WAGNER ORTHODONTICS

PRELIMINARY DRAINAGE REPORT (PDR)

JUNE 2022

RB Engineering

DESIGN → PERMIT → MANAGE

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Project Engineer

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Reference:	2019 WSDOE Stormwater Manual

Project Engineers Certification

"I hereby certify that this Drainage and Erosion Control Plan for **Wagner Orthodontics** has been prepared by me or under my supervision and meets minimum standards the **Stormwater Management Manual for Western Washington** and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me."

Project Engineers Stamp

SECTION 1 – PROJECT OVERVIEW

Permit Requested:	Drainage and Grading
Other Permits Required:	Building Permit, SEPA Checklist Grading/Earthwork Permit
Agency Permit No.:	Pending
Site Address:	1319 & 1327 Bishop Rd Chehalis, WA 98532
Total Site Area:	0.88 Acres
Zoning:	CG – General Commercial
WaterShed:	WRIA 23 – Upper Chehalis https://waecy.maps.arcgis.com/apps/webappviewer/index.html?id=996e6b21ae394cc3a3b63c6da0c3aa0a

Project Overall Description

The proposal is to combine two 0.44-acre lots into a single 0.88-acre lot. The project will consist of a new 4,000 sf orthodontics building with associated driveway and parking areas. The project will also provide frontage improvements along Bishop Rd, consisting of curb, gutter, and sidewalk.

Proposed Flow Control Improvements

The flow control facilities proposed for this project were designed and modeled using the latest edition of the Western Washington Hydrology Manual Continuous Simulation Program. The site will utilize a detention pond for the developments Threshold Discharge Areas (TDA).

Proposed Water Quality Improvements

The water quality improvements for the project site runoff consist of a Bio-filtration Swale for the developments Threshold Discharge Areas (TDA).

Proposed Conveyance System

The proposed conveyance systems will consist of concrete catch basins and PVC pipe in various sizes to collect and convey stormwater to the proposed flow control pond. The pond will outlet through a control structure into the bio-filtration swale. After flowing through the swale, the stormwater will then be conveyed through PVC pipe and outlet into the existing roadside ditch. The proposed conveyance system will be sized to accommodate a minimum of the 25-year storm event.

Proposed Discharge Location

The project site will discharge runoff from the developed areas to the existing roadside ditch that runs south along Bishop Road, where it eventually enters a stream roughly 260 ft south of the property.

Downstream Condition

The natural drainage leaves the site at the southeast corner and drains to the adjacent property. It then flows across the property and enters a stream roughly 260 ft south of the project location.

Onsite Soils and Geology

An onsite soils report was completed for this project site. A copy of that report in included in Appendix 3 of this report.

NRCS Soil Survey

RBE staff reviewed the onsite soils information provided by NRCS. Appendix 3 includes copies of the site map and soil descriptions that make up the property geology. In addition to the NRCS information,

Hydrologic Soil Group:	Lacamas Silt Loam – Class C/D Soils
	Prather Silty Clay Loam – Class C Soils

Project Topography

Based on the site topography, the project site is mostly flat, with a steepest slope of about 10% in the southeast corner.

Land Use and Ground Cover

The existing land use is residential, with multiple residential structures which will be removed prior to construction.

Natural Drainage Patterns

The site has natural drainage to the south where it enters a stream about 260 ft away from the project site.

Tributary and Discharge Points of Flow

The site has no tributary points of flow.

Historical Drainage Problems

There are no know drainage problems associated with the project site.

Existing Utilities (Storm, Sewer, Water)

The existing utilities available to the site include sanitary sewer, water, gas, power and phone services. Existing onsite septic systems will be abandoned, and public sewer will be utilized.

Erosion Potential

The site has a **medium** erosion potential based on the NRCS Soil Survey. As part of the development plans a detailed Erosion Control Plan and Storm Water Pollution Prevention Plan will be prepared for use during site construction to minimize erosion and migration of sediment within and off the site. A NPDES Stormwater Construction Permit **is not** required by WSDOE for this project.

Critical Areas Onsite

The site **is not** located within a Critical Aquifer Recharge Area (CARA).

Existing Fuel Storage Tanks

Review of the onsite parcels resulted in no evidence of existing fuel storage tanks above or below ground for this property.

Groundwater Wells

The property does not include any onsite ground water wells.

Septic Systems

The site does consist of an existing septic system. The existing septic will be abandoned prior to construction, and public sewer services will be utilized.

Wellhead Protection Area

The site **is not** within any wellhead protection areas.

100-Year Flood Plain

The site **is not** within any flood plains.

Section 2 – APPLICABLE MINIMUM REQUIREMENTS

Manual Exemptions

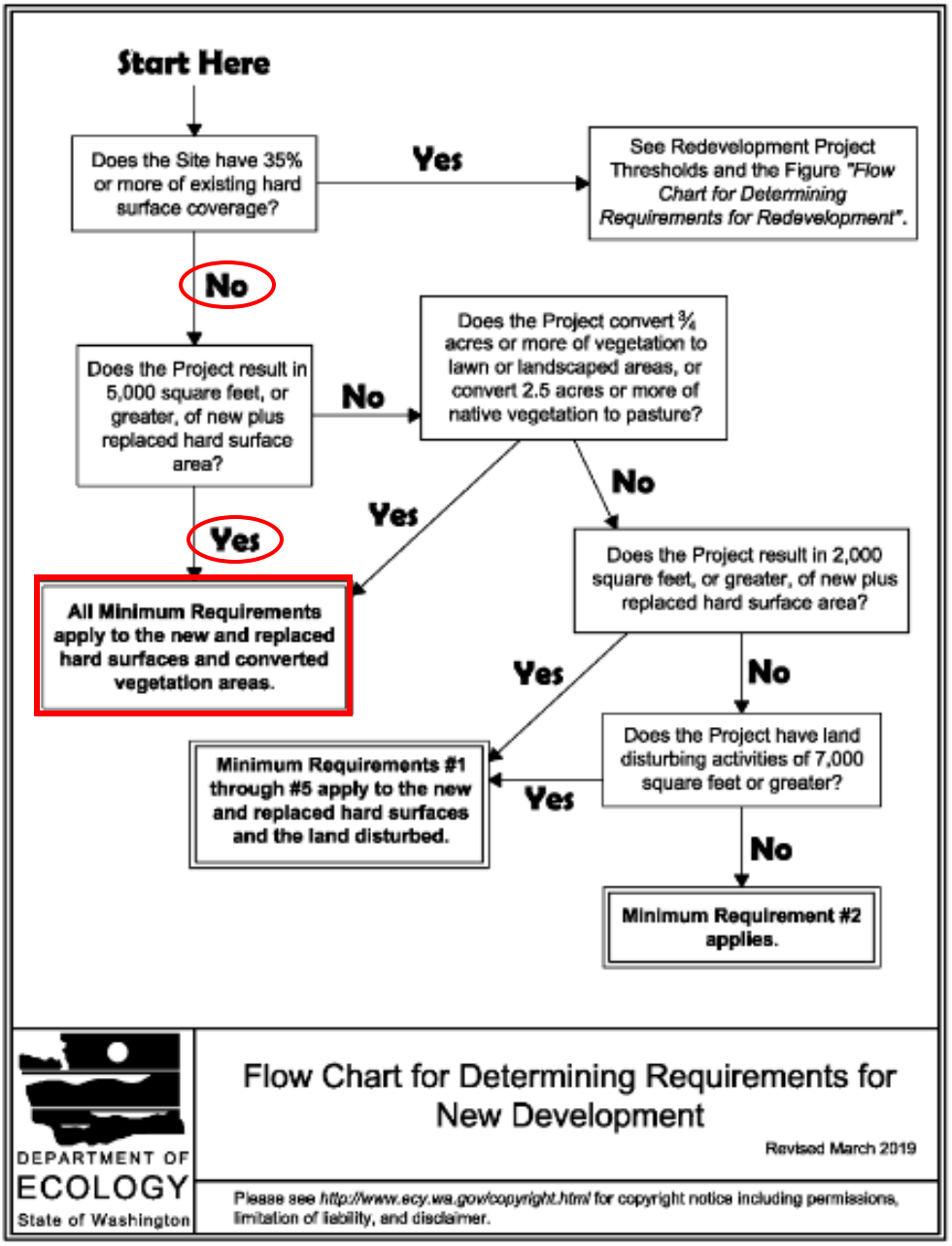
Exemptions	Applicable to Project
Forest Practices (Title 222 WAC)	No
Commercial Agriculture	No
Oil & Gas Field Activities or Operations	No
Pavement Maintenance	No
Underground Utility Projects	No

New Development and Re-Development Review

The minimum requirements for stormwater development and redevelopment sites are listed in Volume I of the 2019 SMMWW. Not all minimum requirements of this section apply to all projects. Determination of applicable minimum requirements is also based in part on Section 1-3 of the Manual. See detailed area calculations in Section 5 of this report.

Applicable Criteria	Areas
Total Site Area	0.88 AC
Existing Site Impervious Coverage	0.15 AC
New Plus Replaced Impervious Surface	0.49 AC
Vegetation Area Converted to Lawn or Landscaped Area	0.43 AC
Land Disturbing Area	0.88 AC
Percent of Existing Impervious Surface	17 %

Figure I-3.1: Flow Chart for Determining Requirements for New Development



Section 2.1 – Minimum Requirements

Based on the thresholds given in Figures 1-3.1 and/or 1-3.2 of Volume I of the Manual, the proposed project must address or comment on **Minimum Requirements #1 through #9**. These requirements as they apply to the project are discussed in more detail below.

Minimum Requirement (MR) #1 – Stormwater Site Plans:

> All projects meeting the thresholds in I-3.3 Applicability of the Minimum Requirements shall prepare a Stormwater Site Plan for local government review. Stormwater Site Plans shall use site-appropriate development principles, as required and encouraged by local development codes, to retain native vegetation and minimize impervious surfaces to the extent feasible. Stormwater Site Plans shall be prepared in accordance with III-3 Stormwater Site Plans

The proposed project will create over 5,000 square feet of new impervious surfacing, and therefore a Stormwater Site Plan complying with minimum requirements #1 through #9 is required.

MR #2 – Construction Storm Water Pollution Prevention Plan:

> All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters.
>
> Projects which result in 2,000 square feet or more of new plus replaced hard surface area, or which disturb 7,000 square feet or more of land must prepare a Construction Stormwater Pollution Prevention Plan (SWPPP) as part of the Stormwater Site Plan (see I-3.4.1 MR1: Preparation of Stormwater Site Plans).
>
> Projects below those thresholds (listed above) are not required to prepare a Construction SWPPP, but must consider all of the Construction SWPPP Elements (listed below) and develop controls for all Construction SWPPP Elements that pertain to the project site.

The proposed project exceeds the thresholds of Section 2.5 and therefore a Construction Storm Water Pollution Prevention Plan is required for this project. The site **does not** disturb more than 1 acre of land and discharges to waters of the state. Therefore, a NPDES stormwater construction permit **is not** required. A SWPPP has been created as a standalone document for this project and included in Appendix 5 of this TIR.

MR #3 – Source Control of Pollution:

> All known, available and reasonable Source Control BMPs must be applied to all projects. Source Control BMPs must be selected, designed, and maintained in accordance with this Manual.

All known, available and reasonable source control BMPs shall be applied to the project to limit pollutants coming in contact with stormwater. The Source Control BMPs for this project will be incorporated into the project's Final Operation and Maintenance Plan.

MR #4 – Preservation of Natural Drainage Systems/Outfalls:

Natural drainage patterns shall be maintained, and discharges from the Project Site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the Project site must not cause a significant adverse impact to downstream receiving waters and downgradient properties. All outfalls require energy dissipation.

Proposed stormwater discharges from the project site shall be treated and detained and then released to the original natural drainage location. The natural site drainage outfall will be maintained but will have a reduced flow due to the onsite drainage design facility.

MR #5 – On-Site Stormwater Management:

Projects shall employ Stormwater Management BMPs in accordance with the following thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on site to the extent feasible without causing flooding or erosion impacts.

All projects that require Minimum Requirement #5 (as detailed in I-3.3 Applicability of the Minimum Requirements) must employ Stormwater Management BMPs as detailed below. The compliance options for the project depend on the amount of improvements proposed, the locationof the project, the size of the parcel the project is on, and whether or not the project is Flow Control exempt.

Note that the site may contain multiple parcels. The designer may choose different compliance methods for different parcels, depending on the proposed design and the options for each parcel as detailed below.

Projects that Trigger Only Minimum Requirements #1 - #5
Projects that are not Flow Control exempt that trigger only Minimum Requirements #1 through #5 (per I-3.3 Applicability of the Minimum Requirements) shall either:

Use the LID BMPs from List #1 for all surfaces within each type of surface in List #1; or
Use any Flow Control BMP(s) desired to achieve the LID Performance Standard, and apply BM P T5.13: Post-Construction Soil Quality and Depth.

Projects that Trigger Minimum Requirements #1 - #9
Projects that are not Flow Control exempt that trigger Minimum Requirements #1 through #9 (per I-3.3 Applicability of the Minimum Requirements) have the compliance options shown in Table I-3.1: Minimum Requirement #5 Compliance Options for Projects Triggering Minimum Requirements #1 - #9.

Projects triggering Minimum Requirements #1 through #9, must meet the requirements in Table I-3.1.

Table I-3.1: Minimum Requirement #5 Compliance Options for Projects Triggering Minimum Requirements #1 - #9

Project Location and Parcel Size	Minimum Requirement #5 Compliance Options
Projects inside the UGA, on any size parcel	• Use the LID BMPs from List #2 for all surfaces within each type of surface in List #2; or • Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.
Projects outside the UGA, on a parcel smaller than 5 acres	
Projects outside the UGA, on a parcel 5 acres or larger	Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.
Note: This text refers to the Urban Growth Area (UGA) as designated under the Growth Management Act (GMA) (Chapter 36.70A RCW) of the State of Washington. If the project is located in a county that is not subject to planning under the GMA, the city limits shall be used instead.	

Flow Control Exempt Projects

Projects qualifying as Flow Control exempt in accordance with the TDA Exemption in I-3.4.7 MR7: Flow Control shall either:

- Use the LID BMPs from List #3 for all surfaces within each type of surface in List #3;

  or

- Use any Flow Control BMP(s) desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.

If the project has multiple TDAs, all TDAs must be Flow Control exempt per the TDA Exemption in I-3.4.7 MR7: Flow Control for the project to use the options listed here.

The text in this box originates from one or more of the following Permits:
Appendix 1 of the Phase I / Phase II Municipal Stormwater Permits
Construction Stormwater General Permit

Figure I-3.3: Flow Chart for Determining MR #5 Requirements

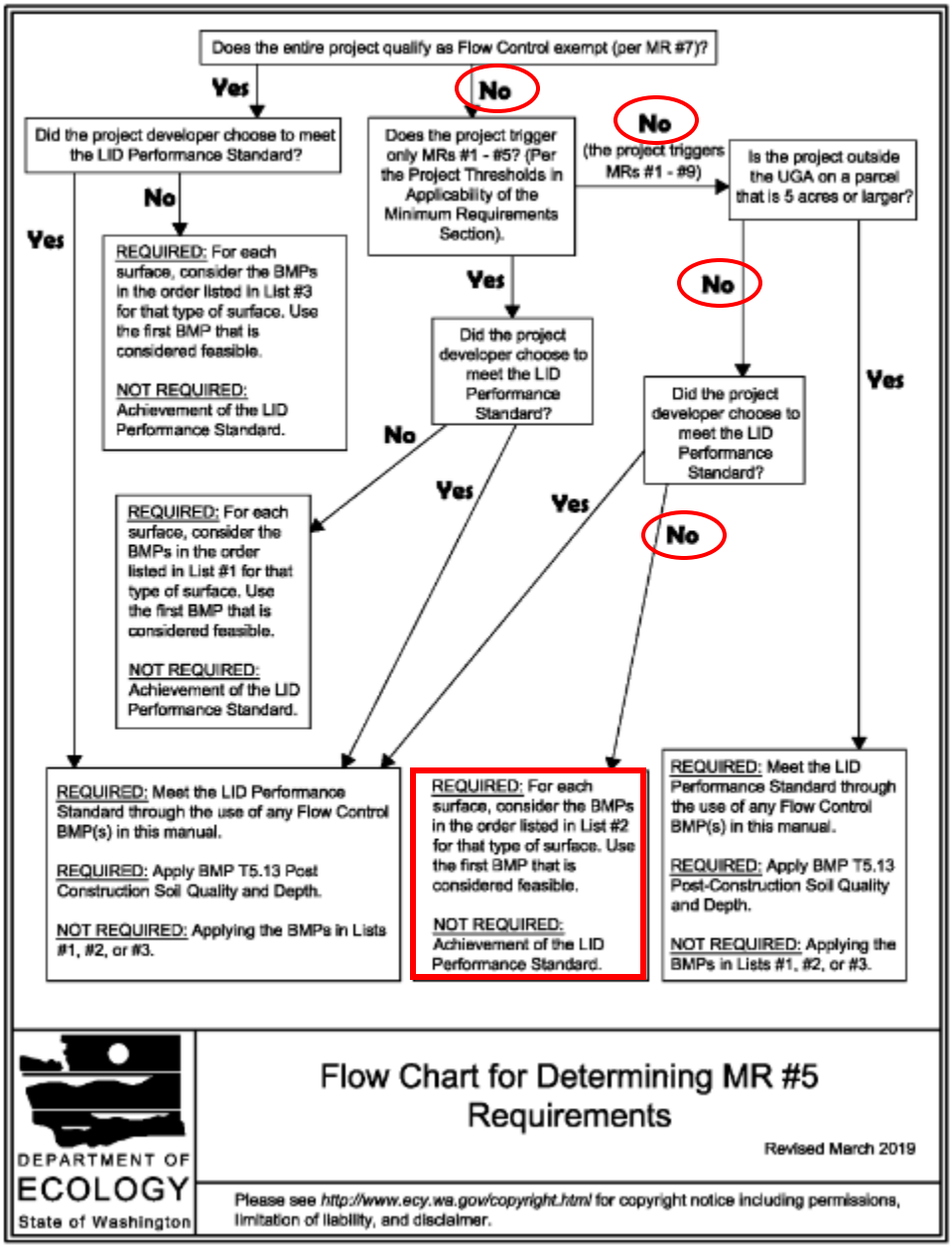


Table I-3.2: The List Approach for MR5 Compliance

List #1 (For MR #1 - #5 Projects That Are Not Flow Control Exempt)	List #2 (For MR #1 - #9 Projects That Are Not Flow Control Exempt)	List #3 (For Flow Control Exempt Projects)
Surface Type: Lawn and Landscaped Areas		
BMP T5.13: Post-Construction Soil Quality and Depth	BMP T5.13: Post-Construction Soil Quality and Depth	BMP T5.13: Post-Construction Soil Quality and Depth
	Surface Type: Roofs	
1. BMP T5.30: Full Dispersion or BMP T5.10A: Downspout Full Infiltration	1. BMP T5.30: Full Dispersion or BMP T5.10A: Downspout Full Infiltration	1. BMP T5.10A: Downspout Full Infiltration
2. BMP T5.14: Rain Gardens or BMP T7.30: Bioretention	2. BMP T7.30: Bioretention	2. BMP T5.10B: Downspout Dispersion Systems
3. BMP T5.10B: Downspout Dispersion Systems	3. BMP T5.10B: Downspout Dispersion Systems	3. BMP T5.10C: Perforated Stub-out Connections
4. BMP T5.10C: Perforated Stub-out Connections	4. BMP T5.10C: Perforated Stub-out Connections	
	Surface Type: Other Hard Surfaces	
1. BMP T5.30: Full Dispersion	1. BMP T5.30: Full Dispersion	
2. BMP T5.15: Permeable Pavements or BMP T5.14: Rain Gardens or BMP T7.30: Bioretention	2. BMP T5.15: Permeable Pavements	BMP T5.12: Sheet Flow Dispersion or BMP T5.11: Concentrated Flow Dispersion
3. BMP T5.12: Sheet Flow Dispersion or BMP T5.11: Concentrated Flow Dispersion	3. BMP T7.30: Bioretention	
	4. BMP T5.12: Sheet Flow Dispersion or BMP T5.11: Concentrated Flow Dispersion	

Table I-3.2: The List Approach for MR5 Compliance (continued)

List #1 (For MR #1 - #5 Projects That Are Not Flow Control Exempt)	List #2 (For MR #1 - #9 Projects That Are Not Flow Control Exempt)	List #3 (For Flow Control Exempt Projects)
ing to it. 2. When the designer encounters BMP T5.15: Permeable Pavements in the List Approach, it is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless BMP T5.30: Full Dispersion is employed.		

Low Impact Development Performance Standard:

The project **has not** chosen to utilize the LID performance standards for this project. The project will match the pre-developed durations for 50% for the 2-year peak flow up to the full 50-year flow. See MR# 6 and 7 for BMP's utilized for treatment and flow control.

List #2: Onsite Stormwater Management BMPs for Projects Triggering Minimum Requirements #1 through #9

Lawn and landscape Runoff:

Post construction soil quality BMP T5.13 will be used for disturbed landscape areas.

Roof Runoff:

Where roof downspout controls are planned, the following types must be considered in descending order of preference.

1) **Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V, or Downspout Full Infiltration Systems in accordance with BMP T5.10A in Section 3.1.1 in Chapter 3 of Volume III**

   Full Dispersion per BMP T5.30 is not feasible due to limited site area.

   BMP T5.10A is not feasible due to poorly infiltrating soils.

2) **Bio-retention (See Chapter 7 of Volume V) facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface are drainage to it.**

   A Bio-Retention BMP is not feasible due to poorly infiltration soils.

3) **Downspout Dispersion Systems in accordance with BMP T5.10B in Section 3.1.2 in Chapter 3 of Volume III**

   BMP T5.10B is not feasible due to limited site area.

4) **Perforated Stub-out Connections in accordance with BMP T5.10C in Section 3.1.3 in Chapter 3 of Volume III**

   BMP T5.10C is not feasible due to poorly infiltration soils.

Other Hard Surfaces:

1) **Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V.**

   Full Dispersion per BMP T5.30 is not feasible due to limited site area.

2) **Permeable pavement in accordance with BMP T5.15 in chapter 5 of Volume V.**

   BMP T5.15 is not feasible due to poorly infiltrating soils.

3) **Bioretention BMP's (See chapter 7, Volume V of the SMMWW) that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.**

   The Bio-retention facility is not feasible due to poorly infiltrating soils.

4) **Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 6 of Volume V.**

   Sheet flow and concentrated flow dispersion are not feasible due to limited site area.

MR #6 – Runoff Treatment:

Projects shall employ Runoff Treatment BMPs in accordance with the following thresholds, standards, and requirements to remove pollutants from stormwater runoff.

The following require construction of stormwater treatment facilities:

1) **Projects in which the total of, pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area of the project, or**

   The proposed project **will** develop more than 5,000 square feet of openly exposed pollution generating impervious surface and therefore meets the threshold requirements of this section. See Chapter 5.2 for selected water quality treatment method.

Determine the Receiving Waters/Pollutants of Concern Based on Offsite Analyses

Pollutants of Concern

Step 2: Oil Control Facility

This project will require oil control facility based on the analysis below.

Oil Control Determination Chart	
ADT 100 Vehicles or Greater per 1000 SF Building Area	Yes or **No**
Site Subject to Petroleum Storage or Transfer Greater than 1500 Gallons per year.	Yes or **No**
Site have Parking, Storage or maintenance of 25 or more vehicles over 25 Tons gross weight. (Trucks, Buses, Trains, Heavy Equipment)	Yes or **No**
Road Intersection with measured ADT of 25000 vehicles or more on main roadway and 15000 vehicles or more on intersection roadway.	Yes or **No**

Step 3: Is Infiltration Practicable for pollutant removal?

No

Step 4: Phosphorus Control Required

Phosphorus Control Determination Chart	
Local Government Require Phosphorus control	**No**

Step 5: Enhanced Treatment Required

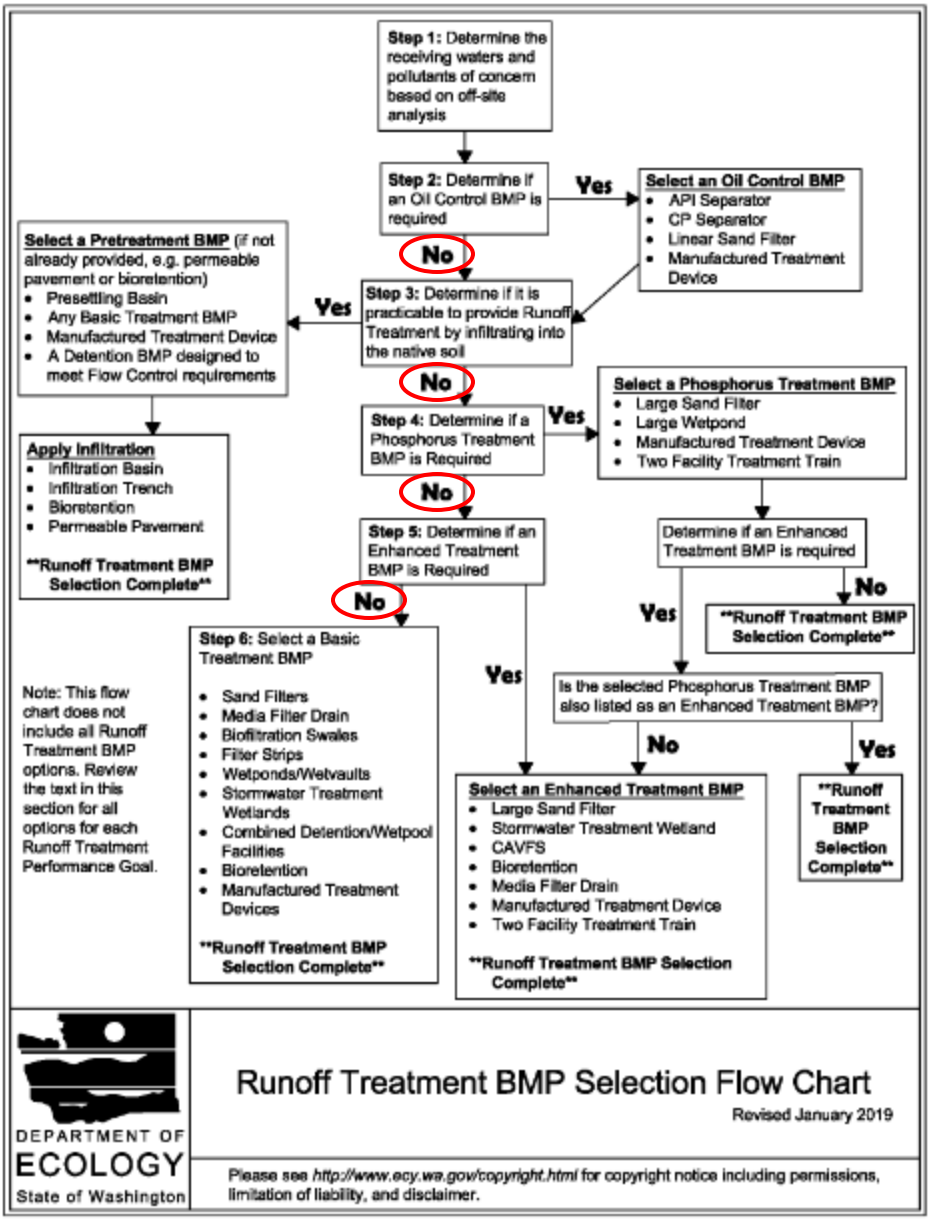
Oil Control Determination Chart	
Site discharge directly to fresh waters or conveyance systems tributary to fresh waters?	**No**
Site uses infiltration strictly for flow control and the discharge is within 1.4 mile of fresh water designate for aquatic life?	**No**

Site an industrial project site?	**No**
Site a commercial project site?	**Yes**
Site a multi-family residential project site	**No**
UGA – Fully controlled and partially controlled limited access highways with AADT 15000 or greater	No
UGA - All other roads with and AADT of 7500 or greater.	No
Outside UGA - Roads with and AADT of 15,000 or greater unless discharging to a Strahler order Stream or large	No
Outside UGA - Road with an AADT of 30,000 or greater if discharging to a 4th Strahler order stream or larger.	No

Step 6: Select Basic/Enhanced Treatment Facility

Based on the above determinations, the treatment BMP's selected for this project were determined from figure III-1.1 on the following page.

Figure III-1.1: Runoff Treatment BMP Selection Flow Chart



Water Quality BMP's

The drainage basins delineated for this project will have openly exposed pollution generating hard surfaces. These tributary areas will be treated using the BMP technologies identified on Figure III-1.1: Runoff Treatment BMP Selection Flow Chart located on the previous page. A summary of the selected BMP's per the associated TDA is listed below.

Basin ID / TDA	BMP Used	Treatment Level
D1/TDA1	Biofiltration Swale	Basic

Underground Injection Control (UIC) Program

Depending on the type and size of the proposed project, different combinations of the Minimum Requirements or UIC Program regulations apply. Information on the UIC program regulations can be found at Section I-4 UIC of the Manual.

Project UIC Compliance:

This project does not use infiltration for stormwater control or

MR #7 – Flow Control:

Projects shall employ Flow Control BMPs in accordance with the following thresholds, stand ards, and requirements to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions.

Flow Control is not required for TDAs that discharge directly to, or indirectly through an MS4 to a water listed in Appendix I-A of the WSDOE
Manual: Flow Control Exempt Receiving Waters, subject to all of the fol-lowing restrictions.

TDA Threshold

When assessing a TDA against the following thresholds, only consider the types of surfaces (e.g. new hard surfaces, replaced hard surfaces, converted vegetation areas) that are subject to Minimum Requirement #7, per the Project Thresholds in I-3.3 Applicability of the Minimum Requirements.

The following circumstances require achievement of the standard flow control requirement for western Washington:

Projects in which the total of effective impervious surfaces is10,000 square feet or more in a threshold discharge area, or

This project **does** create more than 10,000 square feet of effective impervious surface in its threshold discharge area.

Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drain-age system. Impervious surfaces are considered ineffective if:

1. The runoff is dispersed through at least one hundred feet of native vegetation in accordance with BMP T5.30: Full Dispersion;

2. Residential roof runoff is infiltrated in accordance with BMP T5.10A: Downspout Full Infiltration; or

3. Approved continuous runoff modeling methods indicate that the entire runoff file is infiltrated

Basin ID / TDA	BMP Used	Effective Impervious Surface Area
D1/TDA1	Detention Pond	21,344 sf

Standard Flow Control Requirement
The project **will** provide flow control as outlined in Section 5.1 of this report.

MR #8 – Wetlands Protection:

Projects shall employ Stormwater Management BMPs in accordance with the following thresholds, standards, and requirements to reduce the impacts of stormwater runoff to wetlands.

There are no wetlands within the proposed project limits.

MR #9 – Operation & Maintenance:

An operation and maintenance manual that is consistent with the provisions in Volume V shall be provided for proposed Runoff Treatment and Flow Control BMPs. The party (or parties) responsible for maintenance and operation shall be identified in the operation and maintenance manual. At private facilities, a copy of the operation and maintenance manual shall be retained.

A Stormwater Maintenance Agreement and Operation and Maintenance Manual is included in Appendix 4 of this TIR.

Section 2.2 - Additional Protective Measures (APM)

Facility agreements and financial guarantees when required will be reviewed by the applicant and executed at the appropriate time determined by the reviewing agency.

APM1 - Financial Liability

Performance Bonding for this project's stormwater facility improvements (**is or is not)** required by the jurisdiction.

APM2 – Offsite Analysis and Mitigation

The initial qualitative analysis shall extend along the flow path from the project site to the receiving water, for a distance up to one mile. If the receiving water is within one-quarter mile from the project site, the analysis shall extend within the receiving water to one-quarter mile from the project site. The analysis shall extend one-quarter mile beyond any improvements proposed as mitigation. The analysis must extend upstream form the project site to a point where there are no backwater effects created by the project, and the designer can determine all areas contributing run-on to the project. Impacts to be evaluated should include:

1. Conveyance System Capacity Problems

2. Localized Flooding

3. Erosion, including landslide hazards and erosion along streambanks and at the outfall location

4. Violations of surface water quality standards as identified in the Basin Plan or a TMDL, or violations of ground water quality standards in a wellhead protection area.

The objective of the off-site analysis report is to identify, evaluate, and determine measures to prevent off-site water quality, erosion, slope stability, and drainage impacts that may be caused or aggravated by the proposed project. "Aggravated" shall mean increasing the frequency of occurrence and /or severity of a problem.

<u>Qualitative Analysis</u>

TDA 1 - Basin D1 – Developed Basin

RBE xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

TDA 1 - Basin D2 – Developed Basin

RBE xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Quantitative Analysis

TDA 1 - Basin D1 – Developed Basin

RBE xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

TDA 1 - Basin D2 – Developed Basin

RBE xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Mitigation Measures

The offsite analysis for this project **(did or did not)** yield any mitigation for this project.

Section 2.3 – Adjustments and Exceptions/Variances to the MRs

Adjustments to the Minimum Requirements may be granted prior to permit approval and construction. The jurisdiction may grant an adjustment provided that written findings of fact are prepared that address the following:

1. The adjustment provides substantially equivalent environmental protection and

2. Based on sound Engineering practices, the objectives of safety, function, environmental protection, and facility maintenance are met.

Adjustments:

No adjustments have been requested for this project.

Exceptions and Variances:

No exceptions or variances have been requested for this project.

SECTION 3 – SOURCE CONTROL BMPS

The following permanent source control BMPs that apply to all sites:

IV – 1 Source Control BMPs Applicable to All Sites:

S410 BMPs for Correcting Illicit Discharges to Storm Drains.
S453 BMPs for Formation of a Pollution Prevention Team.
S545 BMPs for Preventive Maintenance / Good Housekeeping.
S455 BMPs for Spill Prevention and Cleanup.
S457 BMPs for Inspections.
S458 BMPs for Record Keeping – Vol. IV – Page 503.

The following permanent source control BMPs will be utilized for this project and will be included in the final Operation and Maintenance Manual submitted prior to final project acceptance by the Review Agency.

IV-2 – Cleaning or Washing Source Control BMPs

S410 BMPs for Correcting Illicit Discharges to Storm Drains.

IV-3 – Roads, Ditches, and Parking Lot Source Control BMP's

S410 BMPs for Correcting Illicit Discharges to Storm Drains.
S416 BMPs for Maintenance of Roadside Ditches.
S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems.
S421 BMPs for Parking and Storage of Vehicles and Equipment.
S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems.

IV-4 – Soil Erosion, Sediment Control and Landscaping

S407 BMPs for Dust Control at Disturbed Land Areas and Un-paved Roads.
S408 BMPs for Dust Control at Manufacturing Areas.
S411 BMPs for Landscaping and Lawn/Vegetation Management.
S425 BMPs for Soil Erosion and Sediment Control at Industrial Sites.
S435 BMPs for Pesticides and an Integrated Pest Management Plan.
S450 BMPs for Irrigation

IV-5 – Storage and Stockpiling Source Control

S427 BMPs for Storage of Liquid, Food Waste, or Dangerous Waste Containers.
S428 BMPs for Storage of Liquid in Permanent Aboveground Tanks.
S429 BMPs for Storage or Transfer (Outside) of Solid Raw Materials or Finish Products.

IV-6 – Storage and Stockpiling Source Control

S409 BMPs for Fueling at Dedicated Stations.
S412 BMPs for Loading and Unloading Areas for Liquid or Solid Material.

S419 BMPs for Mobile Fueling of Vehicles and Heavy Equipment.
S426 BMPs for Spills of Oil and Hazardous Substances.

IV-7 – Other Source Control BMPs

S402 BMPs for Commercial Animal Handling
S403 BMPs for Commercial Composting.
S404 BMPs for Commercial Printing Operations.
S413 BMPs for Log Sorting and Handling.
S414 BMPs for Maintenance and Repair of Vehicles and Equipment.
S418 BMPs for Manufacturing Activities Outside.
S423 BMPs for Recyclers and Scrap Yards.
S424 BMPs for Roof / Building Drains at Manufacturing and Commercial Buildings.
S438 BMPs for Construction Demolition.
S442 BMPs for Labeling Storm Drain Inlets On Your Property.
S443 BMPs for Fertilizer Application.

SECTION 4 – SITE SUITABILITY CRITERIA (SSC)

This section outlines the criteria used to help select the stormwater type of flow control and treatment facility for this project. Based on our review of the criteria below we have selected the following type of facilities for this project.

Basin ID / TDA	Flow Control	Water Quality
D1/TDA1	Detention	Filtration

Infiltration SSC Review if Applicable

SSC – 1 Setback Criteria

Setback requirements for this project for the following stormwater facilities that include retention, treatment and detention facilities are:

Facility Id	Foundation	Property Line	Water Well	Septic Drain Field	Right of Way / Easement
Detention Pond	20 ft	20 ft	100 ft	100 ft	20 ft
Infiltration Pond	20’ Down /100’ Up Slope	20 ft	100 ft	100 ft	20 ft
Bio-filtration Cell	20’ Down /100’ Up Slope	10 ft	100 ft	100 ft	20 ft
Rain Garden	20’ Down /100’ Up Slope	10 ft	100 ft	100 ft	10 ft
Wetpond	20 ft	20 ft	100 ft	100 ft	10 ft

Infiltration will not be used for stormwater control, therefor further investigation was not required.

SECTION 5 – PERMANENT STORMWATER CONTROL PLAN

Existing Site Hydrology

Existing site hydrology is based on our site investigation, field topographic survey, aerial topographic mapping and completed soils review for the subject project. The site consists of the basins outlined below.

Pre-developed Basin (P#)

The existing site consists of a single-family residence with multiple structures onsite. All onsite structures will be removed prior to construction. The pre-developed condition will be modeled as Forested per WSDOE standards.

Current Land Use: Residential
Modeled Land Use: Forested

TDA No. 1 Basin ID	Land Use Assumptions and Site Parameters				
	Land Use Cover	Slope	Acres	Hydrologic Group	Comments
P1	Forested	Flat	0.92	SAT	Hydric Soils

Developed Site Hydrology (D#)

The proposed project will consist of a 4,000 sf orthodontics building with associated parking area.

Basin Summary

Proposed and Modeled Land Use: As follows

TDA No. 1 Basin ID	Land Use Assumptions and Site Parameters				
	Land Use Cover	Slope	Acres	Hydrologic Group	Comments
D1	Lawn	Flat	0.43		
	Roof	Flat	0.09		
	Parking	Flat	0.37		
Total Area			0.92		

Basin Maps

The following figures are included in Appendix 1 of this report:

Basin Map

SECTION 5.1 – FLOW CONTROL

Flow Control System Design & Analysis

The proposed stormwater facility was designed using the latest version of the WWHM stormwater model created for WSDOE. A copy of the WWHM Data Output Report is included in Appendix 2 of this TIR.

Flow Control for TDA No. 1

Basin D1 - Detention Pond (DP) DP No. 1

The auto-pond function in WWHM was used to size the detention pond facility. That model passed resulted in the following pond parameters:

Bottom Pond Area (sf)	Pond Storage Depth (ft)	Free Board Provided (ft)	Side Slopes	Control Structure Type
992.25	4	1 ft	3:1	Wier/Orifice

The following detention pond facility designed meets or exceeds the modeled pond parameters:

Bottom Pond Area Provided (sf)	Pond Storage Depth (ft)	Free Board Provided (ft)	Side Slopes	Control Structure Type
747	4	1 ft	3:1	Wier/Orifice

Detention Pond Stage Storage Summary

Pond Stage Storage	Elevation (ft)	Detention Volume (ac-ft)
Emergency Overflow	209	
Design Water Surface	208	8,274 CF / 0.19 ac-ft
Bottom Live Storage	204	0 ac-ft
WWHM Required Storage		0.18 ac-ft

The new pond will be constructed with an impervious clay or synthetic membrane liner to prevent infiltration in the pond.

SECTION 5.2 – WATER QUALITY DESIGN

Water Quality System Design & Analysis

The drainage basins delineated for this project will have openly exposed pollution generating impervious surfaces. These tributary areas will be treated using the following treatment technologies listed under the associated drainage basins.

TDA No. 1

Basin DX - BMP T9.10 – Basic Bio-filtration Swale

RBE has selected this treatment method for water quality control for the new PGIS associated with the project. Below is a copy of the Water Quality Analysis from WWHM and Summary of the Swale Design.

Insert Snip of WWHM WQ Analysis here.

Swale Length (ft)	Swale Bottom Width (ft)	Swale Longitudinal Slope (%)	Swale Side Slope	Design Flow Depth (in)	WWHM Design Flow (cfs)	Design Flow Velocity (ft/s)
100	2	1.5	3:1	2	0.023	0.01

Stability Check

The bio-filtration swale has been designed as an online swale. Therefore, the swale has the following full flow capacity that exceeds the mitigated basins 100 yr flow rate calculated by WWHM.

$$Q = \frac{1.49}{\eta} * A * R^{2/3} * S^{1/2}$$

Q =	0.29	*Discharge (cfs)*
η =	0.240	*Mannings Number (Roughness Coefficient)*
A =	0.99	*Area (ft^2)*
w =	2 (ft)	
y =	0.33 (ft)	
Z =	3 :1	
P =	4.09	*Wetted Permieter (ft)*
R =	0.24	*Hydraulic Radius (ft)*
S =	0.0150	*Slope (ft/ft)*

Flow Frequency

Flow(cfs)	Pre	Post	Mitigated
2 Year =	0.0421	0.1767	0.0230
5 Year =	0.0884	0.2268	0.0370
10 Year =	0.1192	0.2590	0.0492
25 Year =	0.1541	0.2992	0.0686
50 Year =	0.1766	0.3287	0.0864
100 Year =	0.1960	0.3581	0.1076

SECTION 5.3 – CONVEYANCE SYSTEM DESIGN

Pipe Conveyance Design

All onsite storm conveyance systems will be sized to accommodate the 25-year storm flows. All proposed onsite storm drain pipe will be 8 inches in diameter and the minimum slope shall not be less than 0.5%. The minimum required pipe size at 0.5% slope to convey the 100-year event for the onsite developed area is 8-inch pipe per Field's Hydraulic Calculator.

WWHM Un-Mitigated Flow Rates for Basin D1

Listed below are the flow frequency date generated by WWHM for the developed basin D1.

```
Flow Frequency
Flow(cfs)       Pre        Post       Mitigated
2 Year   =    0.0421     0.1767     0.0230
5 Year   =    0.0884     0.2268     0.0370
10 Year  =    0.1192     0.2590     0.0492
25 Year  =    0.1541     0.2992     0.0686
50 Year  =    0.1766     0.3287     0.0864
100 Year =    0.1960     0.3581     0.1076
```

Overflow Spillway Design

The flow control facility has been outfitted with an emergency overflow spillway per the construction and sizing requirements of *Section 3.2.1, Volume III of the WSDOE Stormwater Management Manual for Western Washington, 2012.* The spillway will be set at one half foot above the design water surface elevation providing one foot of freeboard in the pond. WWHM modeling's 100-year peak (unmitigated) flow rate were calculated for use in sizing the spillway. See the civil construction plans for design full details.

Structure ID	25 Year Unmitigated Flow (cfs)	100 Year Unmitigated Flow (cfs)	Overflow Spillway Width (ft)
DP-1	0.2992	0.3581	5

Sediment Pond Sizing

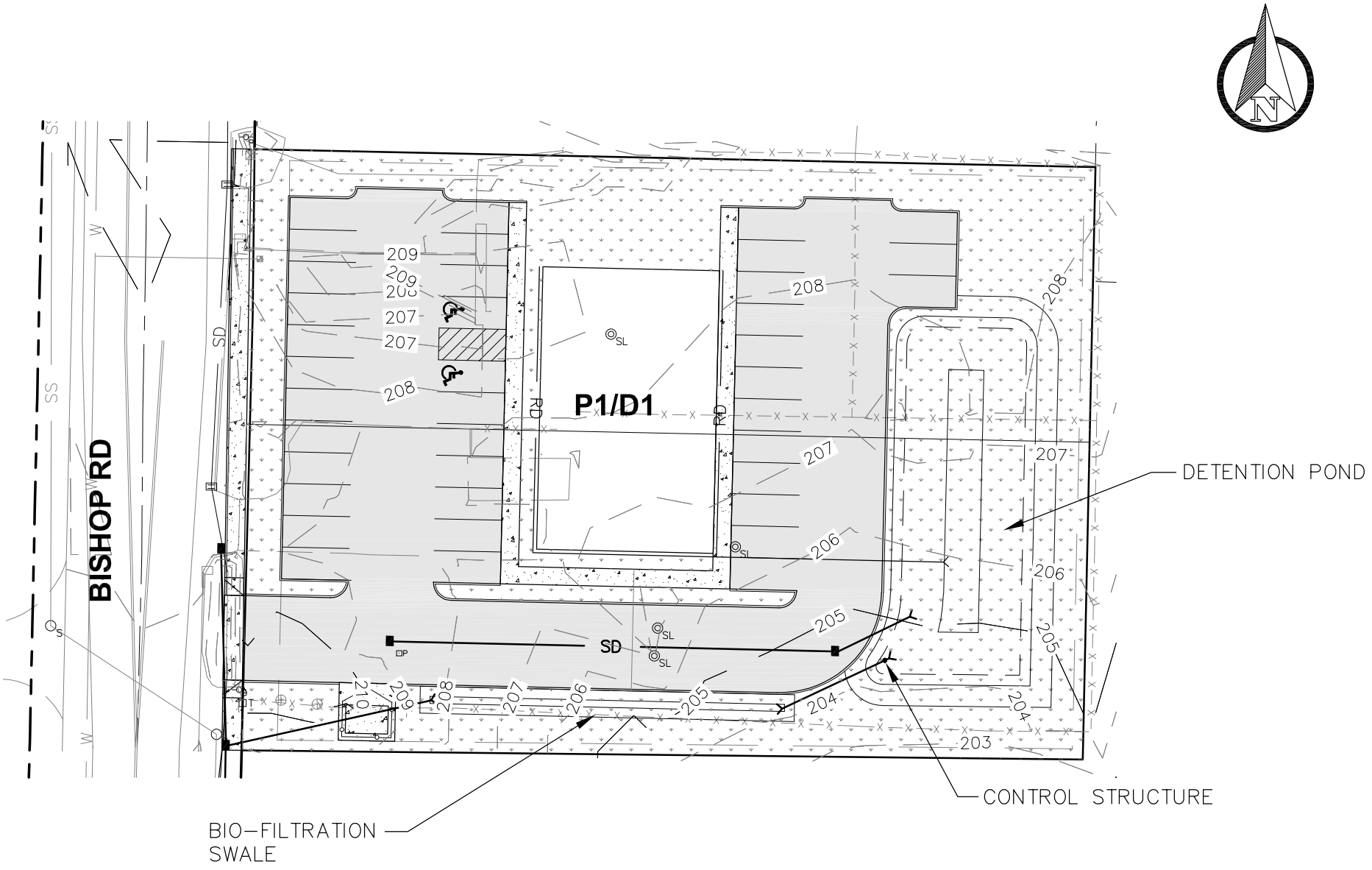
Listed below is the minimum sediment pond size per the WSDOE stormwater manual.

Structure ID	2 Year Unmitigated Flow (cfs)	Required Sediment Pond Surface Area (sf)
Sediment Pond D1	0.0421	248

APPENDIX 1 – MAP SUBMITTALS

TDA No. 1

Basin Map



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CHEHALIS, WA 98532
OFF: (360) 740-8919
FAX: (360) 740-8912

WAGNER ORTHODONTICS

BASIN MAP

JOB NUMBER 21140

DRAWING NAME 21140_BM

FIGURE BM

APPENDIX 2 – DRAINAGE DESIGN CALCULATIONS AND MODELING

TDA No. 1

Basin D1 WWHM Flow Control and Water Quality Modeling

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	21140_wwhm_prelim_pond
Site Name:	Wagner Orthodontics
Site Address:	Bishop Rd
City:	Chehalis
Report Date:	6/24/2022
Gage:	Olympia
Data Start:	1955/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	0.800
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Flat	0.92
Pervious Total	0.92
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.92

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SAT, Lawn, Flat	0.43
Pervious Total	0.43

Impervious Land Use	acre
ROOF TOPS FLAT	0.09
SIDEWALKS FLAT	0.03
PARKING FLAT	0.37
Impervious Total	0.49
Basin Total	0.92

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length: 31.50 ft.
Bottom Width: 31.50 ft.
Depth: 5 ft.
Volume at riser head: 0.1821 acre-feet.
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 4 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.023 ft.
Notch Height: 1.368 ft.
Orifice 1 Diameter: 0.68 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

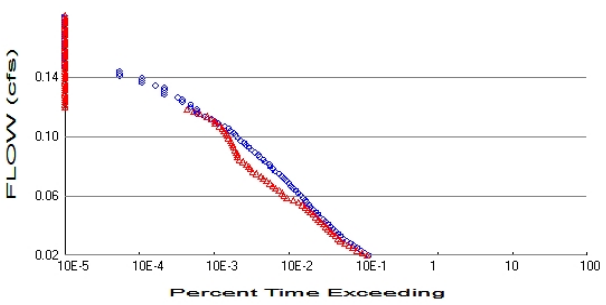
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.022	0.000	0.000	0.000
0.0556	0.023	0.001	0.003	0.000
0.1111	0.023	0.002	0.004	0.000
0.1667	0.024	0.003	0.005	0.000
0.2222	0.024	0.005	0.005	0.000
0.2778	0.025	0.006	0.006	0.000
0.3333	0.025	0.008	0.007	0.000
0.3889	0.026	0.009	0.007	0.000
0.4444	0.026	0.011	0.008	0.000
0.5000	0.027	0.012	0.008	0.000
0.5556	0.027	0.014	0.009	0.000
0.6111	0.028	0.015	0.009	0.000
0.6667	0.028	0.017	0.010	0.000
0.7222	0.029	0.018	0.010	0.000
0.7778	0.030	0.020	0.011	0.000
0.8333	0.030	0.022	0.011	0.000
0.8889	0.031	0.023	0.011	0.000
0.9444	0.031	0.025	0.012	0.000
1.0000	0.032	0.027	0.012	0.000
1.0556	0.032	0.029	0.012	0.000
1.1111	0.033	0.031	0.013	0.000
1.1667	0.034	0.032	0.013	0.000
1.2222	0.034	0.034	0.013	0.000
1.2778	0.035	0.036	0.014	0.000
1.3333	0.035	0.038	0.014	0.000
1.3889	0.036	0.040	0.014	0.000
1.4444	0.037	0.042	0.015	0.000
1.5000	0.037	0.044	0.015	0.000
1.5556	0.038	0.047	0.015	0.000
1.6111	0.038	0.049	0.015	0.000
1.6667	0.039	0.051	0.016	0.000
1.7222	0.040	0.053	0.016	0.000

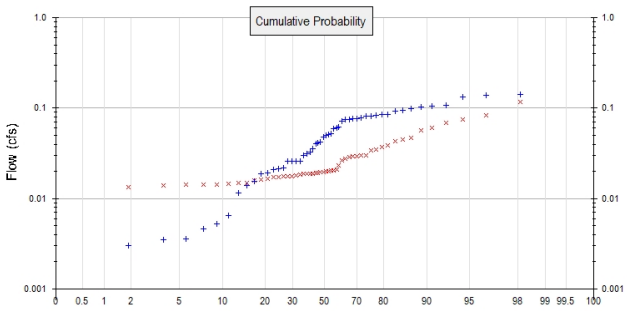
1.7778	0.040	0.055	0.016	0.000
1.8333	0.041	0.058	0.017	0.000
1.8889	0.042	0.060	0.017	0.000
1.9444	0.042	0.062	0.017	0.000
2.0000	0.043	0.065	0.017	0.000
2.0556	0.044	0.067	0.018	0.000
2.1111	0.044	0.070	0.018	0.000
2.1667	0.045	0.072	0.018	0.000
2.2222	0.046	0.075	0.018	0.000
2.2778	0.046	0.077	0.018	0.000
2.3333	0.047	0.080	0.019	0.000
2.3889	0.048	0.082	0.019	0.000
2.4444	0.048	0.085	0.019	0.000
2.5000	0.049	0.088	0.019	0.000
2.5556	0.050	0.091	0.020	0.000
2.6111	0.051	0.094	0.020	0.000
2.6667	0.051	0.096	0.021	0.000
2.7222	0.052	0.099	0.022	0.000
2.7778	0.053	0.102	0.025	0.000
2.8333	0.054	0.105	0.027	0.000
2.8889	0.054	0.108	0.030	0.000
2.9444	0.055	0.111	0.034	0.000
3.0000	0.056	0.114	0.037	0.000
3.0556	0.057	0.118	0.041	0.000
3.1111	0.057	0.121	0.044	0.000
3.1667	0.058	0.124	0.048	0.000
3.2222	0.059	0.127	0.052	0.000
3.2778	0.060	0.131	0.057	0.000
3.3333	0.060	0.134	0.061	0.000
3.3889	0.061	0.137	0.065	0.000
3.4444	0.062	0.141	0.069	0.000
3.5000	0.063	0.144	0.074	0.000
3.5556	0.064	0.148	0.078	0.000
3.6111	0.064	0.151	0.083	0.000
3.6667	0.065	0.155	0.088	0.000
3.7222	0.066	0.159	0.093	0.000
3.7778	0.067	0.162	0.099	0.000
3.8333	0.068	0.166	0.104	0.000
3.8889	0.069	0.170	0.110	0.000
3.9444	0.069	0.174	0.116	0.000
4.0000	0.070	0.178	0.122	0.000
4.0556	0.071	0.182	0.330	0.000
4.1111	0.072	0.186	0.710	0.000
4.1667	0.073	0.190	1.197	0.000
4.2222	0.074	0.194	1.760	0.000
4.2778	0.075	0.198	2.372	0.000
4.3333	0.075	0.202	3.006	0.000
4.3889	0.076	0.206	3.633	0.000
4.4444	0.077	0.211	4.227	0.000
4.5000	0.078	0.215	4.763	0.000
4.5556	0.079	0.219	5.221	0.000
4.6111	0.080	0.224	5.592	0.000
4.6667	0.081	0.228	5.878	0.000
4.7222	0.082	0.233	6.099	0.000
4.7778	0.083	0.237	6.374	0.000
4.8333	0.084	0.242	6.594	0.000
4.8889	0.084	0.247	6.806	0.000
4.9444	0.085	0.252	7.012	0.000

5.0000	0.086	0.256	7.212	0.000
5.0556	0.087	0.261	7.406	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.92
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.43
Total Impervious Area: 0.49

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.042091
5 year	0.088445
10 year	0.119156
25 year	0.154111
50 year	0.17658
100 year	0.195974

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.02296
5 year	0.036957
10 year	0.049159
25 year	0.068583
50 year	0.086429
100 year	0.107598

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.059	0.023
1957	0.072	0.039
1958	0.036	0.014
1959	0.021	0.019
1960	0.074	0.047
1961	0.061	0.020
1962	0.003	0.015
1963	0.078	0.030
1964	0.099	0.020
1965	0.105	0.017

1966	0.021	0.014
1967	0.051	0.020
1968	0.026	0.018
1969	0.019	0.015
1970	0.030	0.019
1971	0.042	0.035
1972	0.133	0.060
1973	0.026	0.019
1974	0.050	0.018
1975	0.031	0.016
1976	0.048	0.030
1977	0.007	0.014
1978	0.026	0.019
1979	0.081	0.018
1980	0.026	0.019
1981	0.081	0.020
1982	0.075	0.027
1983	0.016	0.020
1984	0.102	0.020
1985	0.012	0.016
1986	0.062	0.057
1987	0.138	0.043
1988	0.005	0.018
1989	0.003	0.017
1990	0.033	0.027
1991	0.095	0.083
1992	0.014	0.016
1993	0.005	0.014
1994	0.002	0.013
1995	0.040	0.029
1996	0.107	0.075
1997	0.076	0.021
1998	0.094	0.019
1999	0.076	0.037
2000	0.019	0.029
2001	0.004	0.013
2002	0.085	0.045
2003	0.022	0.015
2004	0.052	0.030
2005	0.043	0.019
2006	0.084	0.034
2007	0.085	0.069
2008	0.143	0.118

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1434	0.1178
2	0.1377	0.0826
3	0.1329	0.0753
4	0.1066	0.0688
5	0.1048	0.0601
6	0.1025	0.0570
7	0.0986	0.0468
8	0.0950	0.0453
9	0.0936	0.0431
10	0.0850	0.0391
11	0.0847	0.0373

12	0.0841	0.0349
13	0.0814	0.0345
14	0.0811	0.0302
15	0.0780	0.0298
16	0.0763	0.0296
17	0.0759	0.0293
18	0.0748	0.0286
19	0.0743	0.0273
20	0.0719	0.0265
21	0.0622	0.0231
22	0.0608	0.0209
23	0.0592	0.0202
24	0.0521	0.0202
25	0.0513	0.0202
26	0.0497	0.0201
27	0.0476	0.0197
28	0.0425	0.0196
29	0.0416	0.0192
30	0.0402	0.0191
31	0.0358	0.0188
32	0.0326	0.0188
33	0.0314	0.0187
34	0.0302	0.0186
35	0.0259	0.0186
36	0.0258	0.0179
37	0.0257	0.0178
38	0.0257	0.0177
39	0.0216	0.0176
40	0.0213	0.0174
41	0.0211	0.0172
42	0.0191	0.0165
43	0.0189	0.0161
44	0.0155	0.0157
45	0.0138	0.0150
46	0.0116	0.0150
47	0.0065	0.0146
48	0.0052	0.0144
49	0.0046	0.0142
50	0.0036	0.0141
51	0.0035	0.0140
52	0.0030	0.0134
53	0.0022	0.0133

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0210	2184	2093	95	Pass
0.0226	1938	1786	92	Pass
0.0242	1736	1538	88	Pass
0.0258	1548	1348	87	Pass
0.0273	1380	1180	85	Pass
0.0289	1257	1041	82	Pass
0.0305	1114	925	83	Pass
0.0320	1014	855	84	Pass
0.0336	919	784	85	Pass
0.0352	856	714	83	Pass
0.0368	788	668	84	Pass
0.0383	739	623	84	Pass
0.0399	676	580	85	Pass
0.0415	630	542	86	Pass
0.0430	580	496	85	Pass
0.0446	534	461	86	Pass
0.0462	491	427	86	Pass
0.0478	460	395	85	Pass
0.0493	431	361	83	Pass
0.0509	397	333	83	Pass
0.0525	371	310	83	Pass
0.0540	349	284	81	Pass
0.0556	324	251	77	Pass
0.0572	309	213	68	Pass
0.0588	287	175	60	Pass
0.0603	273	160	58	Pass
0.0619	247	151	61	Pass
0.0635	232	137	59	Pass
0.0650	212	123	58	Pass
0.0666	200	113	56	Pass
0.0682	188	104	55	Pass
0.0697	174	93	53	Pass
0.0713	161	84	52	Pass
0.0729	151	78	51	Pass
0.0745	138	68	49	Pass
0.0760	123	61	49	Pass
0.0776	115	57	49	Pass
0.0792	105	54	51	Pass
0.0807	103	50	48	Pass
0.0823	90	45	50	Pass
0.0839	85	40	47	Pass
0.0855	76	38	50	Pass
0.0870	72	38	52	Pass
0.0886	66	37	56	Pass
0.0902	59	35	59	Pass
0.0917	54	34	62	Pass
0.0933	50	33	66	Pass
0.0949	47	32	68	Pass
0.0965	42	31	73	Pass
0.0980	39	29	74	Pass
0.0996	36	28	77	Pass
0.1012	34	27	79	Pass
0.1027	31	25	80	Pass

0.1043	29	24	82	Pass
0.1059	26	22	84	Pass
0.1075	21	19	90	Pass
0.1090	19	19	100	Pass
0.1106	17	17	100	Pass
0.1122	14	15	107	Pass
0.1137	11	12	109	Pass
0.1153	11	10	90	Pass
0.1169	11	8	72	Pass
0.1185	9	0	0	Pass
0.1200	9	0	0	Pass
0.1216	7	0	0	Pass
0.1232	7	0	0	Pass
0.1247	6	0	0	Pass
0.1263	4	0	0	Pass
0.1279	4	0	0	Pass
0.1294	4	0	0	Pass
0.1310	4	0	0	Pass
0.1326	3	0	0	Pass
0.1342	2	0	0	Pass
0.1357	2	0	0	Pass
0.1373	2	0	0	Pass
0.1389	1	0	0	Pass
0.1404	1	0	0	Pass
0.1420	1	0	0	Pass
0.1436	0	0	0	Pass
0.1452	0	0	0	Pass
0.1467	0	0	0	Pass
0.1483	0	0	0	Pass
0.1499	0	0	0	Pass
0.1514	0	0	0	Pass
0.1530	0	0	0	Pass
0.1546	0	0	0	Pass
0.1562	0	0	0	Pass
0.1577	0	0	0	Pass
0.1593	0	0	0	Pass
0.1609	0	0	0	Pass
0.1624	0	0	0	Pass
0.1640	0	0	0	Pass
0.1656	0	0	0	Pass
0.1672	0	0	0	Pass
0.1687	0	0	0	Pass
0.1703	0	0	0	Pass
0.1719	0	0	0	Pass
0.1734	0	0	0	Pass
0.1750	0	0	0	Pass
0.1766	0	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.071 acre-feet
On-line facility target flow:	0.0776 cfs.
Adjusted for 15 min:	0.0776 cfs.
Off-line facility target flow:	0.0438 cfs.
Adjusted for 15 min:	0.0438 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Trapezoidal Pond 1 POC	☐	72.46			☐	0.00			
Total Volume Infiltrated		72.46	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

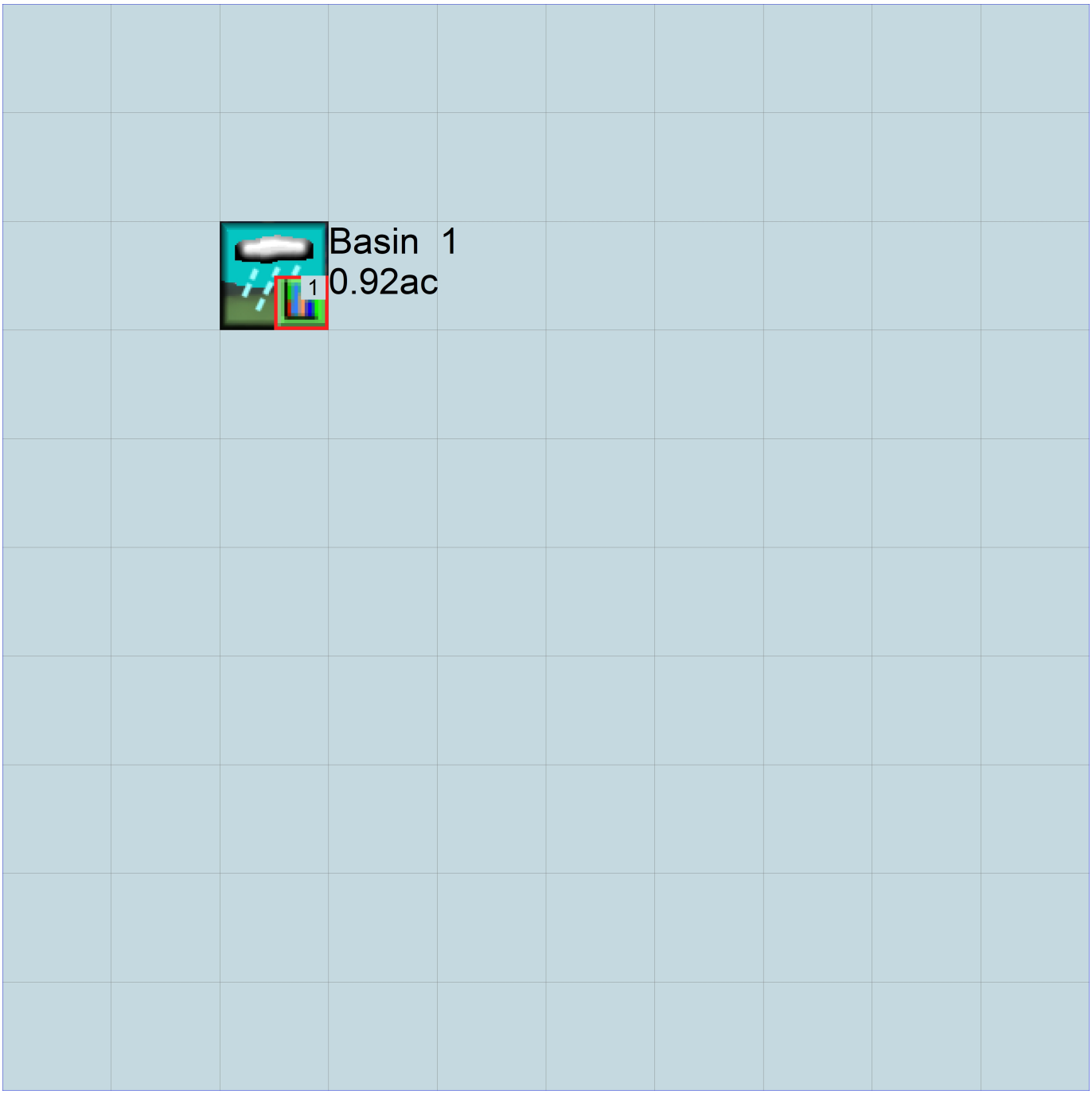
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   21140_wwhm_prelim_pond.wdm
MESSU       25   Pre21140_wwhm_prelim_pond.MES
            27   Pre21140_wwhm_prelim_pond.L61
            28   Pre21140_wwhm_prelim_pond.L62
            30   POC21140_wwhm_prelim_pond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      19
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
   19     SAT, Forest, Flat       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   19         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   19         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   19         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   19              0         4         2       100     0.001       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   19             0         0        10         2         0         0       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   19           0.2         3       0.5         1       0.7       0.8
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   19             0         0         0         0       4.2         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  19                       0.92     COPY   501     12
PERLND  19                       0.92     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><---><---><---><---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   21140_wwhm_prelim_pond.wdm
MESSU       25   Mit21140_wwhm_prelim_pond.MES
            27   Mit21140_wwhm_prelim_pond.L61
            28   Mit21140_wwhm_prelim_pond.L62
            30   POC21140_wwhm_prelim_pond1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND      25
      IMPLND       4
      IMPLND       8
      IMPLND      11
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   25     SAT, Lawn, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   25         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
```

```
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   25         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   25         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   25              0         4         1       100     0.001       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   25              0         0        10         2         0         0      0.35
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   25           0.1         3       0.5         1       0.7       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   25              0         0         0         0       4.2         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
   11      PARKING/FLAT           1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
```

```
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >       IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >       IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    8              0         0
   11              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    8              0         0
   11              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  25                       0.43     RCHRES   1      2
PERLND  25                       0.43     RCHRES   1      3
IMPLND   4                       0.09     RCHRES   1      5
IMPLND   8                       0.03     RCHRES   1      5
IMPLND  11                       0.37     RCHRES   1      5

******Routing******
PERLND  25                       0.43     COPY     1     12
IMPLND   4                       0.09     COPY     1     15
IMPLND   8                       0.03     COPY     1     15
IMPLND  11                       0.37     COPY     1     15
PERLND  25                       0.43     COPY     1     13
RCHRES   1                          1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<----------------><---> User T-series  Engl Metr LKFG             ***
                                        in  out                             ***
    1     Trapezoidal Pond-010    1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
```

```
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1               1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.022776  0.000000  0.000000
  0.055556  0.023260  0.001279  0.002958
  0.111111  0.023750  0.002585  0.004183
  0.166667  0.024245  0.003918  0.005123
  0.222222  0.024745  0.005279  0.005915
  0.277778  0.025250  0.006667  0.006613
  0.333333  0.025760  0.008084  0.007245
  0.388889  0.026275  0.009530  0.007825
  0.444444  0.026795  0.011004  0.008365
  0.500000  0.027321  0.012507  0.008873
  0.555556  0.027851  0.014040  0.009353
  0.611111  0.028387  0.015602  0.009809
  0.666667  0.028928  0.017194  0.010245
  0.722222  0.029473  0.018816  0.010664
  0.777778  0.030024  0.020469  0.011066
  0.833333  0.030580  0.022152  0.011455
  0.888889  0.031142  0.023867  0.011830
  0.944444  0.031708  0.025613  0.012195
  1.000000  0.032279  0.027390  0.012548
  1.055556  0.032856  0.029199  0.012892
  1.111111  0.033437  0.031041  0.013227
  1.166667  0.034024  0.032915  0.013553
  1.222222  0.034615  0.034821  0.013872
  1.277778  0.035212  0.036761  0.014184
  1.333333  0.035814  0.038734  0.014489
  1.388889  0.036421  0.040741  0.014788
  1.444444  0.037033  0.042781  0.015081
  1.500000  0.037651  0.044856  0.015368
  1.555556  0.038273  0.046965  0.015650
  1.611111  0.038901  0.049108  0.015927
  1.666667  0.039533  0.051287  0.016199
  1.722222  0.040171  0.053501  0.016467
```

```
  1.777778  0.040813  0.055750  0.016731
  1.833333  0.041461  0.058036  0.016990
  1.888889  0.042114  0.060357  0.017246
  1.944444  0.042772  0.062715  0.017497
  2.000000  0.043436  0.065110  0.017746
  2.055556  0.044104  0.067542  0.017990
  2.111111  0.044777  0.070011  0.018232
  2.166667  0.045456  0.072517  0.018470
  2.222222  0.046139  0.075061  0.018706
  2.277778  0.046828  0.077644  0.018938
  2.333333  0.047522  0.080265  0.019167
  2.388889  0.048220  0.082924  0.019394
  2.444444  0.048924  0.085623  0.019619
  2.500000  0.049634  0.088360  0.019840
  2.555556  0.050348  0.091138  0.020059
  2.611111  0.051067  0.093955  0.020276
  2.666667  0.051791  0.096812  0.020983
  2.722222  0.052521  0.099709  0.022733
  2.777778  0.053255  0.102648  0.025030
  2.833333  0.053995  0.105627  0.027723
  2.888889  0.054740  0.108647  0.030729
  2.944444  0.055490  0.111709  0.033992
  3.000000  0.056245  0.114813  0.037471
  3.055556  0.057005  0.117959  0.041130
  3.111111  0.057770  0.121147  0.044945
  3.166667  0.058540  0.124378  0.048890
  3.222222  0.059316  0.127652  0.052945
  3.277778  0.060096  0.130969  0.057093
  3.333333  0.060882  0.134329  0.061317
  3.388889  0.061673  0.137733  0.065602
  3.444444  0.062468  0.141182  0.069935
  3.500000  0.063269  0.144674  0.074303
  3.555556  0.064075  0.148212  0.078694
  3.611111  0.064886  0.151794  0.083098
  3.666667  0.065703  0.155422  0.088062
  3.722222  0.066524  0.159094  0.093469
  3.777778  0.067350  0.162813  0.099009
  3.833333  0.068182  0.166578  0.104679
  3.888889  0.069018  0.170389  0.110476
  3.944444  0.069860  0.174247  0.116398
  4.000000  0.070707  0.178151  0.122441
  4.055556  0.071559  0.182103  0.330886
  4.111111  0.072416  0.186103  0.710592
  4.166667  0.073278  0.190150  1.197228
  4.222222  0.074145  0.194245  1.760074
  4.277778  0.075018  0.198388  2.372134
  4.333333  0.075895  0.202580  3.005985
  4.388889  0.076778  0.206821  3.633553
  4.444444  0.077665  0.211111  4.227431
  4.500000  0.078558  0.215451  4.763055
  4.555556  0.079456  0.219840  5.221481
  4.611111  0.080359  0.224279  5.592632
  4.666667  0.081267  0.228769  5.878946
  4.722222  0.082180  0.233309  6.099373
  4.777778  0.083098  0.237900  6.374626
  4.833333  0.084021  0.242542  6.594144
  4.888889  0.084950  0.247236  6.806464
  4.944444  0.085883  0.251981  7.012250
  5.000000  0.086822  0.256779  7.212071
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
```

```
END EXT SOURCES

EXT TARGETS
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<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1005 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
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<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX 3 – SPECIAL REPORTS AND STUDIES

1. NRCS Soil Survey Data
2. Geotechnical Report –Insight Geologic

INSIGHT GEOLOGIC, INC.

March 21, 2022

RB Engineering
PO Box 923
Chehalis, Washington 98532
Attention: Bob Balmelli, P.E.

Report
Geotechnical Investigation
Proposed Wagner Orthodontics Office
1319 & 1327 Bishop Road
Chehalis, Washington
Project No. 369-028-01

INTRODUCTION

Insight Geologic, Inc. is pleased to provide our proposal to conduct an evaluation of site soil conditions at the location of the proposed Wagner Orthodontics office building to be located at 1319 & 1327 Bishop Road in Chehalis, Washington. The location of the site is shown relative to surrounding physical features in the Vicinity Map, Figure 1. The site consists of two parcels (Lewis County Parcel No. 010480000000 and 010479000000) totaling approximately 1 acre. The parcels are currently developed with residential structures.

We understand that the project will include development of a single-story medical office building with appurtenant parking and driveway areas. Stormwater runoff from the new building and parking area is to be detained and released.

SCOPE OF SERVICES

The purpose of our services is to evaluate subsurface soil conditions as they relate to geotechnical properties. The specific tasks to be performed are outlined below:

1. Provided for the location of subsurface utilities on the site. We performed this task by notifying the "One Call" system.
2. Conducted a site reconnaissance to evaluate and mark proposed test pit locations at the site and for access.
3. Excavated three exploratory test pits site in the locations requested by the project engineer. The test pits will be excavated to a depth of approximately 8 feet bgs.
4. Collected representative soil samples from the test pits for laboratory analysis.
5. Logged the soils exposed in the test pits in general accordance with ASTM D2487-06.

6. Provided for laboratory testing of the soils, as appropriate. We performed gradation analyses and Atterberg testing to evaluate soil type, plasticity and bearing capacity.
7. Prepared a report summarizing our field activities including our recommendations for site preparation and grading, bearing capacity, seismic class, temporary and final cut slopes, earth pressures, pavement design and suitability of the on-site soils for use as fill.

FINDINGS

Surface Conditions

The project site is situated at an approximate elevation of 208 feet above mean sea level and consists of two Lewis County tax parcels (Lewis County Parcel No. 010480000000 and 010479000000), which total approximately 1 acre. The property is bounded by Bishop Road to the west, a residential property to the north, medical buildings to the east and an undeveloped parcel to the south. The properties are currently developed with a single-family residence, mobile home, and commercial daycare, along with associated gravel driveways and detached outbuildings. The remainder of the site is grass and landscaped areas.

Geology

Based on our review of available published geologic maps, Pleistocene-age alpine glacial outwash deposits (river terrace and flood plain deposits) of the Hayden Creek Drift underlie the project site. Quaternary alluvium is mapped to the south of the site. The drift material is described as poorly-sorted sands and gravels with units of silt, and varying fractions of organic material and with the upper portions generally being heavily weathered. Soils in this area are known to have the potential for being soft and having moderate plasticity.

Subsurface Explorations

We explored subsurface conditions at the site on February 18. 2022, by excavating three test pits in the locations as shown on the Site Plan, Figure 2. The test pits were excavated using a track-mounted excavator. A geologist from Insight Geologic monitored the test pits and maintained a log of the conditions encountered. The test pits were completed to a depth of 8 feet bgs. The soils were visually classified in general accordance with the system described in ASTM D2487-06. The explorations logs are contained in Attachment A.

Soil Conditions

Soil conditions at the site were generally consistent across the site. Surficial conditions at test pits TP-1 to TP-3 consisted of a sod horizon approximately 6 inches in depth. Underlying this sod horizon, we encountered approximately 2 feet of brown sandy silt to silt with fine to medium sand and fine gravel (ML) in a stiff and moist condition underlain by 2 feet of light brown to yellow-brown fat clay with fine to medium sand (CH) in a stiff and moist condition. Underlying the fine grained soils we encountered yellow-brown to red-brown silty fine to coarse sand with fine to coarse gravel (SM) in a very dense and moist condition to the base of the test pits with one exception. Test pit TP-2 encountered brown silty gravel with sand at a depth of 6 feet bgs.

Groundwater Conditions

Groundwater was not encountered in any of the explorations completed at the site. In addition, no evidence of seasonal high groundwater was encountered.

Laboratory Testing

We selected four samples from our explorations for grain-size analyses in general accordance with ASTM D422, and two samples were evaluated using plasticity index tests in general accordance with ASTM D4318 to define soil class and engineering properties of the soil. Soil testing indicated that, in general, the soils classified as silt with a liquid limit of 40 percent and plasticity of 14 percent, and as fat clay with liquid limit of 73 percent and plasticity of 45 percent. Our laboratory test results are provided in Attachment B.

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 1. 2018 IBC Seismic Design Parameters

Spectral Response Accel. at Short Periods (SS) = 1.161
Spectral Response Accel. at 1 Second Periods (S1) = 0.479
Site Class = D
Site Coefficient (FA) = 1.036
Site Coefficient (FV) = 1.821

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 loose to medium dense, clean to silty sands and non-plastic silts.

Based on our review of the *Washington State Department of Natural Resources Geologic Information Portal*, the majority of the site including the building location is identified to have a very low potential risk for liquefaction. Based on our experience with detailed seismic studies in the area, including areas that are mapped within the same soil deposits as the project site, it is our opinion that the soil profile at the site has a low risk of liquefaction.

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 soil profile at the site has a low to moderate risk for settlement due to seismic compression.

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 at the site, it is our opinion that there is 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 review, subsurface explorations and engineering analyses, it is our opinion that the proposed development is feasible from a geotechnical standpoint. We recommend that any proposed structures be supported on shallow concrete foundations that are designed using an allowable soil bearing capacity of 1,500 pounds per square foot (psf).

The soils encountered in our explorations are typically in a stiff condition near ground surface. To limit the potential for structure settlement, we recommend that all shallow foundations and slabs-on-grade be established on a minimum 1-foot thick layer of structural fill or adequately compacted native material. We do not recommend the reuse the on-site soils as structural fill under the foundations/slabs. Reuse of the silt soils will require significant moisture conditioning and compaction efforts, and is unlikely to be sufficiently compacted as structural fill.

Earthwork

General

We anticipate that site development earthwork will include removing existing structures and vegetation, stripping sod/topsoil materials, preparing subgrades, excavating for utility trenches, installing ground improvements, and placing and compacting structural fill. The soils at the site contain a high percentage of fines and will be moisture sensitive through most of the year. These materials may be difficult to operate on or compact during wet weather. Operation of heavy equipment at the site under wet conditions or when the soils are above optimum moisture content can be expected to result in considerable disturbance to the exposed subgrade soils. We recommend that earthwork be undertaken during periods of dry weather to reduce grading costs using tracked, low ground pressure equipment. Compaction of native soils should be conducted using a sheeps-foot roller and not a smooth vibratory drum roller.

Our explorations did not encounter appreciable amounts of debris or unsuitable soils associated with past site development other than the existing structures. Still, it is possible that concrete slabs, abandoned utility lines or other development features 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, 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 were required to remove the vegetation encountered in our explorations. Deeper stripping depths may be required if additional unsuitable soils are exposed during stripping operations.

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 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.

In areas of porous pavement, if proposed, the subgrade should be either non-compacted or minimally compacted to maximize infiltration into the subsurface.

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 it 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 56 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 should not take place during periods of heavy precipitation.
- Slopes with exposed soil be 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 silt with a high moisture content. It is our opinion that this material is not a suitable source for structural fill during a significant portion of the year. It will likely be difficult or impossible to compact this material without significant effort to reduce the moisture content. It is our opinion that the silts encountered during excavation and grading should be wasted and hauled offsite, as it is not reusable as structural fill. All soils used as fill shall be select granular fill as described as follows.

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 2018 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 on Table 2. Structural fill materials should be compacted in accordance with the compaction criteria provided in Table 3.

Table 2. Recommended Uncompacted Lift Thickness

Compaction Equipment	Recommended Uncompacted Fill Thickness (inches)	
	Granular Materials Maximum Particle Size ≤ 1 1/2 inch	Granular Materials Maximum Particle Size > 1 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 3. Recommended Compaction Criteria in Structural Fill Zones

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

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

Shallow Foundation Support

General

We recommend that 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. 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 an experienced geotechnical owner-representative 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 1,500 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.

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 total settlement of footings that are designed and constructed as recommended should be less than 1 inch. We estimate that differential settlements 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.

Subsurface Drainage

It is our opinion that foundation footing drains are likely necessary for any proposed structure. The site soils consist of silt and are generally poorly draining. Footing drains should be routed to existing on-site or planned storm drainage.

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 (Kp) may be estimated using an equivalent fluid density of 159 pounds per cubic foot (pcf), assuming that the footings are backfilled with structural fill. Active earth pressure (Ka) for the soil is 55 pcf as equivalent fluid density. Frictional resistance may be estimated using 0.20 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 100 pounds per cubic inch (pci) for 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 a 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.

Conventional Retaining Walls

General

The following sections provide general guidelines for retaining wall design on this site. Since the site is fairly level, we do not anticipate that retaining walls will be necessary. However, 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 ¾-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 34 pcf 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 55 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 will be operated within one-half 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

We recommend a pavement section to consist of the following minimum compacted thicknesses placed on a properly prepared subgrade: 8 inches of gravel base, 2 inches of crushed surfacing top course, (CSTC), and 3 inches of compacted commercial asphalt concrete pavement. These thicknesses assume the subgrade can be properly compacted to 95% of MDD. If this cannot be achieved, Insight Geologic should be consulted for other options.

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 silt. Based on our experience with similar soil types, our analysis is based on a California Bearing Ratio (CBR) value of 5 percent. These values assume the upper foot of subgrade soils can be compacted to a minimum of 95 percent of the modified proctor maximum dry density.

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.
- Subbase Course: We recommend that the subbase conform to Section 9-03.10, Gravel Base, of the 2018 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.

- Base Course: We recommend that the crushed aggregate base course conform to Section 9-03.9(3), Crushed Surfacing Top Course, (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 conform to Section 9-02.1(4) for PG 58-22 or PG 64-22 Performance Graded Asphalt Binder as presented in the 2018 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 or to a firm and unyielding condition in accordance with ASTM D1557. 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 be 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.

Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge and Municipal Construction Manual, 2022.

LIMITATIONS

We have prepared this geotechnical investigation report for the exclusive use of RB Engineering and their authorized agents, for the proposed Wagner Orthodontics office to be located at 1319 & 1327 Bishop Road in Chehalis, Washington.

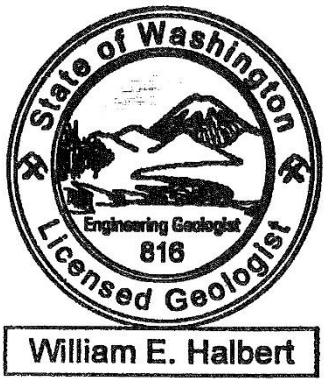
Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

Please refer to Attachment D 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.

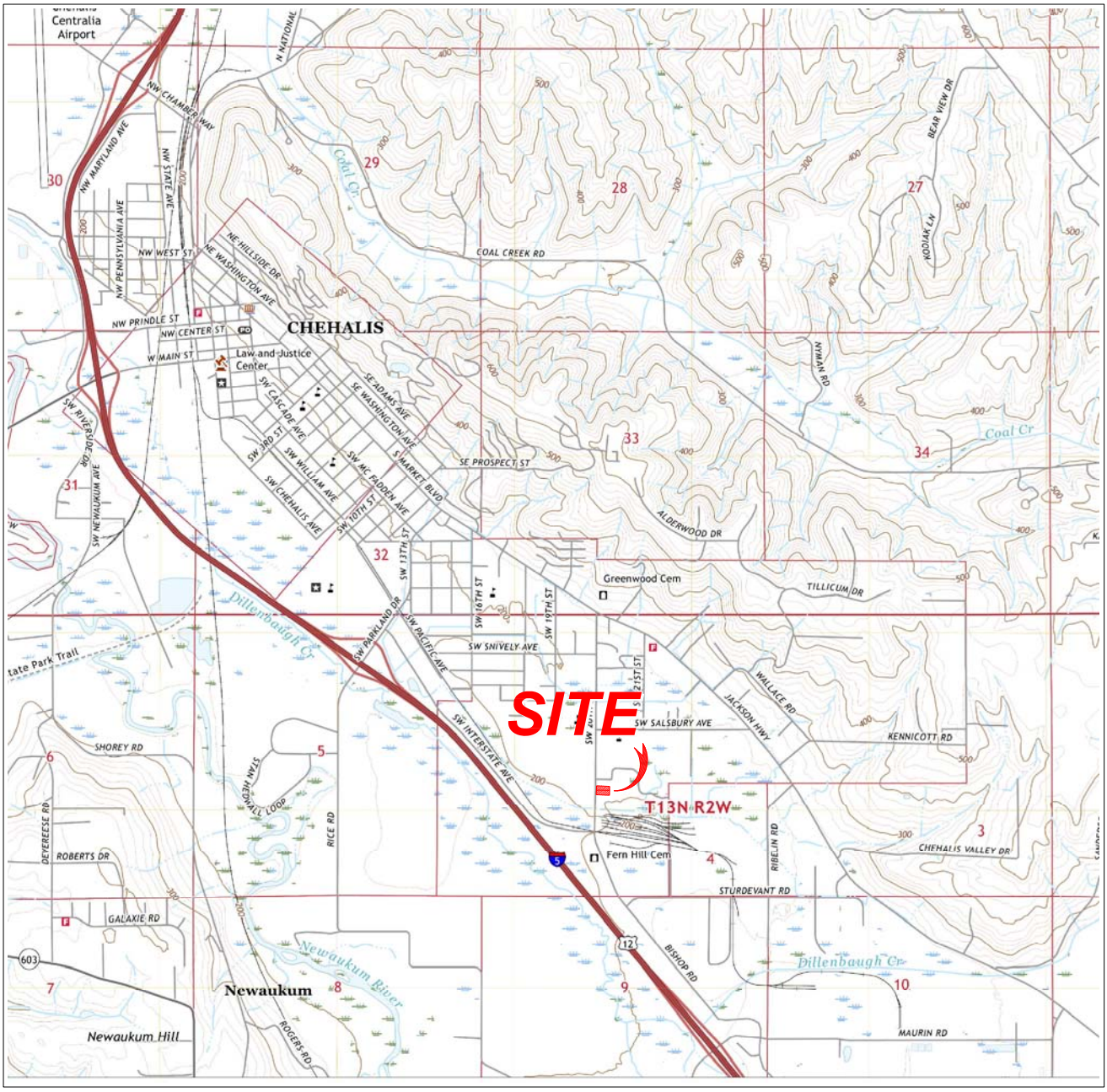
Respectfully Submitted,
INSIGHT GEOLOGIC, INC.

William E. Halbert, L.E.G., L.HG.
Principal



Attachments

FIGURES



Source: USGS (c) 2020

CENTRALIA QUADRANGLE
WASHINGTON - LEWIS COUNTY
7.5-MINUTE SERIES
Year 2020

SCALE: 1" = 3000'

WAGNER ORTHODONTICS

CHEHALIS, WASHINGTON

INSIGHT GEOLOGIC, INC.

Figure 1
Vicinity Map

Source: Google Earth

LEGEND:

TP-1 APPROXIMATE TEST PIT LOCATION

APPROXIMATE PROJECT BOUNDARY

SCALE: 1"= 50'

WAGNER ORTHODONTICS

CHEHALIS, WASHINGTON

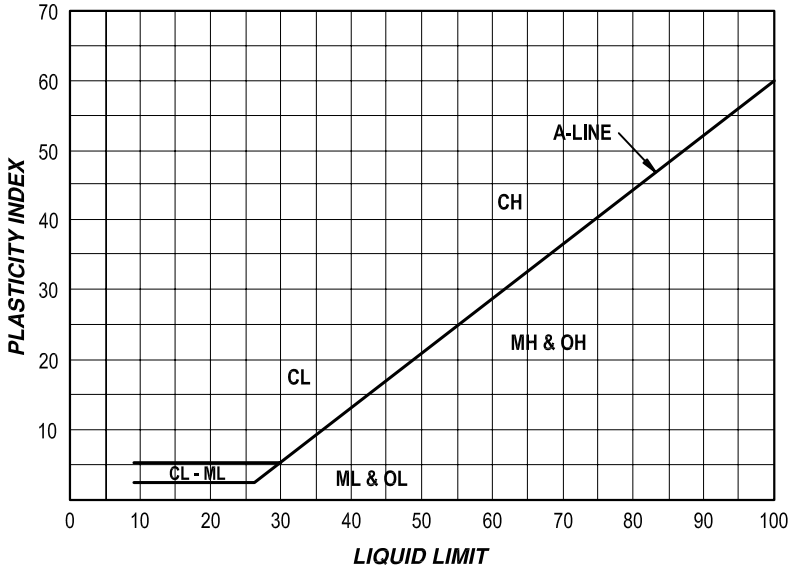
INSIGHT GEOLOGIC, INC.

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			PT	PEAT



SOIL MOISTURE MODIFIERS:
DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST - DAMP, BUT NO VISIBLE WATER
WET - VISIBLE FREE WATER OR SATURATED, USUALLY SOIL IS OBTAINED BELOW WATER TABLE

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS	TYPICAL DESCRIPTION
CC	CEMENT CONCRETE
AC	ASPHALT CONCRETE
CR	CRUSHED ROCK / QUARRY SPALLS
TS	TOPSOIL/SOD/DUFF

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

- APPROXIMATE CONTACT BETWEEN SOIL STRATA OR GEOLOGIC UNIT
- APPROXIMATE LOCATION OF SOIL STRATA CHANGE WITHIN GEOLOGIC SOIL UNIT
- APPROXIMATE GRADUAL CHANGE BETWEEN SOIL STRATA OR GEOLOGIC SOIL UNIT
- APPROXIMATE GRADUAL CHANGE OF SOIL STRATA WITHIN GEOLOGIC SOIL UNIT

LABORATORY / FIELD TEST CLASSIFICATIONS

- **%F** PERECENT FINES
- **AL** ATTERBERG LIMITS
- **CA** CHEMICAL ANALYSIS
- **CP** LABORATORY COMPACTION TEST
- **CS** CONSOLIDATION TEST
- **DS** DIRECT SHEAR
- **HA** HYDROMETER ANALYSIS
- **MC** MOISTURE CONTENT
- **MD** MOISTURE CONTENT AND DRY DENSITY
- **OC** ORGANIC COMPOUND
- **PM** PERMEABILITY OR HYDRAULIC CONDUCTIVITY
- **PP** POCKET PENETROMETER
- **SA** SIEVE ANALYSIS
- **TX** TRIAXIAL COMPRESSION
- **UC** UNCONFINED COMPRESSION
- **VS** VANE SHEAR

SAMPLER SYMBOLS

- 2.4 INCH I.D. SPLIT BARREL
- DIRECT-PUSH
- STANDARD PENETRATION TEST
- SHELBY TUBE
- PISTON
- BULK OR GRAB

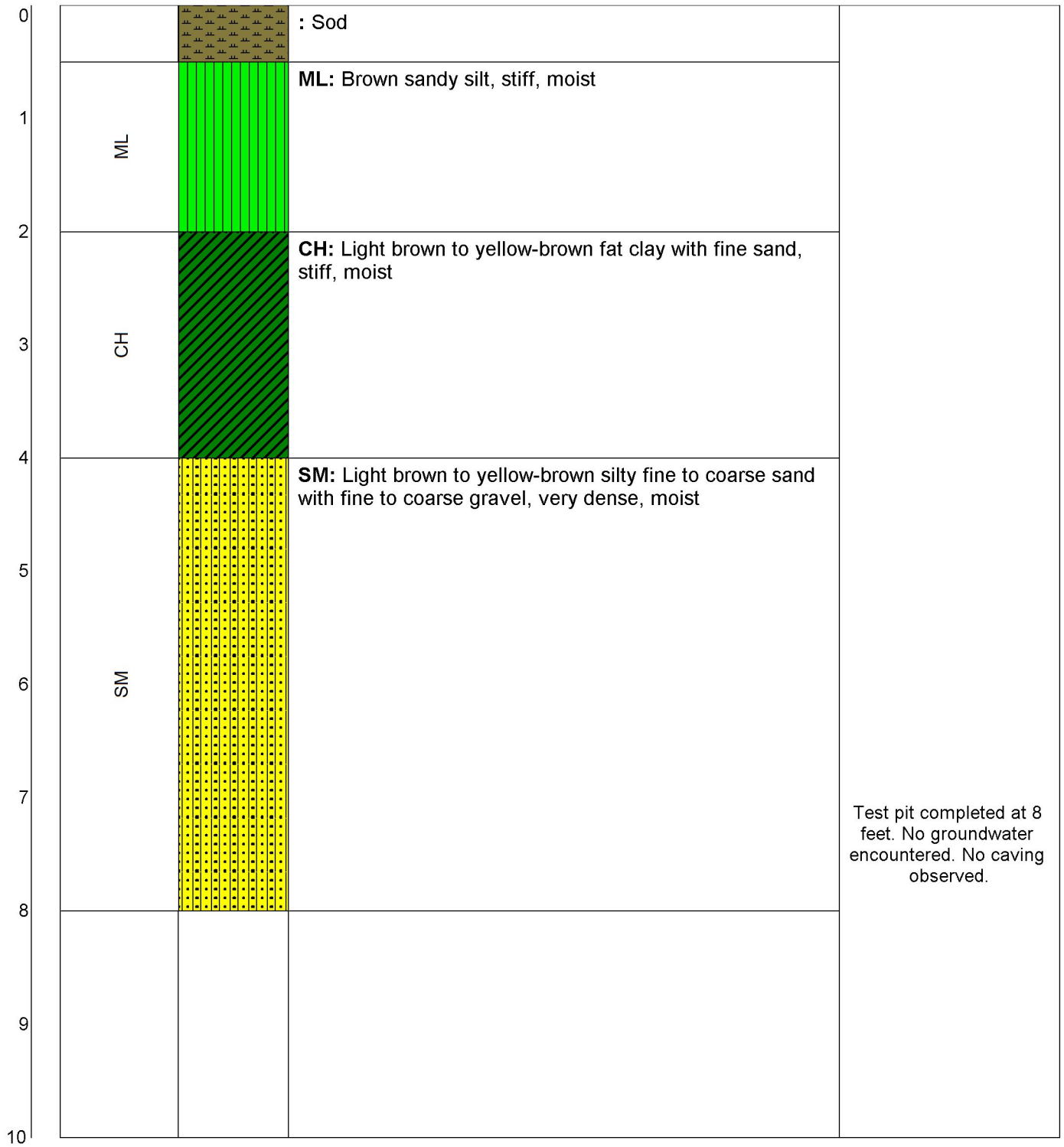
SHEEN CLASSIFICATIONS

- **NS** NO VISIBLE SHEEN
- **SS** SLIGHT SHEEN
- **MS** MODERATE SHEEN
- **HS** HEAVY SHEEN
- **NT** NOT TESTED

PROJECT: Wagner Orthodontics
PROJECT NO.: 369-028-01
LOCATION: Chehalis, Washington

TP-1

DATE: 2/18/22
TOTAL DEPTH: 8



INSIGHT GEOLOGIC, INC.

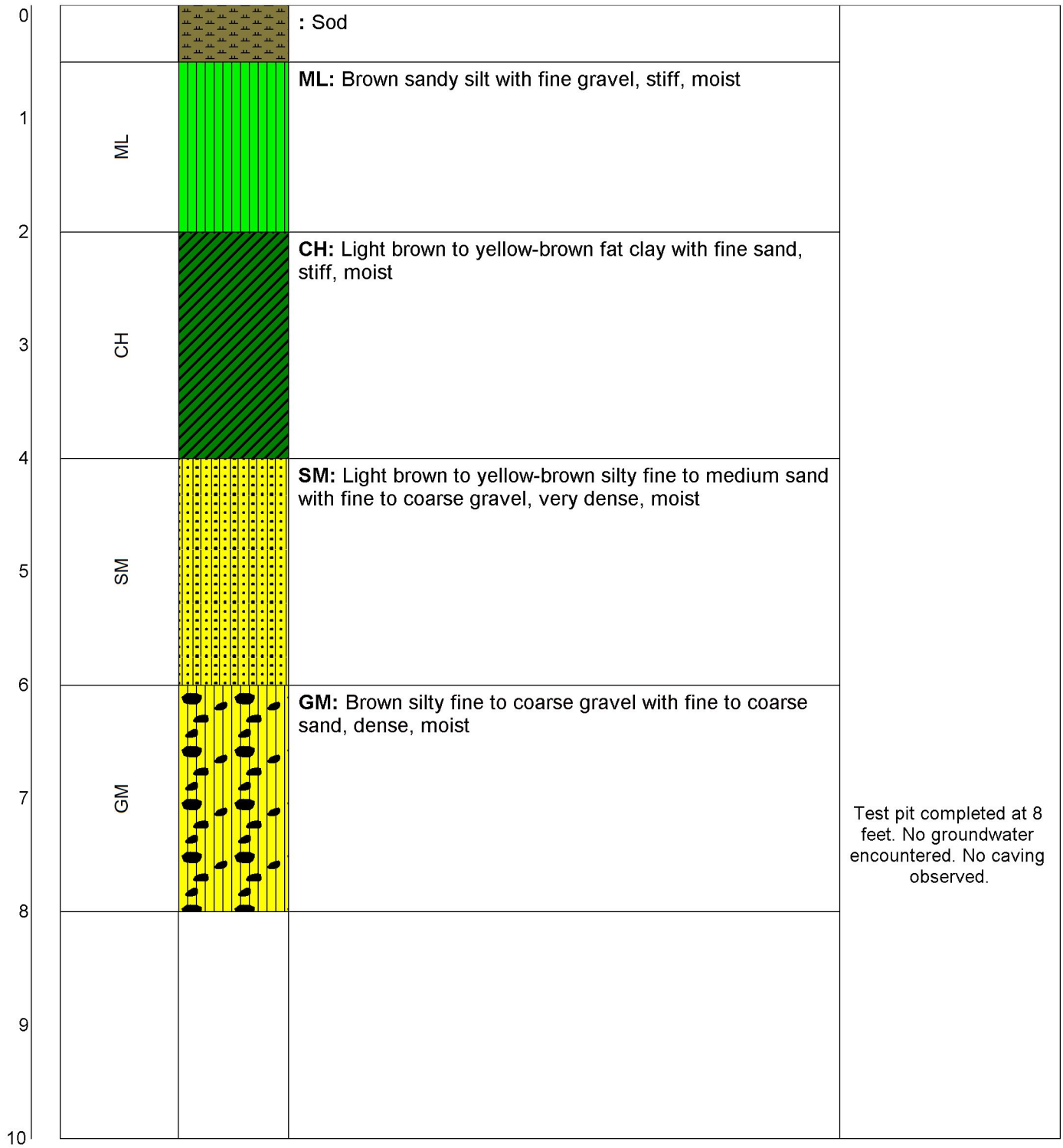
Operator Neal Graham
Equipment: Yanmar 35C
Logged By: Neal Graham

Figure A-2

PROJECT: Wagner Orthodontics
PROJECT NO.: 369-028-01
LOCATION: Chehalis, Washington

TP-2

DATE: 2/18/22
TOTAL DEPTH: 8



INSIGHT GEOLOGIC, INC.

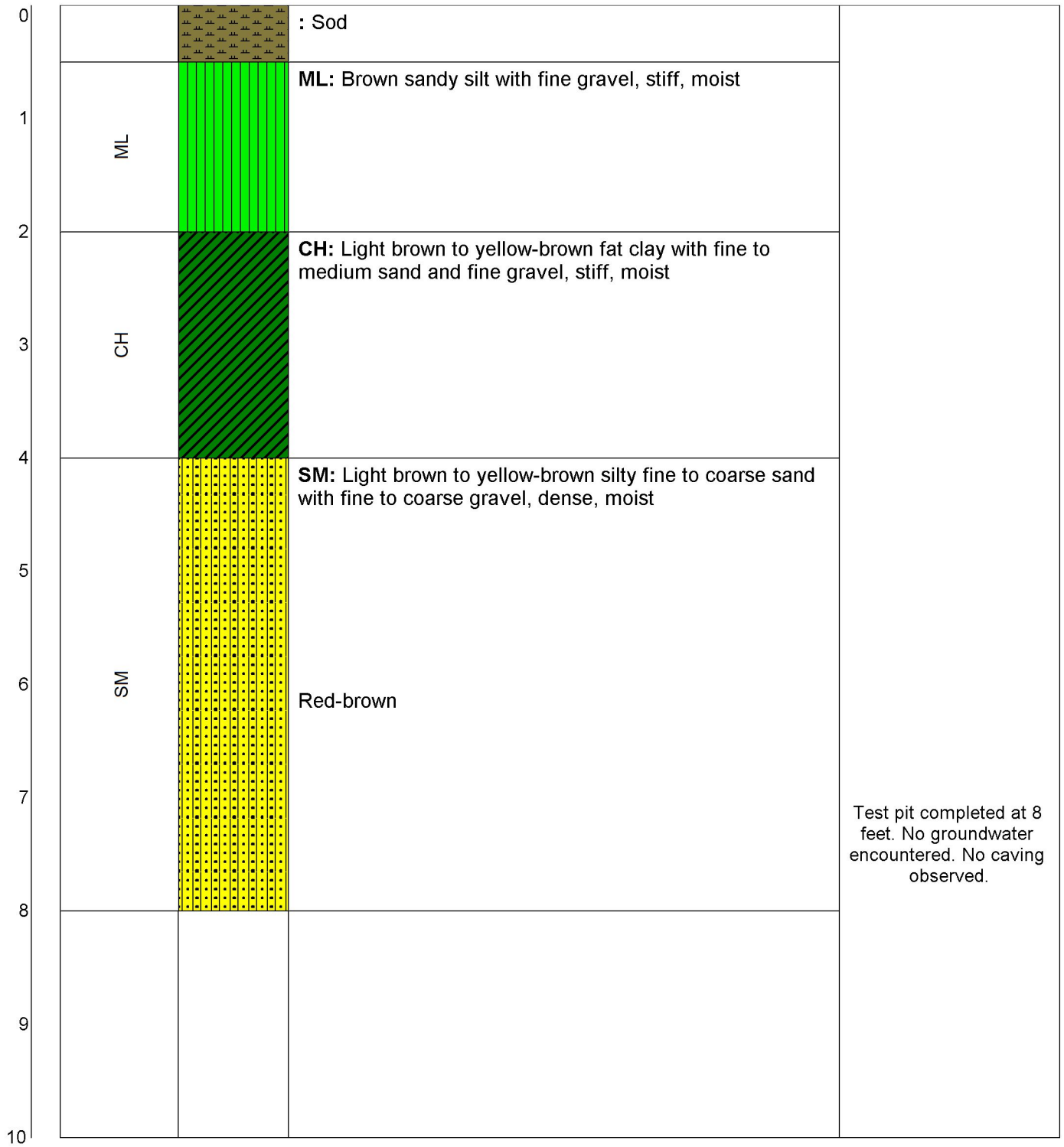
Operator **Neal Graham**
Equipment: **Yanmar 35C**
Logged By: **Neal Graham**

Figure A-3

PROJECT: Wagner Orthodontics
PROJECT NO.: 369-028-01
LOCATION: Chehalis, Washington

TP-3

DATE: 2/18/22
TOTAL DEPTH: 8



INSIGHT GEOLOGIC, INC.

Operator Neal Graham
Equipment: Yanmar 35C
Logged By: Neal Graham

Figure A-4

ATTACHMENT B
LABORATORY ANALYSES RESULTS

Gradation Analysis Summary Data

Job Name: Wagner Orthodontics
Job Number: 369-028-01
Date Tested: 2/22/22
Tested By: Dalton Prichard

Sample Location: TP-1
Sample Name: TP-1 2.0' - 4.0'
Depth: 2 - 4 Feet

Moisture Content (%) 37.2%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	100.0
3/8 in. (9.5-mm)	100.0
No. 4 (4.75-mm)	99.9
No. 10 (2.00-mm)	99.3
No. 20 (.850-mm)	98.3
No. 40 (.425-mm)	95.1
No. 60 (.250-mm)	90.0
No. 100 (.150-mm)	84.3
No. 200 (.075-mm)	78.8

Size Fraction	Percent by Weight
Coarse Gravel	0.0
Fine Gravel	0.1
Coarse Sand	0.6
Medium Sand	4.2
Fine Sand	16.3
Fines	78.8
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.00
D_{30}	0.00
D_{60}	0.00
D_{90}	0.25
Cc	- -
Cu	- -

ASTM Classification
Group Name: **Fat Clay with Sand**
Symbol: **CH**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wagner Orthodontics
Job Number: 369-028-01
Date Tested: 2/22/22
Tested By: Dalton Prichard

Sample Location: TP-2
Sample Name: TP-2 4.0' - 6.0'
Depth: 4 - 6 Feet

Moisture Content (%) 27.7%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	88.6
3/8 in. (9.5-mm)	86.8
No. 4 (4.75-mm)	83.8
No. 10 (2.00-mm)	80.5
No. 20 (.850-mm)	73.5
No. 40 (.425-mm)	60.2
No. 60 (.250-mm)	53.4
No. 100 (.150-mm)	42.5
No. 200 (.075-mm)	30.1

Size Fraction	Percent by Weight
Coarse Gravel	11.4
Fine Gravel	4.8
Coarse Sand	3.2
Medium Sand	20.3
Fine Sand	30.1
Fines	30.1
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.00
D_{30}	0.08
D_{60}	0.43
D_{90}	21.00
Cc	- -
Cu	- -

ASTM Classification
Group Name: **Silty Sand with Gravel**
Symbol: **SM**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wagner Orthodontics
Job Number: 369-028-01
Date Tested: 2/22/22
Tested By: Dalton Prichard

Sample Location: TP-2
Sample Name: TP-2 6.0' - 8.0'
Depth: 6 - 8 Feet

Moisture Content (%) 17.3%

Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	74.5
3/8 in. (9.5-mm)	55.0
No. 4 (4.75-mm)	48.6
No. 10 (2.00-mm)	40.4
No. 20 (.850-mm)	31.5
No. 40 (.425-mm)	23.2
No. 60 (.250-mm)	19.5
No. 100 (.150-mm)	17.1
No. 200 (.075-mm)	14.2

Size Fraction	Percent by Weight
Coarse Gravel	25.5
Fine Gravel	25.9
Coarse Sand	8.2
Medium Sand	17.2
Fine Sand	9.0
Fines	14.2
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.00
D_{30}	0.75
D_{60}	12.00
D_{90}	28.00
Cc	- -
Cu	- -

ASTM Classification
Group Name: **Silty Gravel with Sand**
Symbol: **GM**

INSIGHT GEOLOGIC, INC.

Gradation Analysis Summary Data

Job Name: Wagner Orthodontics
Job Number: 369-028-01
Date Tested: 2/22/22
Tested By: Dalton Prichard

Sample Location: TP-3
Sample Name: TP-3 0.0' - 2.0'
Depth: 0 - 2 Feet

Moisture Content (%) 24.2%

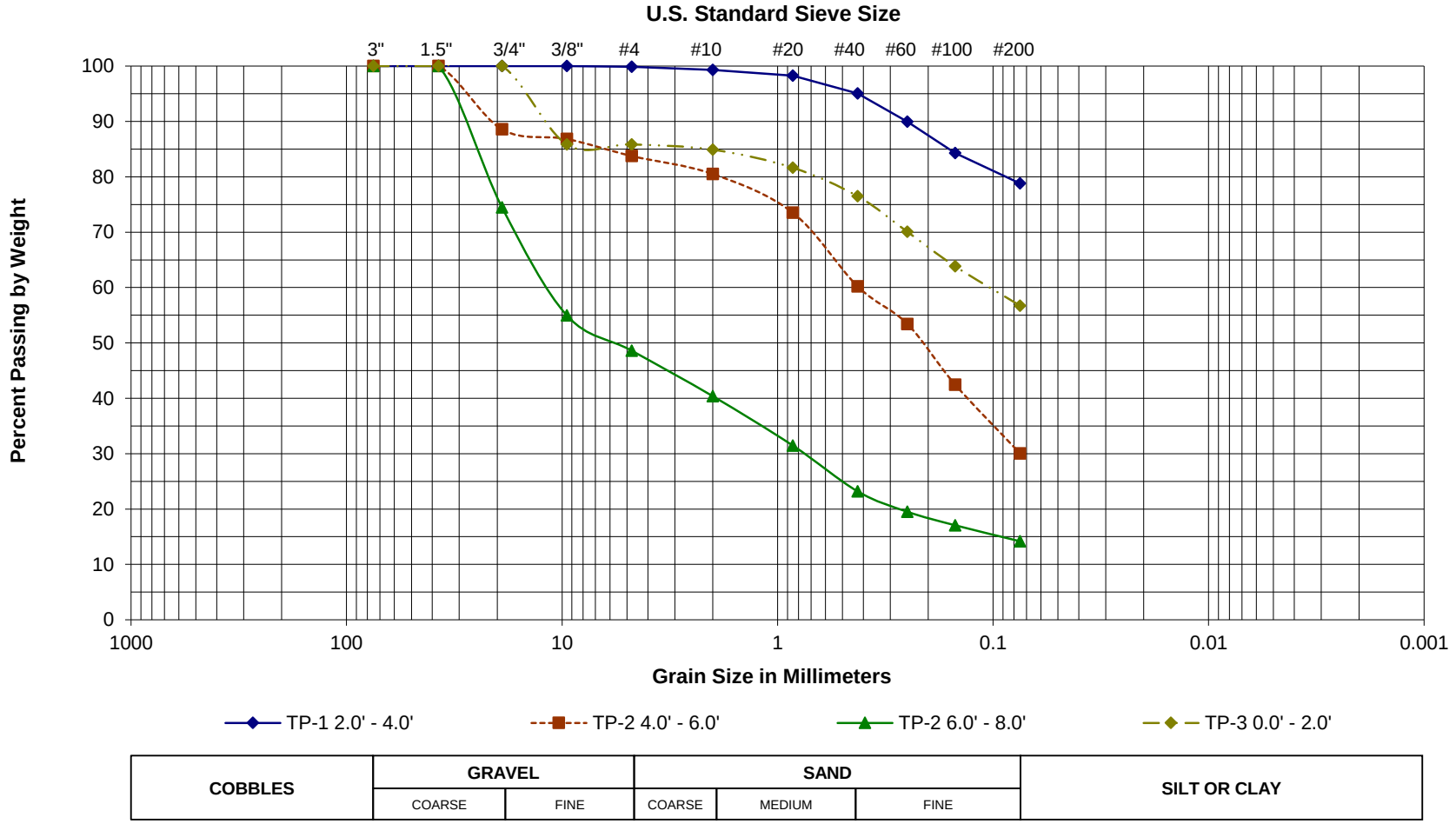
Sieve Size	Percent Passing
3.0 in. (75.0)	100.0
1.5 in. (37.5)	100.0
3/4 in. (19.0)	100.0
3/8 in. (9.5-mm)	85.8
No. 4 (4.75-mm)	85.8
No. 10 (2.00-mm)	84.9
No. 20 (.850-mm)	81.6
No. 40 (.425-mm)	76.5
No. 60 (.250-mm)	70.1
No. 100 (.150-mm)	63.8
No. 200 (.075-mm)	56.7

Size Fraction	Percent by Weight
Coarse Gravel	0.0
Fine Gravel	14.2
Coarse Sand	0.9
Medium Sand	8.4
Fine Sand	19.7
Fines	56.7
Total	**100.0**

LL	- -
PL	- -
PI	- -
D_{10}	0.00
D_{30}	0.00
D_{60}	0.10
D_{90}	12.00
Cc	- -
Cu	- -

ASTM Classification
Group Name: **Sandy Silt**
Symbol: **ML**

INSIGHT GEOLOGIC, INC.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

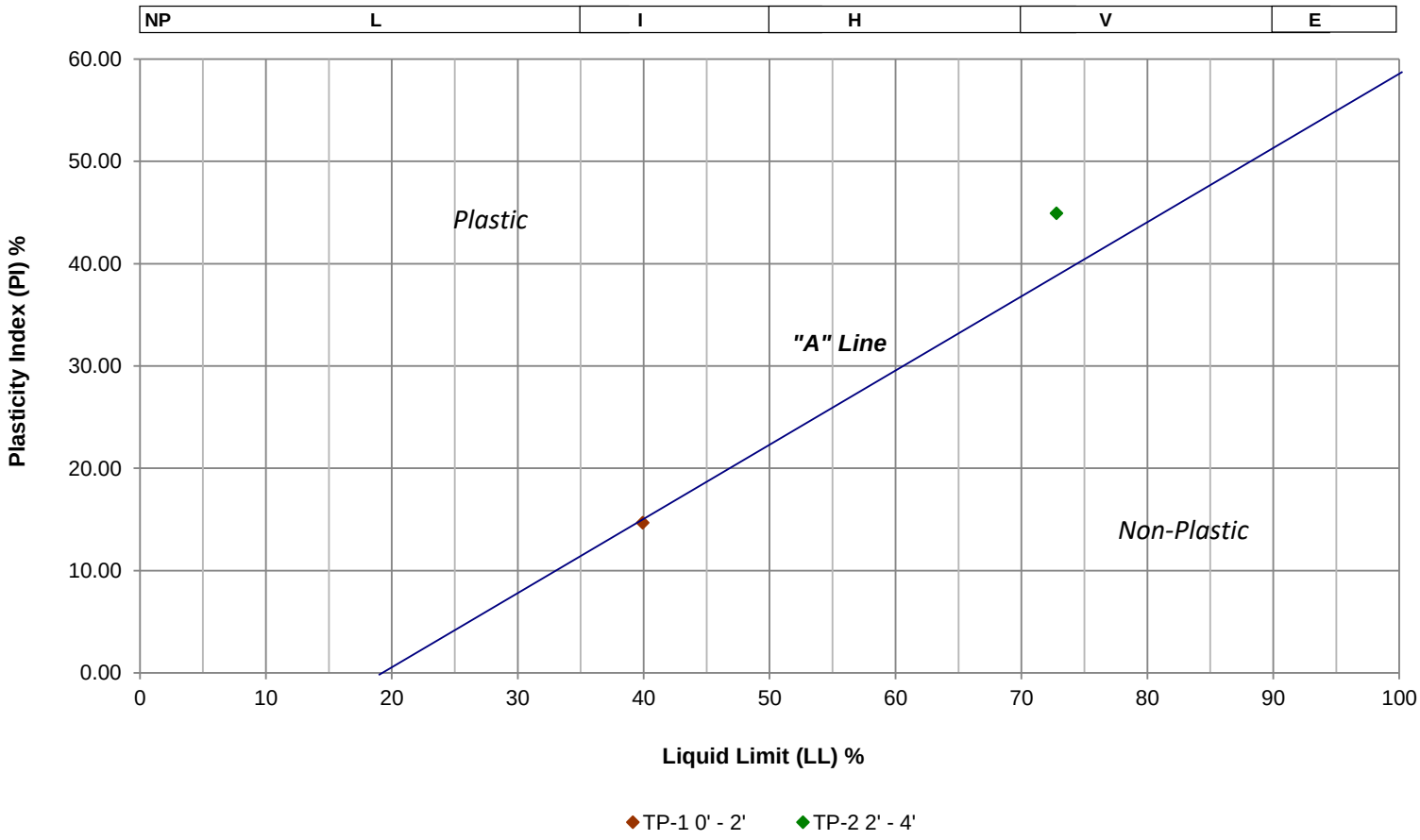
WAGNER ORTHODONTICS

CHEHALIS, WASHINGTON

INSIGHT GEOLOGIC, INC.

Graph 1
Gradation Analysis Results

Plasticity Chart



Key: Plasticity Symbol = **NP** - Non-Plastic **L -** Low **I -** Intermediate **H** - High **V -** Very High **E** - Extremely High

INSIGHT GEOLOGIC, INC.

Graph 2
Plastic Limit Test Results

ATTACHMENT C
REPORT LIMITATIONS AND GUIDELINES FOR USE

ATTACHMENT C

REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

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 RB Engineering (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

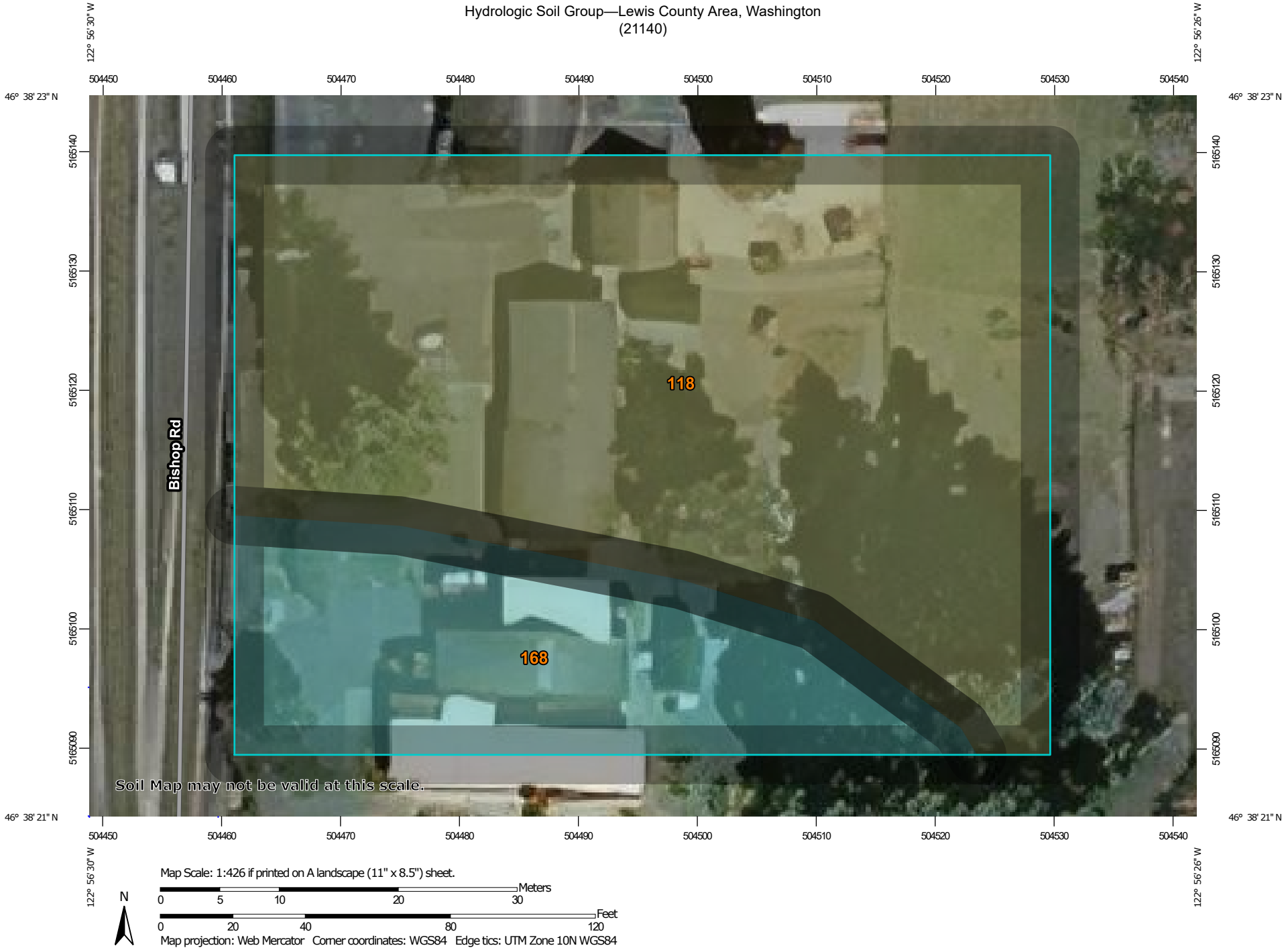
Hydrogeologic engineers and geologists prepare final boring and test pit logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a hydrogeologic engineering or geologic report should never be redrawn for inclusion in architectural or 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.



Map Scale: 1:426 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 5 10 20 30

Feet
0 20 40 80 120

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lewis County Area, Washington
Survey Area Data: Version 21, Aug 31, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 30, 2019—May 10, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
118	Lacamas silt loam, 0 to 3 percent slopes	C/D	0.6	73.8%
168	Prather silty clay loam, 5 to 15 percent slopes	C	0.2	26.2%
Totals for Area of Interest			**0.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Lewis County Area, Washington

118—Lacamas silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2h8l
Elevation: 250 to 1,200 feet
Mean annual precipitation: 40 to 70 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 125 to 200 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Lacamas, drained, and similar soils: 60 percent
Lacamas, undrained, and similar soils: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lacamas, Drained

Setting

Landform: Flood plains, terraces

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 17 inches: silt loam
H3 - 17 to 27 inches: silty clay
H4 - 27 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Ecological site: F001XC003OR - Mesic Aquic Forest
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Other vegetative classification: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: Yes

Description of Lacamas, Undrained

Setting

Landform: Flood plains, terraces

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 17 inches: silt loam
H3 - 17 to 27 inches: silty clay
H4 - 27 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Ecological site: F001XC003OR - Mesic Aquic Forest
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Other vegetative classification: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: Yes

Minor Components

Klaber

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Prather

Percent of map unit: 3 percent
Hydric soil rating: No

Scamman

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Lewis County Area, Washington
Survey Area Data: Version 21, Aug 31, 2021

Lewis County Area, Washington

168—Prather silty clay loam, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2hbd
Elevation: 200 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Prather and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Prather

Setting

Landform: Terraces
Parent material: Glacial drift

Typical profile

H1 - 0 to 14 inches: silty clay loam
H2 - 14 to 26 inches: silty clay
H3 - 26 to 51 inches: silty clay
H4 - 51 to 60 inches: clay

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F002XA005WA - Puget Lowlands Moist Forest
Forage suitability group: Soils with Moderate Limitations (G002XV602WA)
Other vegetative classification: Soils with Moderate Limitations (G002XV602WA)
Hydric soil rating: No

Minor Components

Lacamas

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: Yes

Scamman

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Lewis County Area, Washington
Survey Area Data: Version 21, Aug 31, 2021

APPENDIX 4 – OPERATION AND MAINTENANCE MANUAL

An Operation and Maintenance plan will be provided in the Final Drainage Report

APPENDIX 5 – CONSTRUCTION SWPPP

Construction Stormwater General Permit

Stormwater Pollution Prevention Plan (SWPPP)

for

Wagner Orthodontics

Prepared for:

The Washington State Department of Ecology

SW Regional Office

Permittee / Owner	Developer	Operator / Contractor
Peter Wagner	Pending	Pending

Certified Erosion and Sediment Control Lead (CESCL)

Name	Organization	Contact Phone Number
Pending	Pending	Pending

SWPPP Prepared By

Name	Organization	Contact Phone Number
Robert Balmelli	RB Engineering	(360) 740-8919

SWPPP Preparation Date

6.24.22

Project Construction Dates

Activity / Phase	Start Date	End Date
Pending	Pending	Pending

PROJECT OVERVIEW

WAR No. : Pending

Site Address: 1319 & 1327 Bishop Rd
Chehalis, WA 98532

Applicable Criteria	Areas
Total Site Area	0.88 AC
Land Disturbing Area	0.88 AC

Existing land cover: Residential structures and lawn areas

Drainage Patterns: Natural drainage leaves the site to the southeast of the property.

Critical Areas: No critical areas are present onsite.

Steep Slopes: Slopes onsite are relatively flat with all slopes less than 10%.

Receiving Water Body: Nearby stream

WaterShed: WRIA 23 – Upper Chehalis
https://waecy.maps.arcgis.com/apps/webappviewer/index.html?id=996e6b21ae394cc3a3b63c6da0c3aa0a

Description of Construction Activities (example: site preparation, demolition, excavation):

Project includes the construction of a new 4,000 sf orthodontics building and associated parking. Typical construction activities include demolition of existing onsite structures, excavation, paving, etc.

Description of site drainage including flow from and onto adjacent properties. Must be consistent with Site Drainage and Erosion Control Plan:

There is no tributary flow onto the parcel. Drainage leaving the parcel will enter the existing roadside ditch that runs South along Bishop Road.

Description of Final Stabilization (example: extent of revegetation, paving, landscaping):

Project final stabilization will include installation of new impervious hard surfaces and landscaping.

CONSTRUCTION SWPPP

All new development and redevelopment shall comply with Construction SWPPP Elements #1 through #12 listed below. The suggested BMPs underlined and in **bold** are proposed for use in all phases of construction. Copies of the details for each of the recommended BMPs are included.

Element 1: Mark Clearing Limits

- Prior to beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. These shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
- Plastic, metal, or stake wire fence may be used to mark the clearing limits.
- Suggested BMPs:

  BMP C101: Preserving Natural Vegetation
  BMP C102: Buffer Zones
  BMP C103: High-Visibility Fence
  BMP C233: Silt Fence

Element 2: Establish Construction Access

- Construction vehicle access and exit shall be limited to one route if possible, or two for linear projects such as roadways where one access is necessary for large equipment maneuvering.
- Access points shall be stabilized with quarry spall or crushed rock to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located onsite, if applicable.
- Roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.
- Street wash wastewater shall be controlled by pumping back onsite or otherwise be prevented from discharging into systems tributary to state surface waters.
- Construction access restoration shall be equal to or better than the pre-construction condition.
- Suggested BMPs:

  BMP C105: Stabilized Construction Access
  BMP C106: Wheel Wash
  BMP C107: Construction Road/Parking Area Stabilization

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, as required by local plan approval authority.
- Downstream analysis is necessary if changes in offsite flows could impair or alter conveyance systems, streambanks, bed sediment, or aquatic habitat.
- Where necessary to comply with Minimum Requirement #7, stormwater detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e.g. impervious surfaces).
- Suggested BMPs:

  BMP C203: Water Bars
  BMP C207: Check Dams
  BMP C209: Outlet Protection
  BMP C235: Wattles
  BMP C240: Sediment Trap
  BMP C241: Sediment Pond (Temporary)
  See also, V-12 Detention BMPs

Element 4: Install Sediment Controls

- The duff layer, native top soil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.
- Prior to leaving a construction site or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3, bullet #1. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The local permitting authority shall inspect and approve areas fully stabilized by means other than pavement or quarry spalls.
- BMPs intended to trap sediment on site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.
- BMPs intended to trap sediment on site must be located in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages, often during non-storm events, in response to rain event changes in stream elevation or wetted area.
- Suggested BMPs

  BMP C231: Brush Barrier
  BMP C232: Gravel Filter Berm

BMP C233: Silt Fence
BMP C234: Vegetated Strip
BMP C235: Wattles
BMP C240: Sediment Trap
BMP C241: Sediment Pond (Temporary)
BMP C250: Construction Stormwater Chemical Treatment
BMP C251: Construction Stormwater Filtration

Element 5: Stabilize Soils

- Exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrops, flowing water, and wind.
- From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This stabilization requirement applies to all soils on site, whether at final grade or not. These time limits may be adjusted by the local permitting authority if it can be shown that the average time between storm events justifies a different standard.
- Soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.
- Selected soil stabilization measures shall be appropriate for the time of year, site conditions, estimated duration of use, and the water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized and protected with sediment trapping measures.
- Linear construction activities such as right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirement. Contractors shall install the bedding materials, roadbeds, structures, pipelines, or utilities and re-stabilize the disturbed soils so that:

– from October 1 through April 30 no soils shall remain exposed and unworked for more than 2 days and

– from May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days.

- Suggested BMPs:

BMP C120: Temporary and Permanent Seeding
BMP C121: Mulching
BMP C122: Nets and Blankets
BMP C123: Plastic Covering
BMP C124: Sodding
BMP C125: Topsoiling / Composting

BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection
BMP C130: Surface Roughening
BMP C131: Gradient Terraces
BMP C140: Dust Control

Element 6: Protect Slopes

- Design, construct, and phase cut and fill slopes in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
- Divert upslope drainage and run-on waters with interceptors at top of slope. Stormwater from off site should be handled separately from stormwater generated on the site. Diversion of offsite stormwater around the site may be a viable option. Diverted flows shall be redirected to the natural drainage location at or before the property boundary.
- Contain downslope collected flows in pipes, slope drains, or protected channels. Check dams shall be used within channels that are cut down a slope.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Stabilize soils on slopes, as specified in Element #5.
- Suggested BMPs

  BMP C120: Temporary and Permanent Seeding
  BMP C121: Mulching
  BMP C122: Nets and Blankets
  BMP C123: Plastic Covering
  BMP C124: Sodding
  BMP C130: Surface Roughening
  BMP C131: Gradient Terraces
  BMP C200: Interceptor Dike and Swale
  BMP C201: Grass-Lined Channels
  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 (TSD)

Element 7: Protect Drain Inlets

- Storm drain inlets operable during construction shall be protected so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.

- Approach roads shall be kept clean. Sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the state.

- Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices should be cleaned or removed and replaced before six inches of sediment can accumulate.

- Suggested BMPs:

  BMP C220: Inlet Protection

Element 8: Stabilize Channels and Outlets

- Temporary onsite conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected flow velocity of a 2-year, 24-hour frequency storm for the developed condition.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems.
- Suggested BMPs:

  BMP C122: Nets and Blankets
  BMP C202: Riprap Channel Lining
  BMP C207: Check Dams
  BMP C209: Outlet Protection

Element 9: Control Pollutants

- All pollutants, including waste materials and demolition debris, that occur on site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater. Woody debris may be chopped and spread on site.
- 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. Emergency repairs may be performed onsite using temporary plastic placed beneath and, if raining, over the vehicle.

- Wheel wash or tire bath wastewater shall be discharged to a separate onsite treatment system or to the sanitary sewer.
- Application of agricultural chemicals including fertilizers and pesticides shall be conducted in a manner and at application rate that will not result in loss of chemicals to stormwater runoff. Manufacturer recommendations for application rates and procedures shall be followed.
- BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources include bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters. Stormwater discharges shall not cause a violation of the water quality standard for pH in the receiving water.
- Suggested BMPs:

  BMP C151: Concrete Handling
  BMP C152: Sawcutting and Surfacing Pollution Prevention
  BMP C153: Material Delivery, Storage, and Containment
  BMP C154: Concrete Washout Area
  BMP C250: Construction Stormwater Chemical Treatment
  BMP C251: Construction Stormwater Filtration
  BMP C252: Treating and Disposing of High pH Water
  Also see, the Source Control BMPs detailed in Volume IV

Element 10: Control De-Watering

- Foundation, vault, and trench de-watering water shall be discharged into a controlled conveyance system prior to discharge to a sediment pond. Channels must be stabilized, as specified in Element #8.
- Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, 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 contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam shall be handled separately from stormwater.
- Other disposal options, depending on site constraints, may include:

1. infiltration,
2. transport off site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters,
3. onsite treatment using chemical treatment or other suitable treatment technologies,
4. sanitary sewer discharge with local sewer district approval, or

5. use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

- Suggested BMPs:

  BMP C203: Water Bars
  BMP C236: Vegetative Filtration

Element 11: Maintain BMPs

- Temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with BMPs.
- Sediment control BMPs shall be inspected weekly or after a runoff-producing storm event during the dry season and daily during the wet season. The inspection frequency for stabilized, inactive sites shall be determined by the local permitting authority based on the level of soil stability and potential for adverse environmental impacts.
- Temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

- Suggested BMPs:

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

Element 12: Manage the Project

- Phasing of Construction

  Development projects shall be phased where feasible in order to prevent, to the maximum extent practicable, the transport of sediment from the development site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

  Clearing and grading activities for development shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance and compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by local jurisdictions, shall be delineated on the site plans and the development site.

- Seasonal Work Limitations

  From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that the

transport of sediment from the construction site to receiving waters will be prevented through a combination of the following:

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

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

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

Local governments may restrict clearing and grading activities where site conditions may present a significant risk of impact to property or critical areas. Contact the local government permitting authority for information on specific site restrictions.

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

1. Routine maintenance and necessary repair of erosion and sediment control BMPs,
2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil, and
3. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

- Coordination with Utilities and Other Contractors

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

- Inspection and Monitoring

  All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function.

  A certified professional in erosion and sediment control shall be identified in the Construction SWPPP and shall be onsite or on-call at all times.

  Sampling and analysis of the stormwater discharges from a construction site may be necessary on a case-by-case basis to ensure compliance with standards. The local permitting authority may establish monitoring and reporting requirements when necessary.

Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, the SWPPP shall be modified, as appropriate, in a timely manner.

- Maintenance of the Construction SWPPP

  The Construction SWPPP shall be retained onsite or within reasonable access to the site. The Construction SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP.

- Suggested BMPs:

  BMP C150: Materials on Hand
  BMP C160: Certified Erosion and Sediment Control Lead
  BMP C162: Scheduling

Element #13: Protect Low Impact Development BMPs

Municipal Stormwater Permits Requirements

Protect all Bioretention and Rain Garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden BMPs. Restore the BMP so their fully functioning condition if they accumulate sediment during construction. Re-storing the BMP must include removal of sediment and any sediment-laden Bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.

Prevent compacting Bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.

Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements.

Pavements fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures from the local stormwater manual or the manufacturer's procedures.

Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

Additional Guidance

See Chapter 5: Precision Site Preparation, Construction & Inspection of LID Facilities in the

LID Technical Guidance Manual for Puget Sound (2012) for more detail on pro-tecting LID integrated management practices.

Note that the LID Technical Guidance Manual for Puget Sound (2012) is for additional informational purposes only. You must follow the guidance within this manual if there are any discrepancies between this manual and the LID Technical Guidance Manual for Puget Sound 2012).

- Suggested BMPs:

  BMP C102: Buffer Zones
  BMP C103: High-Visibility Fence
  BMP C200: Interceptor Dike and Swale
  BMP C201: Grass-Lined Channels
  BMP C207: Check Dams
  BMP C208: Triangular Silt Dike (TSD)
  BMP C231: Brush Barrier
  BMP C233: Silt Fence
  BMP C234: Vegetated Strip

Project Specific Construction BMPs

BMP C105: Stabilized Construction Access
BMP C120: Temporary and Permanent Seeding
BMP C140: Dust Control
BMP C152: Sawcutting and Surfacing Pollution Prevention
BMP C209: Outlet Protection
BMP C220: Inlet Protection
BMP C233: Silt Fence

BMP C105: Stabilized Construction Access

Purpose

Stabilized construction accesses are established to reduce the amount of sediment transported onto paved roads outside the project site by vehicles or equipment. This is done by constructing a stabilized pad of quarry spalls at entrances and exits for project sites.

Conditions of Use

Construction accesses shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential subdivision construction sites, provide a stabilized construction access for each residence, rather than only at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size and configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized accesses not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

See Figure II-3.1: Stabilized Construction Access for details. Note: the 100' minimum length of the access shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').

Construct stabilized construction accesses with a 12-inch thick pad of 4-inch to 8-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride for construction access stabilization because these products raise pH levels in stormwater and concrete discharge to waters of the State is prohibited.

A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the standards listed in Table II-3.2: Stabilized Construction Access Geotextile Standards.

Table II-3.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.
Grab Tensile Elongation (ASTM D4632)	30% max.

Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized access. Also consider the installation of excess concrete as a stabilized access. During large concrete pours, excess concrete is often available for this purpose.
- Fencing (see BMP C103: High-Visibility Fence) shall be installed as necessary to restrict traffic to the construction access.
- Whenever possible, the access shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction accesses should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction access must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Alternative Material Specification

WSDOT has raised safety concerns about the Quarry Spall rock specified above. WSDOT observes that the 4-inch to 8-inch rock sizes can become trapped between Dually truck tires, and then released off-site at highway speeds. WSDOT has chosen to use a modified specification for the rock while continuously verifying that the Stabilized Construction Access remains effective. To remain effective, the BMP must prevent sediment from migrating off site. To date, there has been no performance testing to verify operation of this new specification. Jurisdictions may use the alternative specification, but must perform increased off-site inspection if they use, or allow others to use, it.

Stabilized Construction Accesses may use material that meets the requirements of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Section 9-03.9(1) (WSDOT, 2016) for ballast except for the following special requirements.

The grading and quality requirements are listed in Table II-3.3: Stabilized Construction Access Alternative Material Requirements.

Table II-3.3: Stabilized Construction Access Alternative Material Requirements

Sieve Size	Percent Passing
2½″	99-100
2″	65-100
¾″	40-80
No. 4	5 max.
No. 100	0-2
% Fracture	75 min.

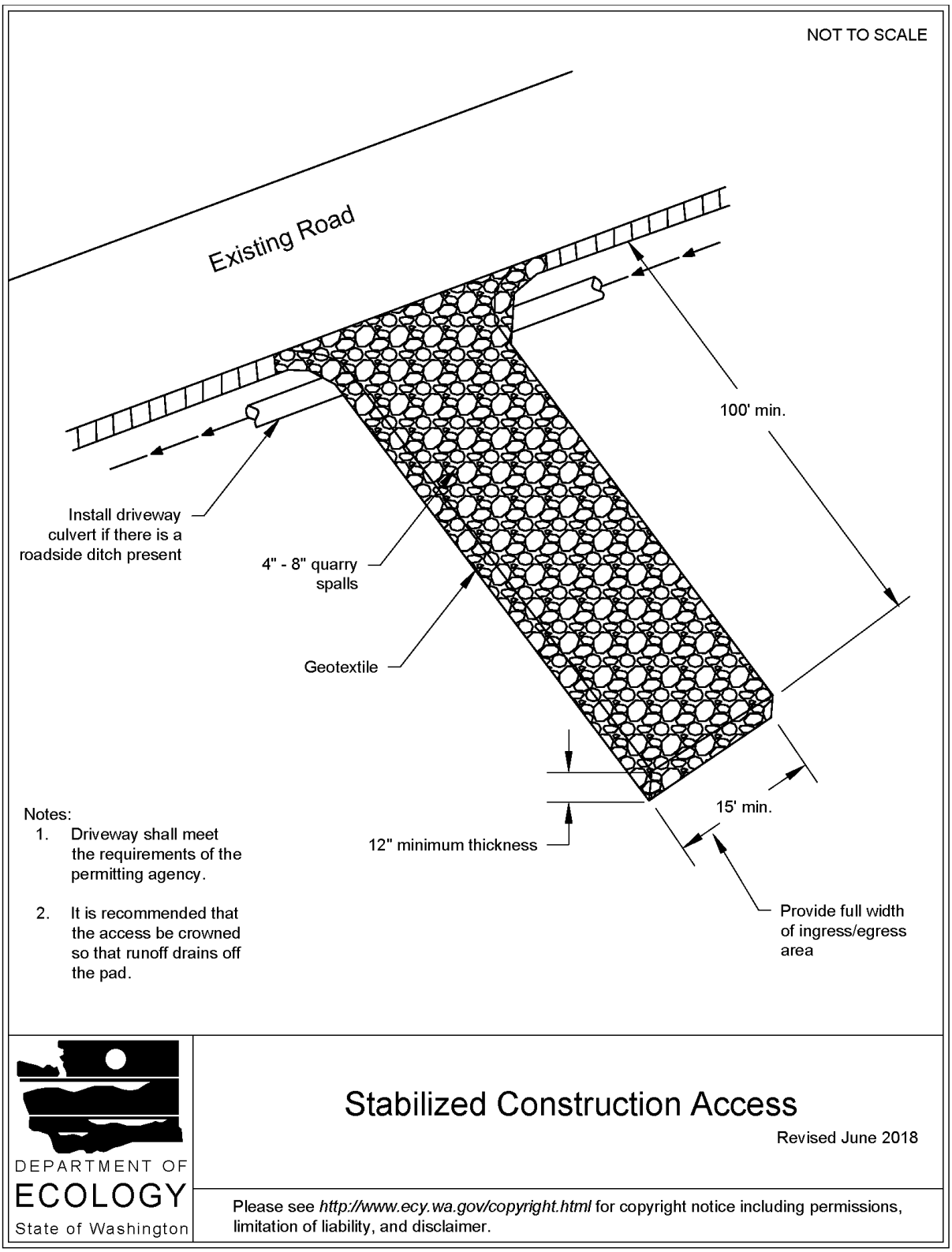
- All percentages are by weight.
- The sand equivalent value and dust ratio requirements do not apply.
- The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.

Maintenance Standards

Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the access is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions of the access, or the installation of BMP C106: Wheel Wash.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when high efficiency sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction access(es), BMP C103: High-Visibility Fence shall be installed to control traffic.
- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

Figure II-3.1: Stabilized Construction Access



Approved as Functionally Equivalent

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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

Use seeding 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.

Review all disturbed areas in late August to early September and complete all seeding by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.

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.

Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. 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 T5.13: 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 the top of 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 top of hydromulch and erosion con- trol blankets.
- Confirm the installation of all required surface water control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 per-

cent 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 on the disturbed soil surface before application. See BMP T5.13: Post-Construction Soil Quality and Depth.
- 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.
- Enhance vegetation establishment by dividing the hydromulch operation into two phases:
    - Phase 1- Install all seed and fertilizer with 25-30 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 800-1000 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 Bon- ded Fiber Matrix/ Mechanically Bonded Fiber Matrix (BFM/MBFMs) (3,000 pounds per acre minimum).

- Seed may be installed by hand if:
    - Temporary and covered by straw, mulch, or topsoil.
    - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- The seed mixes listed in Table II-3.4: Temporary and Permanent Seed Mixes include recommended mixes for both temporary and permanent seeding.
- Apply these mixes, with the exception of the wet area seed mix, 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 the local suppliers or the local conservation district for their recommendations. 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 local authority may be used, depending on the soil type and hydrology of the area.

Table II-3.4: Temporary and Permanent Seed Mixes

Common Name	Latin Name	% Weight	% Purity	% Germination
Temporary Erosion Control Seed Mix A standard mix for areas requiring a temporary vegetative cover.				
Chewings or annual blue grass	*Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye	*Lolium perenne*	50	98	90
Redtop or colonial bentgrass	*Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover	*Trifolium repens*	5	98	90
Landscaping Seed Mix A recommended mix for landscaping seed.				
Perennial rye blend	*Lolium perenne*	70	98	90
Chewings and red fescue blend	*Festuca rubra var. commutata* or *Festuca rubra*	30	98	90
Low-Growing Turf Seed Mix A turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.				
Dwarf tall fescue (several varieties)	*Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay)	*Lolium perenne var. barclay*	30	98	90
Red fescue	*Festuca rubra*	20	98	90
Colonial bentgrass	*Agrostis tenuis*	5	98	90
Bioswale Seed Mix A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	75-80	98	90

Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	92	85
Redtop bentgrass	*Agrostis alba or Agrostis gigantea*	5-10	90	80
Wet Area Seed Mix A low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.				

Table II-3.4: Temporary and Permanent Seed Mixes (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	98	85
Meadow foxtail	*Alepocurus pratensis*	10-15	90	80
Alsike clover	*Trifolium hybridum*	1-6	98	90
Redtop bentgrass	*Agrostis alba*	1-6	92	85
Meadow Seed Mix A recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. 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. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.				
Redtop or Oregon bentgrass	*Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue	*Festuca rubra*	70	98	90
White dutch clover	*Trifolium repens*	10	98	90

Roughening and Rototilling

- The seedbed should be firm and rough. Roughen all soil no matter what the slope. Track walk slopes before seeding if engineering purposes require compaction. Backblading or smoothing of slopes greater than 4H:1V is not allowed if they are to be seeded.
- Restoration-based landscape practices require 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 soil amendments to achieve organic matter and

permeability per- formance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches complete the rototilling process in multiple lifts, or prepare the engineered soil system per specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer is recommended. This will prevent the over-application of fertilizer.
- Organic matter is the most appropriate form of fertilizer because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form.
- In general, use 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre. Always use slow-release fertilizers because they are more efficient and have fewer environmental impacts. Do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use. Too much agitation destroys the slow-release coating.
- There are numerous products available 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 provides 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. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre with approximately 10 percent tackifier. Achieve a minimum of 95 percent soil coverage during application. Numerous products are available commercially. Most products require 24-36 hours to cure before rainfall and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs provide good alternatives to blankets in most areas requiring vegetation establishment. Advantages over blankets include:
    - BFM and MBFMs do not require surface preparation.
    - Helicopters can assist in installing BFM and MBFMs in remote areas.
    - On slopes steeper than 2.5H:1V, blanket installers may require ropes and harnesses for safety.
    - Installing BFM and MBFMs can save at least $1,000 per acre compared to blankets.

Maintenance Standards

Reseed any seeded areas that fail to establish at least 75 percent cover (100 percent cover for areas that receive sheet or concentrated flows). If reseeding is ineffective, use an alternate method such

as sodding, mulching, nets, or blankets.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. Reseed and protect by mulch any eroded area.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes run-off.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

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BMP C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use

Use dust control in areas (including roadways) subject to surface and air movement of dust where on-site or 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. 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 the surface is wet. Repeat as needed. To prevent carryout of mud onto the street, refer to BMP C105: Stabilized Construction Access and BMP C106: Wheel Wash.
- Irrigation water can be used for dust control. Irrigation systems should be installed 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. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
- PAM (BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection) added to water at a rate of 0.5 pounds per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to 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 reduce the quantity of water needed for dust control. Note that the application rate specified here applies to this BMP, and is not the same application rate that is specified in BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection, but the downstream protections still apply.

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.

- Contact your local Air Pollution Control Authority for guidance and training on other dust con-

trol measures. Compliance with the local Air Pollution Control Authority constitutes

compliance with this BMP.

- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- 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.
    - 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.
    - Limit dust-causing work on windy days.
    - Pave unpaved permanent roads and other trafficked areas.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose

Sawcutting and 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 waters of the State is prohibited. Use this BMP to minimize and eliminate process water and slurry created through sawcutting or surfacing from entering waters of the State.

Conditions of Use

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

- 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 of collected slurry and cuttings in a manner that does not violate ground water or surface water quality standards.
- Do not allow process water generated during hydro-demolition, surface roughening or similar operations to drain to any natural or constructed drainage conveyance including stormwater systems. Dispose of process water in a manner that does not violate ground water or surface water quality standards.
- Handle and dispose of cleaning waste material and demolition debris in a manner that does not cause contamination of water. Dispose of sweeping material from a pick-up sweeper at 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 vacuumtrucks.

BMP C209: Outlet Protection

Purpose

Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Conditions of Use

Use outlet protection at the outlets of all ponds, pipes, ditches, or other conveyances that discharge to a natural or manmade drainage feature such as a stream, wetland, lake, or ditch.

Design and Installation Specifications

- The receiving channel at the outlet of a pipe shall be protected from erosion by lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1–foot above the maximum tailwater elevation, or 1-foot above the crown, whichever is higher. For pipes larger than 18 inches in diameter, the outlet protection lining of the channel shall be four times the diameter of the outlet pipe.
- Standard wingwalls, tapered outlets, and paved channels should also be considered when appropriate for permanent culvert outlet protection (WSDOT, 2015).
- BMP C122: Nets and Blankets or BMP C202: Riprap Channel Lining provide suitable options for lining materials.
- With low flows, BMP C201: Grass-Lined Channels can be an effective alternative for lining material.
- The following guidelines shall be used for outlet protection with riprap:
    - If the discharge velocity at the outlet is less than 5 fps, use 2-inch to 8-inch riprap. Minimum thickness is 1-foot.
    - For 5 to 10 fps discharge velocity at the outlet, use 24-inch to 48-inch riprap. Minimum thickness is 2 feet.
    - For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), use an engineered energy dissipator.
    - Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion. See BMP C122: Nets and Blankets.
- Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. This work may require a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife. See I-2.11 Hydraulic Project Approvals.

Maintenance Standards

- Inspect and repair as needed.

- Add rock as needed to maintain the intended function.
- Clean energy dissipator if sediment builds up.

BMP C220: Inlet Protection

Purpose

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

Conditions of Use

Use inlet protection at inlets that are operational before permanent stabilization of the disturbed areas that contribute runoff to the inlet. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless those inlets are preceded by a sediment trapping BMP.

Also consider inlet protection for lawn and yard drains on new home construction. These small and numerous drains coupled with lack of gutters 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-3.10: Storm Drain Inlet Protection lists several options for inlet protection. All of the methods for inlet protection tend to plug and require a high frequency of maintenance. Limit contributing drainage areas for an individual inlet to one acre or less. If possible, provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

Table II-3.10: 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 may occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area requirement: 30'x30'/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	Paved or Earthen	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 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	N/A	N/A	18 month expected life.

Design and Installation Specifications

Excavated Drop Inlet Protection

Excavated drop inlet protection consists of 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 of 1-2 ft as measured from the crest of the inlet structure.
- Slope sides of excavation should be no steeper than 2H:1V.
- Minimum volume of excavation is 35 cubic yards.
- Shape the excavation to fit the site, with the longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water.

- Clear the area of all debris.

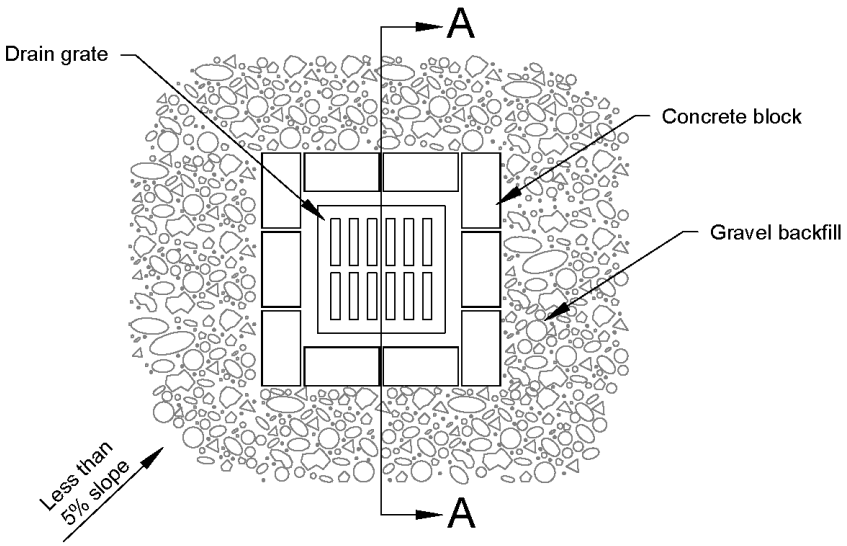
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope side of the structure to prevent bypass flow.

Block and Gravel Filter

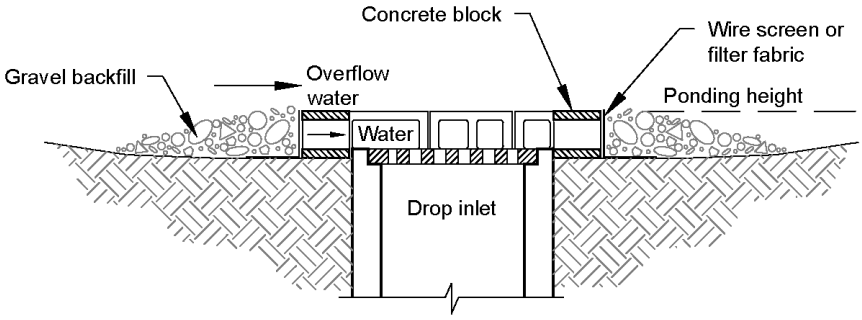
A block and gravel filter is a barrier formed around the inlet with standard concrete blocks and gravel. See Figure II-3.17: Block and Gravel Filter. Design and installation specifications for block gravel fil- ters include:

- Provide a height of 1 to 2 feet above the inlet.
- Recess the first row of blocks 2-inches into the ground for stability.
- Support subsequent courses by placing a pressure treated wood 2x4 through the block open- ing.
- Do not use mortar.
- Lay some blocks in the bottom row on their side to allow for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel to 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-3.17: Block and Gravel Filter



Plan View



Section A-A

Notes:

1. Drop inlet sediment barriers are to be used for small, nearly level drainage areas. (less than 5%)
2. Excavate a basin of sufficient size adjacent to the drop inlet.
3. The top of the structure (ponding height) must be well below the ground elevation downslope to prevent runoff from bypassing the inlet. A temporary dike may be necessary on the downslope side of the structure.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Block and Gravel Filter

Revised June 2016

Gravel and Wire Mesh Filter

Gravel and wire mesh filters are gravel barriers 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 aggregate over the entire inlet opening and extend at least 18-inches on all sides.

Catch Basin Filters

Catch basin filters are 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

Curb inlet protection with wooden weir is an option that consists of a barrier formed around a curb inlet with a wooden frame and gravel. Design and installation specifications for curb inlet protection with wooden weirs include:

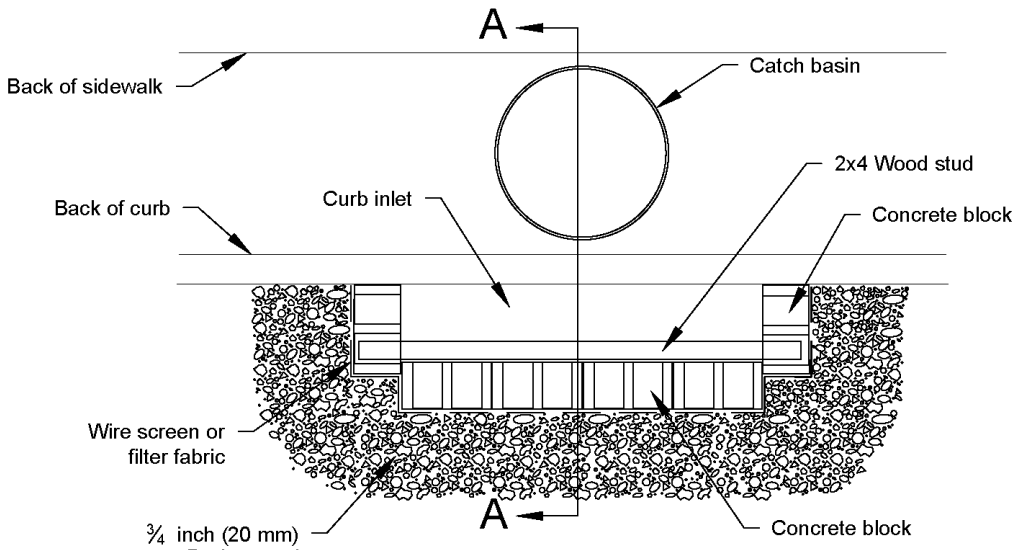
- Use wire mesh with ½-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against the wire and fabric.
- Place weight on the frame anchors.

Block and Gravel Curb Inlet Protection

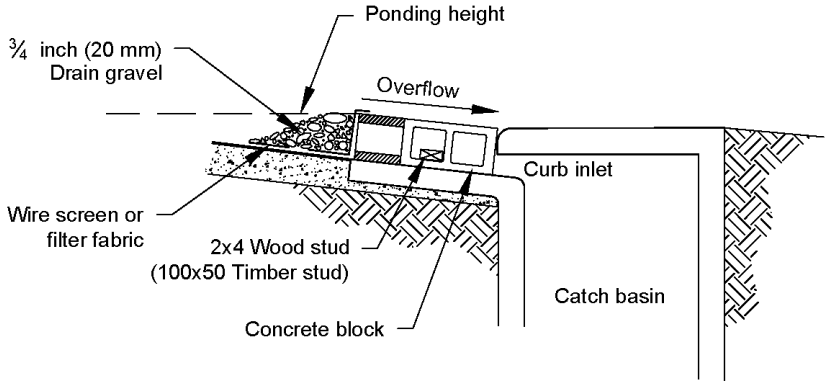
Block and gravel curb inlet protection is a barrier formed around a curb inlet with concrete blocks and gravel. See Figure II-3.18: Block and Gravel Curb Inlet Protection. Design and installation specifications for block and gravel curb inlet protection include:

- 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.

Figure II-3.18: Block and Gravel Curb Inlet Protection



Plan View



Section A-A

Notes:

1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Block and Gravel Curb Inlet Protection

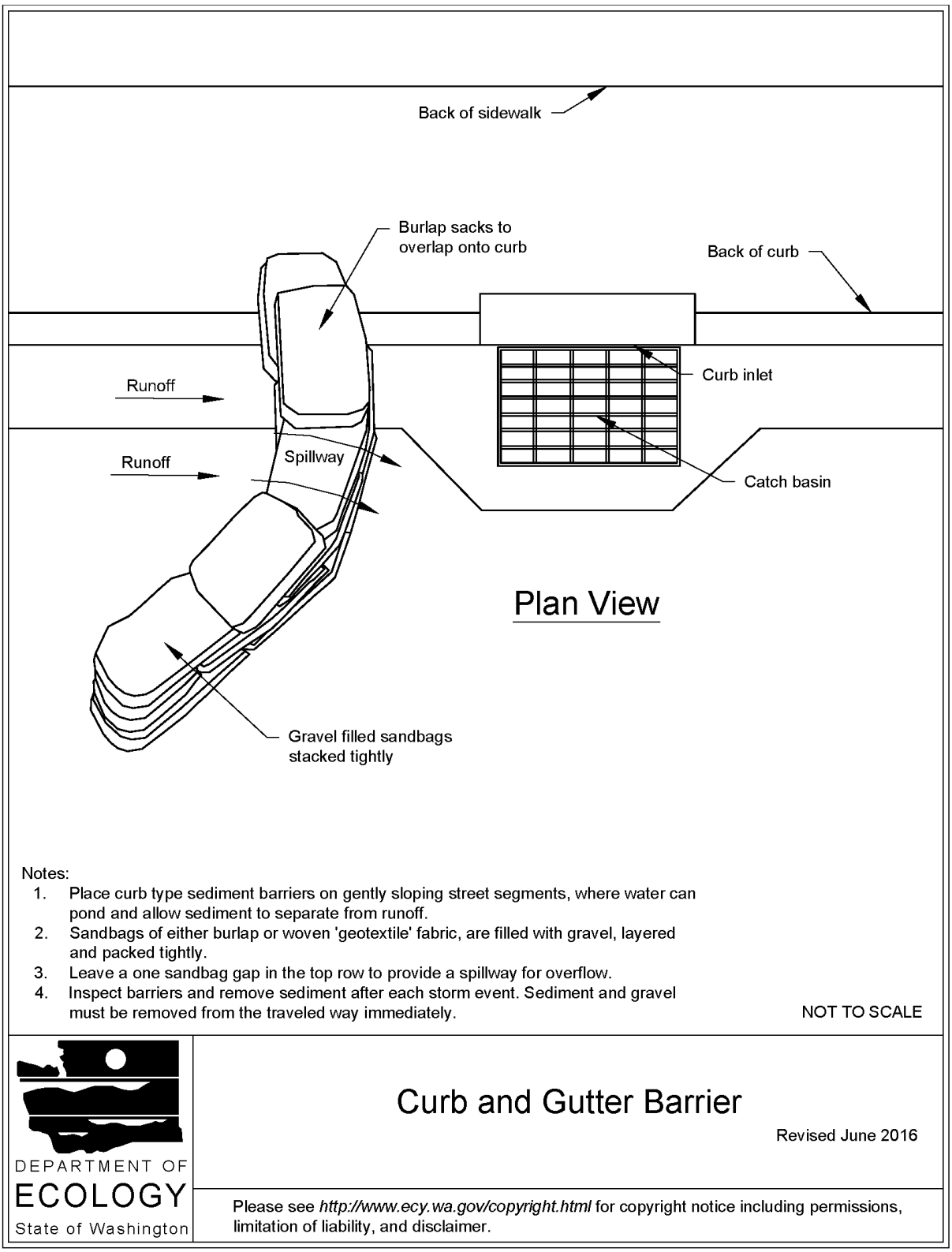
Revised June 2016

Curb and Gutter Sediment Barrier

Curb and gutter sediment barrier is a sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure II-3.19: Curb and Gutter Barrier. 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 trap to sediment trap standards for protecting a culvert inlet.

Figure II-3.19: Curb and Gutter Barrier



Maintenance Standards

- Inspect all forms of inlet protection frequently, especially after storm events. Clean and replace clogged catch basin filters. For rock and gravel filters, pull away the rocks from the inlet and clean or replace. An alternative approach would be to use the clogged rock as fill and put fresh rock 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.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent 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 C233: Silt Fence

Purpose

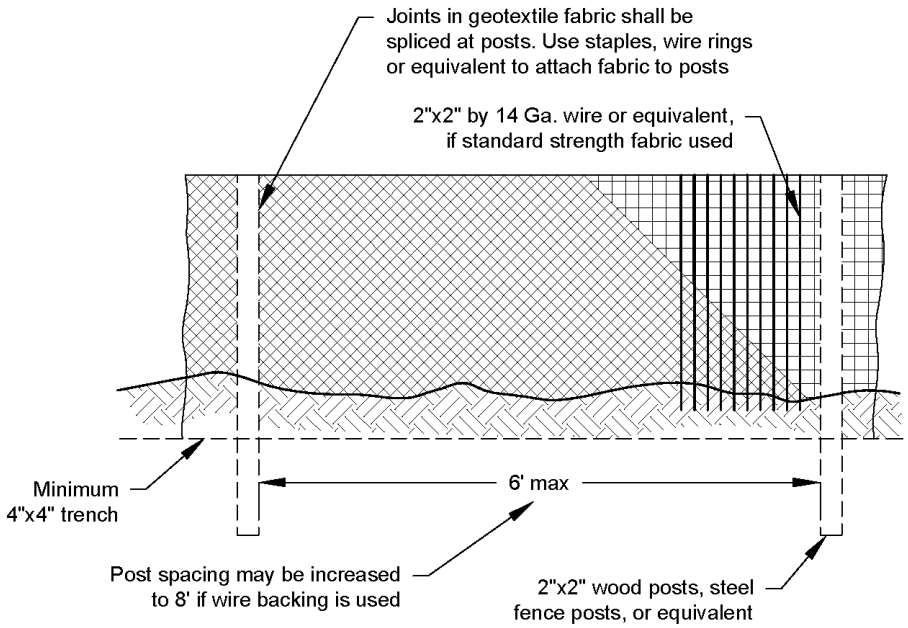
Silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

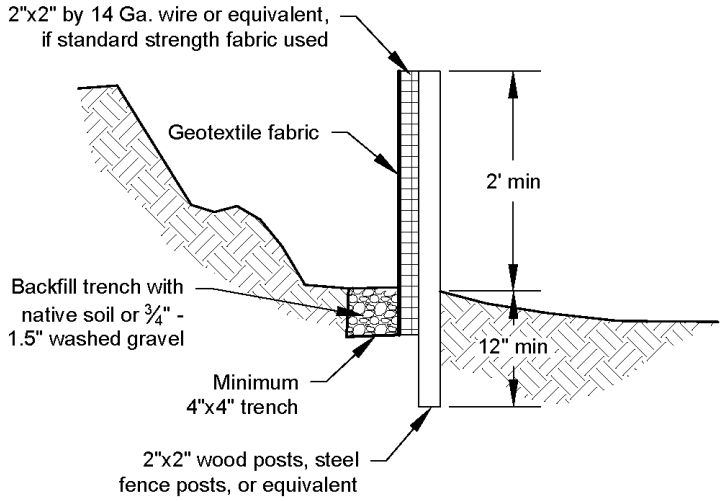
Conditions of Use

Silt fence may be used downslope of all disturbed areas.

- Silt fence shall prevent sediment carried by runoff 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 trapping BMP.
- Do not construct silt fences in streams or use in V-shaped ditches. Silt fences do not provide an adequate method of silt control for anything deeper than sheet or overland flow.

Figure II-3.22: Silt Fence





NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Silt Fence

Revised July 2017

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.
- Use geotextile fabric that meets 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-3.11: Geotextile Fabric Standards for Silt Fence):

Table II-3.11: Geotextile Fabric Standards for Silt Fence

Geotextile Property	Minimum Average Roll Value
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film woven (#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 geotextiles with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the geotextile. 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.
- One-hundred percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by the local jurisdiction.
- Refer to Figure II-3.22: Silt Fence for standard silt fence details. Include the following Standard Notes for silt fence on construction plans and specifications:

    1. The Contractor shall install and maintain temporary silt fences at the locations shown in the Plans.
    2. Construct silt fences in areas of clearing, grading, or drainage prior to starting those

activities.

3. The silt fence shall have a 2-feet min. and a 2½-feet max. height above the original ground surface.

4. The geotextile fabric shall be sewn together at the point of manufacture to form fabric lengths as required. Locate all sewn seams at support posts. Alternatively, two sections of silt fence can be overlapped, provided that the overlap is long enough and that the adjacent silt fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.

5. Attach the geotextile fabric on the up-slope side of the posts and secure with staples, wire, or in accordance with the manufacturer's recommendations. Attach the geotextile fabric to the posts in a manner that reduces the potential for tearing.

6. Support the geotextile fabric with wire or plastic mesh, dependent on the properties of the geotextile selected for use. If wire or plastic mesh is used, fasten the mesh securely to the up-slope side of the posts with the geotextile fabric up-slope of the mesh.

7. 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 geotextile fabric it supports.

8. Bury the bottom of the geotextile fabric 4-inches min. below the ground surface. Backfill and tamp soil in place over the buried portion of the geotextile fabric, so that no flow can pass beneath the silt fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the ground 3-inches min.

9. Drive or place the silt fence posts into the ground 18-inches min. A 12–inch min. depth is allowed if topsoil or other soft subgrade soil is not present and 18-inches cannot be reached. Increase fence post min. depths 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.

10. Use wood, steel or equivalent posts. The spacing of the support posts shall be a maximum of 6-feet. Posts shall consist of either:

    - Wood with minimum dimensions of 2 inches by 2 inches by 3 feet. Wood shall be free of defects such as knots, splits, or gouges.
    - No. 6 steel 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.

11. Locate silt fences 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.

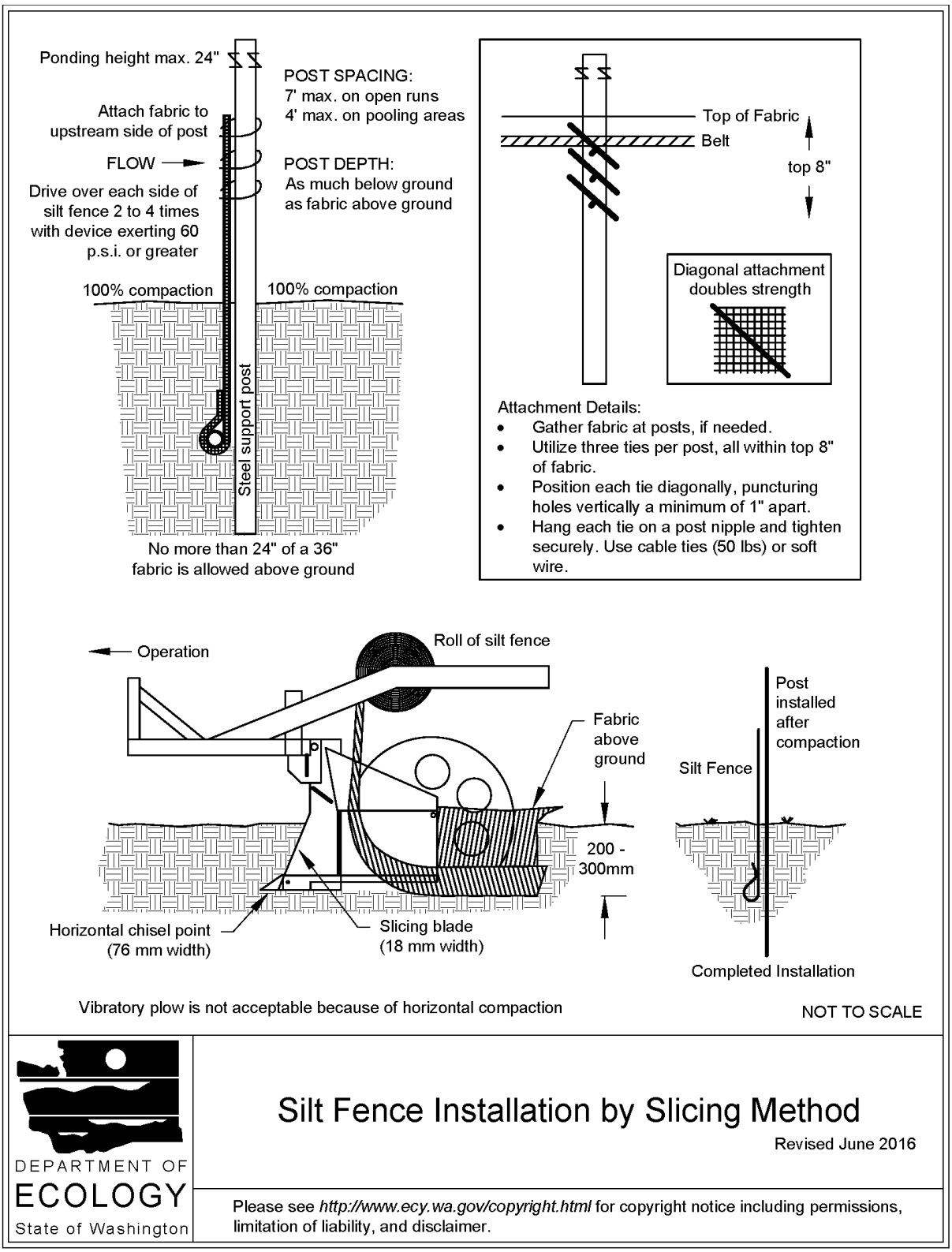
12. If the fence must cross contours, with the exception of the ends of the fence, place check dams perpendicular to the back of the fence to minimize concentrated flow and erosion. The slope of the fence line where contours must be crossed shall not be steeper than 3H:1V.

    - Check dams shall be approximately 1-foot deep at the back of the fence. Check dams 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.
    - Check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. Check dams shall be located every 10 feet along the fence where the fence must cross contours.

- Refer to Figure II-3.23: Silt Fence Installation by Slicing Method for slicing method details. The following are specifications for silt fence installation using the slicing method:

    1. The base of both end posts must be at least 2- to 4-inches above the top of the geotextile 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 geotextile fabric, enabling posts to support the geotextile fabric from upstream water pressure.
    4. Install posts with the nipples facing away from the geotextile fabric.
    5. Attach the geotextile 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. Each tie should be positioned to hang on a post nipple when tightening to prevent sagging.
    6. Wrap approximately 6-inches of the geotextile fabric around the end posts and secure with 3 ties.
    7. No more than 24-inches of a 36-inch geotextile fabric is allowed above ground level.
    8. Compact the soil immediately next to the geotextile 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. Check and correct the silt fence installation for any deviation before compaction. Use a flat-bladed shovel to tuck the fabric deeper into the ground if necessary.

Figure II-3.23: Silt Fence Installation by Slicing Method



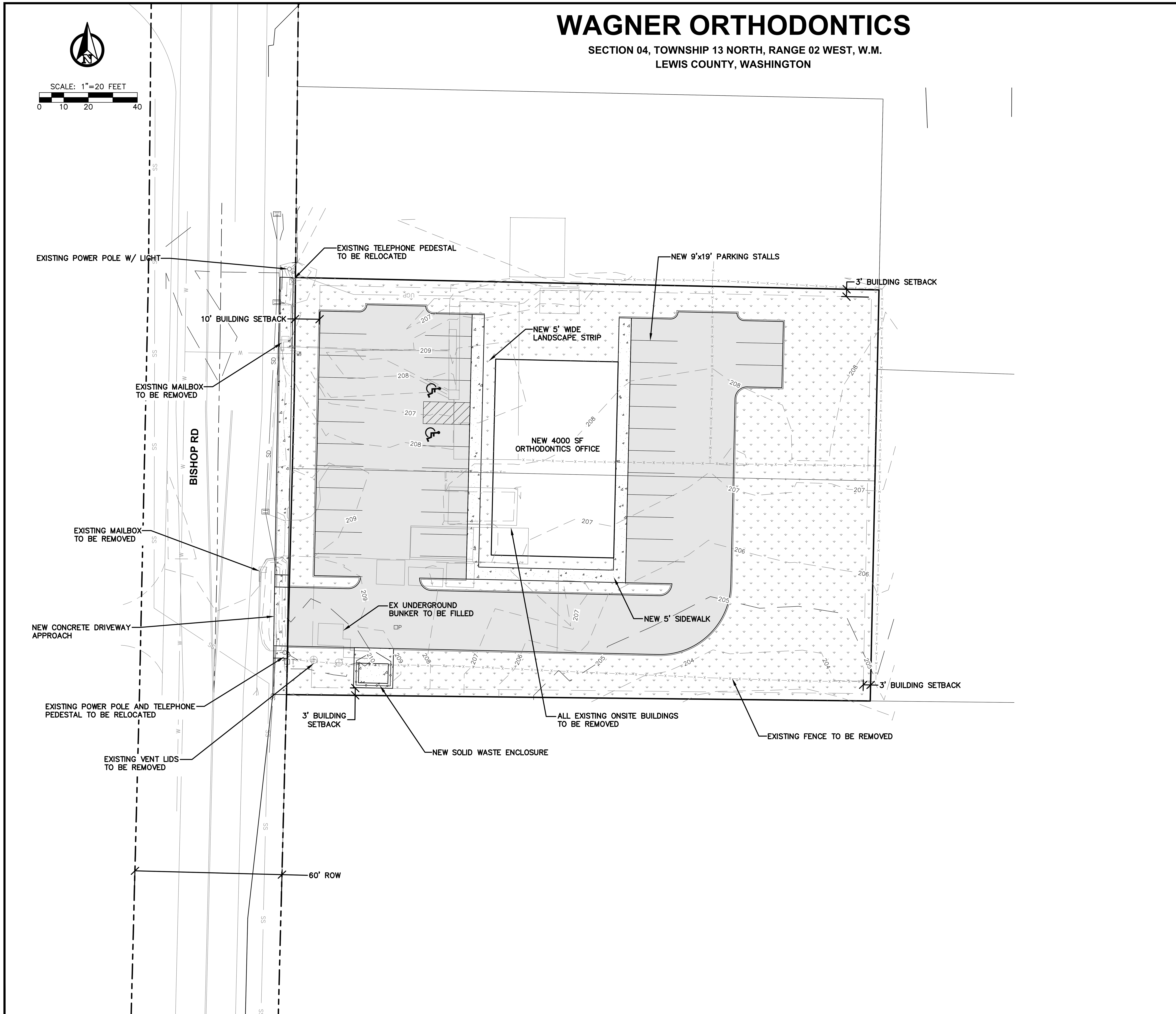
Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment trapping BMP.
- Check the uphill side of the silt 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.
- Remove sediment deposits when the deposit reaches approximately one-third the height of the silt fence, or install a second silt fence.
- Replace geotextile fabric that has deteriorated due to ultraviolet breakdown.

APPENDIX 6 – DRAINAGE AND TESC PLANS

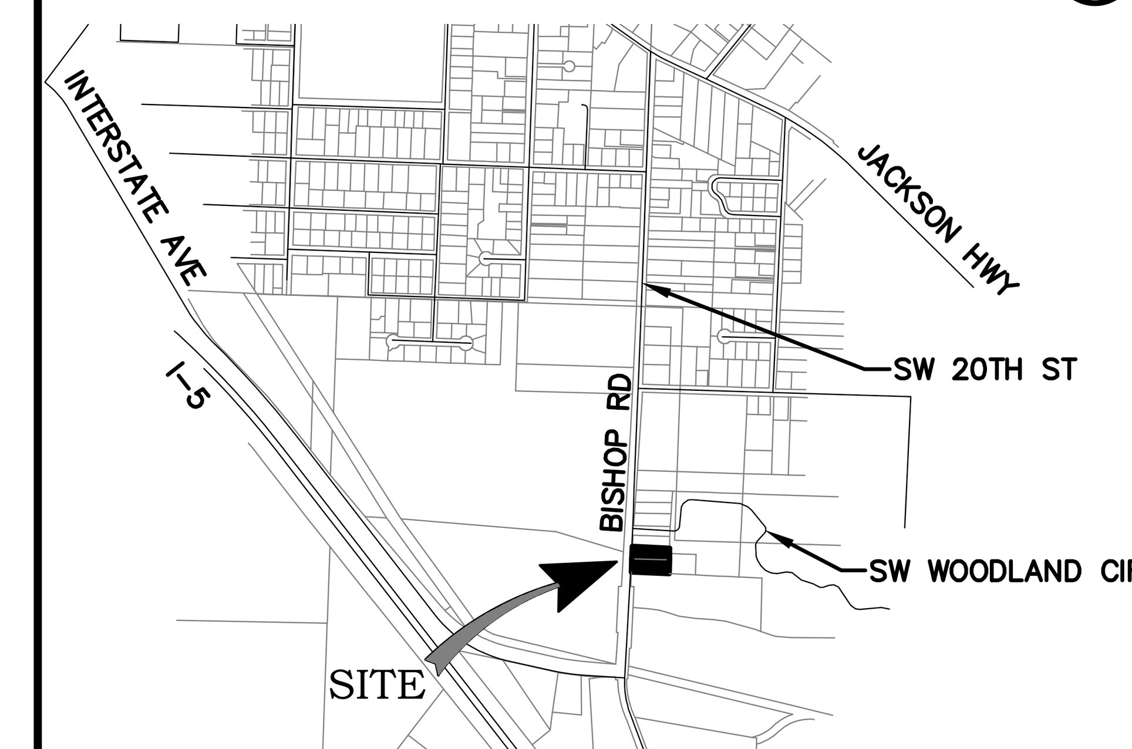
WAGNER ORTHODONTICS

SECTION 04, TOWNSHIP 13 NORTH, RANGE 02 WEST, W.M.
LEWIS COUNTY, WASHINGTON



VICINITY MAP

N.T.S.



PROJECT INFORMATION

APPLICANT:	PETER WAGNER (360) 269 6993 PETER_WAGNER3@HOTMAIL.COM
PARCEL NOS:	010480000000 010479000000
SITE ADDRESS:	1319 & 1327 BISHOP RD CHEHALIS, WA 98532
ZONING:	CG – GENERAL COMMERCIAL
SITE AREA:	0.44 ACRES EACH
GRADING:	XX± CY FILL
SOILS:	LACAMAS SILT LOAM PRATHER SILTY CLAY LOAM
SANITARY SEWER:	CITY OF CHEHALIS
WATER:	CITY OF CHEHALIS
FIRE DISTRICT:	LEWIS COUNTY

SHEET INDEX

NO.	DATE	REVISION

DESIGNED BY: ZRW
DRAWN BY: ZRW
CHECKED BY: RWB
DATE: 7/6/22
SCALE:

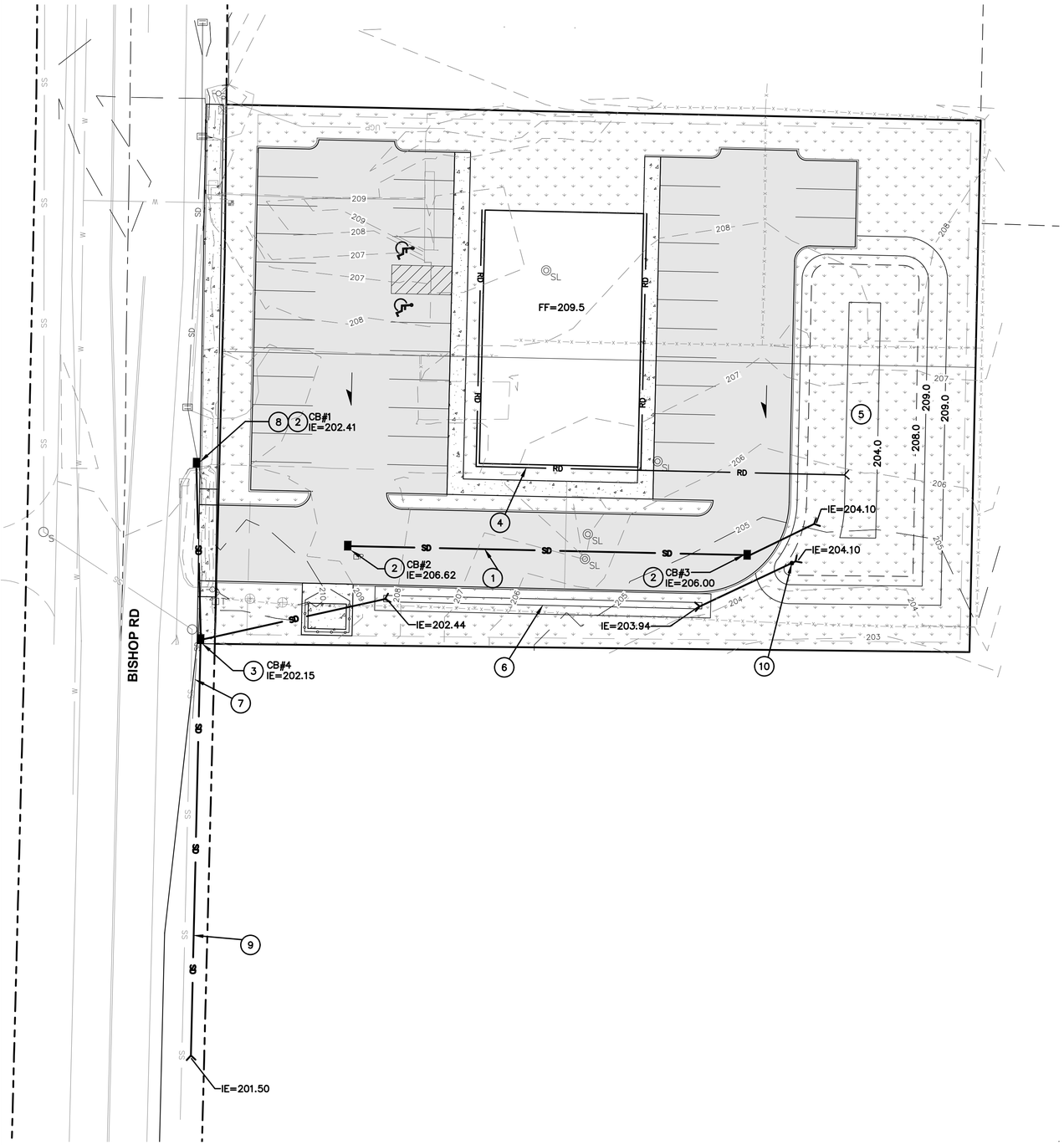
WAGNER ORTHODONTICS
CHEHALIS WA.

PRELIMINARY SITE PLAN

RB Engineering
DESIGN → PERMIT → MANAGE
P.O. Box 923
CHEHALIS, WA 98532
OFF: (360) 740-8919
EMAIL: CivilPros@RBEngineers.com

JOB NUMBER 21140
DRAWING NAME 21140_PSP

P0.1
1 OF 6



SCALE: 1"=20 FEET

0 10 20 40

GRADING AND DRAINAGE CONSTRUCTION NOTES:

1. INSTALL ADS N-12 OR EQUAL STORM DRAIN PIPE PER PLAN.
2. INSTALL TYPE 1 CATCHBASINS PER PLAN AND DETAIL ON SHEET P1.4.
3. INSTALL NEW CURB INLET CATCH BASIN PER PLAN AND DETAIL ON SHEET P1.4.
4. INSTALL 6 INCH SDR 35 PVC ROOF DRAIN.
5. GRADE NEW DETENTION POND PER PLAN AND CROSS SECTION ON SHEET P1.4.
6. GRADE NEW 2' WIDE BIO-SWALE PER PLAN AND DETAIL ON SHEET P1.4.
7. REMOVE EXISTING STORM CULVERT.
8. CONNECT EXISTING STORM PIPE TO NEW CATCH BASIN.
9. DAYLIGHT NEW STORM PIPE TO EXISTING DITCH ROUGHLY 130' SOUTH OF PROPERTY.
10. INSTALL FLOW CONTROL STRUCTURE IN POND PER PLAN AND DETAIL ON SHEET P1.4.

NO.	DATE	REVISION

DESIGNED BY: ZRW
DRAWN BY: ZRW
CHECKED BY: RWB
DATE: 7/6/22
SCALE:

WAGNER ORTHODONTICS

CHEHALIS WA.

PRELIMINARY GRADING AND DRAINAGE PLAN

ROBERT W. BAKEWELL
REGISTERED PROFESSIONAL ENGINEER

RB Engineering
DESIGN → PERMIT → MANAGE
P.O. Box 923
CHEHALIS, WA. 98532
OFF: (360) 740-8919
EMAIL: CivilRobB@Engineer.com

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

JOB NUMBER
21140

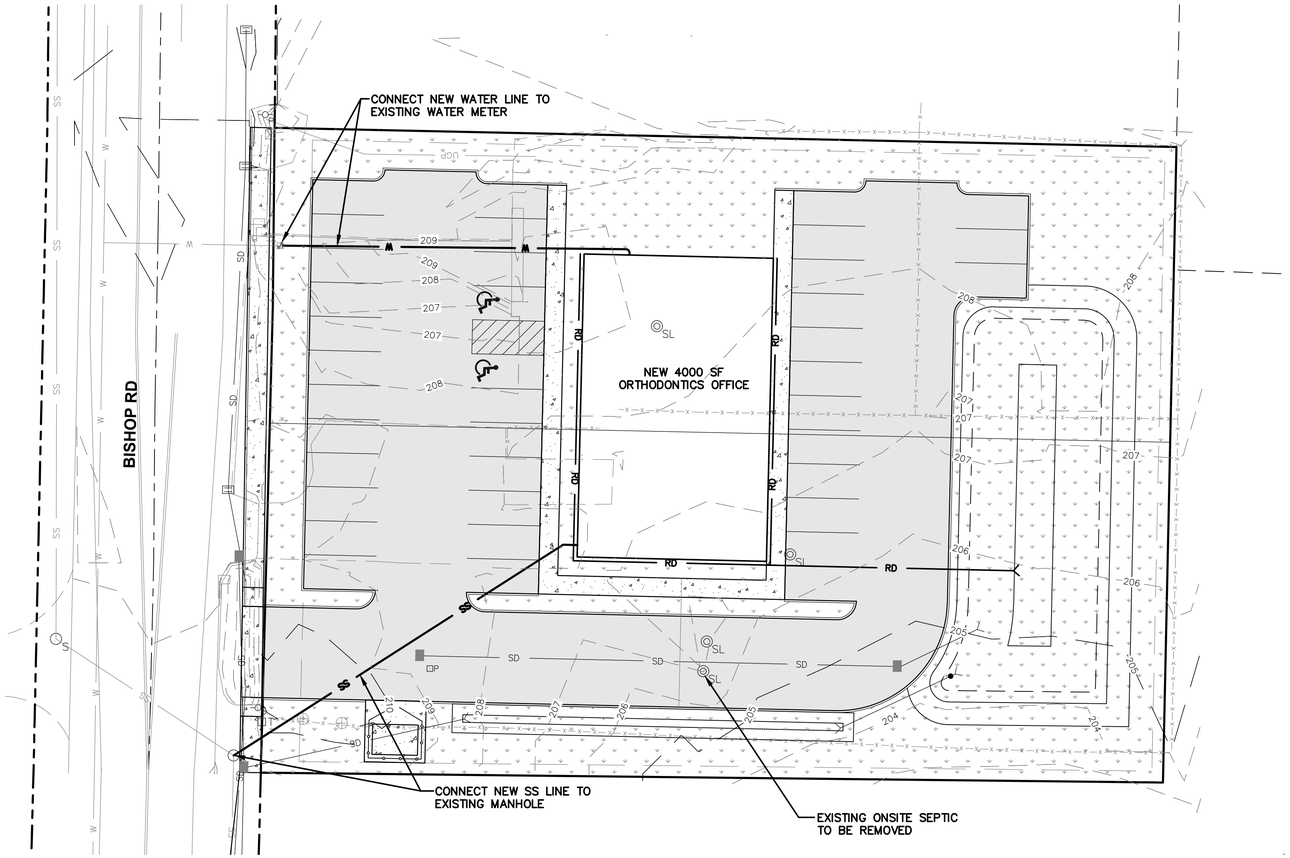
DRAWING NAME
21140_PGDP

P1.1

2 OF 6

SCALE: 1"=20 FEET

0 10 20 40



NO.	DATE	REVISION

DESIGNED BY: ZRW
DRAWN BY: ZRW
CHECKED BY: RWB
DATE: 7/6/22
SCALE:

WAGNER ORTHODONTICS

CHEHALIS WA.

PRELIMINARY UTILITY PLAN

ROBERT W. BAKER
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

RB Engineering
DESIGN → PERMIT → MANAGE
P.O. Box 923
CHEHALIS, WA 98532
OFF: (360) 740-8919
EMAIL: CivilPros@RBEngineers.com

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

JOB NUMBER 21140

DRAWING NAME 21140_PUP

P1.2

3 OF 6

SCALE: 1"=20 FEET

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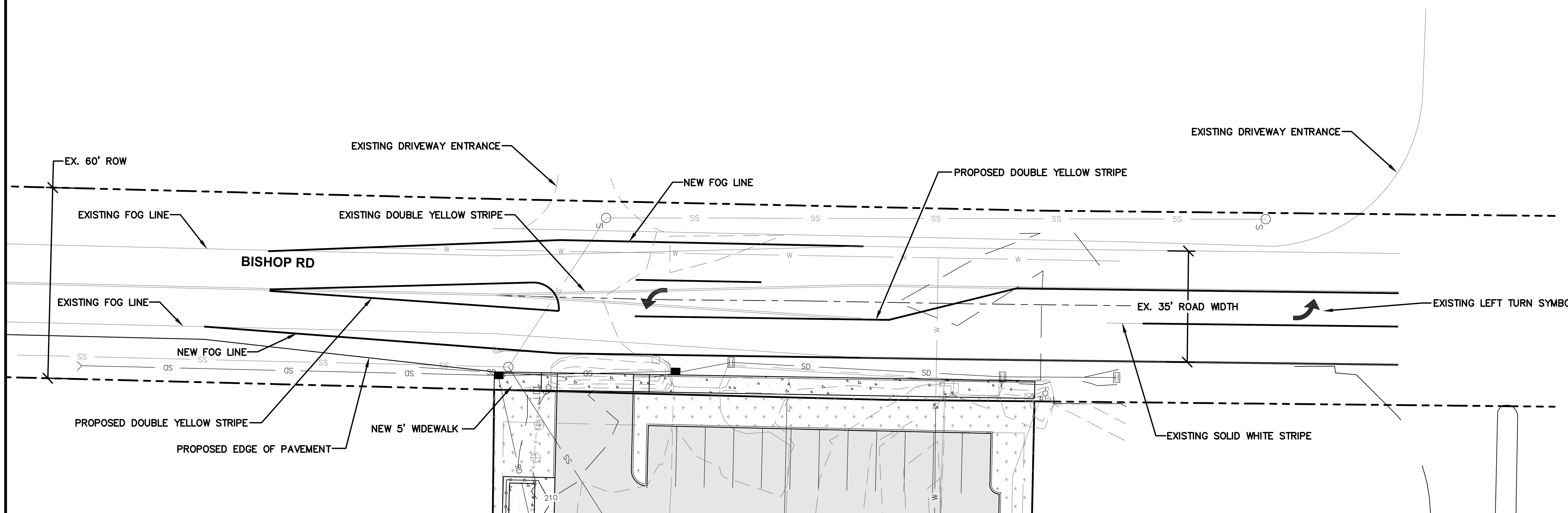
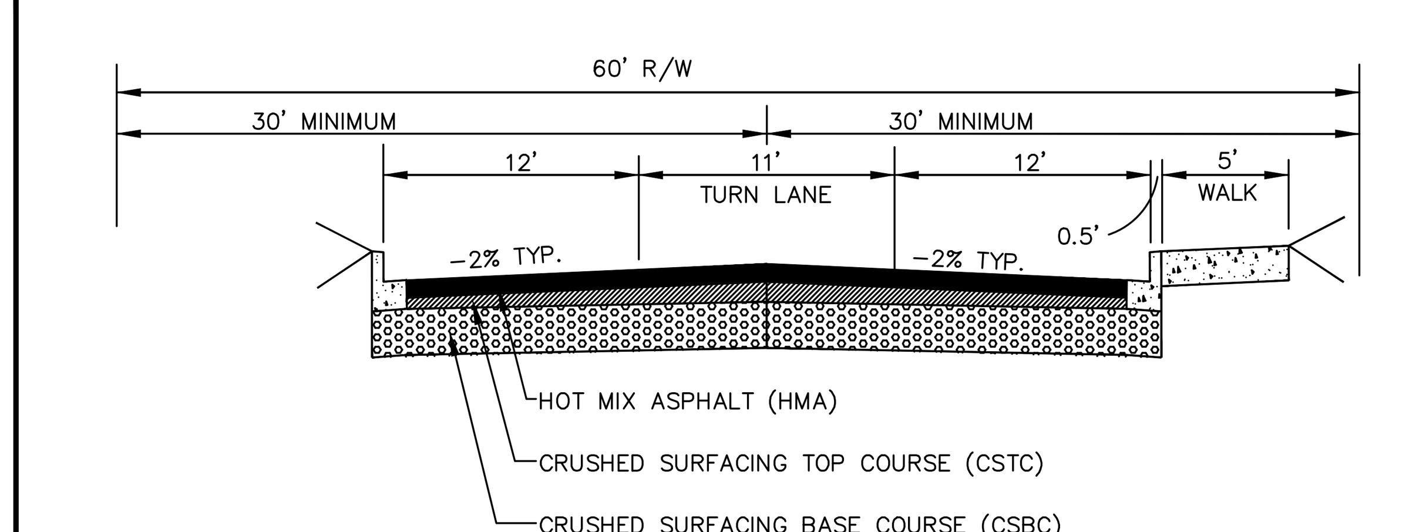




ROAD SECTION

NO.	DATE	REVISION

DESIGNED BY: ZRW
DRAWN BY: ZRW
CHECKED BY: RWB
DATE: 7/6/22
SCALE:

WAGNER ORTHODONTICS

CHEHALIS WA.

PRELIMINARY FRONTAGE IMPROVEMENT PLAN

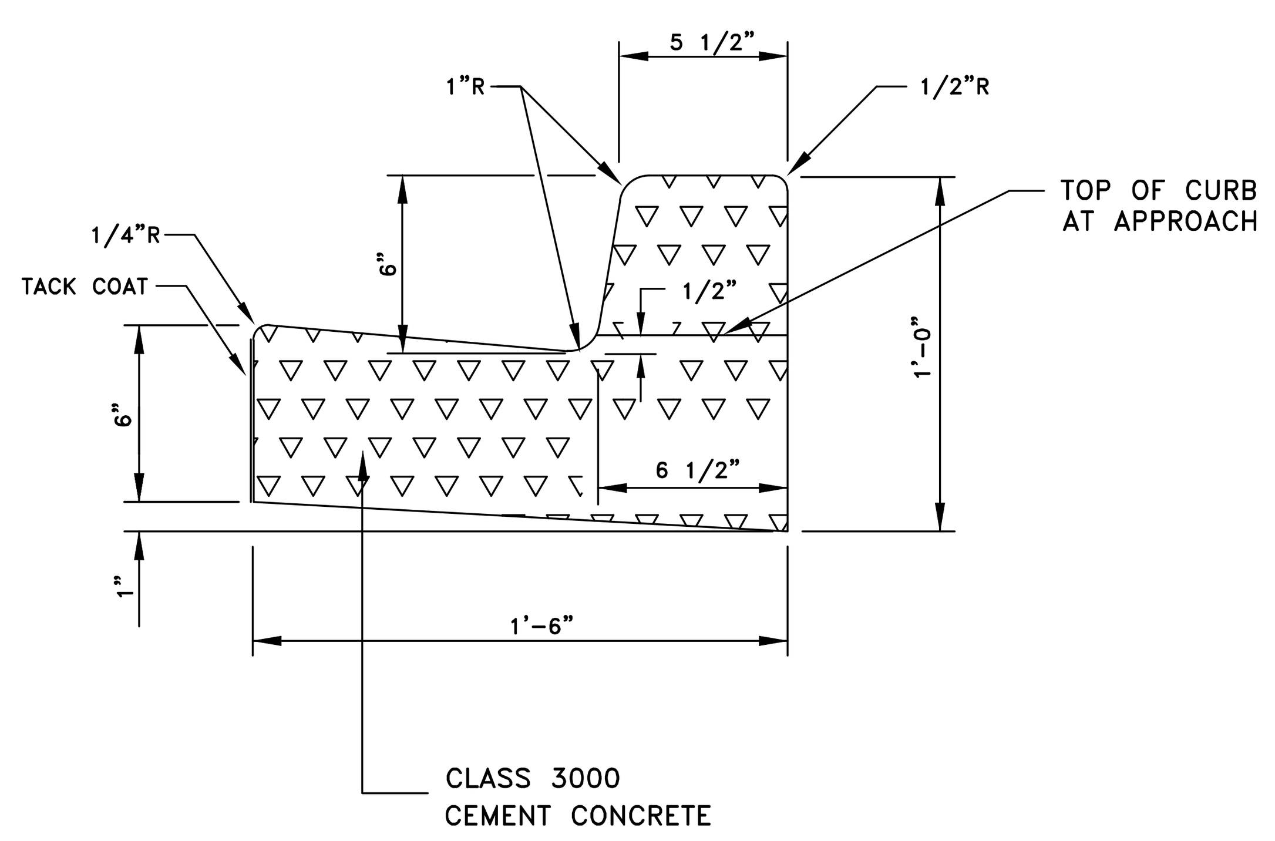
ROBERT W. BALMELLI — REGISTERED PROFESSIONAL ENGINEER

RB Engineering
DESIGN → PERMIT → MANAGE
P.O. Box 923
CHEHALIS, WA 98532
OFF: (360) 740-8919
EMAIL: CaliPros@RBEngineers.com

JOB NUMBER 21140

DRAWING NAME 21140_PFIP

P1.3

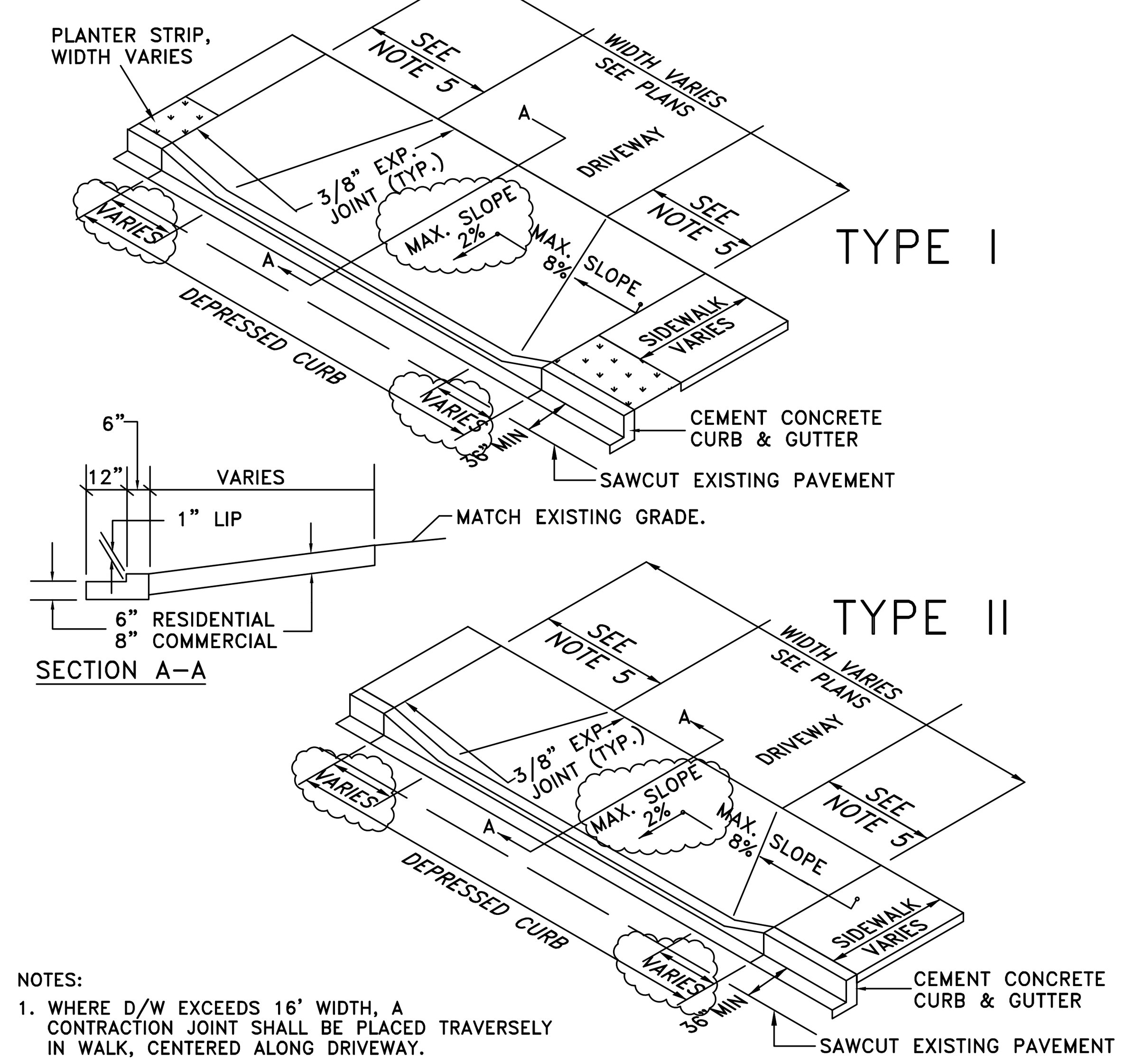


GENERAL NOTES:

1. EXPANSION JOINT MATERIAL TO BE 3/8" THICK PREMOLDED JOINT FILLER FULL THICKNESS OF CONCRETE.
2. FORM AND SUBGRADE INSPECTION REQUIRED BEFORE POURING CONCRETE.
3. SUBGRADE AND BASE REQUIREMENTS SHALL BE THE SAME AS FOR PAVEMENT RESTORATION.

Drawing Not to Scale

City of Chehalis	
CEMENT CONCRETE CURB & GUTTER	
APPROVED BY	DWG. NO. 2-7
	REVISED DATE 1/02/2003
CITY ENGINEER	

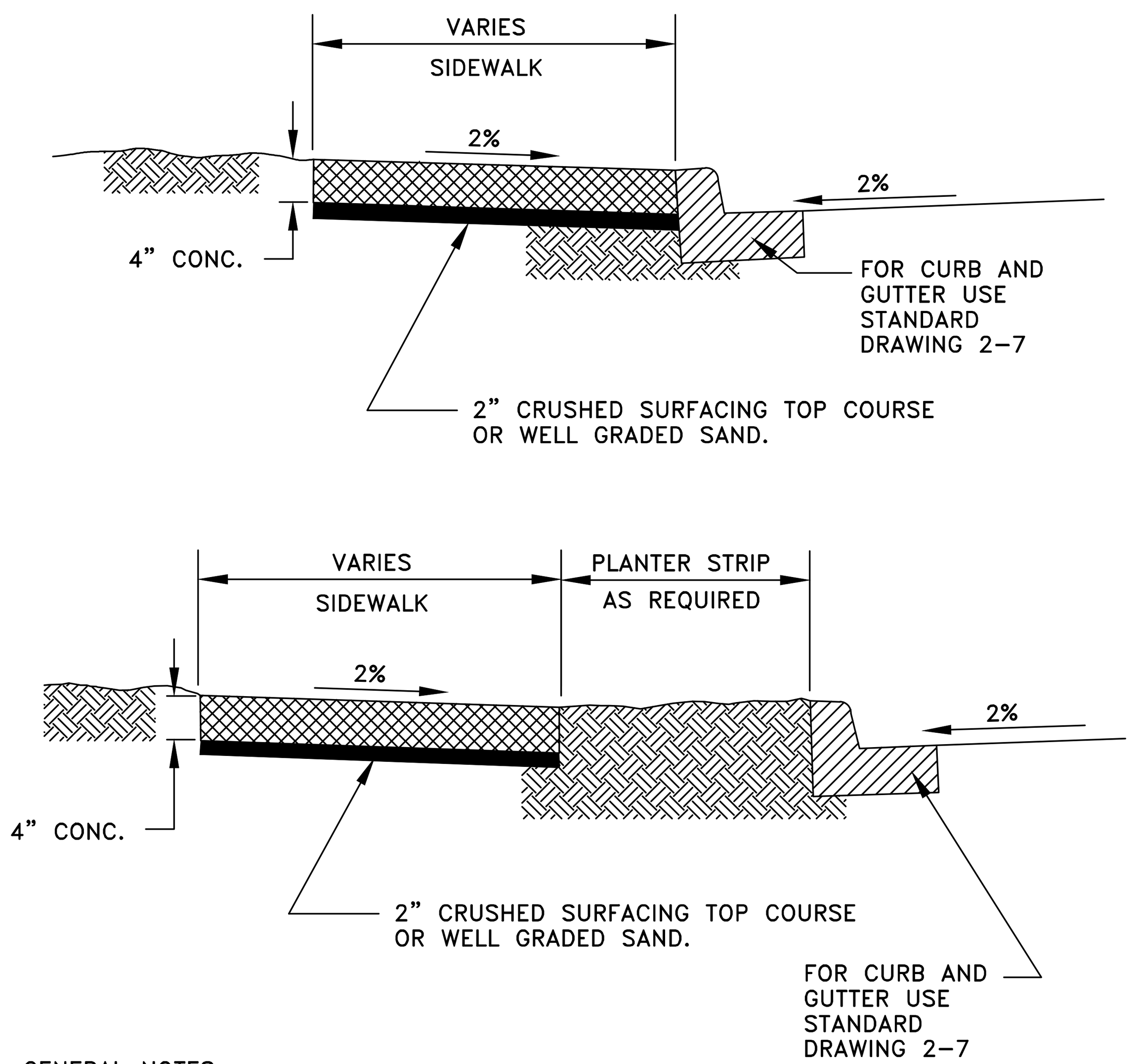


NOTES:

1. WHERE D/W EXCEEDS 16' WIDTH, A CONTRACTION JOINT SHALL BE PLACED TRAVERSELY IN WALK, CENTERED ALONG DRIVEWAY.
2. EXPANSION JOINTS ARE REQUIRED TO ENSURE ISOLATION WHEN NEW CONCRETE IS PLACED AGAINST EXISTING CONCRETE OR EXISTING FEATURES.
3. EXPANSION JOINT MATERIAL TO BE 3/8" THICK PREMOLDED JOINT FILLER FULL THICKNESS.
4. FORM AND SUBGRADE INSPECTION ARE REQUIRED BEFORE PLACING CONCRETE.
5. TRANSITION WIDTH WILL VARY DEPENDING ON DRIVEWAY SLOPE. MAINTAIN MAXIMUM 12:1 TRANSITION SLOPE.
6. WHEN CHECKED WITH A 10 FOOT STRAIGHTEDGE, GRADE SHALL NOT DEVIATE MORE THAN 1/8 INCH & ALIGNMENT SHALL NOT VARY MORE THAN 1/4 INCH.
7. BROOM FINISH LONGITUDINALLY WITH LIGHT BROOM FINISH.

Drawing Not to Scale

City of Chehalis	
CEMENT CONCRETE DRIVEWAY	
APPROVED BY	DWG. NO. 2-8
	REVISED DATE 4/14/2010
CITY ENGINEER	

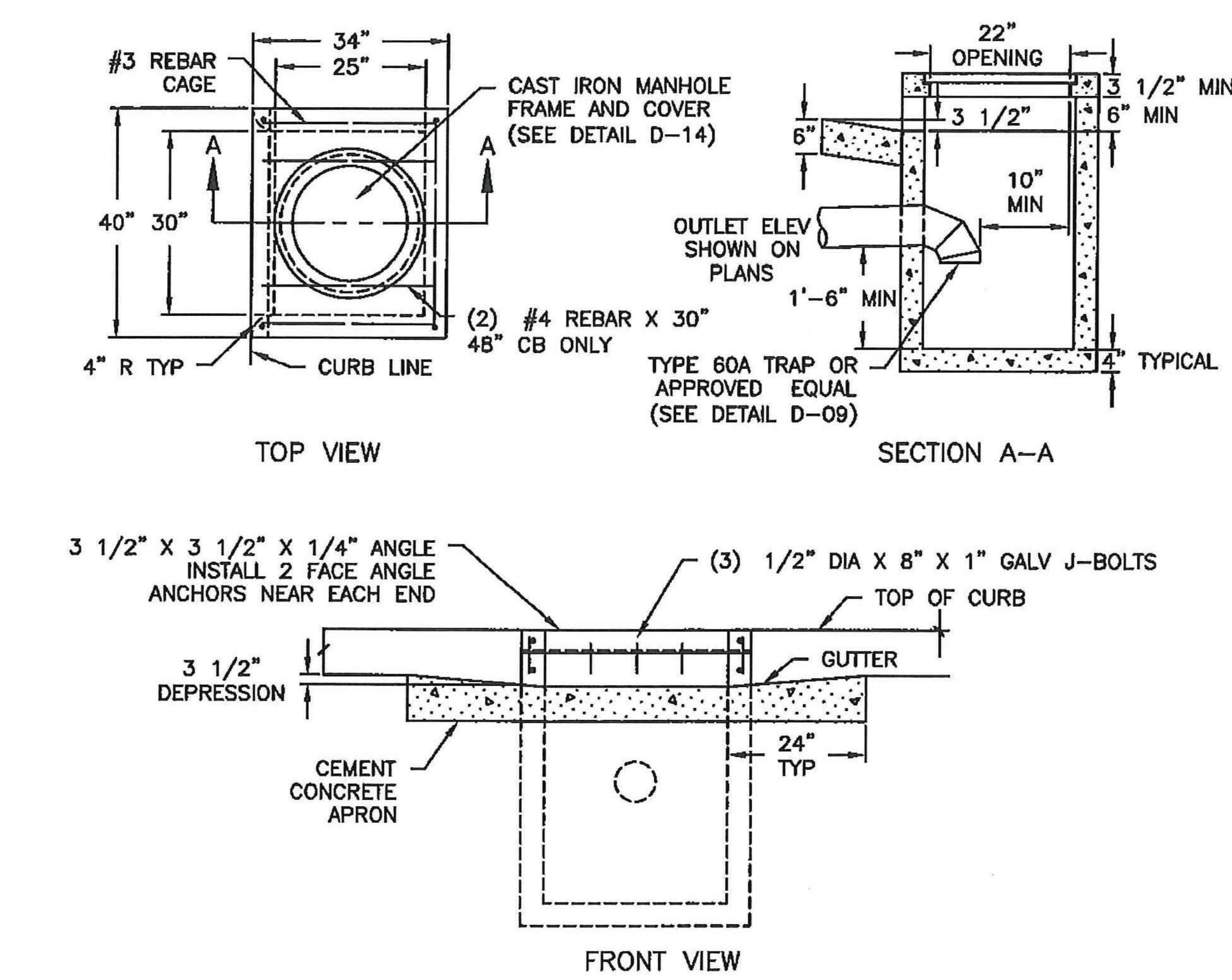


GENERAL NOTES:

1. REFER TO STANDARD DRAWING 2-10 FOR INFORMATION ON JOINTS AND SCORING.
2. SIDEWALK ACROSS CONCRETE DRIVEWAYS REQUIRE A MINIMUM DEPTH OF 6" FOR RESIDENTIAL DRIVES & 8" FOR ALL OTHER DRIVES.
3. WHEN CHECKED WITH A 10' STRAIGHTEDGE, GRADE SHALL NOT DEVIATE MORE THAN 1/8 INCH & ALIGNMENT SHALL NOT VARY MORE THAN 1/4 INCH.

Drawing Not to Scale

City of Chehalis	
SIDEWALK	
APPROVED BY	DWG. NO. 2-9
	REVISED DATE 1/02/2003
CITY ENGINEER	



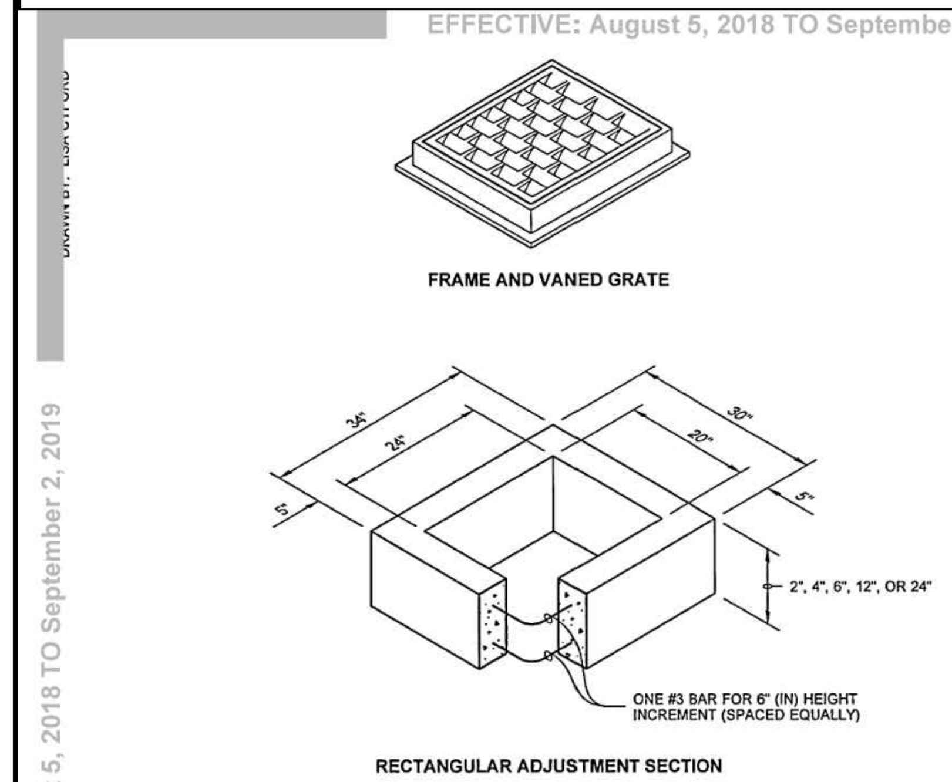
NOTES:

1. LATERALS WILL BE CONSTRUCTED TO ENTER THE BASIN PERPENDICULAR TO THE BASIN WALL. THE LATERAL WILL ENTER ONLY AT THE FRONT OR SIDE OF THE BASIN WITH NO LATERALS ALLOWED TO ENTER THE CATCH BASIN AT THE CORNERS. IF NEEDED, A BEND MAY BE USED AS THE FIRST SECTION OF PIPE OUTSIDE THE BASIN WALL. THE MAXIMUM BEND ALLOWED IS 45 DEGREES.
2. ALL REINFORCED STEEL SHALL HAVE A 1-1/2" CLEAR COVER UNLESS OTHERWISE NOTED, AND SHALL BE GRADE 40 OR GRADE 60 (ASTM A-615)
3. ANY PROTRUDING ENDS OF PIPES SHALL BE TRIMMED FLUSH WITH THE INSIDE WALLS AND GROUTED.
4. THE METAL FRAME AND GRATE SHALL BE SET TO A SLOPE TO CONFORM TO THE PARTICULAR DRAINAGE AREA (SEE DETAIL D-08).
5. ELBOW SECTION SHALL BE REMOVABLE FOR MAINTENANCE PURPOSES USING A BELL AND SPIGOT JOINT.
6. ALL PRECAST OR CAST-IN-PLACE CONCRETE SHALL BE CLASS 4000.

Drawing Not to Scale

City of Chehalis
CURB INLET

EFFECTIVE: August 5, 2018 TO September 2, 2019

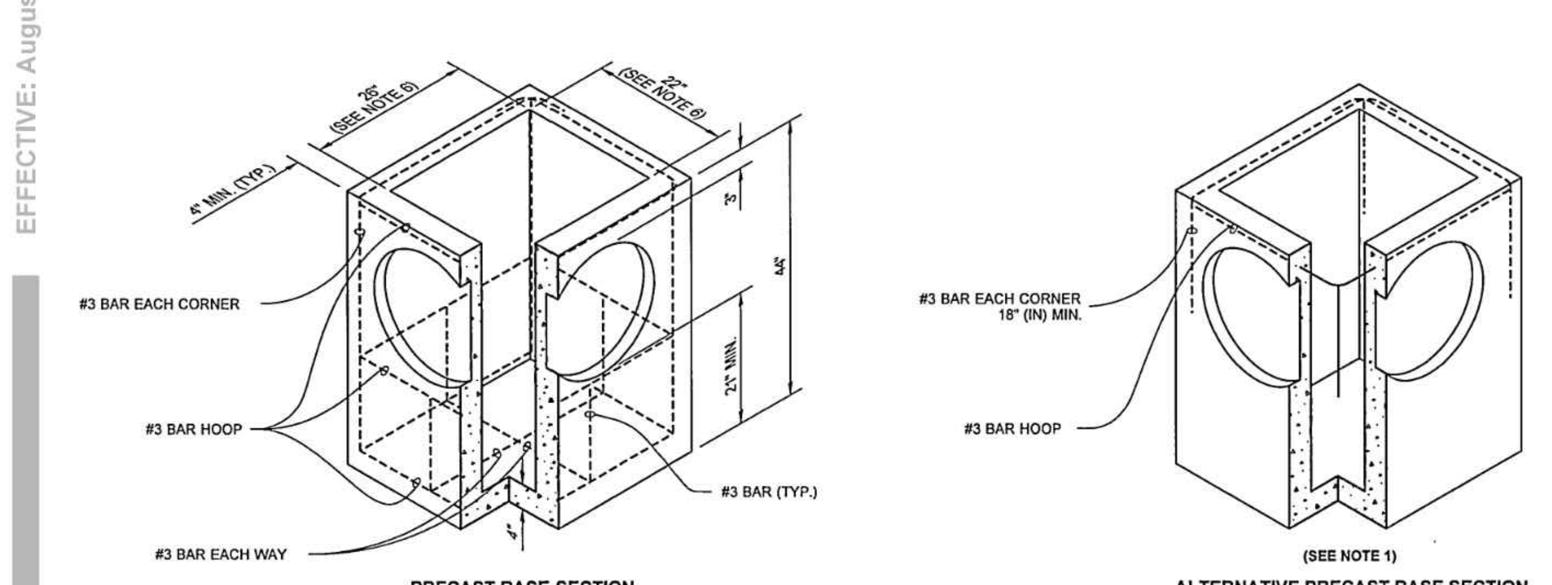


PIPE ALLOWANCES	
PIPE MATERIAL	MAXIMUM INSIDE DIAMETER (INCHES)
REINFORCED OR PLAIN CONCRETE	12"
ALL METAL PIPE	15"
CPSSP ★ (STD. SPEC. SECT. 9-05.20)	12"
SOLID WALL PVC (STD. SPEC. SECT. 9-05.12(1))	15"
PROFILE WALL PVC (STD. SPEC. SECT. 9-05.12(2))	15"

★ CORRUGATED POLYETHYLENE STORM SEWER PIPE

NOTES

1. As acceptable alternatives to the rebar shown in the **PRECAST BASE SECTION**, fibers (placed according to the Standard Specifications), or wire mesh having a minimum area of 0.12 square inches per foot shall be used with the minimum required rebar shown in the ALTERNATIVE **PRECAST BASE SECTION**. Wire mesh shall not be placed in the knockouts.
2. The knockout diameter shall not be greater than 20" (in). Knockouts shall have a wall thickness of 2" (in) minimum to 2.5" (in) maximum. Provide a 1.5" (in) minimum gap between the knockout wall and the outside of the pipe. After the pipe is installed, fill the gap with joint mortar in accordance with **Standard Specification Section 9-04.3.**
3. The maximum depth from the finished grade to the lowest pipe invert shall be 5' (ft).
4. The frame and grate may be installed with the flange down, or integrally cast into the adjustment section with flange up.
5. The Precast Base Section may have a rounded floor, and the walls may be sloped at a rate of 1 : 24 or steeper.
6. The opening shall be measured at the top of the **Precast Base Section.**
7. All pickup holes shall be grouted full after the basin has been placed.



Heilman, Julie
Jun 25 2017 2:53 PM

CATCH BASIN TYPE 1

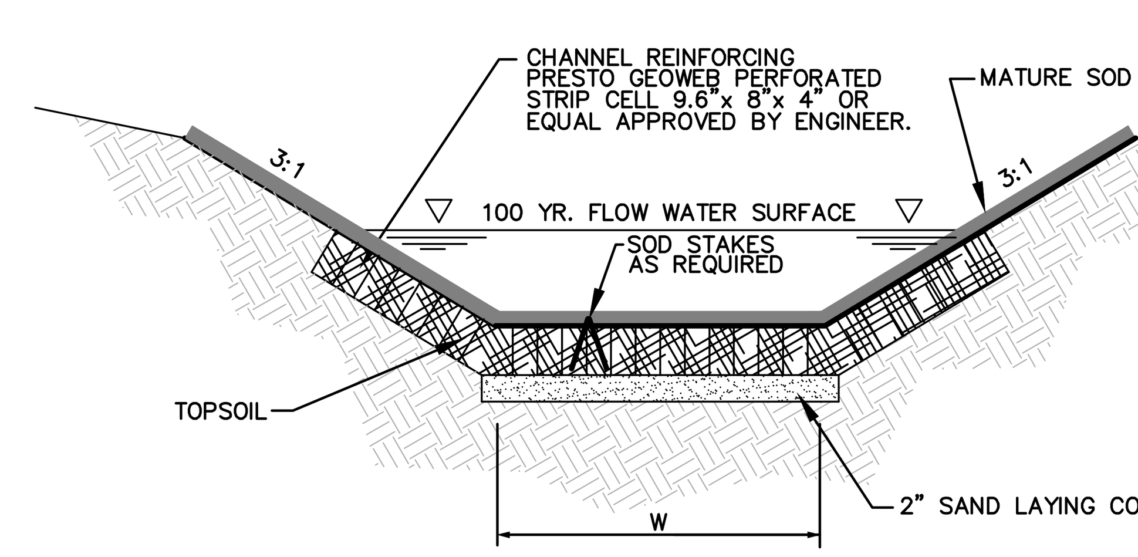
STANDARD PLAN B-5.20-02

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION

Washington State Department of Transportation

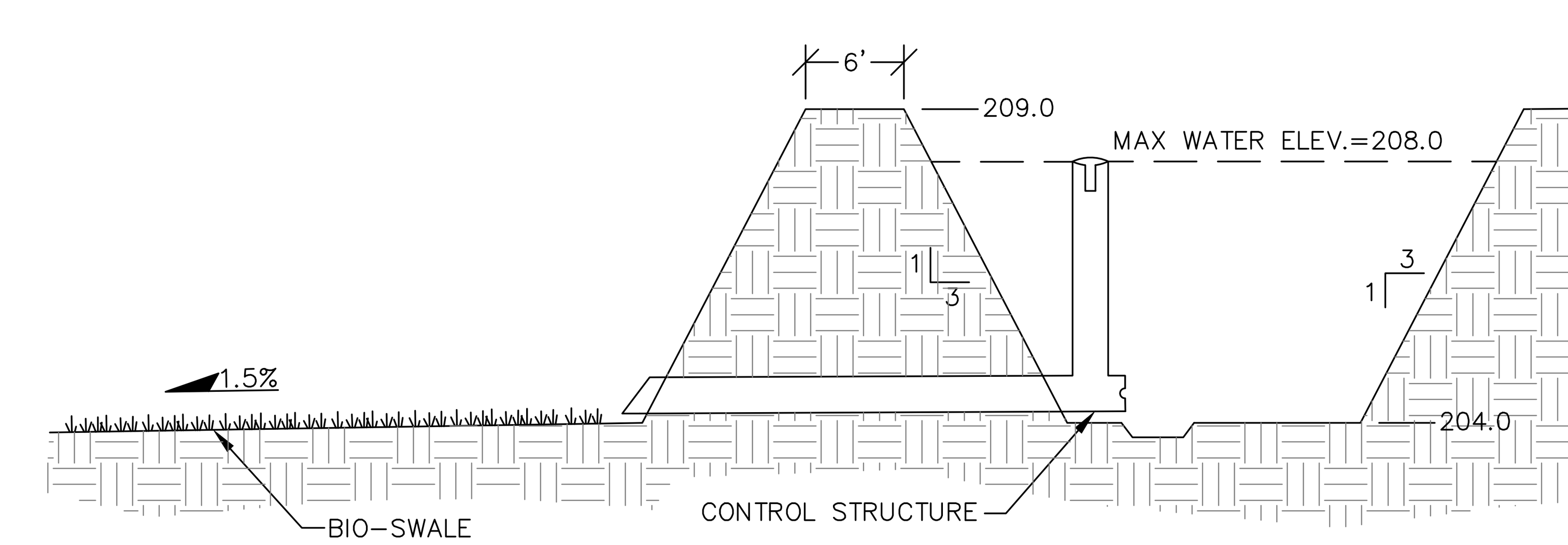
EFFECTIVE: August 5, 2018 TO September 2, 2019



NOTES:

1. THE UNCOMPACTED SAND LAYING COURSE SHALL BE SPREAD EVENLY OVER THE SUBGRADE, SCREEDED LEVEL AND COMPACTED.
2. ONCE SCREEDED, LEVELED, AND COMPACTED TO THE DESIRED ELEVATION THIS SAND LAYING COURSE SHALL NOT BE DISTURBED IN ANY WAY.
3. MATURE SOD (6 MONTHS OLD)
   40% TALL FESCUE
   30% PERENNIAL RYE
   20% CREEPING FESCUE
   10% HIGHLAND BENT

BIOFILTRATION SWALE DETAIL N.T.S.	RB ENGINEERING
	BIOFIL_SWALE.2.dwg



DETENTION POND N.T.S.	RB ENGINEERING
	DTN_PND.dwg

NO.	DATE	REVISION

DESIGNED BY: ZRW
DRAWN BY: ZRW
CHECKED BY: RWB
DATE: 7/6/22
SCALE:

WAGNER ORTHODONTICS
CHEHALIS WA.

PRELIMINARY DETAILS AND CROSS SECTIONS

RB Engineering
DESIGN → PERMIT → MANAGE
P.O. Box 923
CHEHALIS, WA 98532
OFF: (360) 740-8919
EMAIL: CallPros@RBEngineers.com

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

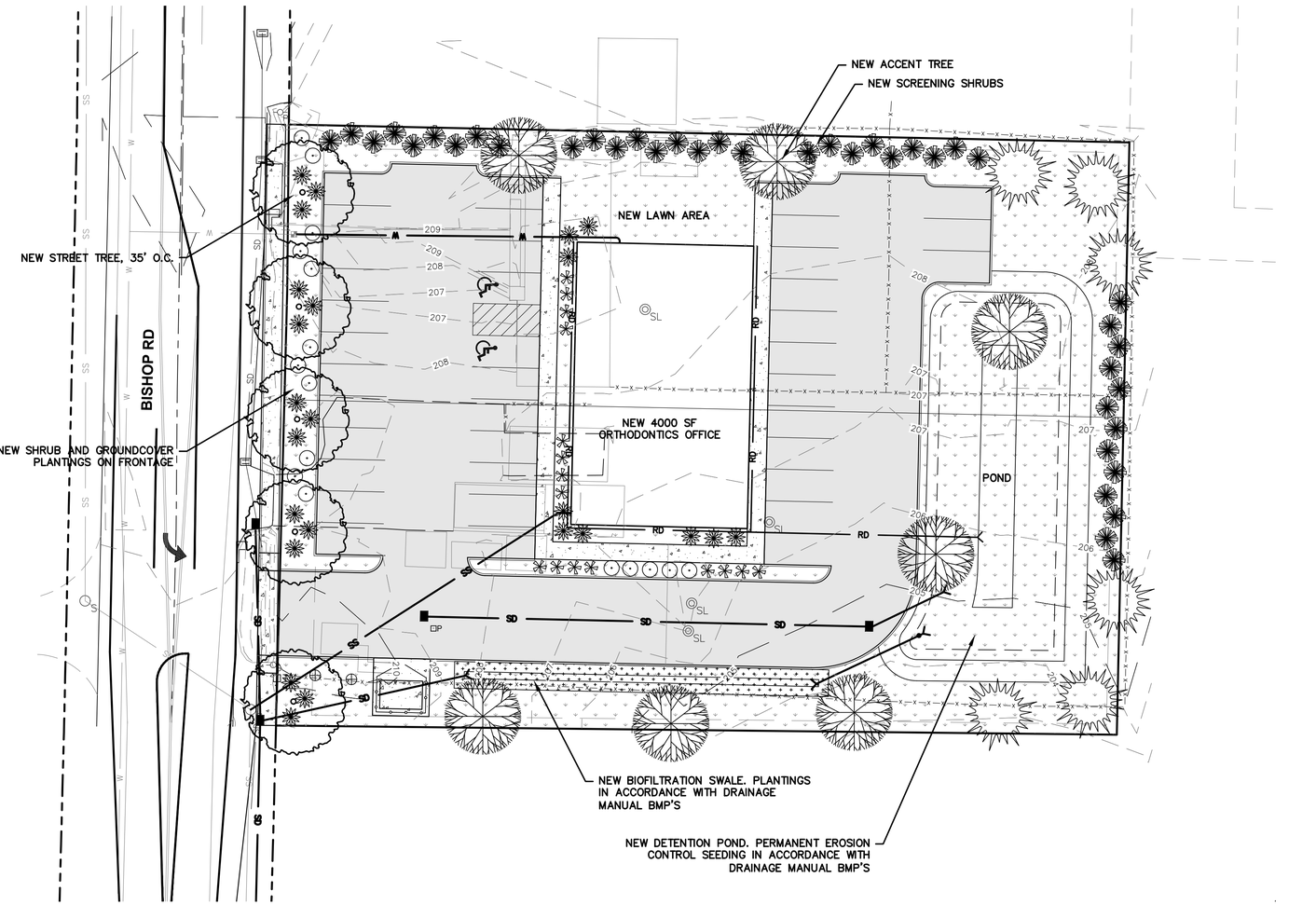
JOB NUMBER 21140

DRAWING NAME 21140_PDCS

P1.4

SCALE: 1"=20 FEET

0 10 20 40



PRELIMINARY PLANT SCHEDULE

SYMBOL	QTY*	BOTANICAL NAME	COMMON NAME	SIZE	SPACING (NOTES)
	9	*SHADE & STREET TREE* *Acer rubrum 'Franksred'* *Liquidambar styraciflua* *Pyrus calleryana* *Tilia codata*	*Red Sunset Maple* *American Sweetgum* *Flowering Pear* *Little-leaf Linden*	*2.0" CAL. MIN.*	*B&B/cont.*
	18	*DECIDIUOUS ACCENT TREE* *Cersis canadensis* *Cerciciphyllum japonicum* *Fraxinum oxycarpa 'Aureofolia'* *Betula jacquemontii*	*Eastern Redbud* *Katsura Tree* *Golden Desert Ash* *Whitebark Himalayan Birch*	*2" CAL. MIN.*	*B&B/cont.*
	37	*EVERGREEN BUFFER TREE* *Chamaecyparis nootkatensis* *Pinus nigra* *Calocedrus decurrens* *Cedrus decurrens*	*Alaskan Weeping Cedar* *Austrian Pine* *Insence Cedar* *Deodar Cedar*	*7-8' HT. MIN.*	*B&B/cont.*
	45 **	*SCREENING SHRUBS* *Thuja occidentalis* *Euonymus alata 'Compacta'* *Ilex crenata* *Prunus lusitanica*	*Emerald Green Arborvitae* *Dwarf Burning Bush* *Japanese Holly* *Portugese Laurel*	*5 GAL.*	*5' O.C.*
	* 25	*ORNAMENTAL PLANTINGS* *Nandina Domestica* *Prunus laurocerasus* *Spirea x. bumalda* *Pieris japonica*	*Heavenly Bamboo* *'Otto Luyken' Laurel* *Gold Mound Spirea* *'Lilly Of The Valley' Shrub*	*3 GAL.*	*(3)/800SF*
		LOW GROWING SHRUB/GROUNDCOVERS *Viburnum davidii* *Euonymus fortunei* *Archtostaphylos uva-ursi* *Erica* *Spirea japonica* *Azalea* *Cotoneaster dammerii* *Gaultheria shallon*	*David's Viburnum* *'Emerald Gaiety' Euonymus* *Kinnickinnick* *Heather asstd.* *'Little Princess' Spirea* *Azalea spp.* *Bearberry* *Salal*		
		SEEDED TURF AREA			
		BIOFILTRATION SEED MIX *Seed or specie mix as required by the Drainage Manual*			
	36 **	*PERIMETER BUFFER SHRUBS* *Photinia x fraseri* *Myrica californica*	*Evergreen Photinia* *Pacific Wax Myrtle*	*5 GAL.*	*10' O.C.*

** PRELIMINARY QUANTITY BASED ON MINIMUM CODE REQUIREMENTS. THE FINAL LANDSCAPE PLAN SHALL BE REVIEWED AND APPROVED ILLUSTRATING THE ACTUAL LANDSCAPE PLANT MATERIALS PROPOSED FOR CONSTRUCTION.*

*** SOME SCREENING MATERIAL IS NOT REQUIRED BY CODE*

FINAL LANDSCAPE PLANTING PLANS SHALL ILLUSTRATE LANDSCAPE INSTALLATION DETAILS.

AREA TAKE OFF ESTIMATE:
SHRUB/GC AREA: 10,920 S.F. ORNAMENTAL/BUFFER
INCL. LAWN AREAS & PARKING ISLANDS
POND AREA (EST): 7,775 S.F.
BIOFILTRATION AREA: 850 S.F.
TOTAL LANDSCAPE AREA TO PREP: 19,545 SQUARE FEET

EDGING: (TO BE DETERMINED)
SAFETY SURFACE: N/A

NO. | DATE | REVISION

DESIGNED BY: CLA
DRAWN BY: CLA
CHECKED BY: RWB
DATE: X/XX/XX
SCALE:

WAGNER ORTHODONTICS
CHEHALIS WA.

PRELIMINARY LANDSCAPE PLAN

STATE OF WASHINGTON
CHRISTINA L. ACHESON
LANDSCAPE ARCHITECT
CERTIFICATE NO. 585
EXPIRES ON 6-5-2014

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JOB NUMBER 21140

DRAWING NAME 21140_PLSP

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