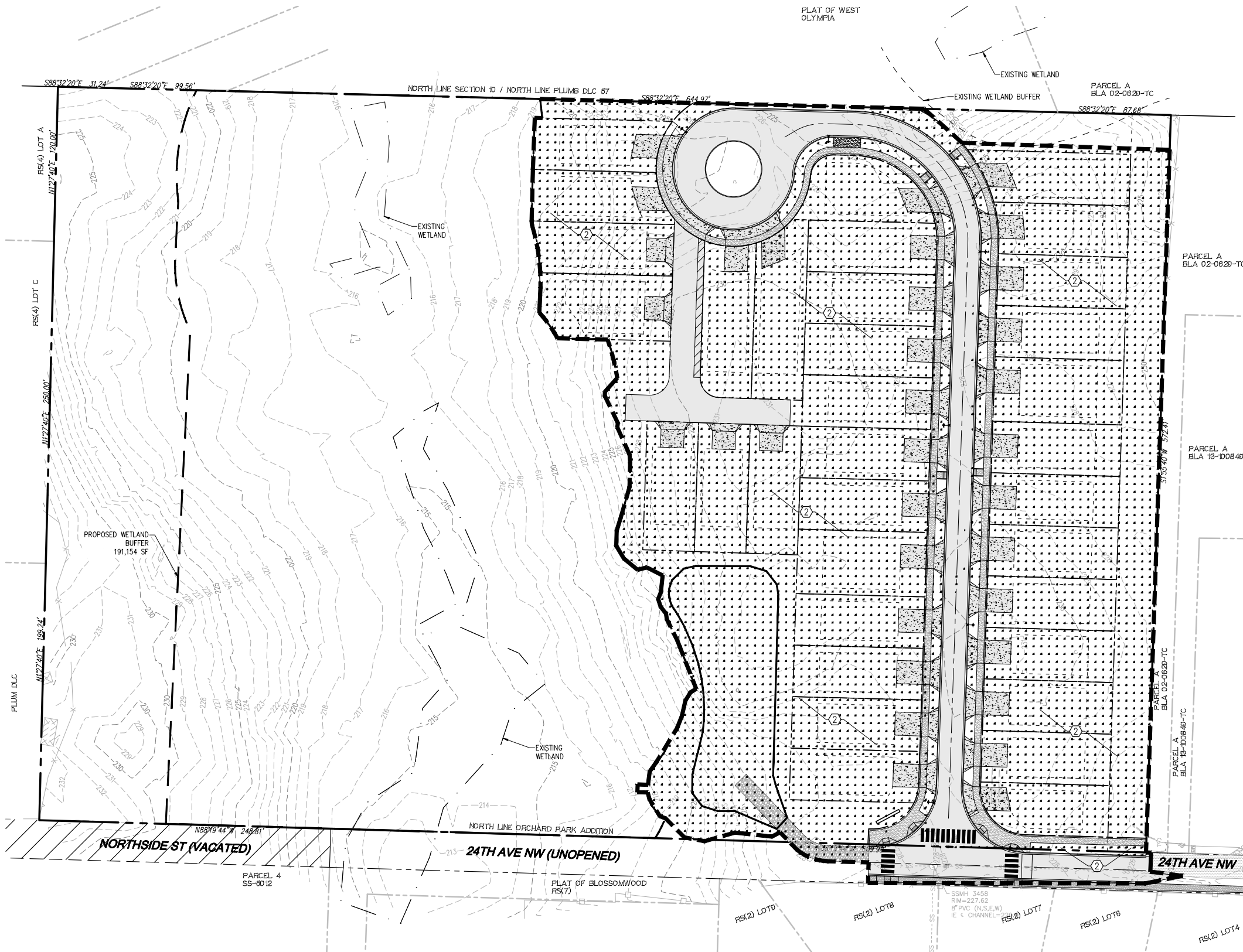
APPENDIX 8

ESTABLISHMENT OF MAINTENANCE COVENANT NOT INCLUDED AT THIS TIME

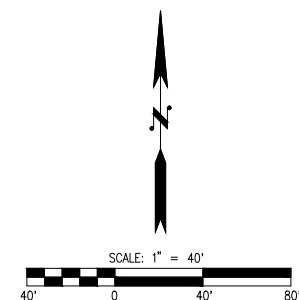
APPENDIX 9

SOIL MANAGEMENT PLAN

PORTION OF SEC 10, TWN 18, RGE 2W, W.M., THURSTON COUNTY, WASHINGTON



VICINITY MAP
SCALE: 1"=2000'



LEGEND

- SOIL MANAGEMENT OPTION 2
- PROJECT DISTURBANCE LIMITS

② OPTION 2 - AMEND SOIL

- SOIL AMENDMENTS SHALL BE APPLIED TO ALL AREAS THAT ARE BEING SET ASIDE AS NON-BUILDABLE AREAS (OPEN SPACE OR NATURAL RESOURCE PROTECTION AREAS) AND ARE IN NEED OF REHABILITATION BECAUSE OF PAST LAND USE DISTURBANCES SUCH AS CLEARING AND INTRUSION OF INVASIVE SPECIES. THE PURPOSE IS TO ENHANCE AND ACCELERATE THE REHABILITATION OF THE SOIL STRUCTURE. THE APPLICATION WILL BE NON-DESTRUCTIVE TO THE EXISTING VEGETATION THAT IS RETAINED BY TAKING CARE TO TAPER DEPTHS OF SOIL AMENDMENT NEAR THE SURFACE ROOTS.
- AMEND EXISTING SITE TOPSOIL OR SUBSOIL EITHER AT DEFAULT PREAPPROVED RATES OR AT CUSTOM CALCULATED RATES TO MEET SOIL QUALITY GUIDELINES BASED ON ENGINEERING TESTS OF THE SOIL AND AMENDMENT. (REFER TO THE BUILDING SOIL MANUAL [STENN ET AL. 2012] OR WEBSITE <WWW.BUILDINGSOIL.ORG> FOR CUSTOM CALCULATION METHODS.)

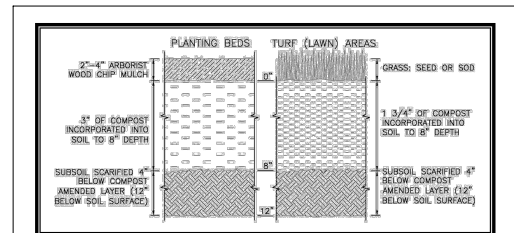


Figure 6.1. Cross-Section of Soil Amendment.

SURVEY INFORMATION

HORIZONTAL - WASHINGTON STATE PLANE COORDINATES, SOUTH ZONE, NAD 83/91 BASED ON GPS TIES TO THURSTON COUNTY MONUMENTS 518AZ AND 519.

VERTICAL - NAVD 88 BASED ON GPS TIE TO THURSTON COUNTY MONUMENT 518AZ, NAVD 88 ELEVATION= 162.35.

UTILITY NOTE

THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO ANY CONSTRUCTION. AGENCIES INVOLVED SHALL BE NOTIFIED WITHIN A REASONABLE TIME PRIOR TO THE START OF CONSTRUCTION.

DISCLAIMER

THE TOPOGRAPHIC SURVEY WAS PERFORMED BY MTN2COAST, LLC. IN DECEMBER 2022. ANY CHANGES TO THE SITE AFTER THIS DATE WILL NOT BE REFLECTED IN THE PLANS. ANY DISCREPANCIES FOUND BETWEEN WHAT IS SHOWN ON THE PLANS AND WHAT IS NOTED IN THE FIELD SHOULD BE BROUGHT IMMEDIATELY TO THE ATTENTION OF THE ENGINEER.



REVISIONS	
NO.	DATE

LDC

Surveying
Engineering
Planning

Kent

Woodinville

20210 142nd Avenue NE

Woodinville, WA 98072

T 425.806.1869

www.LDCcorp.com

F 425.882.2893

WEST OLYMPIA DEVELOPMENT

2000 24TH AVE NW

SOIL MANAGEMENT PLAN

JOB NUMBER: C23-127

DRAWING NAME: C23-127 SMP-01

DESIGNER: KH

DRAFTING BY: ES

DATE: APRIL 2024

SCALE: AS NOTED

JURISDICTION: THURSTON

SMP-01

SHEET 1 OF 1

APPENDIX 10

DESIGN CALCULATIONS

MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.59
Program License Number: 201510005
Project Simulation Performed on: 04/01/2024 9:42 AM
Report Generation Date: 04/01/2024 9:42 AM

Input File Name: 2024-0401 Detention Pond
Project Name: West Oly Development
Analysis Title:
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 6
Precipitation Station : 95005205 Puget West 52 in_5min 10/01/1939-10/01/2097
Evaporation Station : 951052 Puget West 52 in MAP

Evaporation Scale Factor : 0.750

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

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

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

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	2.360	2.360
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	2.360	2.360

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

----- Subbasin : Subbasin 1 -----
-----Area (Acres) -----

C, Forest, Flat 2.360

Subbasin Total 2.360

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

```
----- Subbasin : Subbasin 1 -----
-----Area (Acres) -----
C, Pasture, Flat 0.780
ROADS/FLAT      0.670
SIDEWALKS/FLAT          0.620
POND            0.290
-----
Subbasin Total    2.360
```

***** LINK DATA *****

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

***** LINK DATA *****

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

Link Name: New Structure Lnk1

Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft) : 100.00
Riser Crest Elevation (ft) : 106.00
Max Pond Elevation (ft) : 107.00
Storage Depth (ft) : 6.00
Pond Bottom Length (ft) : 88.0
Pond Bottom Width (ft) : 45.0
Pond Side Slopes (ft/ft) : Z1= 3.00 Z2= 3.00 Z3= 3.00 Z4= 3.00
Bottom Area (sq-ft) : 3960.
Area at Riser Crest El (sq-ft) : 10,044.
(acres) : 0.231
Volume at Riser Crest (cu-ft) : 40,716.
(ac-ft) : 0.935
Area at Max Elevation (sq-ft) : 11310.
(acres) : 0.260
Vol at Max Elevation (cu-ft) : 51,387.
(ac-ft) : 1.180

Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydraulic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry

Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.000
Riser Crest Elevation : 106.00 ft

Hydraulic Structure Geometry

Number of Devices: 3

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 103.65
Diameter (in) : 1.20
Orientation : Vertical
Elbow : No

---Device Number 3 ---
Device Type : Circular Orifice
Control Elevation (ft) : 105.15
Diameter (in) : 1.80
Orientation : Horizontal
Elbow : Yes

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

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1
Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1
Number of Links: 1

***** Link: New Structure Lnk1

***** Link WSEL Stats

WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs) WSEL Peak (ft)

=====

1.05-Year	102.502
1.11-Year	102.717
1.25-Year	102.955
2.00-Year	103.845
3.33-Year	104.355
5-Year	104.615
10-Year	105.225
25-Year	105.609

50-Year	105.919
100-Year	106.003

*******Groundwater Recharge Summary*******

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

Model Element	Total Predeveloped Recharge During Simulation Recharge Amount (ac-ft)
---------------	--

Subbasin: Subbasin 1	510.666
----------------------	---------

Total:	510.666
--------	---------

Model Element	Total Post Developed Recharge During Simulation Recharge Amount (ac-ft)
---------------	--

Subbasin: Subbasin 1	152.650
----------------------	---------

Link: New Structure Lnk1	0.000
--------------------------	-------

Total:	152.650
--------	---------

**Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)**

Predeveloped: 3.232 ac-ft/year, Post Developed: 0.966 ac-ft/year

*******Water Quality Facility Data*******

-----**SCENARIO: PREDEVELOPED**

Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Links: 1

***** Link: New Structure Lnk1 *****

Basic Wet Pond Volume (91% Exceedance): 11788. cu-ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 17683. cu-ft

2-Year Discharge Rate : 0.067 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge

On-line Design Discharge Rate (91% Exceedance): 0.31 cfs

Off-line Design Discharge Rate (91% Exceedance): 0.18 cfs

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 1160.24

Inflow Volume Including PPT-Evap (ac-ft): 1160.24

Total Runoff Infiltrated (ac-ft): 0.00, 0.00%

Total Runoff Filtered (ac-ft): 0.00, 0.00%

Primary Outflow To Downstream System (ac-ft): 1160.21
Secondary Outflow To Downstream System (ac-ft): 0.00
Volume Lost to ET (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.00%

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

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Structure Lnk1

*** **Point of Compliance Flow Frequency Data** ***

Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)

2-Year	0.101	2-Year	6.692E-02
5-Year	0.152	5-Year	9.406E-02
10-Year	0.191	10-Year	0.131
25-Year	0.247	25-Year	0.172
50-Year	0.308	50-Year	0.194
100-Year	0.365	100-Year	0.200
200-Year	0.426	200-Year	0.293
500-Year	0.506	500-Year	0.408

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

**** **Flow Duration Performance** ****

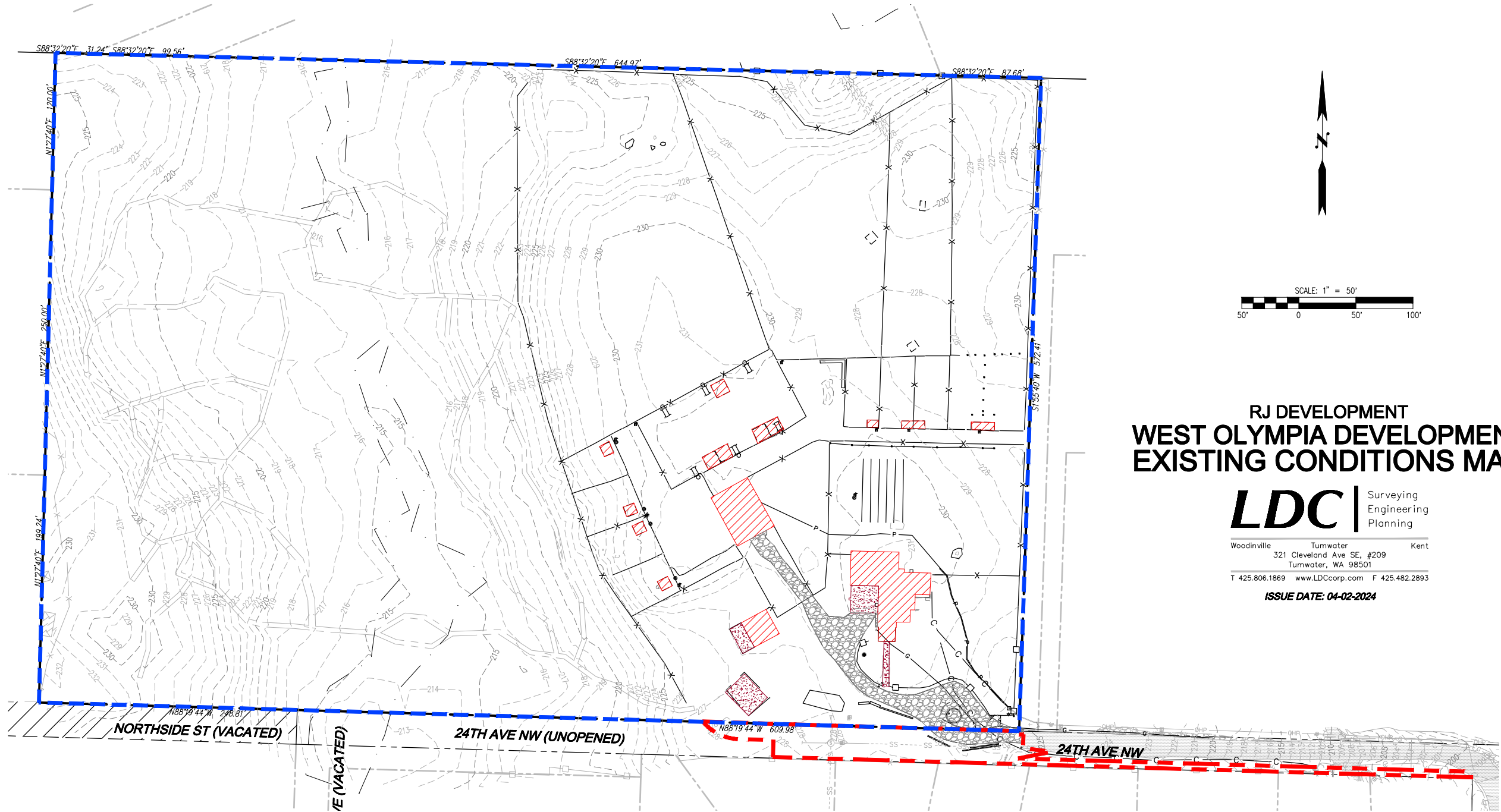
Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-27.6%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-7.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	1.1%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

APPENDIX 11

ADDITIONAL REPORTS/INFORMATION

ADD UPDATED WETLAND REPORT WHEN WE HAVE IT








RJ DEVELOPMENT
WEST OLYMPIA DEVELOPMENT
EXISTING CONDITIONS MAP

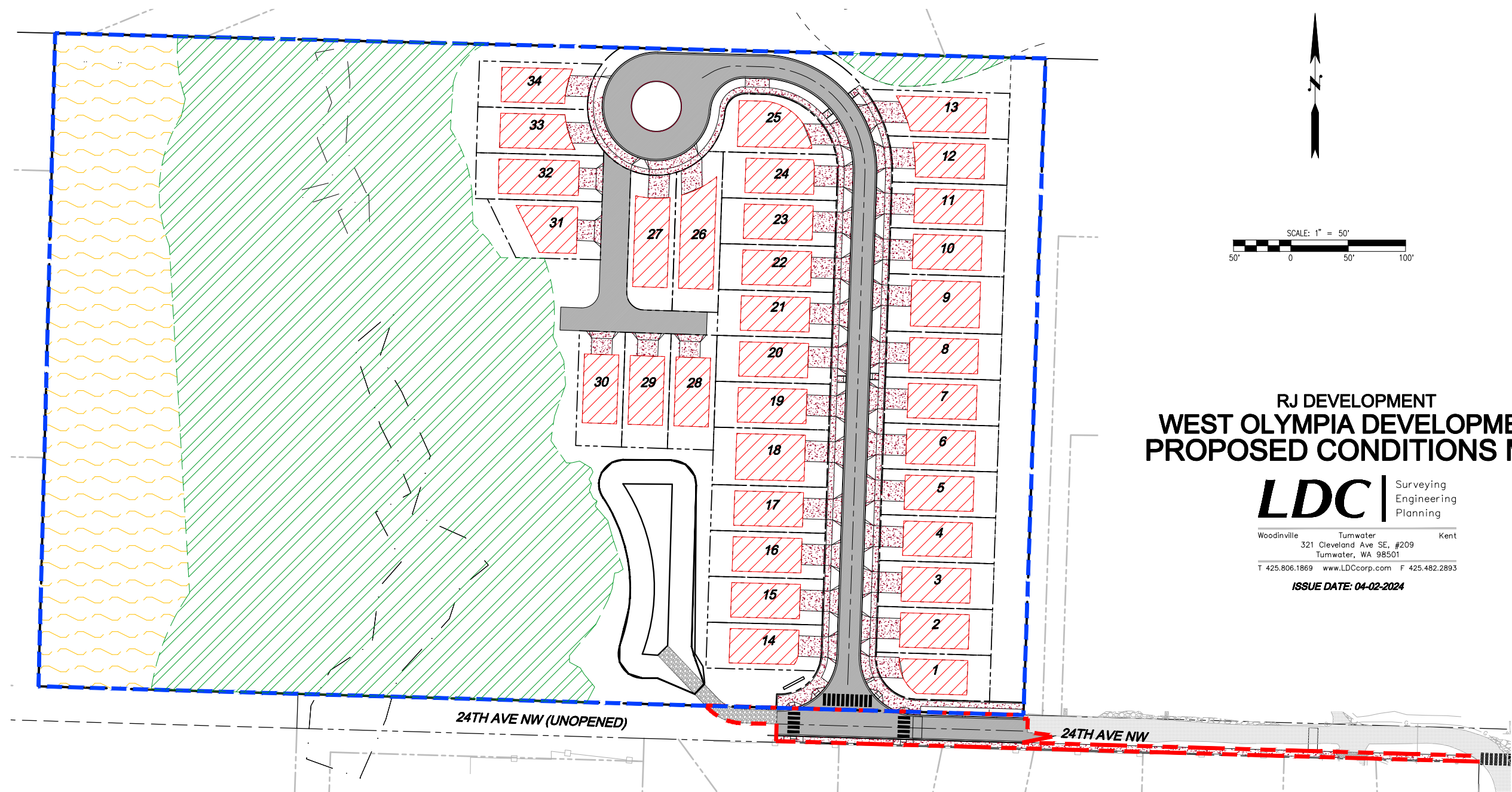
LDC | Surveying
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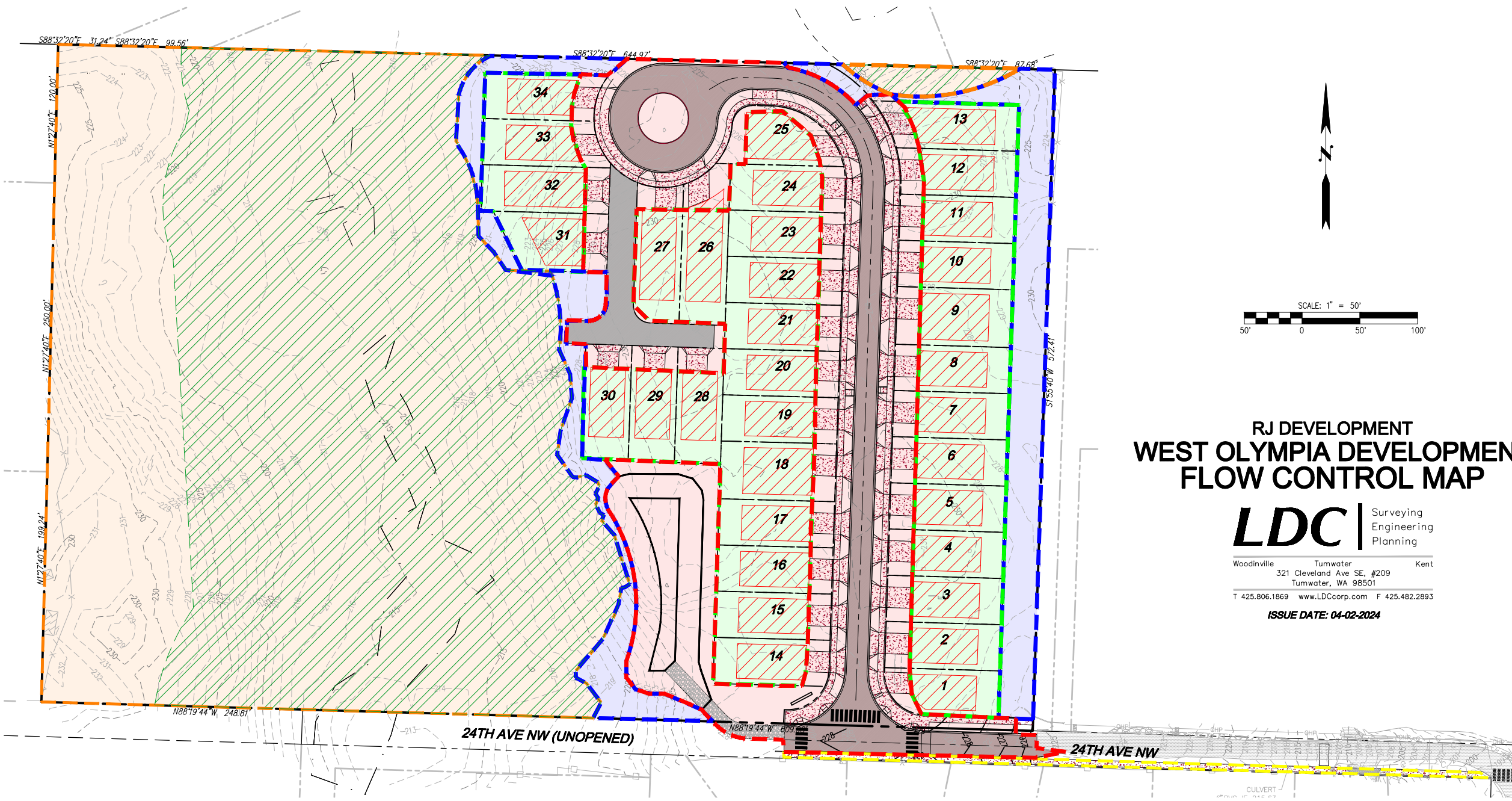
EXISTING ON-SITE AREAS:		
	ROOF AREA:	0.16 ACRES
	CONCRETE AREA:	0.04 ACRES
	GRAVEL AREA:	0.13 ACRES
	PERVIOUS AREA:	10.95 ACRES
	TOTAL:	11.28 ACRES




EXISTING FRONTAGE AREAS:		
	CONCRETE AREA:	0.01 ACRES
	GRAVEL AREA:	0.02 ACRES
	PERVIOUS AREA:	0.15 ACRES
	TOTAL:	0.18 ACRES






PROPOSED ON-SITE AREAS:		
	ROOF AREA:	1.22 ACRES
	CONCRETE AREA:	0.62 ACRES
	ASPHALT AREA:	0.56 ACRES
	UNDISTURBED WETLAND BUFFER AREA:	4.26 ACRES
	UNDISTURBED FOREST AREA:	1.45 ACRES
	POND AREA:	0.29 ACRES
	PERVIOUS AREA:	2.89 ACRES
	TOTAL:	11.28 ACRES


PROPOSED OFF-SITE AREAS:		
	PERMEABLE CONCRETE AREA:	0.07 ACRES
	ASPHALT AREA:	0.11 ACRES
	TOTAL:	0.18 ACRES





PROPOSED BASIN 1 AREAS:		
	ROOF AREA:	0.00 ACRES
	CONCRETE AREA:	0.62 ACRES
	ASPHALT AREA:	0.67 ACRES
	POND AREA:	0.29 ACRES
	PERVIOUS AREA:	0.78 ACRES
	TOTAL:	2.36 ACRES

PROPOSED BASIN 2 AREAS:		
	ROOF AREA:	1.22 ACRES
	BACKYARD AREA:	1.33 ACRES
	TOTAL:	2.55 ACRES

PROPOSED BASIN 3 AREAS:		
	PERVIOUS AREA:	0.77 ACRES
	TOTAL:	0.77 ACRES

PROPOSED BASIN 4 AREAS:		
	PERMEABLE CONCRETE AREA:	0.07 ACRES
	TOTAL:	0.07 ACRES

PROPOSED BASIN 5 AREAS:		
	UNDISTURBED WETLAND BUFFER:	4.26 ACRES
	UNDISTURBED FOREST AREA:	1.45 ACRES
	TOTAL:	5.71 ACRES