

RIVER BEND HUB DEVELOPMENT
PRELIMINARY DRAINAGE REPORT (PDR)
MAY 2023



DESIGN → PERMIT → MANAGE

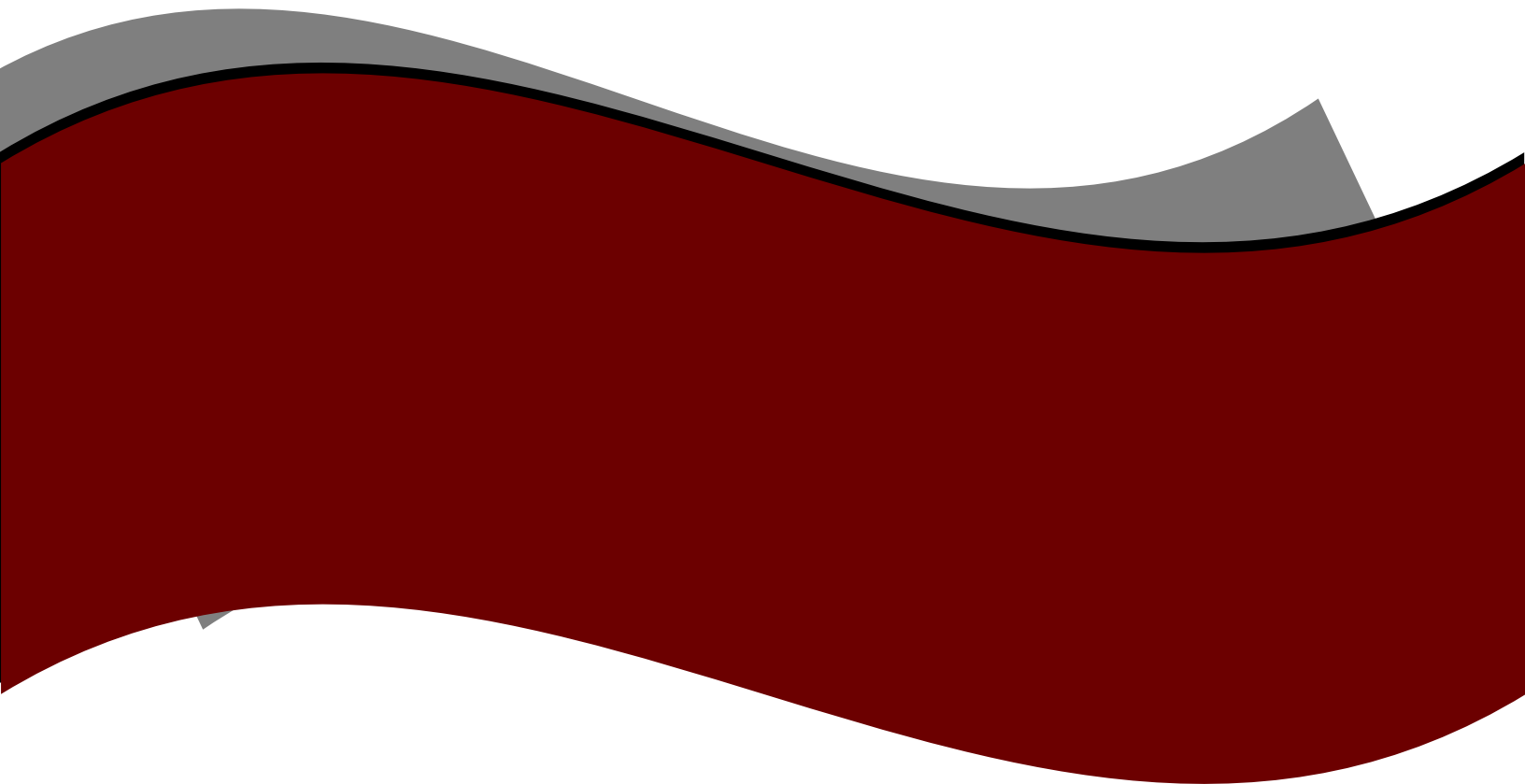


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Project Engineers Certification

"I hereby certify that this Drainage and Erosion Control Plan for **Riverbend Hub Development** 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, NPDES Construction Permit SEPA Checklist Grading/Earthwork Permit
Agency Permit No.:	Pending
Site Address:	1268 NW State St Chehalis, WA 98532
Total Site Area:	1.73 Acres
Zoning:	IL/ CG
WaterShed:	WRIA 23- Upper Chehalis https://waecy.maps.arcgis.com/apps/webappviewer/index.html?id=996e6b21ae394cc3a3b63c6da0c3aa0a

Project Overall Description

The proposal is to develop a 6,000-sf veterinary hospital building with associated parking. Future phases of the project include the addition of 2 more buildings roughly 4,000-sf each, which will be used as adjuncts to the new veterinary hospital. The stormwater system will be constructed during phase 1 but will be sized to accommodate the full build-out of the site.

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 Wetpond 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 water quality and flow control ponds. Roof runoff will be tightlined to nearby catch basins for discharge to the stormwater ponds. 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 stormwater conveyance system in NW Sitka St.

Downstream Condition

The natural drainage leaving the site sheet flows to the North where it enters catch basins in NW Sitka St.

Onsite Soils and Geology

An onsite soils report was completed for this project site. A copy of that report is 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 Soil

Project Topography

Based on the site topography, the project site is very flat with a gradual slope to the North.

Land Use and Ground Cover

The existing land use is an open field with typical grass cover. There are also existing building foundations which will be removed during construction. There is also existing gravel onsite that has been used as parking for the adjacent property.

Natural Drainage Patterns

The site has natural drainage to the North where it enters the stormwater system in NW Sitka St.

Tributary and Discharge Points of Flow

The site does not have any tributary areas.

Historical Drainage Problems

There are no known 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.

Erosion Potential

(Reference: Web Soil Survey – Soil Data Explorer – Soil Properties – Soil Erosion Factors)

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 wetland or other critical area.

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

No existing onsite septic system have been identified on the site.

Aquifer Recharge Area

The site **is not** located in an aquifer recharge area.

Wellhead Protection Area

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

100-Year Flood Plain

The site **is not** within the FEMA 100-year flood plain.

Section 2 – APPLICABLE MINIMUM REQUIREMENTS

Manual Exemptions

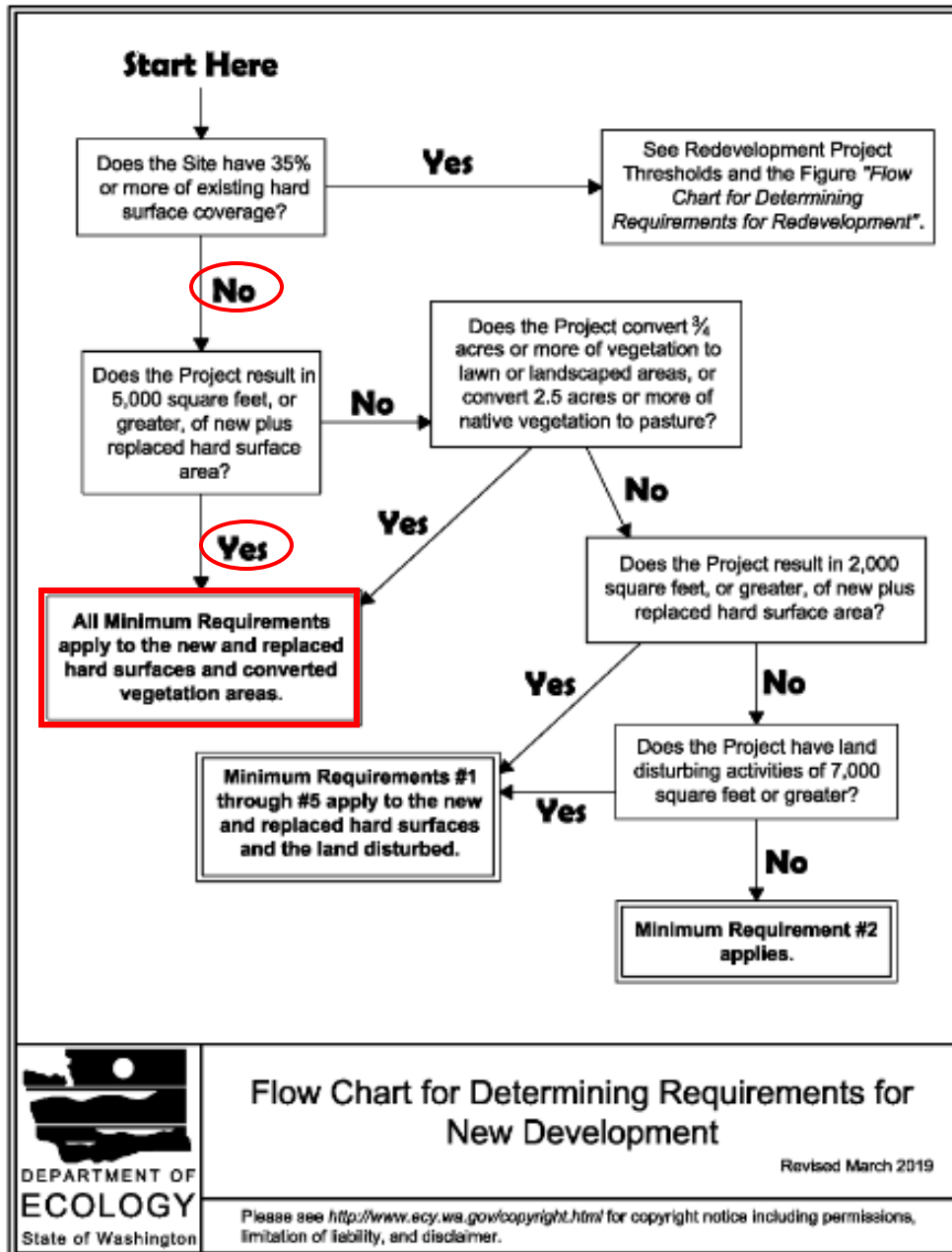
Exemptions	Applicable to Project
Forest Practices (Title 222 WAC)	No
Commercial Agriculture	No
Oil & Gas Field Activities or Operations	No
Pavement Maintenance	No
Underground Utility Projects	No

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	1.73 AC
Existing Site Impervious Coverage	0.37 AC
New Plus Replaced Impervious Surface	0.88 AC
Vegetation Area Converted to Lawn or Landscaped Area	0.85 AC
Land Disturbing Area	1.73 AC
Percent of Existing Impervious Surface	21 %

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 disturbs over an acre of the site. Therefore, a NPDES stormwater construction permit is 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 existing public drainage system.

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 location of 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 BMP 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	<ul style="list-style-type: none"> 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

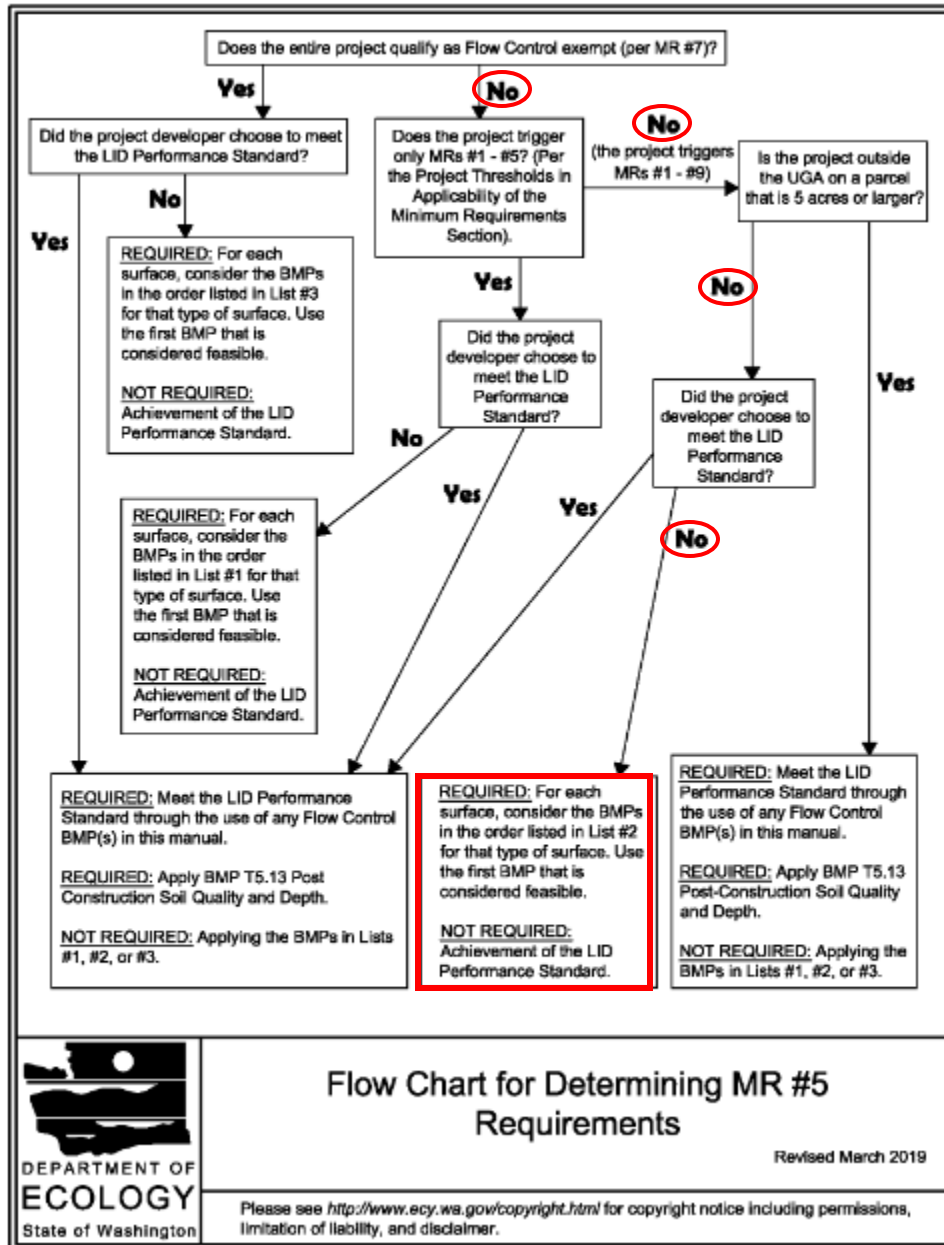


Table I-3.2: The List Approach for MR5 Compliance

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)
<p>ing to it.</p> <p>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.</p>		

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% of 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 draining 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 drainage soils and limited site area.

- 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 and dispersion 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 drained soils.

Roof runoff will be tightlined to nearby catch basins for conveyance to the new stormwater pond.

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.**

Permeable pavement is not feasible due to poorly drained 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.**

A Bio-retention facility is not feasible due to poorly drained 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.**

A dispersion BMP is not feasible due to limited site area and existing outlet location.

All new impervious surfaces will be collected in catch basins and conveyed to a new combination wetpool/ detention pond. The pond will outlet into the existing public stormwater conveyance system.

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

Oil Control Determination Chart	
Local Government Require Phosphorus control	No

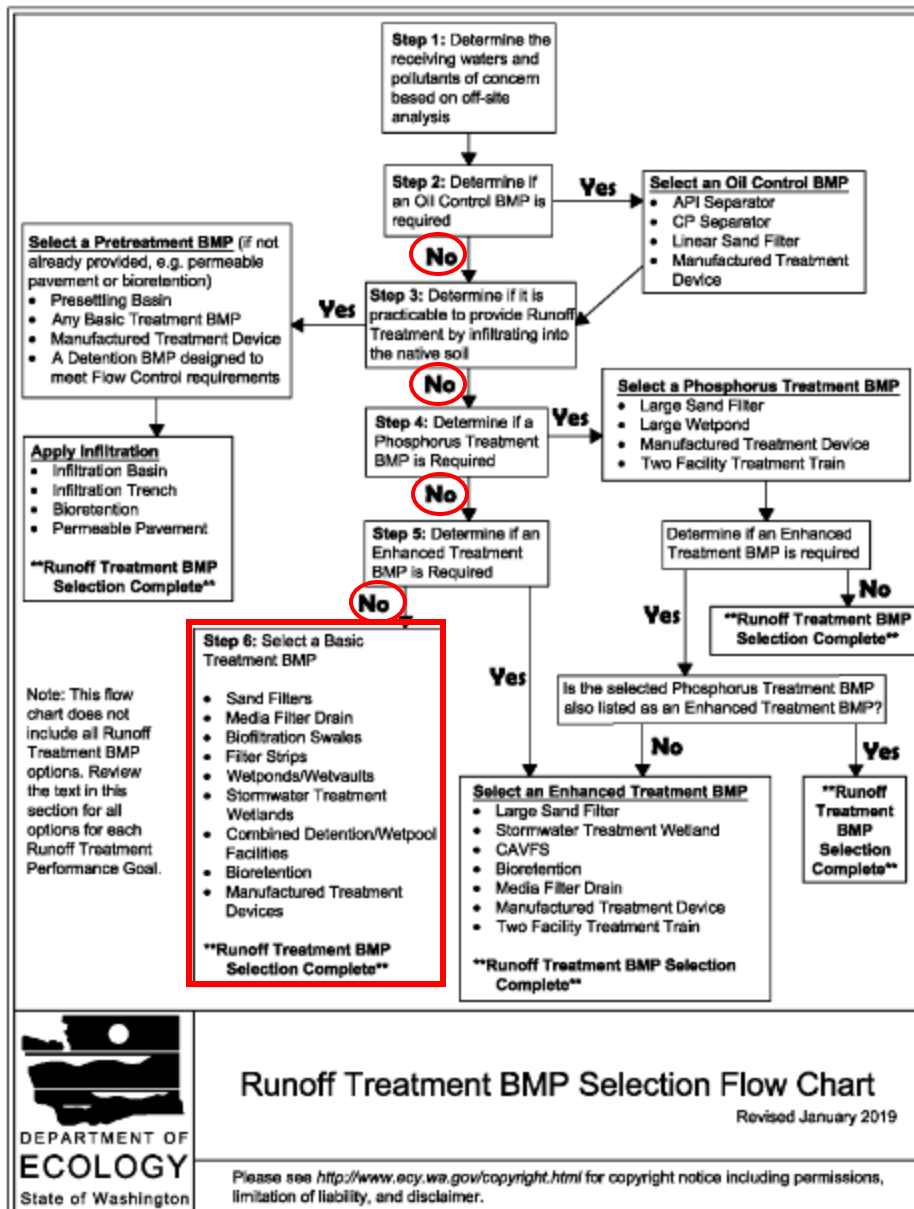
Step 5: Enhanced Treatment Required

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 4 th 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	Combo Detention/Wetpool	Basic

MR #7 – Flow Control:

Projects shall employ Flow Control BMPs in accordance with the following thresholds, standards, 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 following 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 is 10,000 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 drainage 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	Combo Detention/Wetpool	38,000 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 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 from 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.

Qualitative Analysis

The developed site will collect stormwater runoff in catch basins and discharge them into the existing stormwater system at rates less than the pre-developed conditions.

Mitigation Measures

Because the runoff is discharged directly into an existing system at rates less than the current conditions, no mitigation measures were required.

Section 2.3 – Adjustments and Exceptions/Variations 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 Variations:

No exceptions or variations 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.

IV-4 – Soil Erosion, Sediment Control and Landscaping

S407 BMPs for Dust Control at Disturbed Land Areas and Un-paved Roads.
S411 BMPs for Landscaping and Lawn/Vegetation Management.
S450 BMPs for Irrigation

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	Detain and Release	Wetpond

Infiltration SSC Review if Applicable

Infiltration will not be used for stormwater control, therefore no further investigation was 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 an open field, as well as existing building and parking areas. However, the existing building and parking runoff flow to a separate stormwater collection point, and therefore are part of a different basin. The basin associated with the development only consists of existing forested area.

Modeled Land Use:

TDA No. 1 Basin ID	Land Use Assumptions and Site Parameters				
	Land Use Cover	Slope	Acres	Hydrologic Group	Comments
P1	Forested	Flat	1.73	Sat	Hydric

Developed Site Hydrology (D#)

The developed site will consist of the new 6,000 sf veterinary hospital, as well as future commercial buildings, and all associated parking.

Basin Summary

TDA No. 1 Basin ID	Land Use Assumptions and Site Parameters				
	Land Use Cover	Slope	Acres	Hydrologic Group	Comments
D1	Lawn	Flat	0.59	Sat	
	Roof	Flat	0.32		
	Parking	Flat	0.63		
	Sidewalk	Flat	0.04		
	Pond		0.15		
Total Area			1.73		

Basin Maps

A basin map is included in Appendix 1 of this report.

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
2977	5	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
3470	5	1 ft	3:1	Wier/Orifice

Detention Pond Stage Storage Summary

Pond Stage Storage	Elevation (ft)	Detention Volume (ac-ft)
Emergency Overflow	182	
Design Water Surface	181	0.63 ac-ft
Bottom Live Storage	176	0 ac-ft
WWHM Required Storage		0.59 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 T10.10 – Wetponds - Basic and Large

RBE has selected this treatment method for water quality control for the new PGIS associated with the project. Below are the design calculations.

Water Quality	
On-Line BMP	Off-Line BMP
24 hour Volume (ac-ft) <input type="text" value="0.1684"/>	
Standard Flow Rate (cfs) <input type="text" value="0.1697"/>	Standard Flow Rate (cfs) <input type="text" value="0.0954"/>

Wet Pond Stage Storage Summary

Pond Stage Storage	Elevation (ft)	Detention Volume (ac-ft)
Top Wetpond	176	0.18 ac-ft
Bottom WQ Storage	172	0 ac-ft
WWHM Required Storage		0.1684 ac-ft

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 vary from 8 to 24 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 25-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 data generated by WWHM for the developed basin D1.

Flow Frequency	
Flow (cfs)	0701 15m
2 Year	= 0.4288
5 Year	= 0.5530
10 Year	= 0.6316
25 Year	= 0.7277
50 Year	= 0.7975
100 Year	= 0.8660

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	0.73	0.87	6

Sediment Pond Sizing

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

Structure ID	10 Year Pre-developed Flow (cfs)	Required Sediment Pond Surface Area (sf)
Sediment Pond D1	0.224	466

APPENDIX 1 – MAP SUBMITTALS

TDA No. 1

Basin Map



RB Engineering
 CIVIL ENGINEERING - LAND PLANNING - UTILITIES
 P.O. Box 923
 CHEHALIS, WA 98532
 OFF: (360) 740-8919
 FAX: (360) 740-8912

RIVER BEND HUB DEVELOPEMNT
BASIN MAP

JOB NUMBER
 22034
 DRAWING NAME
 22034_BM

FIGURE
1

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

WWHM2012 Project Name: 22034 PRELIM WWHM

Site Name: 22034 WWHM PRELIM

Site Address:

City:

Report Date: 5/24/2023

Gage: Olympia

Data Start: 1955/10/01

Data End: 2008/09/30

Timestep: 15 Minute

Precip Scale: 0.800

Version Date: 2023/01/27

Version: 4.2.19

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 SAT, Forest, Flat	acre 1.73
Pervious Total	1.73
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.73

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.59
Pervious Total	0.59
Impervious Land Use	acre
ROOF TOPS FLAT	0.32
SIDEWALKS FLAT	0.04
PARKING FLAT	0.63
POND	0.15
Impervious Total	1.14
Basin Total	1.73

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length: 94.44 ft.
 Bottom Width: 31.48 ft.
 Depth: 6 ft.
 Volume at riser head: 0.5925 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: 5 ft.
 Riser Diameter: 18 in.
 Notch Type: Rectangular
 Notch Width: 0.014 ft.
 Notch Height: 0.859 ft.
 Orifice 1 Diameter: 0.846 in. Elevation:0 ft.
 Element Flows To:
 Outlet 1 Outlet 2

Pond Hydraulic Table

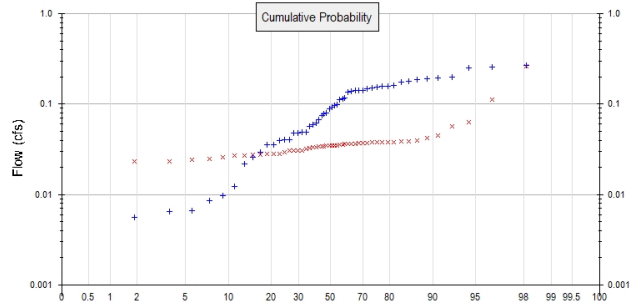
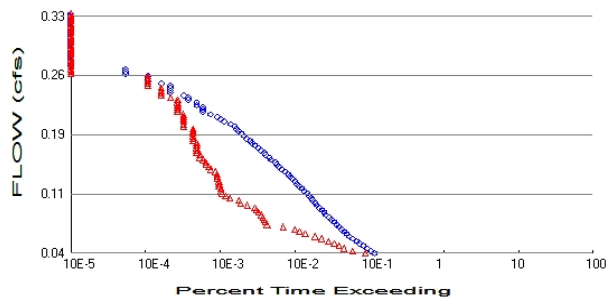
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.068	0.000	0.000	0.000
0.0667	0.069	0.004	0.005	0.000
0.1333	0.070	0.009	0.007	0.000
0.2000	0.071	0.014	0.008	0.000
0.2667	0.072	0.018	0.010	0.000
0.3333	0.074	0.023	0.011	0.000
0.4000	0.075	0.028	0.012	0.000
0.4667	0.076	0.033	0.013	0.000
0.5333	0.077	0.038	0.014	0.000
0.6000	0.079	0.044	0.015	0.000
0.6667	0.080	0.049	0.015	0.000
0.7333	0.081	0.054	0.016	0.000
0.8000	0.082	0.060	0.017	0.000
0.8667	0.083	0.065	0.018	0.000
0.9333	0.085	0.071	0.018	0.000
1.0000	0.086	0.077	0.019	0.000
1.0667	0.087	0.083	0.020	0.000
1.1333	0.089	0.088	0.020	0.000
1.2000	0.090	0.094	0.021	0.000
1.2667	0.091	0.100	0.021	0.000
1.3333	0.092	0.107	0.022	0.000
1.4000	0.094	0.113	0.023	0.000
1.4667	0.095	0.119	0.023	0.000
1.5333	0.096	0.126	0.024	0.000
1.6000	0.098	0.132	0.024	0.000
1.6667	0.099	0.139	0.025	0.000
1.7333	0.100	0.145	0.025	0.000
1.8000	0.102	0.152	0.026	0.000
1.8667	0.103	0.159	0.026	0.000
1.9333	0.104	0.166	0.027	0.000
2.0000	0.106	0.173	0.027	0.000
2.0667	0.107	0.180	0.027	0.000

2.1333	0.109	0.187	0.028	0.000
2.2000	0.110	0.195	0.028	0.000
2.2667	0.111	0.202	0.029	0.000
2.3333	0.113	0.210	0.029	0.000
2.4000	0.114	0.217	0.030	0.000
2.4667	0.116	0.225	0.030	0.000
2.5333	0.117	0.233	0.030	0.000
2.6000	0.118	0.240	0.031	0.000
2.6667	0.120	0.248	0.031	0.000
2.7333	0.121	0.257	0.032	0.000
2.8000	0.123	0.265	0.032	0.000
2.8667	0.124	0.273	0.032	0.000
2.9333	0.126	0.281	0.033	0.000
3.0000	0.127	0.290	0.033	0.000
3.0667	0.129	0.298	0.034	0.000
3.1333	0.130	0.307	0.034	0.000
3.2000	0.132	0.316	0.034	0.000
3.2667	0.133	0.325	0.035	0.000
3.3333	0.135	0.334	0.035	0.000
3.4000	0.136	0.343	0.035	0.000
3.4667	0.138	0.352	0.036	0.000
3.5333	0.139	0.361	0.036	0.000
3.6000	0.141	0.371	0.036	0.000
3.6667	0.143	0.380	0.037	0.000
3.7333	0.144	0.390	0.037	0.000
3.8000	0.146	0.399	0.037	0.000
3.8667	0.147	0.409	0.038	0.000
3.9333	0.149	0.419	0.038	0.000
4.0000	0.150	0.429	0.038	0.000
4.0667	0.152	0.439	0.039	0.000
4.1333	0.154	0.449	0.039	0.000
4.2000	0.155	0.460	0.040	0.000
4.2667	0.157	0.470	0.042	0.000
4.3333	0.158	0.481	0.044	0.000
4.4000	0.160	0.491	0.046	0.000
4.4667	0.162	0.502	0.049	0.000
4.5333	0.163	0.513	0.051	0.000
4.6000	0.165	0.524	0.054	0.000
4.6667	0.167	0.535	0.057	0.000
4.7333	0.168	0.546	0.061	0.000
4.8000	0.170	0.557	0.064	0.000
4.8667	0.172	0.569	0.067	0.000
4.9333	0.173	0.580	0.070	0.000
5.0000	0.175	0.592	0.074	0.000
5.0667	0.177	0.604	0.348	0.000
5.1333	0.179	0.616	0.846	0.000
5.2000	0.180	0.628	1.479	0.000
5.2667	0.182	0.640	2.199	0.000
5.3333	0.184	0.652	2.958	0.000
5.4000	0.186	0.664	3.708	0.000
5.4667	0.187	0.677	4.402	0.000
5.5333	0.189	0.689	5.000	0.000
5.6000	0.191	0.702	5.477	0.000
5.6667	0.193	0.715	5.831	0.000
5.7333	0.194	0.728	6.091	0.000
5.8000	0.196	0.741	6.416	0.000
5.8667	0.198	0.754	6.675	0.000
5.9333	0.200	0.767	6.924	0.000

6.0000	0.202	0.781	7.165	0.000
6.0667	0.203	0.794	7.397	0.000

Analysis Results

POC 1



+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area: 1.73
 Total Impervious Area: 0

Mitigated Landuse Totals for POC #1

Total Pervious Area: 0.59
 Total Impervious Area: 1.14

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.07915
5 year	0.166316
10 year	0.224065
25 year	0.289795
50 year	0.332047
100 year	0.368515

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.033996
5 year	0.047985
10 year	0.058995
25 year	0.075079
50 year	0.088765
100 year	0.104023

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1956	0.111	0.035
1957	0.135	0.036
1958	0.067	0.025
1959	0.040	0.034
1960	0.140	0.056
1961	0.114	0.035
1962	0.006	0.026
1963	0.147	0.038
1964	0.185	0.034
1965	0.197	0.031

1966	0.040	0.028
1967	0.096	0.033
1968	0.049	0.029
1969	0.036	0.027
1970	0.057	0.035
1971	0.078	0.036
1972	0.250	0.045
1973	0.049	0.039
1974	0.093	0.035
1975	0.059	0.027
1976	0.089	0.037
1977	0.012	0.023
1978	0.048	0.037
1979	0.153	0.028
1980	0.048	0.036
1981	0.152	0.035
1982	0.141	0.036
1983	0.029	0.033
1984	0.193	0.031
1985	0.022	0.027
1986	0.117	0.038
1987	0.259	0.042
1988	0.009	0.032
1989	0.007	0.028
1990	0.061	0.037
1991	0.179	0.063
1992	0.026	0.032
1993	0.010	0.024
1994	0.004	0.023
1995	0.076	0.035
1996	0.200	0.038
1997	0.143	0.039
1998	0.176	0.031
1999	0.143	0.040
2000	0.036	0.036
2001	0.007	0.022
2002	0.160	0.038
2003	0.041	0.028
2004	0.098	0.038
2005	0.080	0.030
2006	0.158	0.034
2007	0.159	0.112
2008	0.270	0.261

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2696	0.2609
2	0.2589	0.1117
3	0.2499	0.0631
4	0.2004	0.0565
5	0.1971	0.0452
6	0.1927	0.0424
7	0.1853	0.0399
8	0.1787	0.0391
9	0.1760	0.0387
10	0.1598	0.0383
11	0.1592	0.0382

12	0.1581	0.0381
13	0.1531	0.0377
14	0.1524	0.0377
15	0.1467	0.0375
16	0.1434	0.0369
17	0.1427	0.0368
18	0.1406	0.0364
19	0.1396	0.0363
20	0.1353	0.0363
21	0.1169	0.0362
22	0.1144	0.0356
23	0.1113	0.0353
24	0.0979	0.0350
25	0.0964	0.0350
26	0.0934	0.0350
27	0.0894	0.0348
28	0.0800	0.0347
29	0.0783	0.0343
30	0.0756	0.0342
31	0.0673	0.0339
32	0.0613	0.0333
33	0.0590	0.0331
34	0.0568	0.0324
35	0.0487	0.0321
36	0.0486	0.0310
37	0.0484	0.0308
38	0.0484	0.0306
39	0.0406	0.0304
40	0.0400	0.0291
41	0.0397	0.0282
42	0.0359	0.0282
43	0.0355	0.0279
44	0.0292	0.0278
45	0.0260	0.0273
46	0.0219	0.0272
47	0.0123	0.0269
48	0.0098	0.0257
49	0.0086	0.0250
50	0.0067	0.0243
51	0.0065	0.0232
52	0.0056	0.0232
53	0.0041	0.0225

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0396	2182	1629	74	Pass
0.0425	1937	1111	57	Pass
0.0455	1736	851	49	Pass
0.0484	1547	730	47	Pass
0.0514	1379	630	45	Pass
0.0543	1258	523	41	Pass
0.0573	1114	425	38	Pass
0.0603	1014	351	34	Pass
0.0632	920	256	27	Pass
0.0662	856	215	25	Pass
0.0691	788	185	23	Pass
0.0721	739	130	17	Pass
0.0750	676	79	11	Pass
0.0780	630	75	11	Pass
0.0809	580	72	12	Pass
0.0839	534	70	13	Pass
0.0868	491	67	13	Pass
0.0898	460	61	13	Pass
0.0928	431	57	13	Pass
0.0957	397	54	13	Pass
0.0987	371	43	11	Pass
0.1016	349	35	10	Pass
0.1046	324	33	10	Pass
0.1075	309	25	8	Pass
0.1105	287	22	7	Pass
0.1134	274	20	7	Pass
0.1164	249	19	7	Pass
0.1193	232	19	8	Pass
0.1223	213	18	8	Pass
0.1252	200	18	9	Pass
0.1282	188	18	9	Pass
0.1312	174	17	9	Pass
0.1341	161	17	10	Pass
0.1371	152	17	11	Pass
0.1400	138	16	11	Pass
0.1430	124	14	11	Pass
0.1459	115	13	11	Pass
0.1489	106	12	11	Pass
0.1518	103	12	11	Pass
0.1548	90	11	12	Pass
0.1577	85	10	11	Pass
0.1607	76	10	13	Pass
0.1637	72	9	12	Pass
0.1666	66	9	13	Pass
0.1696	60	9	15	Pass
0.1725	54	9	16	Pass
0.1755	50	9	18	Pass
0.1784	47	8	17	Pass
0.1814	42	8	19	Pass
0.1843	39	8	20	Pass
0.1873	36	8	22	Pass
0.1902	33	8	24	Pass
0.1932	31	8	25	Pass

0.1962	29	6	20	Pass
0.1991	26	6	23	Pass
0.2021	21	6	28	Pass
0.2050	19	6	31	Pass
0.2080	17	6	35	Pass
0.2109	14	6	42	Pass
0.2139	11	5	45	Pass
0.2168	11	5	45	Pass
0.2198	11	5	45	Pass
0.2227	9	5	55	Pass
0.2257	9	5	55	Pass
0.2286	7	5	71	Pass
0.2316	7	4	57	Pass
0.2346	6	3	50	Pass
0.2375	4	3	75	Pass
0.2405	4	3	75	Pass
0.2434	4	3	75	Pass
0.2464	4	2	50	Pass
0.2493	3	2	66	Pass
0.2523	2	2	100	Pass
0.2552	2	2	100	Pass
0.2582	2	2	100	Pass
0.2611	1	0	0	Pass
0.2641	1	0	0	Pass
0.2671	1	0	0	Pass
0.2700	0	0	0	Pass
0.2730	0	0	0	Pass
0.2759	0	0	0	Pass
0.2789	0	0	0	Pass
0.2818	0	0	0	Pass
0.2848	0	0	0	Pass
0.2877	0	0	0	Pass
0.2907	0	0	0	Pass
0.2936	0	0	0	Pass
0.2966	0	0	0	Pass
0.2996	0	0	0	Pass
0.3025	0	0	0	Pass
0.3055	0	0	0	Pass
0.3084	0	0	0	Pass
0.3114	0	0	0	Pass
0.3143	0	0	0	Pass
0.3173	0	0	0	Pass
0.3202	0	0	0	Pass
0.3232	0	0	0	Pass
0.3261	0	0	0	Pass
0.3291	0	0	0	Pass
0.3320	0	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0.1684 acre-feet

On-line facility target flow: 0.1697 cfs.

Adjusted for 15 min: 0.1697 cfs.

Off-line facility target flow: 0.0954 cfs.

Adjusted for 15 min: 0.0954 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	<input type="checkbox"/>	192.41			<input type="checkbox"/>	0.00			
Total Volume Infiltrated		192.41	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

POC 2

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

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



Basin 1
1.73ac

Mitigated Schematic



Predeveloped UCI File

RUN

GLOBAL

```
WVHM4 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      22034 PRELIM WVHM.wdm
MESSU    25      Pre22034 PRELIM WVHM.MES
          27      Pre22034 PRELIM WVHM.L61
          28      Pre22034 PRELIM WVHM.L62
          30      POC22034 PRELIM WVHM1.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->	<Name> #	<--Area-->	<-factor-->	<-Target->	<Name> #	MBLK	Tbl#	***
Basin	1							
PERLND	19		1.73	COPY	501		12	
PERLND	19		1.73	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	***	ODGTFG	for each	FUNCT	for each	***
# - #	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

```
WVHM4 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      22034 PRELIM WVHM.wdm
MESSU    25      Mit22034 PRELIM WVHM.MES
          27      Mit22034 PRELIM WVHM.L61
          28      Mit22034 PRELIM WVHM.L62
          30      POC22034 PRELIM WVHM1.dat
```

END FILES

OPN SEQUENCE

```
INGRP          INDELT 00:15
  PERLND        16
  IMPLND         4
  IMPLND         8
  IMPLND        11
  IMPLND        14
  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  Engr Metr ***
          in  out      ***
```

```
16      C, 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  ***
16      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  *****
16   0   0   4   0   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 VIRG  VLE INFC  HWT ***
16   0   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  LRSUR  SLSUR  KVARY  AGWRC
16   0   4.5  0.03  400   0.05  0.5   0.996
END PWAT-PARM2

```

```

PWAT-PARM3
<PLS > PWATER input info: Part 3          ***
# - # ***PETMAX  PETMIN  INFEXP  INFILD  DEEPFR  BASETP  AGWETP
16   0   0   2   2   0   0   0
END PWAT-PARM3

```

```

PWAT-PARM4
<PLS > PWATER input info: Part 4          ***
# - # CEPSC  UZSN  NSUR  INTFW  IRC  LZETP ***
16   0.1  0.25  0.25  6   0.5  0.25
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
16   0   0   0   0   2.5  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
14  POND             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
14  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   4   1   9
8   0   0   4   0   0   0   1   9
11  0   0   4   0   0   0   1   9
14  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
14     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
14     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
14     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
14     0 0

```

END IWAT-STATE1

END IMPLND

SCHEMATIC

```

<-Source-> <--Area--> <-Target-> MBLK ***
<Name> # <-factor--> <Name> # Tbl# ***
Basin 1***
PERLND 16 0.59 RCHRES 1 2
PERLND 16 0.59 RCHRES 1 3
IMPLND 4 0.32 RCHRES 1 5
IMPLND 8 0.04 RCHRES 1 5
IMPLND 11 0.63 RCHRES 1 5
IMPLND 14 0.15 RCHRES 1 5

```

*****Routing*****

```

PERLND 16 0.59 COPY 1 12
IMPLND 4 0.32 COPY 1 15
IMPLND 8 0.04 COPY 1 15
IMPLND 11 0.63 COPY 1 15
IMPLND 14 0.15 COPY 1 15
PERLND 16 0.59 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  Engr Metr LKFG  ***
              in out
1      Trapezoidal Pond-007      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  GOL  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      0.02      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)***
0.00000  0.068255  0.00000  0.00000  0.00000
0.066667  0.069415  0.004589  0.005015
0.133333  0.070583  0.009256  0.007092
0.200000  0.071757  0.014000  0.008686
0.266667  0.072939  0.018823  0.010030
0.333333  0.074129  0.023726  0.011213
0.400000  0.075325  0.028708  0.012284
0.466667  0.076530  0.033769  0.013268
0.533333  0.077741  0.038912  0.014184
0.600000  0.078960  0.044135  0.015044
0.666667  0.080186  0.049440  0.015858
0.733333  0.081419  0.054827  0.016632
0.800000  0.082660  0.060296  0.017372
0.866667  0.083908  0.065848  0.018081
0.933333  0.085164  0.071484  0.018764
1.000000  0.086427  0.077204  0.019422
1.066667  0.087697  0.083008  0.020059
1.133333  0.088974  0.088897  0.020677
1.200000  0.090259  0.094871  0.021276
1.266667  0.091552  0.100932  0.021859
1.333333  0.092851  0.107079  0.022427
1.400000  0.094158  0.113312  0.022981

```

1.466667	0.095472	0.119633	0.023522
1.533333	0.096794	0.126042	0.024050
1.600000	0.098123	0.132539	0.024567
1.666667	0.099459	0.139125	0.025074
1.733333	0.100803	0.145801	0.025571
1.800000	0.102154	0.152566	0.026058
1.866667	0.103512	0.159422	0.026536
1.933333	0.104878	0.166368	0.027006
2.000000	0.106251	0.173406	0.027467
2.066667	0.107631	0.180535	0.027921
2.133333	0.109019	0.187757	0.028368
2.200000	0.110414	0.195071	0.028808
2.266667	0.111817	0.202479	0.029241
2.333333	0.113226	0.209980	0.029668
2.400000	0.114644	0.217576	0.030089
2.466667	0.116068	0.225266	0.030504
2.533333	0.117500	0.233052	0.030913
2.600000	0.118939	0.240933	0.031317
2.666667	0.120386	0.248911	0.031716
2.733333	0.121839	0.256985	0.032110
2.800000	0.123301	0.265156	0.032500
2.866667	0.124769	0.273425	0.032884
2.933333	0.126245	0.281792	0.033264
3.000000	0.127728	0.290258	0.033640
3.066667	0.129219	0.298823	0.034012
3.133333	0.130717	0.307488	0.034380
3.200000	0.132222	0.316252	0.034744
3.266667	0.133735	0.325117	0.035104
3.333333	0.135255	0.334084	0.035460
3.400000	0.136782	0.343152	0.035813
3.466667	0.138317	0.352322	0.036162
3.533333	0.139859	0.361594	0.036508
3.600000	0.141408	0.370970	0.036851
3.666667	0.142965	0.380449	0.037191
3.733333	0.144529	0.390032	0.037527
3.800000	0.146100	0.399720	0.037861
3.866667	0.147679	0.409512	0.038192
3.933333	0.149265	0.419410	0.038519
4.000000	0.150858	0.429414	0.038844
4.066667	0.152459	0.439525	0.039167
4.133333	0.154067	0.449743	0.039487
4.200000	0.155683	0.460068	0.040463
4.266667	0.157306	0.470501	0.042142
4.333333	0.158936	0.481042	0.044210
4.400000	0.160573	0.491692	0.046565
4.466667	0.162218	0.502452	0.049146
4.533333	0.163870	0.513322	0.051908
4.600000	0.165530	0.524302	0.054820
4.666667	0.167197	0.535392	0.057854
4.733333	0.168871	0.546595	0.060988
4.800000	0.170553	0.557909	0.064202
4.866667	0.172242	0.569335	0.067480
4.933333	0.173938	0.580875	0.070806
5.000000	0.175641	0.592527	0.074166
5.066667	0.177352	0.604294	0.348150
5.133333	0.179071	0.616174	0.846206
5.200000	0.180796	0.628170	1.479490
5.266667	0.182529	0.640281	2.199133
5.333333	0.184270	0.652508	2.958110
5.400000	0.186018	0.664850	3.708071
5.466667	0.187773	0.677310	4.402174
5.533333	0.189535	0.689887	5.000620
5.600000	0.191305	0.702582	5.477918
5.666667	0.193082	0.715395	5.831465
5.733333	0.194866	0.728326	6.091231
5.800000	0.196658	0.741377	6.416020
5.866667	0.198457	0.754548	6.675108
5.933333	0.200264	0.767838	6.924417
6.000000	0.202077	0.781250	7.164979

END FTABLE 1

END FTABLES

EXT SOURCES

<-Volume->	<Member>	SsysSgap	<--Mult-->	Tran	<-Target vols>	<-Grp>	<-Member->	***
<Name>	#	<Name>	#	tem strg	<-factor->	strg	<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***
RCHRES	1	HYDR	RO	1 1	1	WDM	1000	FLOW	ENGL	REPL
RCHRES	1	HYDR	STAGE	1 1	1	WDM	1001	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

<Volume>	<-Grp>	<-Member->	<--Mult-->	<Target>	<-Grp>	<-Member->	***
<Name>	#	<Name>	#	<-factor->	<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

Disclaimer

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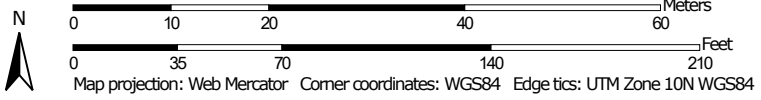
APPENDIX 3 – SPECIAL REPORTS AND STUDIES

NRCS Soil Survey Data
Geotechnical Report – South Sound Geotechnical

Hydrologic Soil Group—Lewis County Area, Washington
(22034)



Map Scale: 1:772 if printed on A landscape (11" x 8.5") sheet.



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: Nov 21, 2021—Nov 22, 2021

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	1.9	100.0%
Totals for Area of Interest			1.9	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

South Sound Geotechnical Consulting

May 2, 2023

RB Engineering
91 SW 13th Street
Chehalis, WA 98532

Attention: Mr. Robert Balmelli, P.E.

Subject: Geotechnical Engineering Report
Riverbend Hub Development
1268 NW State Avenue
Chehalis, Washington
SSGC Project No. 23020

Mr. Balmelli,

South Sound Geotechnical Consulting (SSGC) has completed a geotechnical assessment for the proposed Riverbend Hub Development on the above addressed property in Chehalis, Washington. Our services have been completed in general conformance with our proposal P23024 (dated February 22, 2023) and authorized per signature of our agreement for services. Our scope of services included completion of five test pits on the site, engineering analyses, and preparation of this report.

PROJECT INFORMATION

The site is on the east side of NW State Avenue with an existing veterinary clinic in the southwest portion. Development plans include a new veterinary hospital in the northwest portion of the site and future commercial development in the southeast portion. We anticipate conventional spread footings will be used to support new structures, with slab-on-grade concrete floors. Conventional asphalt access ways and parking areas are anticipated. A stormwater pond is planned in the northeast corner of the site.

SITE CONDITIONS

The northern portion of the lot is currently landscaped lawn with some brush and isolated trees. An old concrete slab is in the central portion of this area indicating previous development. The southeast portion is covered with gravel and used for equipment/vehicle parking/storage. The site is generally level with elevation change on the order of about 4 feet (+/-).

SUBSURFACE CONDITIONS

Subsurface conditions were characterized by completing five test pits on the site on March 30, 2023. Explorations were advanced to depths between 6 and 10 feet below existing ground surface. Approximate locations of the test pits are shown on Figure 1, Exploration Plan. A summary description of observed subgrade conditions is provided below. Logs of the test pits are provided in Appendix A.

Soil Conditions

Topsoil was observed in test pits TP-1 and TP-5 in the northern portion of the site and extended to a depth of about 9 inches. Fill was observed in TP-2 (near the old concrete slab in central northern portion) and consisted of soft silt, clay and sand with some debris associated with the slab. Fill in the southern portion (TP-3 and TP-4) was gravel with sand and silty sand extending to depths between 1 to 2.5 feet.

Native soils below the topsoil/fills consisted of typically fine-grained clayey silt to silty fine sand with occasional gravel. These soils were in a generally soft to stiff condition and extended to the termination depths of the test pits.

Groundwater Conditions

Groundwater was observed in test pit TP-4 at a depth of about 10 feet with slight seepage in TP-5 at a depth of about 3 feet at the time of excavation. We anticipate perched groundwater will occur in soils during the wetter seasons of the year. Groundwater levels will vary throughout the year based on seasonal precipitation and on- and off-site drainage patterns.

Geologic Setting

Native soil on the site is mapped as Lacamas silt loam per the USDA Soil Conservation Service of Lewis County. This soil reportedly formed in alluvium on flood plain terraces. Native soil observed in the test pits appeared to conform to the mapped soil type.

GEOTECHNICAL DESIGN CONSIDERATIONS

Planned development of the site is considered feasible based on observed subsurface conditions in the test holes. Native soils can be used for support of conventional spread footing foundations. Existing topsoil and any fill encountered during construction should be removed from planned building and pavement areas.

Recommendations presented in the following sections should be considered general and may require modifications when earthwork and grading occur. They are based upon the subsurface conditions observed in the test holes and the assumption that finish site grades will be similar to existing grades. It should be noted that subsurface conditions across the site may vary from those depicted on the exploration logs and can change with time. Therefore, proper site preparation will depend upon the weather and soil conditions encountered at the time of construction. We recommend that SSGC review final plans and further assess subgrade conditions at the time of construction, as warranted.

Site Preparation

Site grading and earthwork should include procedures to control surface water runoff. Grading the site without adequate drainage control measures may negatively impact site soils, resulting in increased export of impacted soil and import of fill materials, potentially increasing the cost of the earthwork and subgrade preparation phases of the project.

Site grading should include removal (stripping) of topsoil and any fill in future building and pavement areas. Subgrades should consist of firm native soils following stripping. Stripping depth will be on the order of 1 to 3 feet based on observed soil conditions in the test holes, but may vary across the site. Final stripping depths can only be determined at the time of construction.

Subgrade Preparation

Subgrades in building and pavement areas should consist of firm native soil. We recommend exposed subgrades in building and conventional pavement areas are proofrolled using a large roller, loaded dump truck, or other mechanical equipment to assess subgrade conditions following stripping. Proofrolling efforts should result in the upper 1 foot of subgrade soils achieving a firm and unyielding condition. Wet, loose, or soft subgrades that cannot achieve a firm and unyielding condition should be removed (over-excavated) and replaced with structural fill. The depth of over-excavation should be based on soil conditions at the time of construction. A representative of SSGC should be present to assess subgrade conditions during proofrolling.

Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the development. Allowing surface water into cut or fill areas, utility trenches, and building footprints should be prevented.

Structural Fill Materials

The suitability of soil for use as structural fill will depend on the gradation and moisture content of the soil when it is placed. Soils with higher fines content (soil fraction passing the U.S. No. 200 sieve) will become sensitive with higher moisture content. It is often difficult to achieve adequate compaction if soil moisture is outside of optimum ranges for soils that contain more than about 5 percent fines.

Site Soils: Topsoil and observed fill are not considered suitable for structural fill. Native soils will be difficult to use due to their overall fines concentrations. They could be considered suitable for use as structural fill provided they can be moisture conditioned to within optimal ranges. Optimum moisture is considered within about +/- 2 percent of the moisture content required to achieve the maximum density per the ASTM D-1557 test method. If moisture content is higher

or lower than optimum, soils would need to be dried or wetted prior to placement as structural fill.

Import Fill Materials: We recommend import structural fill placed during dry weather periods consist of material which meets the specifications for *Gravel Borrow* as described in Section 9-03.14(1) of the Washington State Department of Transportation (WSDOT) Specifications for Road, Bridge, and Municipal Construction (Publication M41-10). Gravel Borrow should be protected from disturbance if exposed to wet conditions after placement.

During wet weather, or for backfill on wet subgrades, import soil suitable for compaction in wetter conditions should be provided. Imported fill for use in wet conditions should generally conform to specifications for *Select Borrow* as described in Section 9-03.14(2), or *Crushed Surfacing* per Section 9-03.9(3) of the WSDOT M41-10 manual, with the modification that a maximum of 5 percent by weight shall pass the U.S. No. 200 sieve.

It should be noted that structural fill placement and compaction is weather-dependent. Delays due to inclement weather are common, even when using select granular fill. We recommend site grading and earthwork be scheduled for the drier months of the year. Structural fill should not consist of frozen material.

Structural Fill Placement

We recommend structural fill is placed in lifts not exceeding about 10 inches in loose measure. It may be necessary to adjust lift thickness based on site and fill conditions during placement and compaction. Finer grained soil used as structural fill and/or lighter weight compaction equipment may require significantly thinner lifts to attain required compaction levels. Granular soil with lower fines contents could potentially be placed in thicker lifts (1 foot maximum) if they can be adequately compacted. Structural fill should be compacted to attain the recommended levels presented in Table 1, Compaction Criteria.

Table 1. Compaction Criteria

Fill Application	Compaction Criteria*
Footing areas (below structures and retaining walls)	95 %
Upper 2 feet in pavement areas, slabs and sidewalks, and utility trenches	95 %
Below 2 feet in pavement areas, slabs and sidewalks, and utility trenches	92 %
Utility trenches or general fill in non-paved or -building areas	90 %

*Per the ASTM D1557 test method.

Trench backfill within about 2 feet of utility lines should not be over-compacted to reduce the risk of damage to the line. In some instances, the top of the utility line may be within 2 feet of the surface. Backfill in these circumstances should be compacted to a firm and unyielding condition.

We recommend fill procedures include maintaining grades that promote drainage and do not allow ponding of water within the fill area. The contractor should protect compacted fill subgrades from disturbance during wet weather. In the event of rain during structural fill placement, the exposed fill surface should be allowed to dry prior to placement of additional fill. Alternatively, the wet soil can be removed. We recommend consideration be given to protecting haul routes and other high traffic areas with free-draining granular fill material (i.e., sand and gravel containing less than 5 percent fines) or quarry spalls to reduce the potential for disturbance to the subgrade during inclement weather.

Earthwork Procedures

Conventional earthmoving equipment should be suitable for earthwork at this site. Earthwork may be difficult during periods of wet weather or if elevated soil moisture is present due to the amount of fines in native soil. Excavated site soils may not be suitable as structural fill depending on the soil moisture content and weather conditions at the time of earthwork. If soil is stockpiled and wet weather is anticipated, the stockpile should be protected with securely anchored plastic sheeting. If stockpiled soils become unusable, it may become necessary to import clean, granular soils to complete wet weather site work.

Wet or disturbed subgrade soils should be over-excavated to expose firm, non-yielding, non-organic soils and backfilled with compacted structural fill. We recommend the earthwork portion of this project be completed during extended periods of dry weather. If earthwork is completed during the wet season (typically late October through May) it may be necessary to take extra measures to protect subgrade soils.

If earthwork takes place during freezing conditions, we recommend exposed subgrades are allowed to thaw and re-compacted prior to placing subsequent lifts of structural fill. Alternatively, the frozen soil can be removed to unfrozen soil and replaced with structural fill.

The contractor is responsible for designing and constructing stable, temporary excavations (including utility trenches) as required to maintain stability of excavation sides and bottoms. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards. Temporary excavation cuts should be sloped at inclinations of 1H:1.5V (Horizontal:Vertical) or flatter, unless the contractor can demonstrate the safety of steeper inclinations.

Permanent cut and fill slopes should have inclinations of 2H:1V, or flatter.

A geotechnical engineer and accredited testing material laboratory should be retained during the construction phase of the project to observe earthwork operations and perform necessary tests and observations during subgrade preparation, placement and compaction of structural fill, and backfilling of excavations.

Foundations

Foundations should be placed on native subgrade soils (or structural fill over native subgrades) prepared as described in this report. We recommend a working surface of at least 6 inches of clean granular fill for foundations supported on the native soil to limit disturbance during construction. A separation fabric placed between native subgrades and the working surface gravel is recommended. The following recommendations are for conventional spread footing foundations:

<u>Bearing Capacity (net allowable):</u>	1,500 pounds per square foot (psf) for footings supported on firm native soils or structural fill prepared as described in this report.
<u>Footing Width (Minimum):</u>	16 inches (Strip) 24 inches (Column)
<u>Embedment Depth (Minimum):</u>	18 inches (Exterior) 12 inches (Interior)
<u>Settlement:</u>	Total: < 1 inch Differential: < 1/2 inch (over 30 feet)
<u>Allowable Lateral Passive Resistance:</u>	300 psf/ft* (below 18 inches)
<u>Allowable Coefficient of Friction:</u>	0.35*

*These values include a factor of safety of approximately 1.5.

The net allowable bearing pressures presented above may be increased by one-third to resist transient, dynamic loads such as wind or seismic forces. Lateral resistance to footings should be ignored in the upper 12-inches from exterior finish grade.

Foundation Construction Considerations

All foundation subgrades should be free of water and loose soil prior to placing concrete, and should be prepared as recommended in this report. Concrete should be placed soon after excavating and compaction to reduce disturbance to bearing soils. Should soils at foundation level become excessively dry, disturbed, saturated, or frozen, the affected soil should be removed prior to placing concrete. We recommend SSGC observe all foundation subgrades prior to placement of concrete.

Foundation Drainage

Ground surface adjacent foundations should be sloped away from buildings. We recommend footing drains are installed around perimeter footings. Footing drains should include a minimum 4-inch diameter perforated rigid plastic drain line installed at the base of the footing. The perforated drain lines should be connected to a tight line pipe that discharges to an approved storm drain receptor. The drain line should be surrounded by a zone of clean, free-draining granular material having less than 5 percent passing the No. 200 sieve or meeting the requirements of section 9-03.12(2) “Gravel Backfill for Walls” in the WSDOT (M41-10) manual. The free-draining aggregate zone should be at least 12 inches wide and wrapped in filter fabric. The granular fill should extend to within 6 inches of final grade where it should be capped with compacted fill containing sufficient fines to reduce infiltration of surface water into the footing drains. Cleanouts are recommended for maintenance of the drain system.

On-Grade Floor Slabs

On-grade floor slabs should be placed on native soils or structural fill prepared as described in this report. We recommend a modulus subgrade reaction of 150 pounds per square inch per inch (psi/in) for native soil or compacted granular structural fill over native soil.

We recommend a capillary break is provided between the prepared subgrade and bottom of slab. Capillary break material should be a minimum of 4 inches thick and consist of compacted clean, free-draining, well graded coarse sand and gravel. The capillary break material should contain less than 5 percent fines, based on that soil fraction passing the U.S. No. 4 sieve. Alternatively, a clean angular gravel such as No. 7 aggregate per Section 9-03.1(4)C of the WSDOT (M41-10) manual could be used for this purpose.

Seismic Considerations

Seismic parameters and values in Table 3 are recommended based on the 2018 International Building Code (IBC).

Table 3. Seismic Parameters

PARAMETER	VALUE
2018 International Building Code (IBC) Site Classification ¹	E
S _s Spectral Acceleration for a Short Period	1.187
S ₁ Spectral Acceleration for a 1-Second Period	0.488g

¹ Note: In general accordance with the 2018 International Building Code, Section 1613.2.2 for risk categories I,II,III. IBC Site Class is based on the estimated characteristics of the upper 100 feet of the subsurface profile.

Liquefaction

Soil liquefaction is a condition where loose, typically granular soils located below the groundwater surface lose strength during ground shaking, and is often associated with earthquakes. The Lewis County Liquefaction Susceptibility map shows this site as moderate to high risk of liquefaction. Some deformation of underlying soft soils should be expected during a design level earthquake. Although structural failure of properly designed and constructed foundations is not anticipated, some limited structural damage could occur during a design level seismic event.

Conventional Asphalt Pavement Sections

Subgrades for conventional pavement areas should be prepared as described in the “*Subgrade Preparation*” section of this report. Subgrades below pavement sections should be graded or crowned to promote drainage and not allow for ponding of water beneath the section. If drainage is not provided and ponding occurs, subgrade soils could become saturated, lose strength, and result in premature distress or failure of the section. In addition, the pavement surfacing should also be graded to promote drainage and reduce the potential for ponding of water on the pavement surface.

We recommend a separation fabric (such as Mirafi 140N) is placed on new pavement subgrades prior to placement of structural or pavement section fill. The purpose of the fabric is to provide segregation between new granular structural fill and the softer finer grained native soil. Without the fabric, new granular fill will have the tendency to migrate into the looser fine-grained subgrade soil over time, which can compromise the structural integrity of the structural fill zone leading to premature distress of the pavement section.

Minimum recommended pavement sections for conventional asphalt or concrete pavements are presented in Table 4.

Table 4. Minimum Pavement Sections

Traffic Area	Minimum Recommended Pavement Section Thickness (inches)			
	Asphalt Concrete Surface ¹	Portland Cement Concrete ²	Aggregate Base Course ^{3,4}	Subbase Aggregate ⁵
Heavy Traffic	3	6	4	12
Light Traffic/Parking Areas	2	5	4	12

¹ 1/2 –inch nominal aggregate hot-mix asphalt (HMA) per WSDOT 9-03.8(1)

² A 28-day minimum compressive strength of 4,000 psi and an allowable flexural strength of at least 250 psi

³ Crushed Surfacing Base Course per WSDOT 9-03.9(3)

⁴ Although not required for structural support under concrete pavements, a minimum four-inch-thick base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, and subgrade “pumping” through joints

⁵ 95% compacted native subgrade or Gravel Borrow per WSDOT 9-03.14(1) or Crushed Surfacing Base Course WSDOT 9-03.9(3)

Conventional Pavement Maintenance

The performance and lifespan of pavements can be significantly impacted by future maintenance. The above pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be completed. Proper maintenance will slow the rate of pavement deterioration, and will improve pavement performance and life. Preventive maintenance consists of both localized maintenance (crack and joint sealing and patching) and global maintenance (surface sealing). Added maintenance measures should be anticipated over the lifetime of the pavement section if any fill or topsoil is left in-place beneath pavement sections.

REPORT CONDITIONS

This report has been prepared for the exclusive use of RB Engineering for specific application to the project discussed, and has been prepared in accordance with generally accepted geotechnical engineering practices in the area. No warranties, either express or implied, are intended or made. The analysis and recommendations presented in this report are based on observed soil conditions and test results at the indicated locations, and from other geologic information discussed. This report does not reflect variations that may occur across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

Geotechnical Engineering Report
Riverbend Hub Development
1268 NW State Avenue
Chehalis, Washington
SSGC Project No. 23020
May 2, 2023

SSGC

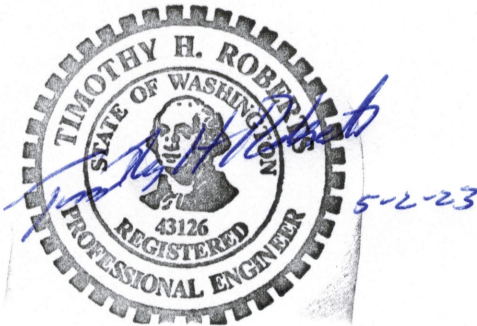
This report was prepared for the planned type of development of the site as discussed herein. It is not valid for third party entities or alternate types of development on the site without the express written consent of SSGC. If development plans change, we should be notified to review those changes and modify our recommendations as necessary.

The scope of services for this project does not include any environmental or biological assessment of the site including identification or prevention of pollutants, hazardous materials, or conditions. Other studies should be completed if the owner is concerned about the potential for contamination or pollution.

We appreciate the opportunity to work with you on this project. Please contact us if additional information is required or we can be of further assistance.

Respectfully,

South Sound Geotechnical Consulting

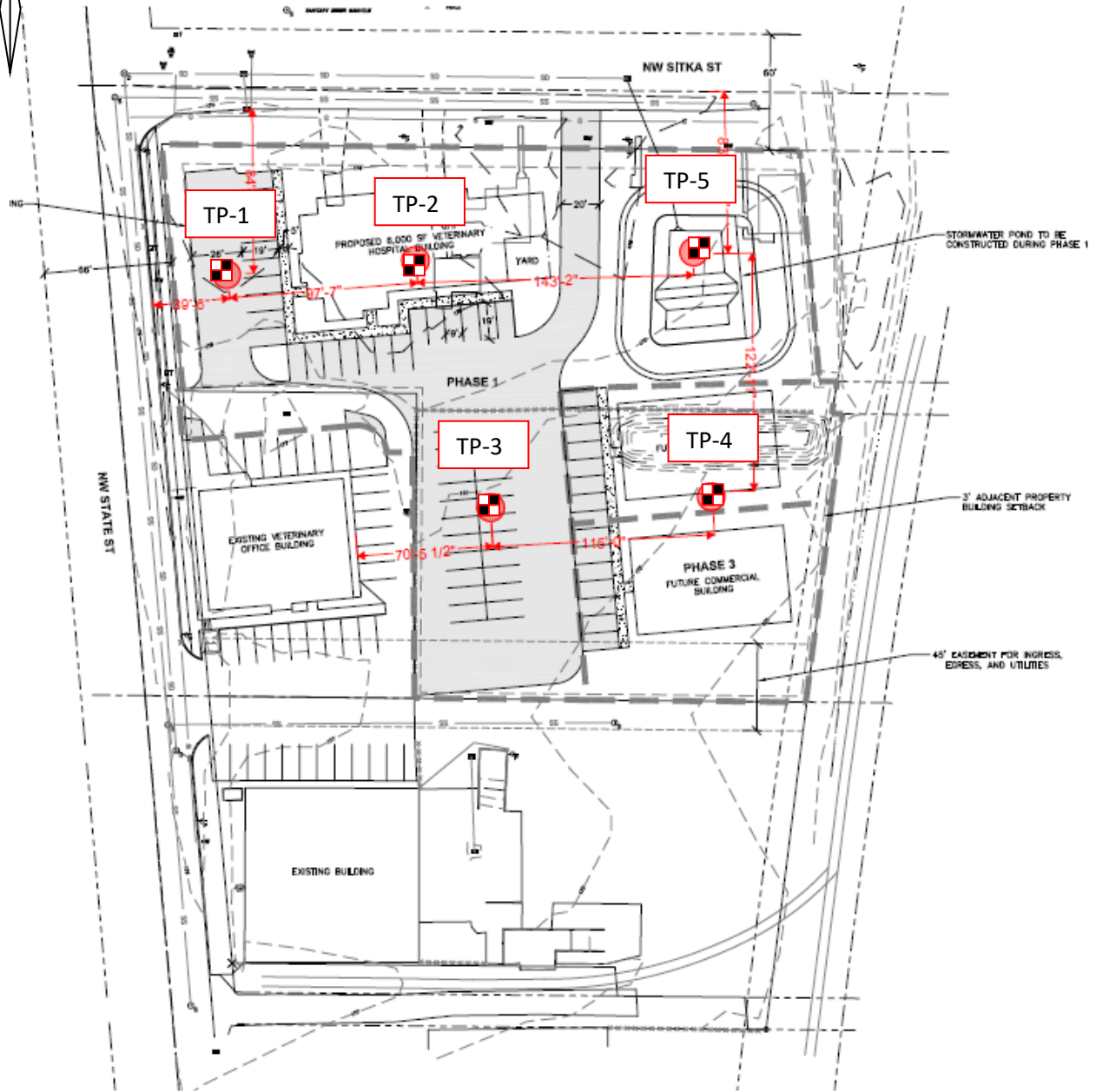


Timothy H. Roberts, P.E.
Member/Geotechnical Engineer

Attachments: Figure 1 – Exploration Plan
Appendix A – Field Exploration Procedures and Exploration Logs
Unified Soil Classification System


N

SECTION 30, TOWNSHIP 14 NORTH, RANGE 02 WEST, W.M.
LEWIS COUNTY, WASHINGTON



Legend

TP - 1

 Approximate Test Pit Location

Scale: NTS

Base map from drawing titled "Preliminary Site Plan", by RB Engineering, dated 8-10-22.

South Sound Geotechnical Consulting

P.O. Box 39500
Lakewood, WA 98496
(253) 973-0515

Figure 1 – Exploration Plan

**Riverbend Hub Development
Chehalis, Washington**

SSGC Project #23020

Geotechnical Engineering Report
Riverbend Hub Development
1268 NW State Avenue
Chehalis, Washington
SSGC Project No. 23020
May 2, 2023

SSGC

Appendix A

Field Exploration Procedures and Exploration Logs

Field Exploration Procedures

Our field exploration for this project included five test pits completed on March 30, 2023. Approximate locations of the explorations are shown on Figure 1, Exploration Plan. Exploration locations were determined by pacing from site features. Ground surface elevations referenced on the logs were inferred from client provided topography. Test hole locations and elevations should be considered accurate only to the degree implied by the means and methods used.

A private excavation company dug the test holes. Select soil samples were collected and stored in moisture tight containers for further assessment and laboratory testing. Explorations were backfilled with excavated soils and tamped when completed. Please note that backfill in the explorations may settle with time. Backfill material located in building or pavement areas should be re-excavated and recompact, or replaced with structural fill.

The following logs indicate the observed lithology of soils and other materials observed in the explorations at the time of excavation. Where a soil contact was observed to be gradational, our log indicates the average contact depth. Our logs also indicate the approximate depth to groundwater (where observed at the time of excavation), along with sample numbers and approximate sample depths. Soil descriptions on the logs are based on the Unified Soil Classification System.

Test Pit TP-1

<u>Depth (feet)</u>	<u>Material Description</u>
0 – 0.75	Topsoil
0.75 – 4.5	Clayey SILT with some fine sand: Soft to medium stiff, moist, mottled orange-gray. (ML)
4.5 – 8	Silty SAND with occasional gravel: Stiff, moist, gray with slight orange mottling. (SM)

Test pit completed at approximately 8 feet on 3/30/23.
Groundwater not observed at time of excavation.
Approximate surface elevation: 175 feet

Test Pit TP-2

<u>Depth (feet)</u>	<u>Material Description</u>
0 – 2	Fill: Silt, clay, sand, and some debris (old clay tile): Loose, moist, brown.
2 – 4.5	Clayey SILT with some fine sand: Soft to medium stiff, moist, mottled orange-gray. (ML)
4.5 – 6	Silty SAND with occasional gravel: Stiff, moist, gray with slight orange mottling. (SM)

Test pit completed at approximately 6 feet on 3/30/23.
Groundwater not observed at time of excavation.
Approximate surface elevation: 175 feet

Test Pit TP-3

<u>Depth (feet)</u>	<u>Material Description</u>
0 – 1	Fill: Sandy gravel: Loose, moist, gray.
1 – 2.5	Fill: Silty SAND: Loose, moist, dark gray. (SM/SW)
2 – 4	Clayey SILT with some fine sand: Soft to medium stiff, moist, gray. (ML)
4 – 7	Clayey SILT/Silty CLAY: Soft grading stiff, moist, gray. (ML/CL)
7 – 8	Silty SAND with occasional gravel: Stiff, moist, gray with slight orange mottling. (SM)

Test pit completed at approximately 8 feet on 3/30/23.
Groundwater not observed at time of excavation.
Approximate surface elevation: 177 feet

Test Pit TP-4

<u>Depth (feet)</u>	<u>Material Description</u>
0 – 1.5	Fill: Sandy gravel: Loose, moist, gray.
1.5 – 3	Clayey SILT with some fine sand: Soft to medium stiff, moist, gray. (ML)
3 – 5	Clayey SILT/Silty CLAY: Soft grading stiff, moist, gray. (ML/CL)
5 – 8	SILT with fine sand and some clay: Stiff, moist to wet, mottled orange-gray. (ML)

Test pit completed at approximately 8 feet on 3/30/23.
Slight seepage at 3 feet at time of excavation.
Approximate surface elevation: 178 feet

Test Pit TP-5Depth (feet)Material Description

0 – 0.75

Topsoil

0.75 – 4.5

Clayey SILT with some fine sand: Soft to medium stiff, moist, mottled orange-gray. (ML)

4.5 – 10

Silty SAND with occasional gravel: Stiff, moist to wet, gray with slight orange mottling. (SM)

Test pit completed at approximately 10 feet on 3/30/23.
 Groundwater observed at 10 feet at time of excavation.
 Approximate surface elevation: 176 feet

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests^A

				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel ^F	
	Sands 50% or more of coarse fraction passes No. 4 sieve	Gravels with Fines More than 12% fines ^C	Clean Sands Less than 5% fines ^D	Fines classify as ML or MH Fines classify as CL or CH	GM	Silty gravel ^{F,G,H}
			Sands with Fines More than 12% fines ^D	Fines classify as ML or MH Fines Classify as CL or CH	GC	Clayey gravel ^{F,G,H}
			Clean Sands Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$ $Cu < 6$ and/or $1 > Cc > 3^E$	SW	Well-graded sand ^I
			Sands with Fines More than 12% fines ^D	Fines classify as ML or MH Fines Classify as CL or CH	SP	Poorly graded sand ^I
Fine-Grained Soils 50% or more passes the No. 200 sieve	Sils and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line ^J $PI < 4$ or plots below "A" line ^J	CL	Lean clay ^{K,L,M}	
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K,L,M}	
		organic	Liquid limit - oven dried < 0.75 Liquid limit - not dried	OL	Organic clay ^{K,L,M,N} Organic silt ^{K,L,M,O}	
			Liquid limit - oven dried < 0.75 Liquid limit - not dried	OH	Organic silt ^{K,L,M,O}	
	Sils and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line PI plots below "A" line	CH	Fat clay ^{K,L,M}	
			PI plots below "A" line	MH	Elastic Silt ^{K,L,M}	
		organic	Liquid limit - oven dried < 0.75 Liquid limit - not dried	OH	Organic clay ^{K,L,M,P} Organic silt ^{K,L,M,Q}	
			Liquid limit - not dried	OH	Organic silt ^{K,L,M,Q}	
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^ABased on the material passing the 3-in. (75-mm) sieve

^BIf field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^CGravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^DSands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^FIf soil contains $\geq 15\%$ sand, add "with sand" to group name.

^GIf fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^HIf fines are organic, add "with organic fines" to group name.

^IIf soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^JIf Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^KIf soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^LIf soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

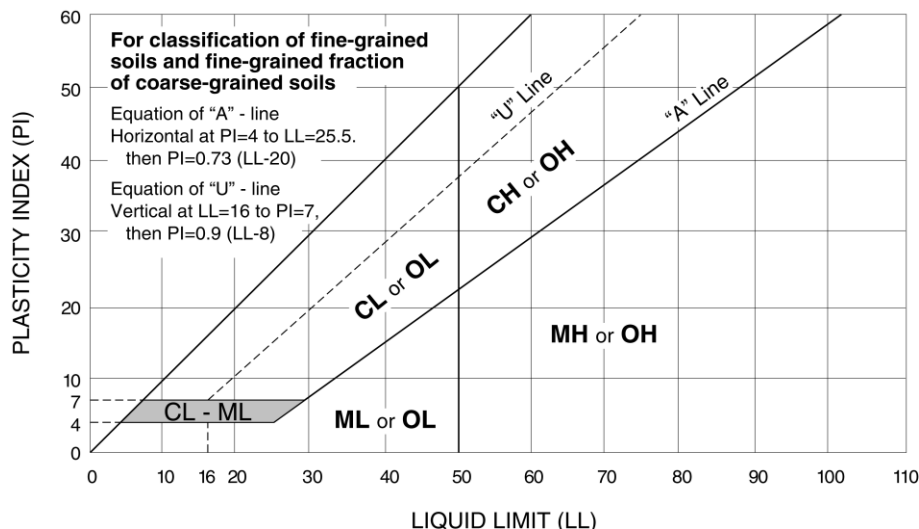
^MIf soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



APPENDIX 4 – OPERATION AND MAINTENANCE MANUAL

An operation and maintenance manual will be included in the final drainage report.

APPENDIX 5 – CONSTRUCTION SWPPP

Construction Stormwater General Permit

**Stormwater Pollution Prevention Plan
(SWPPP)**

for

River Bend Hub Development

Prepared for:

**The Washington State Department of Ecology
*SW Regional Office***

Permittee / Owner	Developer	Operator / Contractor
Pending	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

5/24/23

Project Construction Dates

Activity / Phase	Start Date	End Date
1	Pending	Pending

PROJECT OVERVIEW

WAR No. : Pending

Site Address: 1268 NW State St
Chehalis, WA 98532

Applicable Criteria	Areas
Total Site Area	1.73 AC
Land Disturbing Area	1.73 AC

Existing vegetation: Open Field

Drainage Patterns: Natural drainage to the northwest where it enters catch basins in NW Sitka St.

Critical Areas: None.

Step Slopes: None

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 constructing a new 6,000 sf veterinary hospital building with associated parking and stormwater facilities. Construction will consist of site grading, excavation, paving, and other typical activities associated with construction.

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

Runoff from the site flows to the northwest, where it enters catch basins in NE Sitka St. There is no offsite flow onto the property.

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

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

Contaminated Site Information:

Proposed activities regarding contaminated soils or groundwater (example: on-site treatment system, authorized sanitary sewer discharge):

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.

Due to the small site development no BMPs have been highlighted for Elements 1, 3 and 8.

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 protecting 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 C154: Concrete Washout Area
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.

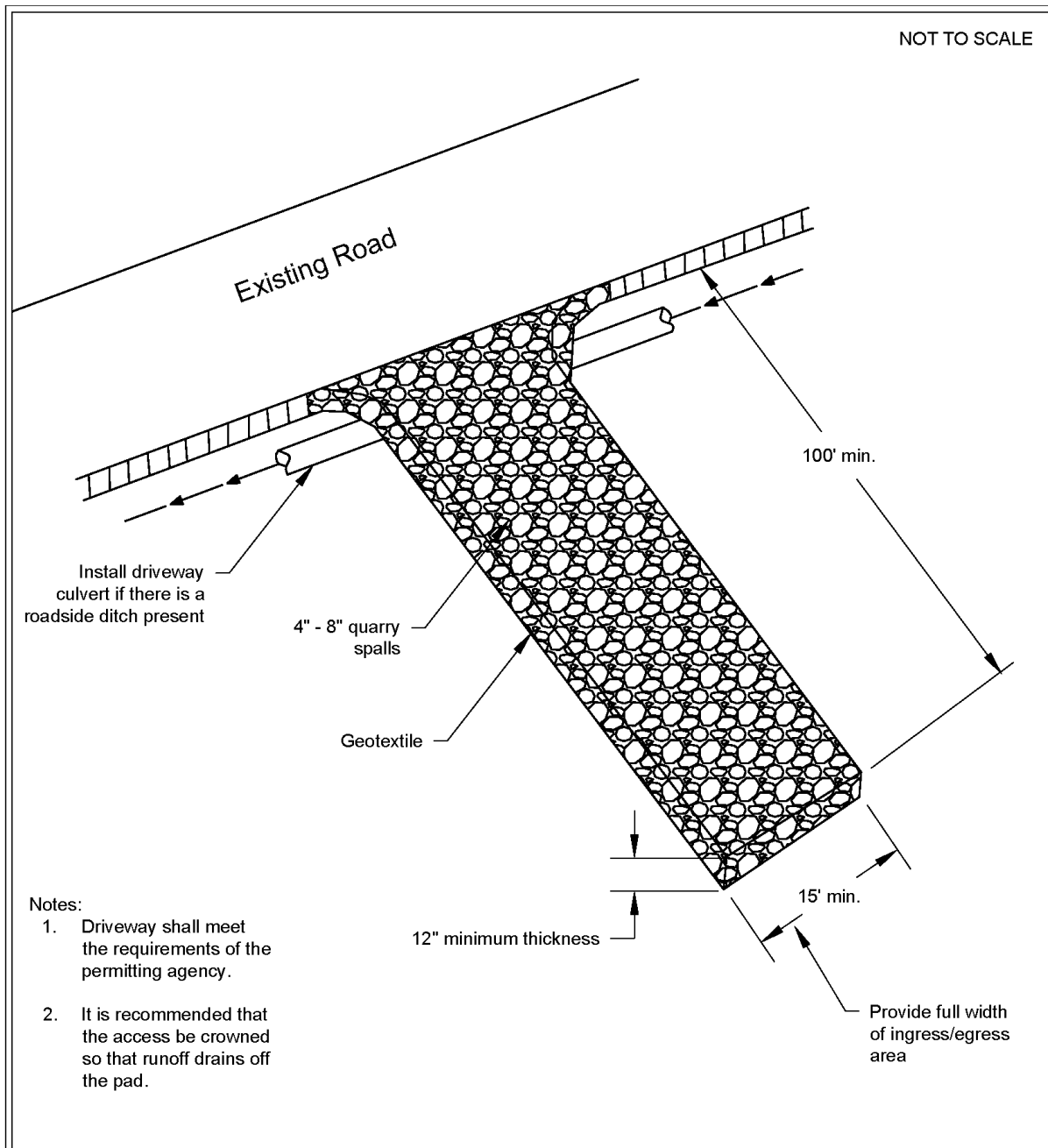
- All percentages are by weight.
- The sand equivalent value and dust ratio requirements do not apply.
- The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.

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



Stabilized Construction Access

Revised June 2018

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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 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 control 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 Bonded 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	<i>Festuca rubra</i> var. <i>commutata</i> or <i>Poa annua</i>	40	98	90
Perennial rye	<i>Lolium perenne</i>	50	98	90
Redtop or colonial bentgrass	<i>Agrostis alba</i> or <i>Agrostis tenuis</i>	5	92	85
White dutch clover	<i>Trifolium repens</i>	5	98	90
Landscaping Seed Mix				
A recommended mix for landscaping seed.				
Perennial rye blend	<i>Lolium perenne</i>	70	98	90
Chewings and red fescue blend	<i>Festuca rubra</i> var. <i>commutata</i> or <i>Festuca rubra</i>	30	98	90
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)	<i>Festuca arundinacea</i> var.	45	98	90
Dwarf perennial rye (Barclay)	<i>Lolium perenne</i> var. <i>barclay</i>	30	98	90
Red fescue	<i>Festuca rubra</i>	20	98	90
Colonial bentgrass	<i>Agrostis tenuis</i>	5	98	90
Bioswale Seed Mix				
A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fescue	<i>Festuca arundinacea</i> or <i>Festuca elatior</i>	75-80	98	90

Seaside/Creeping bentgrass	<i>Agrostis palustris</i>	10-15	92	85
Redtop bentgrass	<i>Agrostis alba</i> or <i>Agrostis gigantea</i>	5-10	90	80
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	<i>Festuca arundinacea</i> or <i>Festuca elatior</i>	60-70	98	90
Seaside/Creeping bentgrass	<i>Agrostis palustris</i>	10-15	98	85
Meadow foxtail	<i>Alepocurus pratensis</i>	10-15	90	80
Alsike clover	<i>Trifolium hybridum</i>	1-6	98	90
Redtop bentgrass	<i>Agrostis alba</i>	1-6	92	85
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	<i>Agrostis alba</i> or <i>Agrostis oregonensis</i>	20	92	85
Red fescue	<i>Festuca rubra</i>	70	98	90
White dutch clover	<i>Trifolium repens</i>	10	98	90

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 performance 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 runoff.

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 control 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 C154: Concrete Washout Area

Purpose

Prevent or reduce the discharge of pollutants from concrete waste to stormwater by conducting washout off-site, or performing on-site washout in a designated area.

Conditions of Use

Concrete washout areas are implemented on construction projects where:

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

Note that auxiliary concrete truck components (e.g. chutes and hoses) and small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheel- barrows) may be washed into formed areas awaiting concrete pour.

At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.

Design and Installation Specifications

Implementation

- Perform washout of concrete truck drums at an approved off-site location or in designated concrete washout areas only.
- Do not wash out concrete onto non-formed areas, or into storm drains, open ditches, streets, or streams.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow excess concrete to be dumped on-site, except in designated concrete washout areas as allowed above.
- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures (above-grade or below-grade).
- Prefabricated containers are most resistant to damage and protect against spills and leaks. Companies may offer delivery service and provide regular maintenance and disposal of solid and liquid waste.
- If self-installed concrete washout areas are used, below-grade structures are preferred over

above-grade structures because they are less prone to spills and leaks.

- Self-installed above-grade structures should only be used if excavation is not practical.
- Concrete washout areas shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

Education

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

Contracts

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

Location and Placement

- Locate concrete washout areas at least 50 feet from sensitive areas such as storm drains, open ditches, water bodies, or wetlands.
- Allow convenient access to the concrete washout area for concrete trucks, preferably near the area where the concrete is being poured.
- If trucks need to leave a paved area to access the concrete washout area, prevent track-out with a pad of rock or quarry spalls (see [BMP C105: Stabilized Construction Access](#)). These areas should be far enough away from other construction traffic to reduce the likelihood of accidental damage and spills.
- The number of concrete washout areas you install should depend on the expected demand for storage capacity.
- On large sites with extensive concrete work, concrete washout areas should be placed in multiple locations for ease of use by concrete truck drivers.

Concrete Truck Washout Procedures

- Washout of concrete truck drums shall be performed in designated concrete washout areas only.

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

Concrete Washout Area Installation

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

Maintenance Standards

Inspection and Maintenance

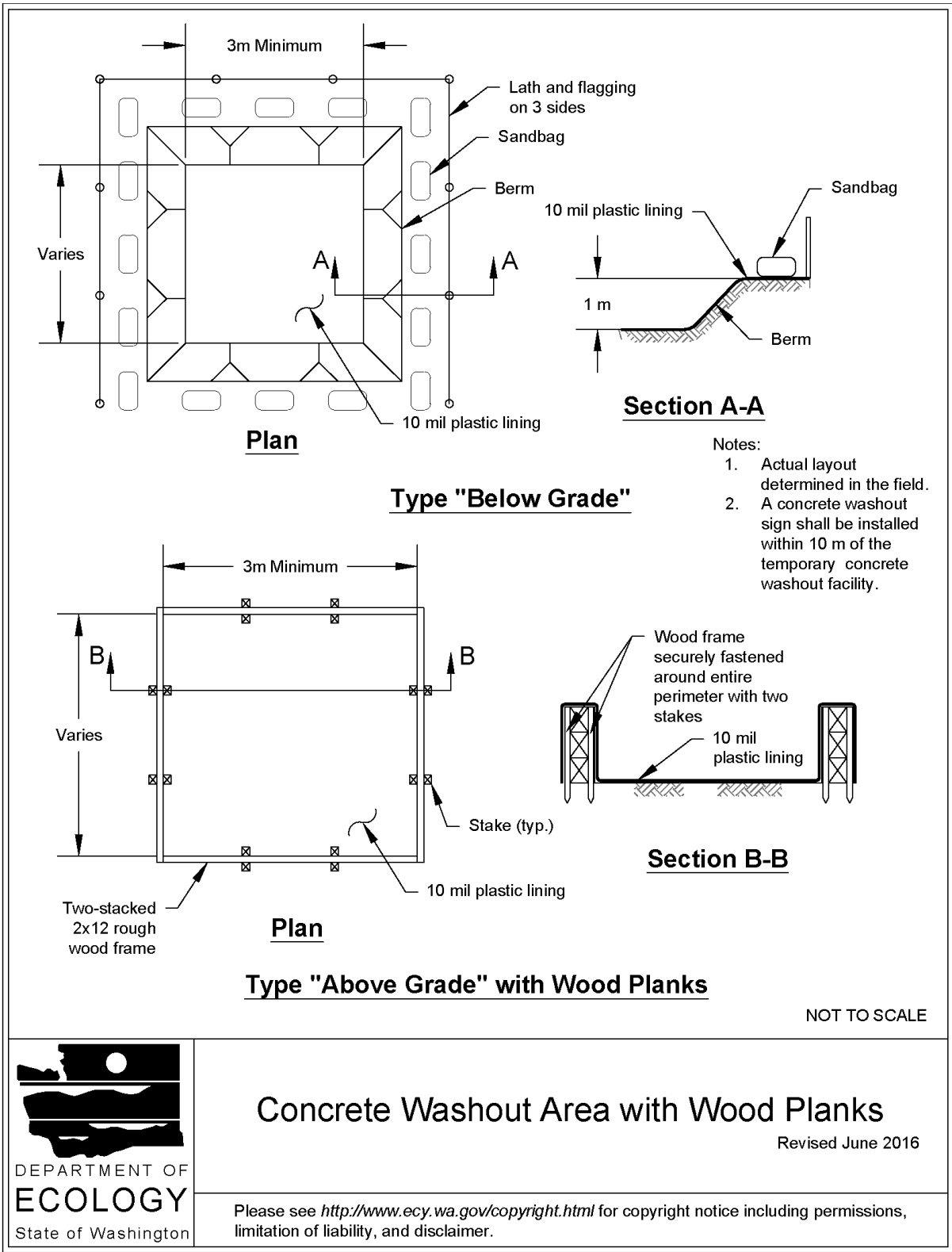
- Inspect and verify that concrete washout areas are in place prior to the commencement of concrete work.
- Once concrete wastes are washed into the designated washout area and allowed to harden, the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.
- During periods of concrete work, inspect the concrete washout areas daily to verify continued performance.
 - Check overall condition and performance.
 - Check remaining capacity (% full).
 - If using self-installed concrete washout areas, verify plastic liners are intact and side-walls are not damaged.
 - If using prefabricated containers, check for leaks.
- Maintain the concrete washout areas to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Concrete washout areas must be cleaned, or new concrete washout areas must be constructed and ready for use once the concrete washout area is 75% full.
- If the concrete washout area is nearing capacity, vacuum and dispose of the waste material in an approved manner.
 - Do not discharge liquid or slurry to waterways, storm drains or directly onto ground.

- Do not discharge to the sanitary sewer without local approval.
- Place a secure, non-collapsing, non-water collecting cover over the concrete washout area prior to predicted wet weather to prevent accumulation and overflow of precipitation.
- Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused on-site or hauled away for disposal or recycling.
- When you remove materials from a self-installed concrete washout area, build a new structure; or, if the previous structure is still intact, inspect for signs of weakening or damage, and make any necessary repairs. Re-line the structure with new plastic after each cleaning.

Removal of Concrete Washout Areas

- When concrete washout areas are no longer required for the work, the hardened concrete, slurries and liquids shall be removed and properly disposed of.
- Materials used to construct concrete washout areas shall be removed from the site of the work and disposed of or recycled.
- Holes, depressions or other ground disturbance caused by the removal of the concrete washout areas shall be backfilled, repaired, and stabilized to prevent erosion.

Figure II-3.7: Concrete Washout Area with Wood Planks



Concrete Washout Area with Wood Planks

Revised June 2016

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Figure II-3.8: Concrete Washout Area with Straw Bales

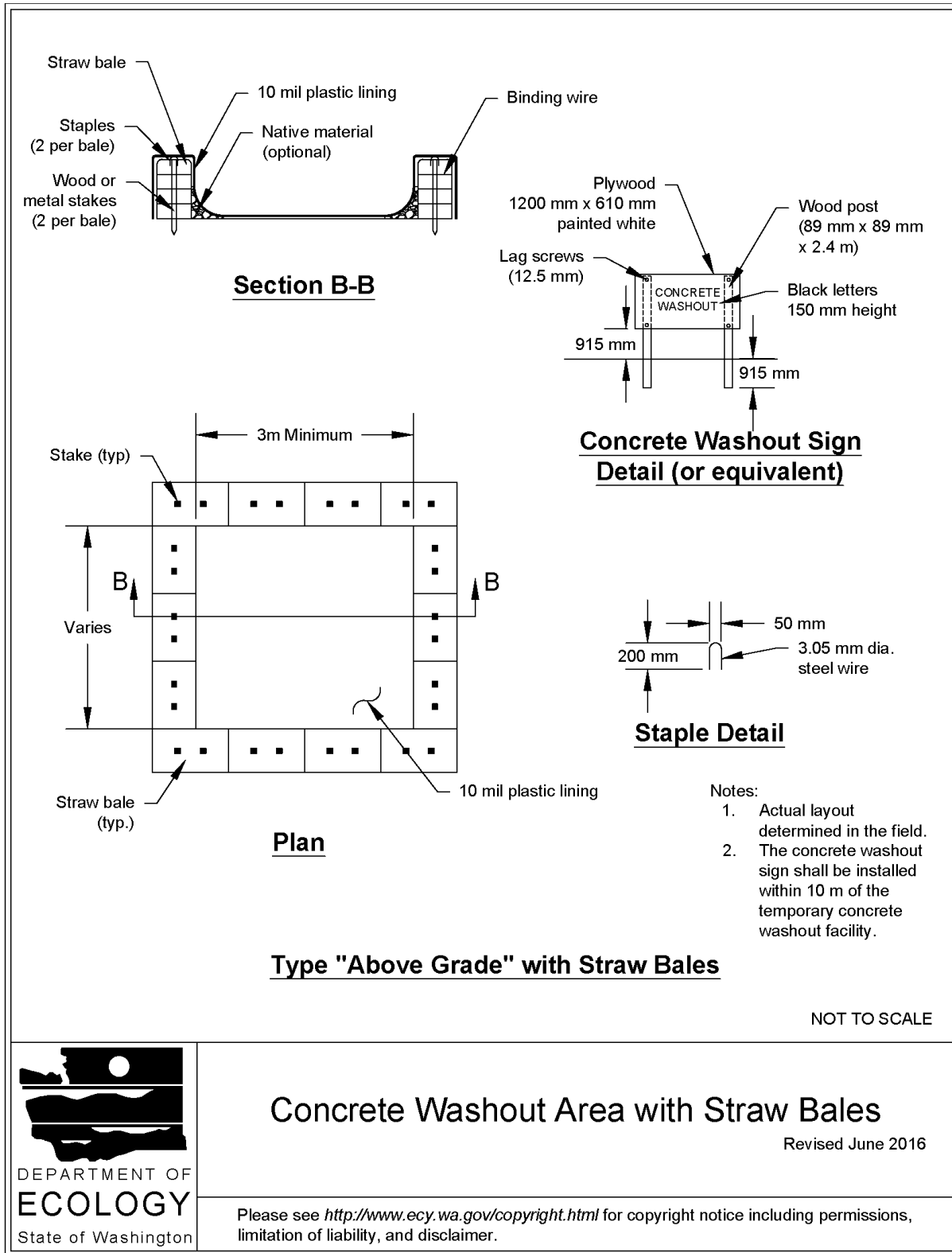
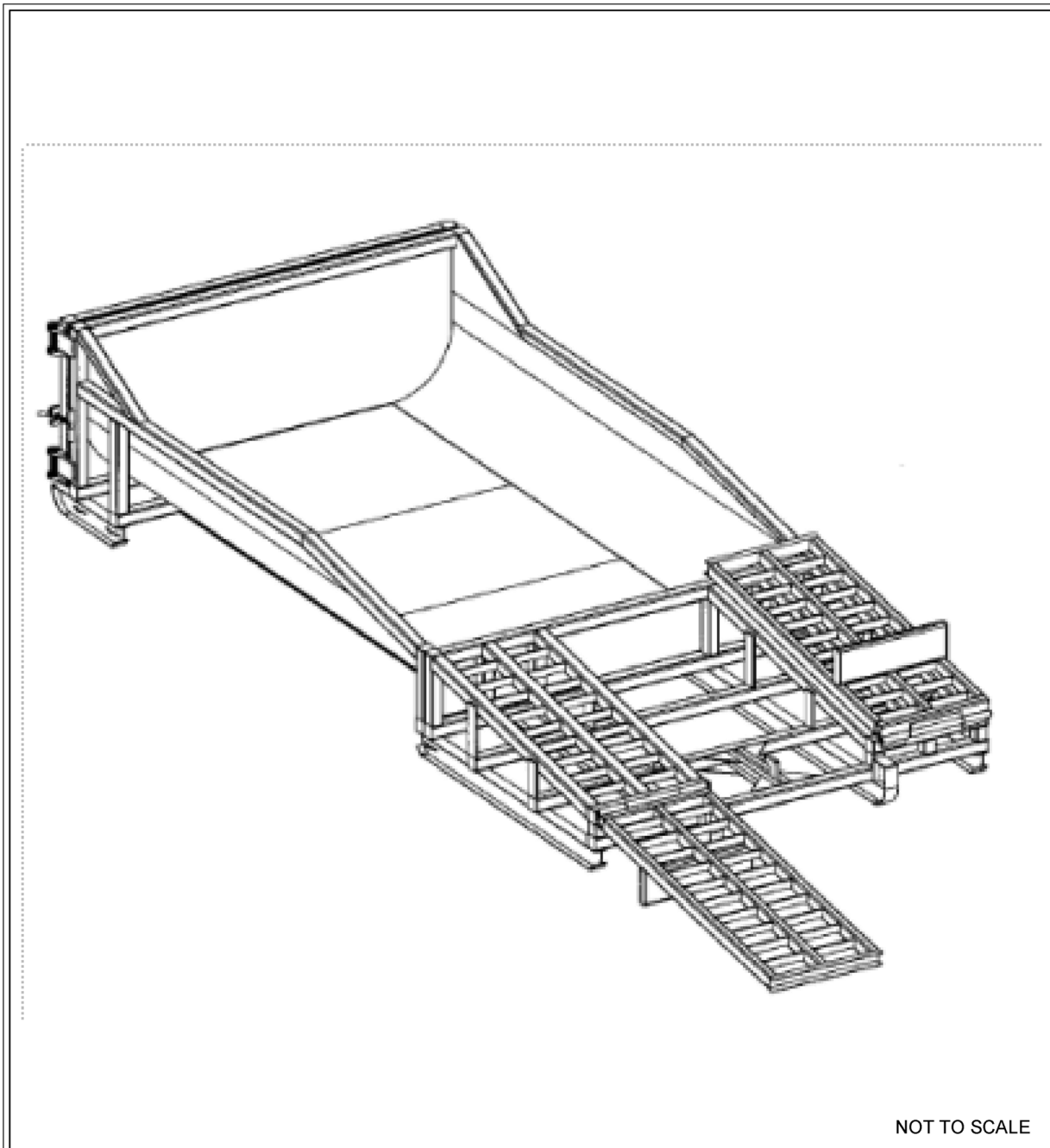


Figure II-3.9: Prefabricated Concrete Washout Container w/Ramp



Prefabricated Concrete Washout Container w/Ramp

Revised June 2016

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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.

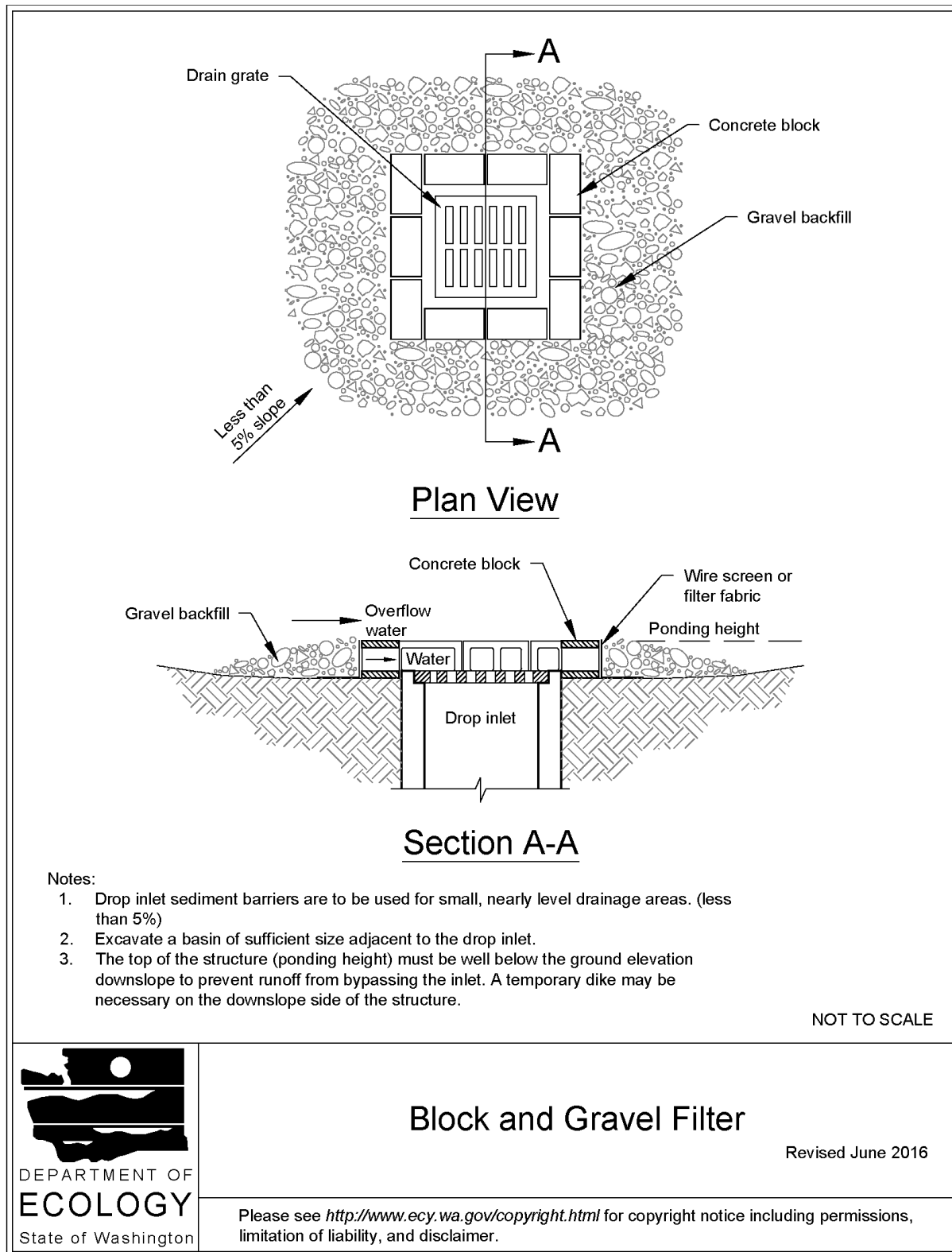
- Clear the area of all debris.
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope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



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:

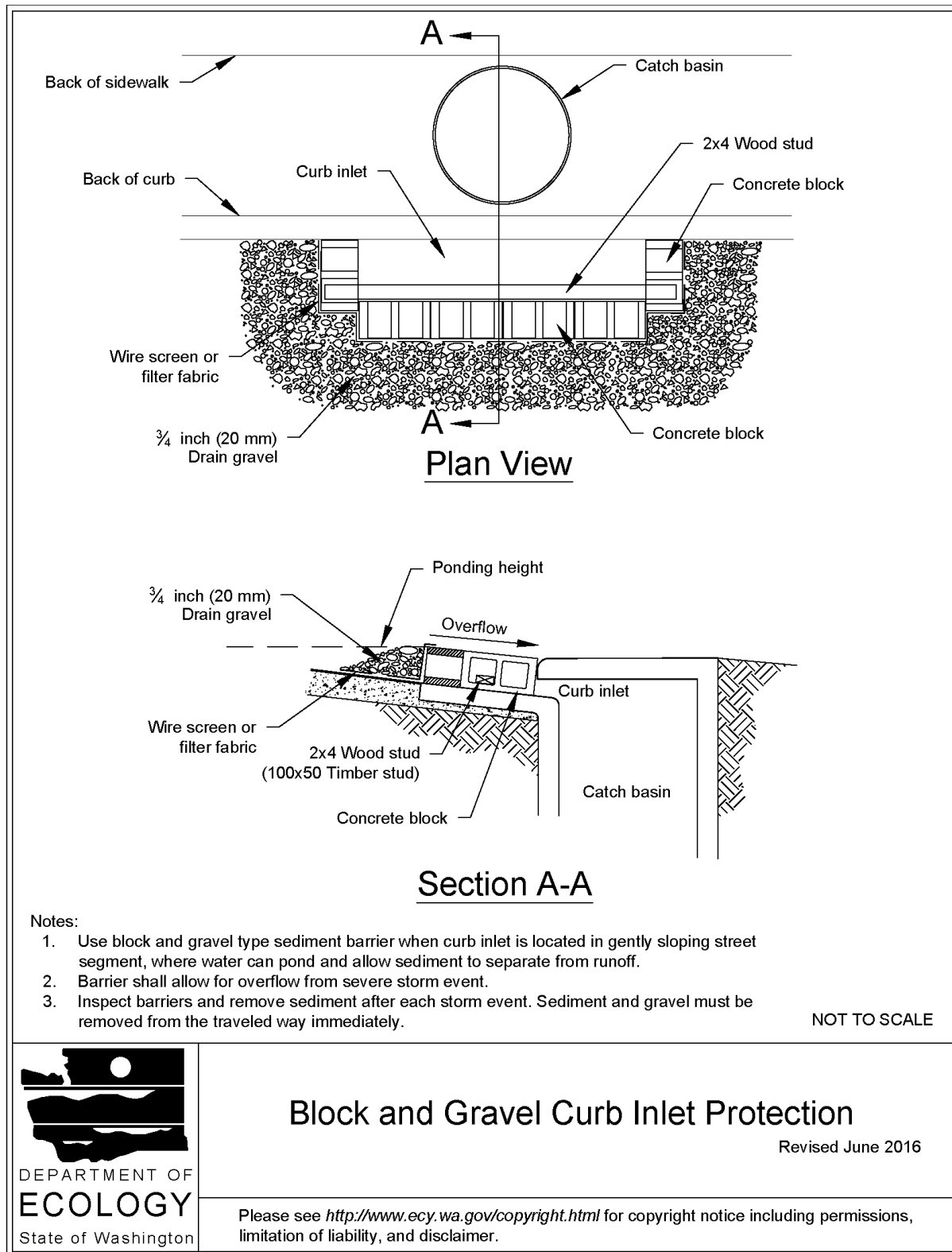
- Use wire mesh with ½-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against the wire and fabric.
- Place weight on the frame anchors.

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

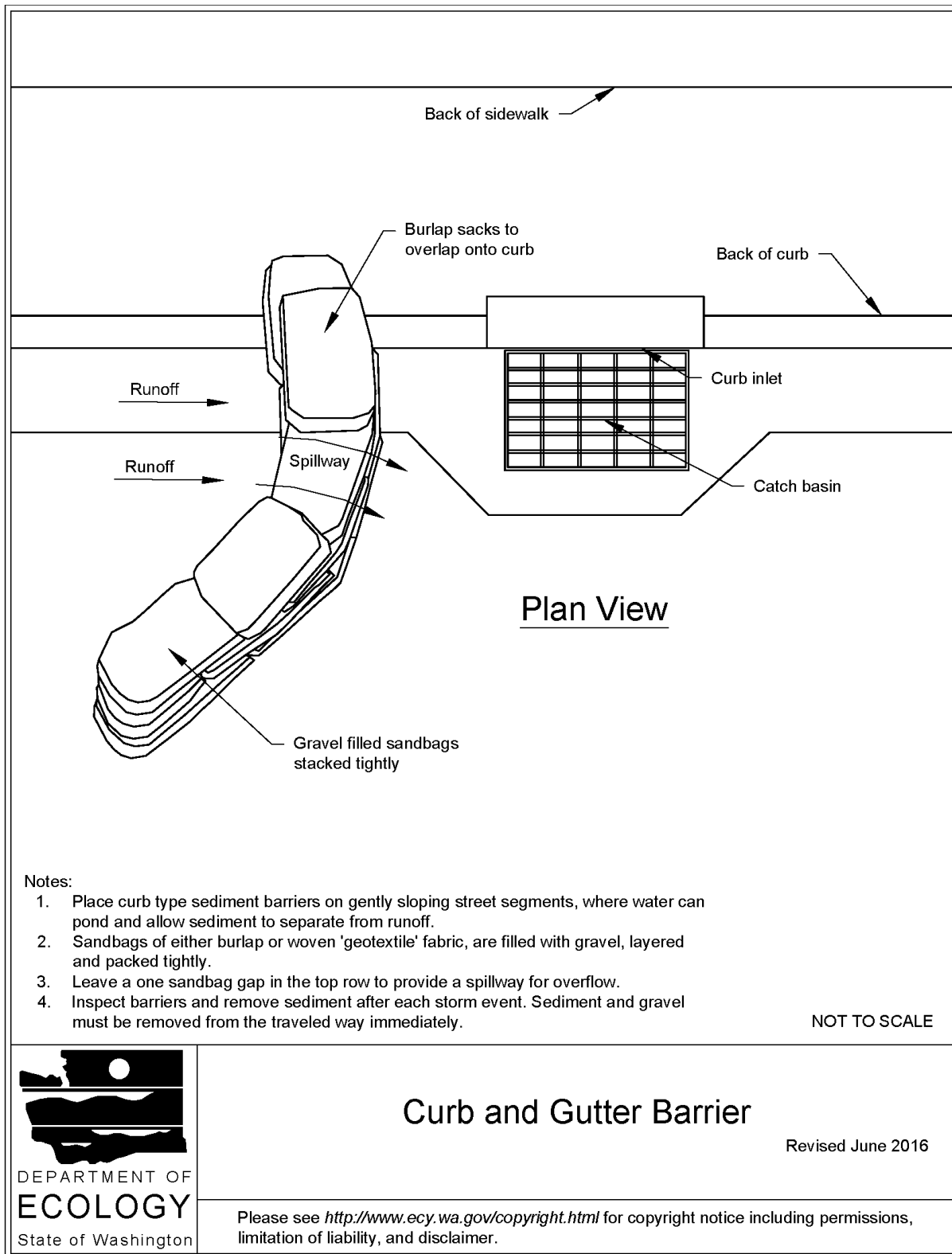


Curb and Gutter Sediment Barrier

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

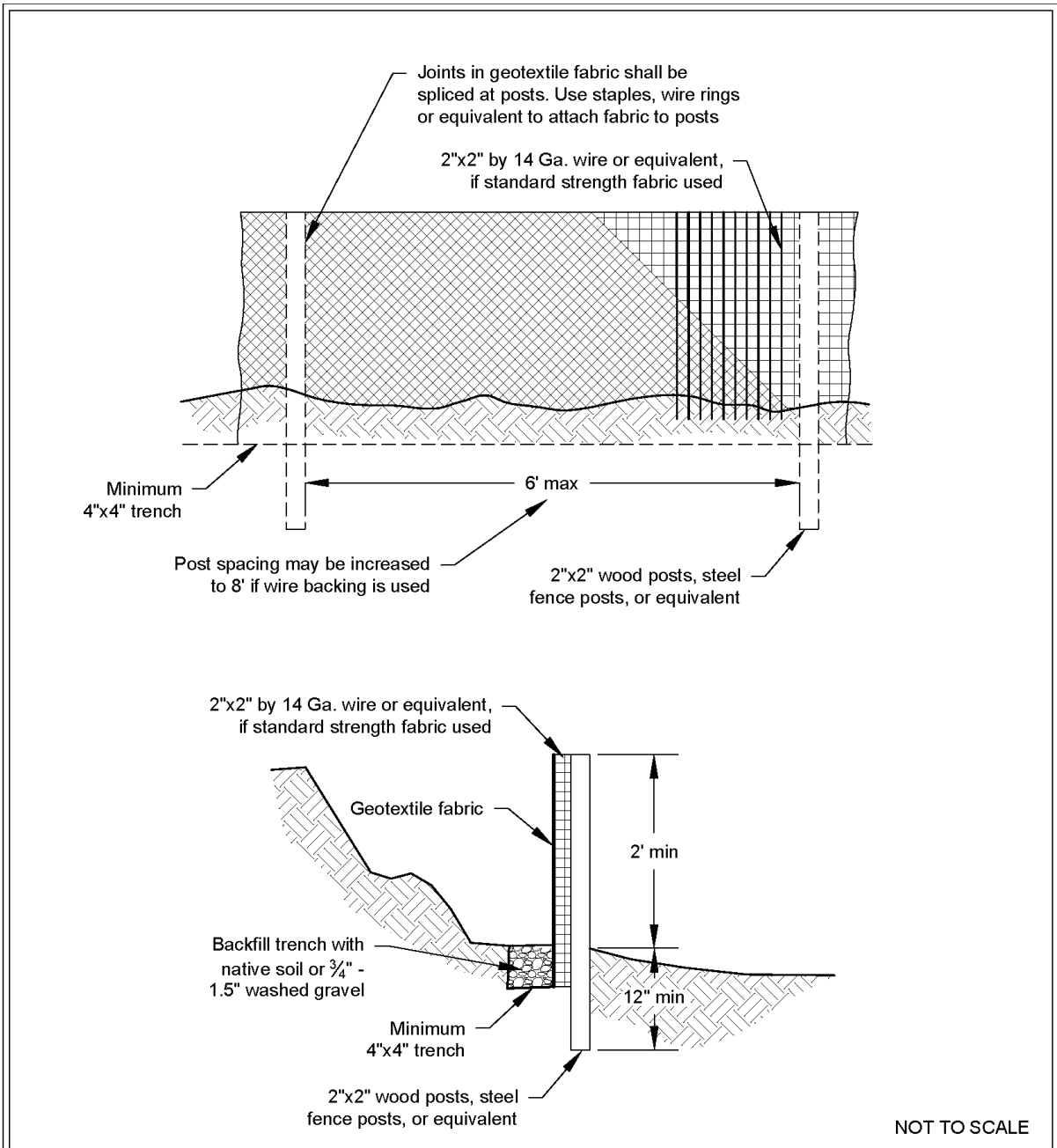
Silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

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



Silt Fence

Revised July 2017

Please see <http://www.ecy.wa.gov/copyright.html> for copyright notice including permissions, limitation of liability, and disclaimer.

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.

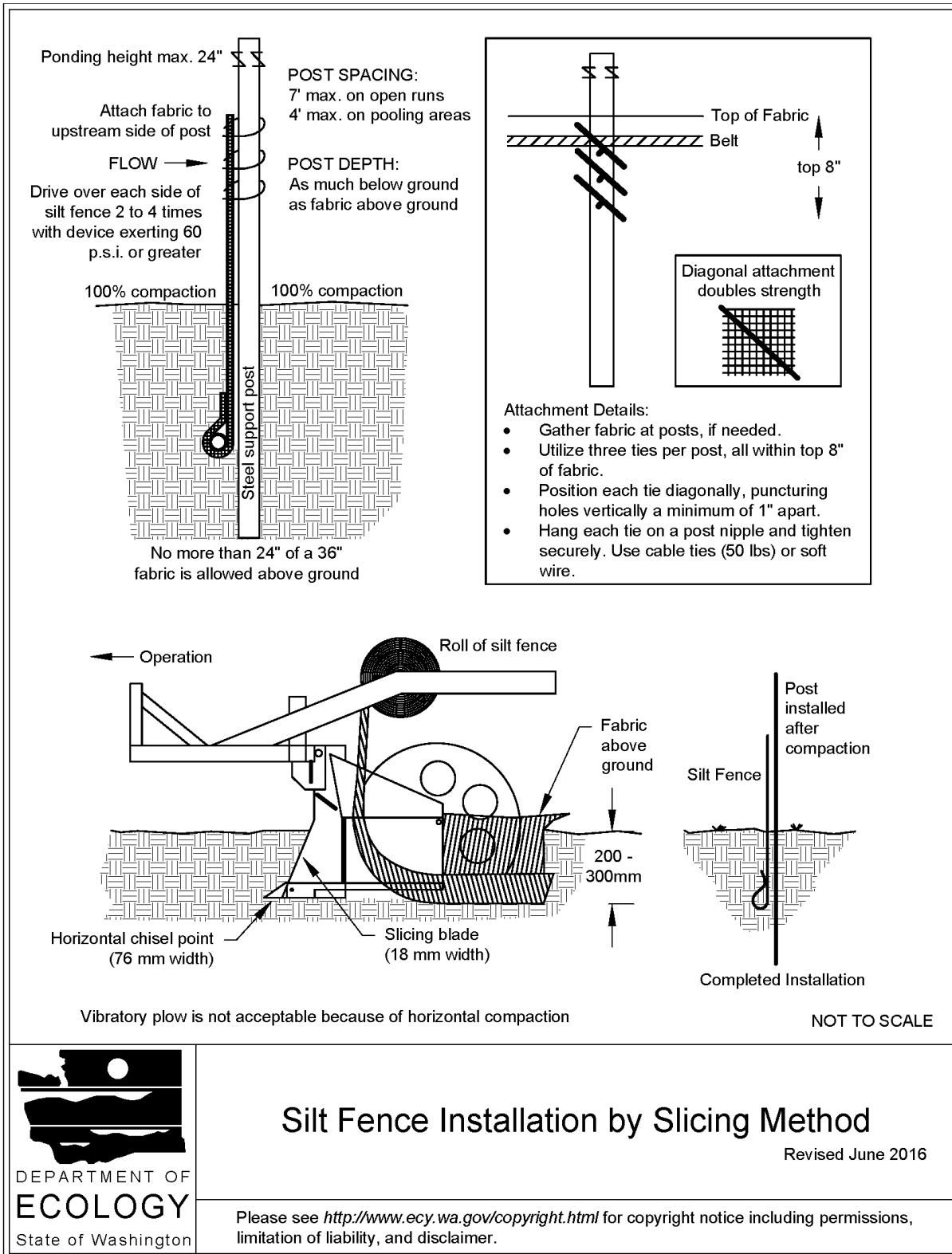
3. The silt fence shall have a 2-foot min. and a 2½-foot max. height above the original ground surface.
4. The geotextile fabric shall be sewn together at the point of manufacture to form fabric lengths as required. Locate all sewn seams at support posts. Alternatively, two sections of silt fence can 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



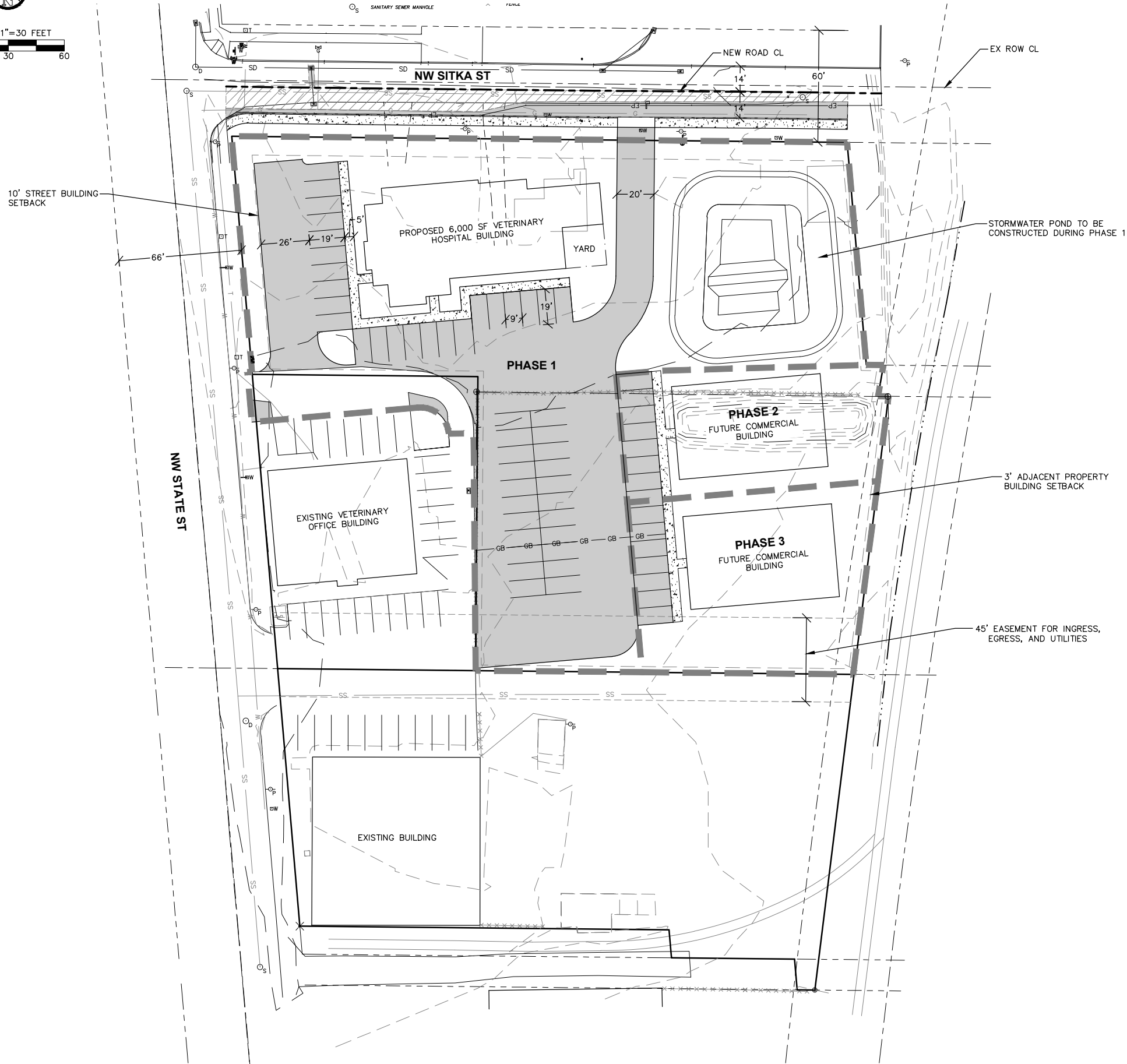
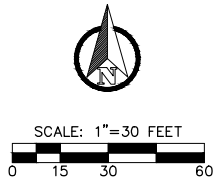
Maintenance Standards

- 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.

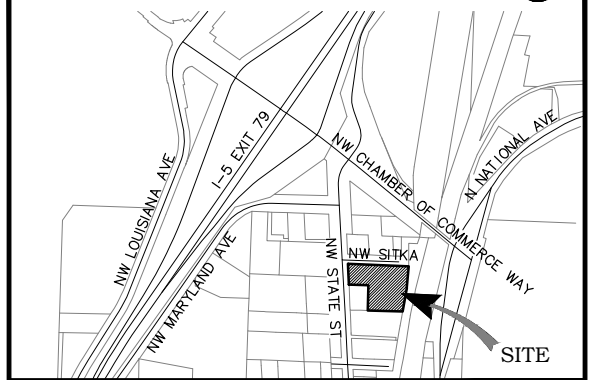
APPENDIX 6 – DRAINAGE AND TESC PLANS

RIVER BEND HUB DEVELOPMENT

SECTION 30, TOWNSHIP 14 NORTH, RANGE 02 WEST, W.M.
LEWIS COUNTY, WASHINGTON



VICINITY MAP



PROJECT INFORMATION

APPLICANT: BRANDY FAY
370 HAMILTON RD
CHEHALIS, WA 98532
(360) 748-3121
DRFAYDVM@GMAIL.COM

PARCEL NOS: 004333003000

SITE ADDRESS: 1268 NW STATE ST
CHEHALIS, WA 98532

ZONING: IL/CG

SITE AREA: 1.73

GRADING: 1160± CY CUT
3420± CY FILL

BUILDING AREA (SF):
5,000 (EXISTING)
6,000 (PHASE 1)
8,000 (FUTURE)
19,000 (TOTAL)

REQUIRED PARKING: 3/ 1,000 SF BUILDING AREA
57 SPOTS

PROVIDED PARKING: 23 SPOTS (EXISTING)
60 SPOTS (NEW)
83 SPOTS (TOTAL)

SOILS: LACAMAS SILT LOAM

SANITARY SEWER: CITY OF CHEHALIS

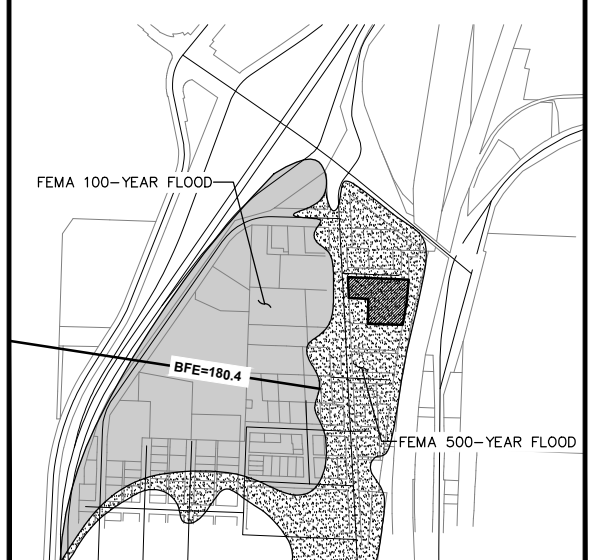
WATER: CITY OF CHEHALIS

FIRE DISTRICT: LEWIS COUNTY

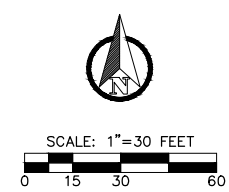
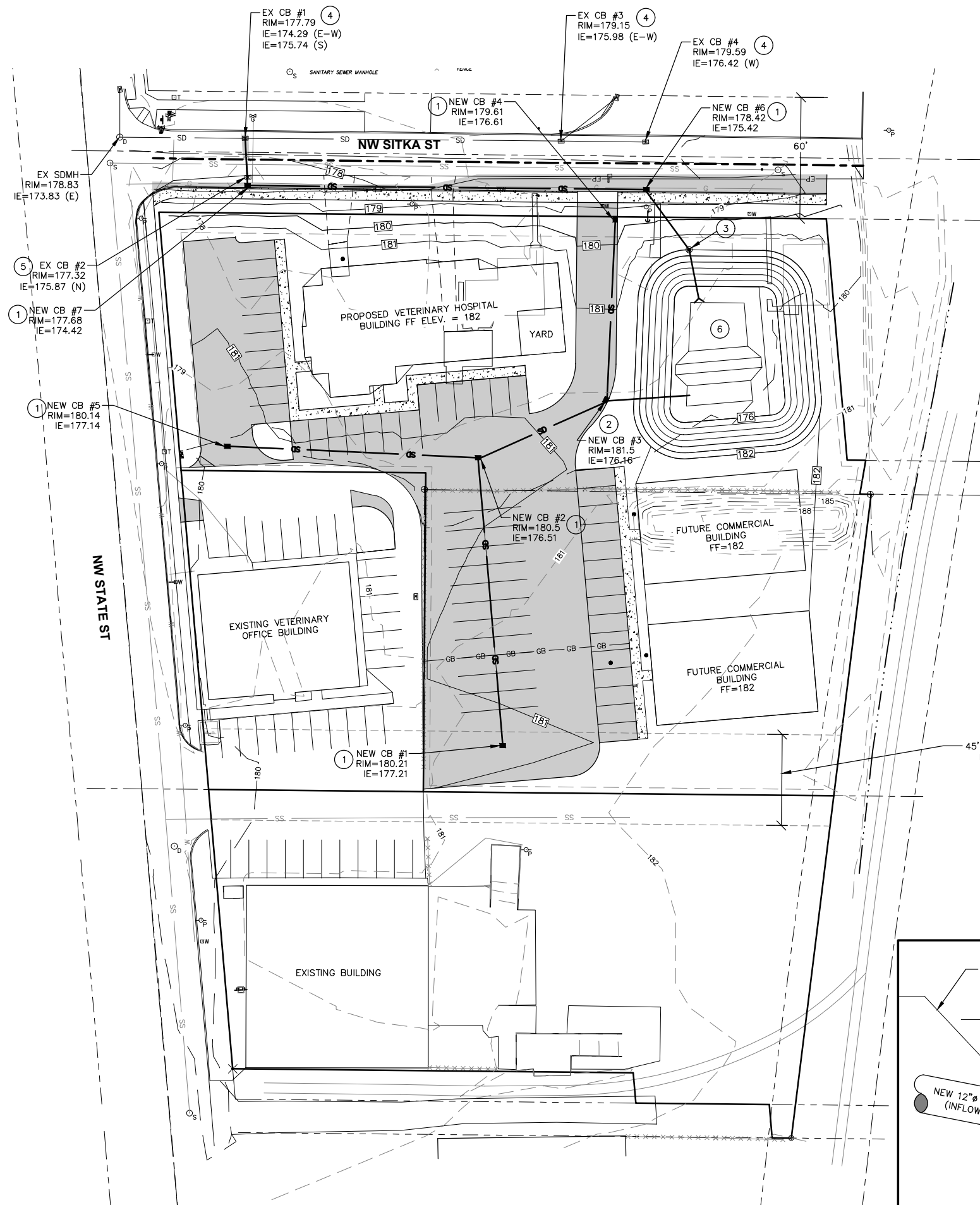
SHEET INDEX

P0.1 PRELIMINARY SITE PLAN
P1.1 PRELIMINARY GRADING AND DRAINAGE PLAN
P1.2 PRELIMINARY UTILITY PLAN
P1.3 PRELIMINARY DETAILS AND NOTES

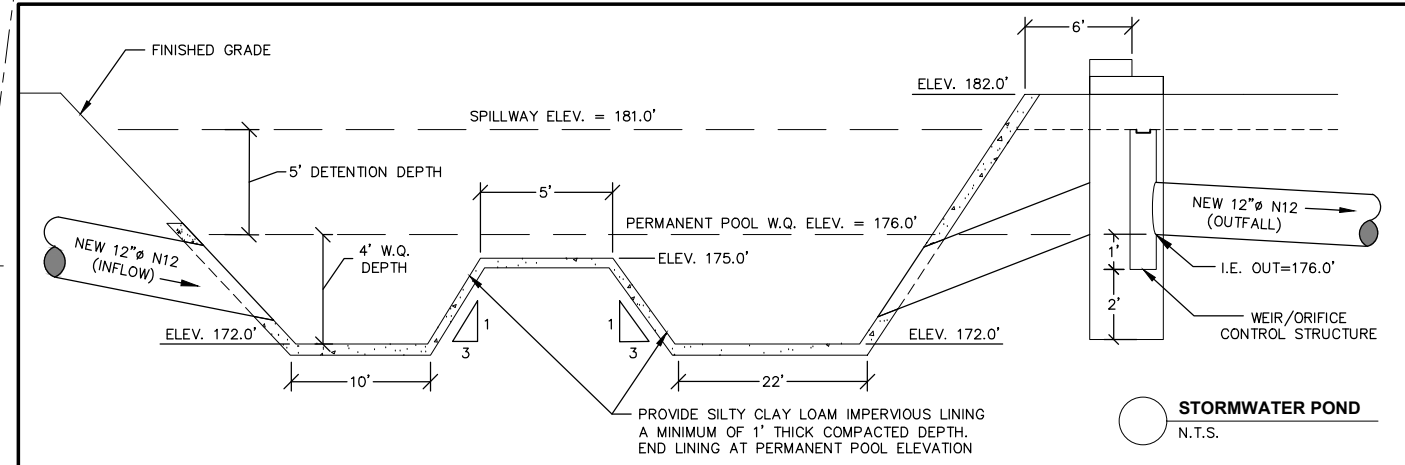
FLOOD MAP



NO.	DATE	REVISION
DESIGNED BY: ZRW	DRAWN BY: ZRW	CHECKED BY: R/WB
DATE: 8/10/22	SCALE:	
RIVER BEND HUB DEVELOPMENT		
PRELIMINARY SITE PLAN		
RB Engineering DESIGN → PERMIT → MANAGE OFF: (360) 740-8819 EMAIL: Chief@rbengineering.com P.O. Box 523 CHEHALIS, WA 98532		
JOB NUMBER: 22034		
DRAWING NAME: 22034_PSP		
P0.1		
1 OF 4		



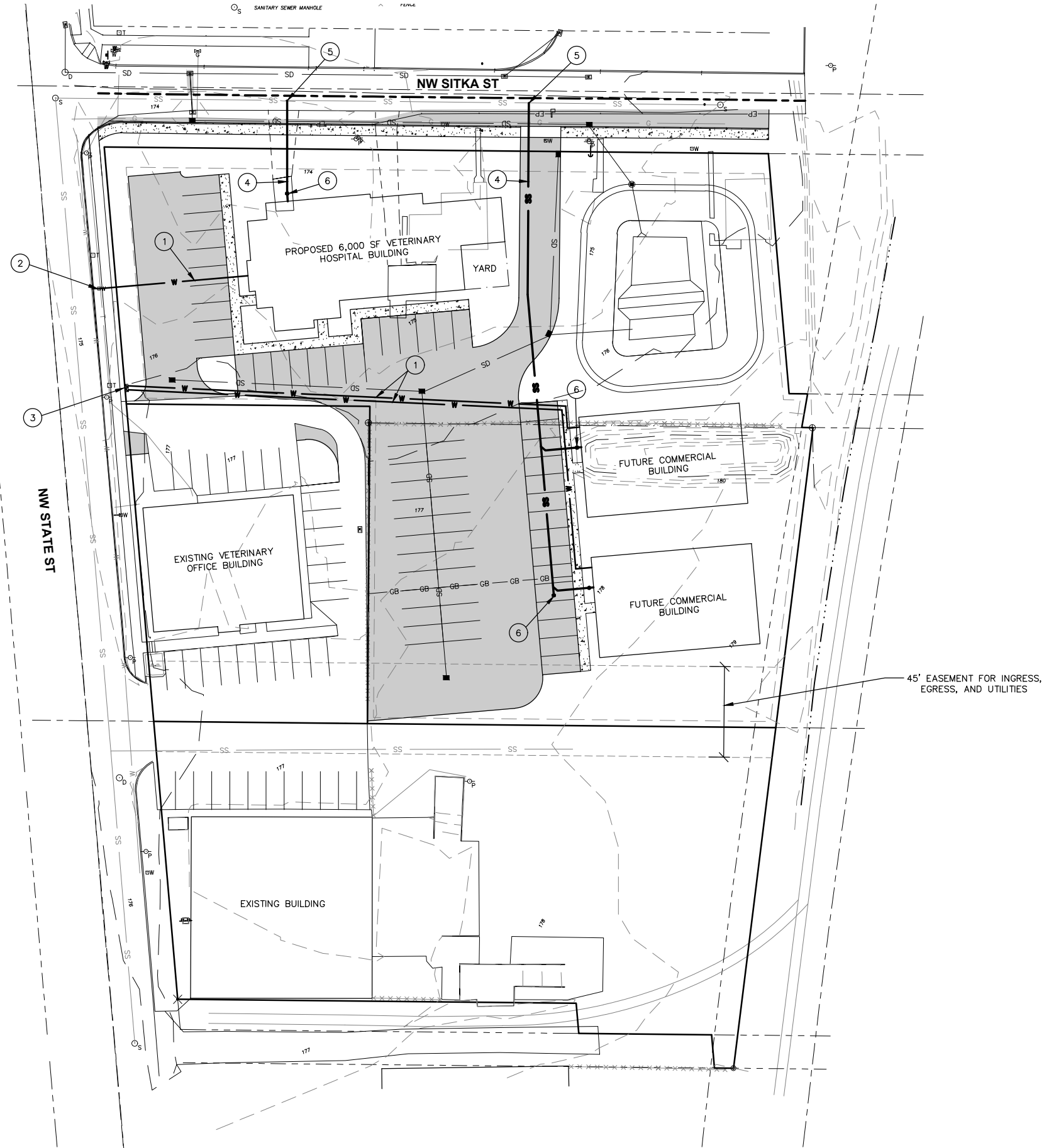
- GRADING CONSTRUCTION NOTES:**
- ① NEW TYPE 1 CATCH BASIN
 - ② NEW TYPE 2 CATCH BASIN
 - ③ NEW OUTLET CONTROL STRUCTURE
 - ④ EXISTING CATCH BASIN TO REMAIN
 - ⑤ EXISTING CATCH BASIN TO BE REMOVED
 - ⑥ NEW STORMWATER POND



NO.	DATE	REVISION
DESIGNED BY: ZRW	DRAWN BY: ZRW	CHECKED BY: R/WB
DATE: 8/10/22	SCALE:	
RIVER BEND HUB DEVELOPMENT		WA.
PRELIMINARY GRADING AND DRAINAGE PLAN		CHEHALIS
RB Engineering DESIGN → PERMIT → MANAGE P.O. Box 523 CHEHALIS, WA 98532 OFF: (360) 740-8819 EMAIL: Chehalis@rbengineers.com		
811 Know what's below. Call 811 before you dig.		
JOB NUMBER: 22034 DRAWING NAME: 22034_PGDP1 P1.1 2 OF 4		



SCALE: 1"=30 FEET
 0 15 30 60



UTILITY CONSTRUCTION NOTES:

- ① INSTALL NEW 2" SCH. 40 PVC WATER LINES FOR SERVICE TO NEW BUILDINGS.
- ② CONNECT NEW VETERINARY HOSPITAL TO EXISTING WATER METER.
- ③ INSTALL NEW 3/4" WATER METERS FOR FUTURE COMMERCIAL BUILDINGS.
- ④ INSTALL NEW 6" SEWER LATERALS FOR SERVICE TO NEW BUILDINGS.
- ⑤ CONNECT NEW SEWER LATERALS TO EXISTING SEWER MAIN.
- ⑥ INSTALL NEW SEWER CLEANOUTS AT LOCATIONS SHOWN.

NO.	DATE	REVISION

DESIGNED BY: ZRW
 DRAWN BY: ZRW
 CHECKED BY: RWB
 DATE: 8/10/22
 SCALE: WA.

RIVER BEND HUB DEVELOPMENT
 CHEHALIS WA.

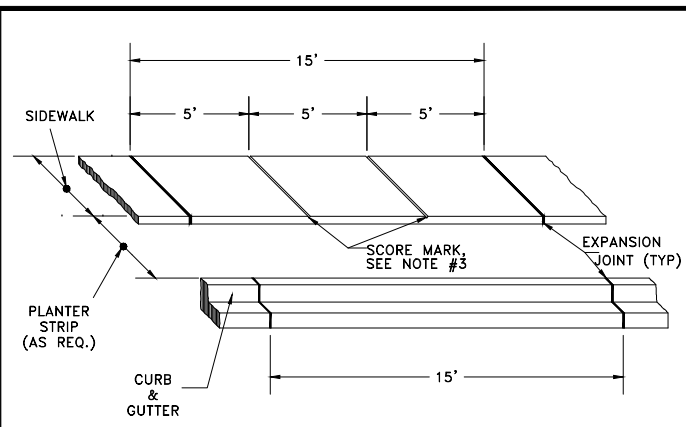
PRELIMINARY UTILITY PLAN



RB Engineering
 DESIGN → PERMIT → MANAGE
 P.O. Box 523
 CHEHALIS, WA 98532
 OFF: (509) 740-8819
 EMAIL: info@rbengineering.com



JOB NUMBER: 22034
 DRAWING NAME: 22034_PUTPL
P1.2
 3 OF 4

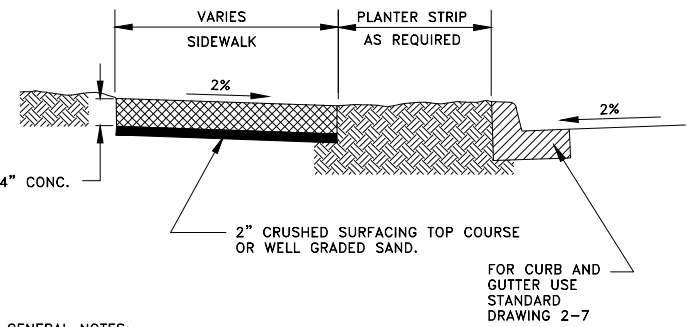
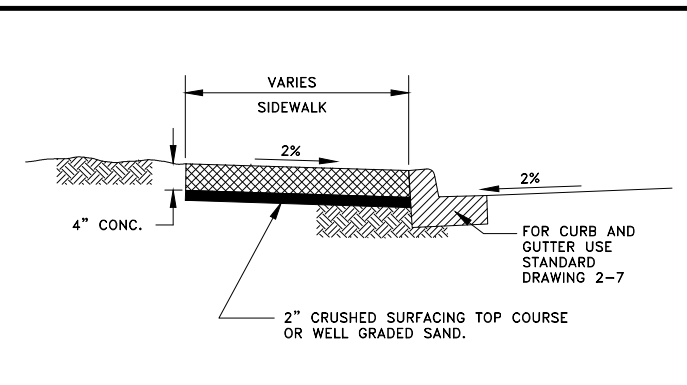


- GENERAL NOTES:**
1. EXPANSION JOINT MATERIAL TO BE 3/8" THICK PREMOLDED JOINT FILLER FULL THICKNESS OF CONCRETE.
 2. FORM AND SUBGRADE INSPECTION REQUIRED BEFORE POURING CONCRETE.
 3. SCORE MARKS SHALL BE ±1/8" WIDE BY ±1/4" DEEP. FOR SIDEWALKS OVER 8' IN WIDTH, A LONGITUDINAL SCORE MARK SHALL BE MADE ALONG CENTER OF WALK.
 4. EXPANSION JOINTS SHALL BE INSTALLED IN CURB AND GUTTER AND IN SIDEWALK AT PC AND PT AT ALL CURB RETURNS. EXPANSION JOINTS SHALL BE PLACED IN SIDEWALK AT SAME LOCATIONS AS THOSE IN CURB AND GUTTER WHEN SIDEWALK IS ADJACENT TO CURB AND GUTTER, UNLESS OTHERWISE DIRECTED BY ENGINEER.

City of Chehalis

**SIDEWALK SPACING
EXPANSION JOINTS & SCORE MARKS**

APPROVED BY	DWG. NO. 2-10
	REVISED DATE 1/02/2003
CITY ENGINEER	

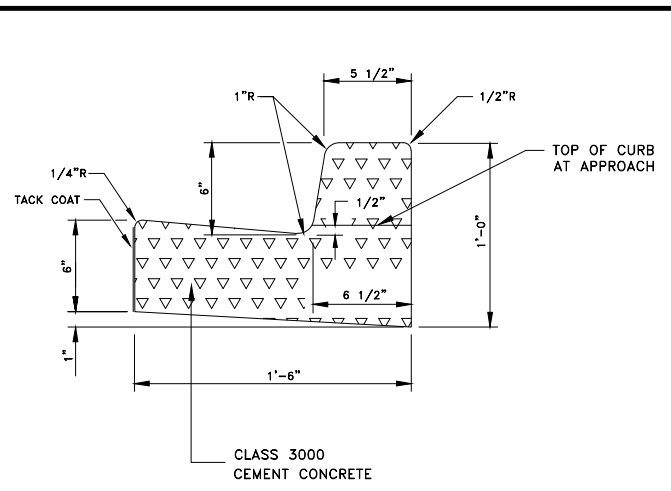


- GENERAL NOTES:**
1. REFER TO STANDARD DRAWING 2-10 FOR INFORMATION ON JOINTS AND SCORING.
 2. SIDEWALK ACROSS CONCRETE DRIVEWAYS REQUIRE A MINIMUM DEPTH OF 6" FOR RESIDENTIAL DRIVES & 8" FOR ALL OTHER DRIVES.
 3. WHEN CHECKED WITH A 10' STRAIGHTEDGE, GRADE SHALL NOT DEVIATE MORE THAN 1/8 INCH & ALIGNMENT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

City of Chehalis

SIDEWALK

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

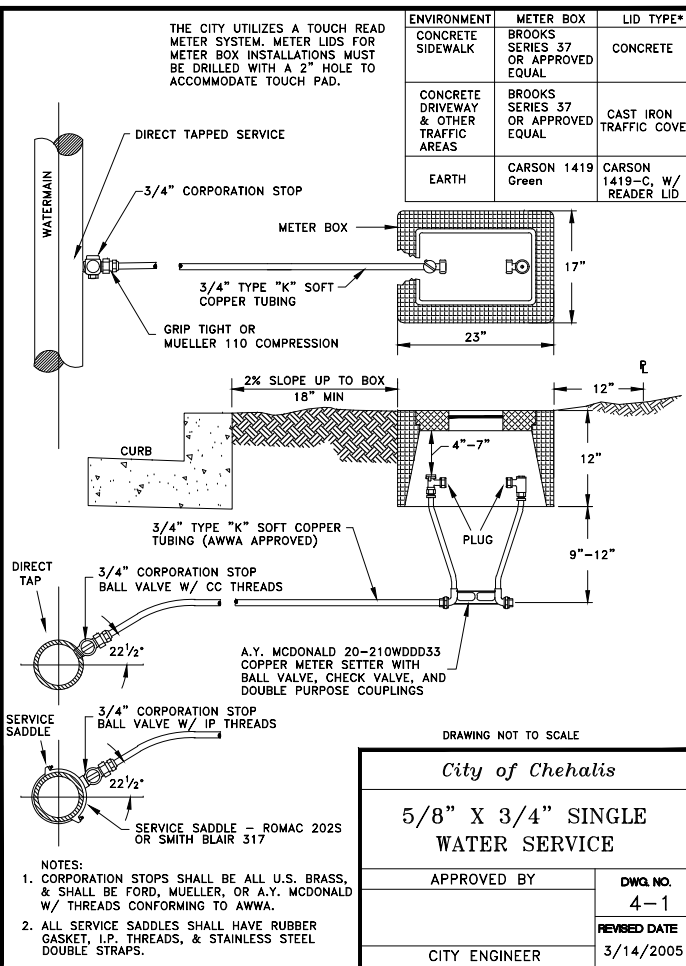


- GENERAL NOTES:**
1. EXPANSION JOINT MATERIAL TO BE 3/8" THICK PREMOLDED JOINT FILLER FULL THICKNESS OF CONCRETE.
 2. FORM AND SUBGRADE INSPECTION REQUIRED BEFORE POURING CONCRETE.
 3. SUBGRADE AND BASE REQUIREMENTS SHALL BE THE SAME AS FOR PAVEMENT RESTORATION.

City of Chehalis

**CEMENT CONCRETE
CURB & GUTTER**

APPROVED BY	DWG. NO. 2-7
	REVISED DATE 1/02/2003
CITY ENGINEER	

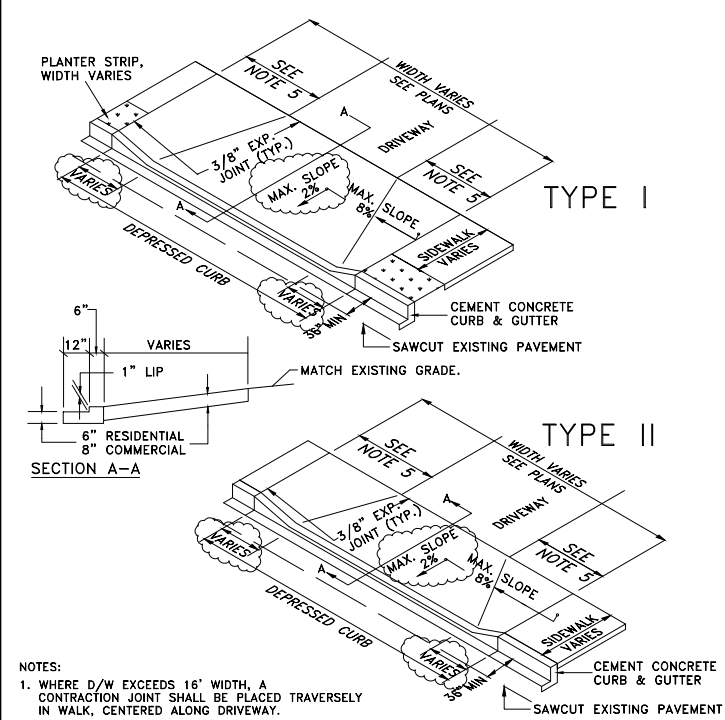


- NOTES:**
1. CORPORATION STOPS SHALL BE ALL U.S. BRASS, & SHALL BE FORD, MUELLER, OR A.Y. MCDONALD W/ THREADS CONFORMING TO AWWA.
 2. ALL SERVICE SADDLES SHALL HAVE RUBBER GASKET, I.P. THREADS, & STAINLESS STEEL DOUBLE STRAPS.

City of Chehalis

**5/8" X 3/4" SINGLE
WATER SERVICE**

APPROVED BY	DWG. NO. 4-1
	REVISED DATE 3/14/2005
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.

City of Chehalis

**CEMENT CONCRETE
DRIVEWAY**

APPROVED BY	DWG. NO. 2-8
	REVISED DATE 4/14/2010
CITY ENGINEER	

PAVEMENT DESIGN-CONSTANTS

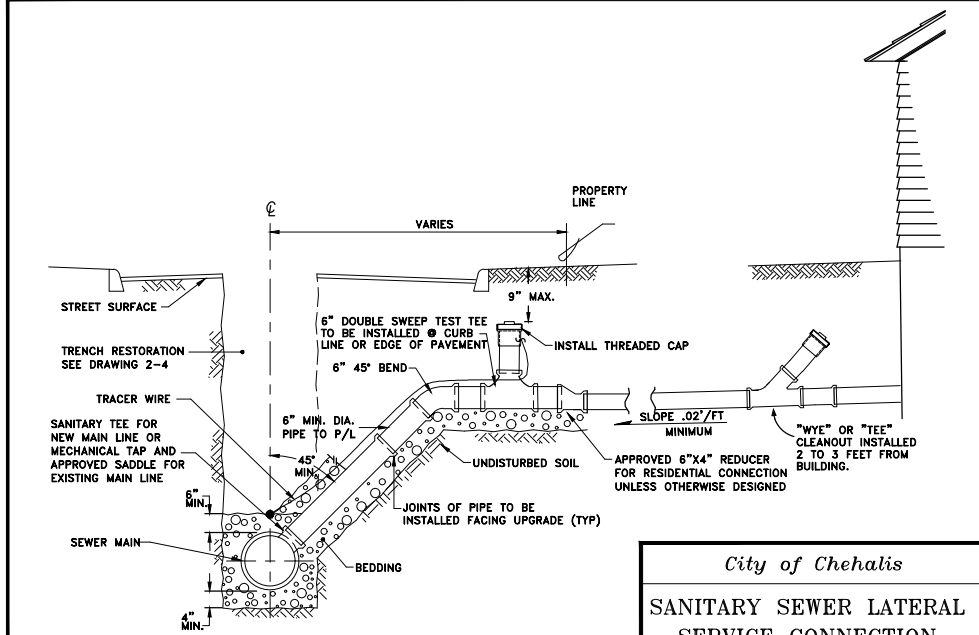
	BOULEVARD & ARTERIAL	COMMERCIAL & INDUSTRIAL COLLECTOR	NEIGHBORHOOD COLLECTOR	LOCAL
ADT	20,000	5,000	4,000	500
% ADT	8	15	5	5
GROWTH RATE	5	5	5	2
LANE FACTOR	0.5	0.5	0.5	0.5
DESIGN EAL	3,000,000	1,400,000	370,000	35,000
R%	95	90	85	80
S _o	0.45	0.45	0.45	0.45
P _i	4.20	4.20	4.20	4.20
P _t	2.5	2.4	2.3	2.2
ΔPSI	1.7	1.8	1.9	2.0
MINIMUM PAVEMENT SECTION WITHOUT PAVEMENT DESIGN *				
AC	6"	6"	4"	3"
CSTC	2"	2"	2"	2"
GRAVEL BORROW	24"	24"	18"	12"
MINIMUM PAVEMENT SECTION WITH PAVEMENT DESIGN *				
AC	4"	4"	3"	3"
CSTC	2"	2"	2"	2"
GRAVEL BORROW	12"	12"	8"	8"

- * PAVEMENT DESIGN IS PER AASHTO DESIGN GUIDELINES AND CERTIFIED CALIFORNIA BEARING RATIO (CBR) SOIL TESTS. SEE STANDARD DRAWING 2-3 FOR PAVEMENT DESIGN WORKSHEET.**
- NOTE:**
1. USE 2% STREET CROSS SLOPE AND NO MORE THAN 33 FEET OF ROADWAY SLOPED IN ANY DIRECTION.

City of Chehalis

**PAVEMENT
DESIGN**

APPROVED BY	DWG. NO. 2-2
	REVISED DATE 3/26/2005
CITY ENGINEER	



- NOTES:**
1. SIDE SEWER PIPE TO BE PVC ASTM D3034.
 2. ALL JOINTS & CONNECTIONS TO BE RUBBER GASKETED TYPE CONFORMING TO ASTM D3212.
 3. BEDDING AND GRADE SHALL BE ESTABLISHED PRIOR TO PIPE BEING PLACED IN TRENCH.

City of Chehalis

**SANITARY SEWER LATERAL
SERVICE CONNECTION**

APPROVED FOR PUBLICATION	DWG. NO. 5-10
TIM GROCHOWSKI	REVISED DATE 3/17/2009
PUBLIC WORKS DIRECTOR	

**PRELIMINARY DETAILS
AND NOTES**

**RIVER BEND HUB
DEVELOPMENT**

CHEHALIS

WA.

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

JOB NUMBER
22034

DRAWING NAME
22034_PDINT

P13

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