Drainage Report

The Landing at Hawks Prairie
Lacey, WA

Prepared For:
MSGS Architects
510 Capitol Way South
Olympia, WA

Prepared By:
LDC, Inc.
1411 State Ave. NE Suite 200
Olympia, WA 98506
425.806.1869

LDC | Surveying Engineering Planning

July 2022

Drainage Report

Project Information

Project:	**The Landing at Hawks Prairie**
Prepared for:	**MSGS Architects** 510 Capitol Way South Olympia, WA Contact Name: Garner Miller Contact Phone:

Reviewing Agency

Jurisdiction:	City of Lacey

Project Representative

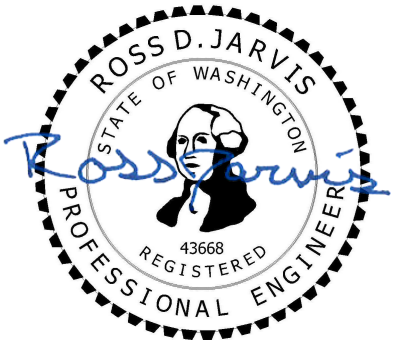
Prepared by:	**LDC, Inc.** 1411 State Ave. NE, Suite 200 Olympia, WA 98506 425.806.1869 ldccorp.com
Contact:	Ross Jarvis, PE
Project Reference:	C22-213 Path: P:\Civil\2022\C22-213 The Landing at Hawks Prairie\Data Engineer\Drainage Report\Working Report\Drainage Report\2022-xxxx Stormwater Site Plan.docx

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Drainage Control Plan for the Landing at Hawks Prairie project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Lacey does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Margaret G. Howsden 07/01/2022

Prepared by: Maggie Howsden, EIT Date
MHowsden@ldccorp.com
(425) 806-1869



07/01/2022

Approved by: Ross Jarvis, PE Date
RJarvis@ldccorp.com
(425) 806-1869

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Appendix 2: Soil Management Plan – **NOT REQUIRED**
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1. PROPOSED PROJECT DESCRIPTION

The following report was prepared for the Landing at Hawks Prairie project in Lacey, WA. This report was prepared to comply with the minimum technical standards and requirements that are set forth in the City of Lacey 2016 *Stormwater Design Manual (SDM).*

Project Proponent: MSGS Architects

Parcel Numbers: 11811430400, 82730000100, 82730000200, 82730000300

Total Parcel Area: 10.69 Acres

Current Zoning: GC: General Commercial

Required Permits: Grading, Utility, Paving, Building, etc.

Site Addresses: 1120, 1200, 1300, 1370 Galaxy Dr NE

Section, Township, Range: Section 11, Township 18 N, Range 1 W

The proposed The Landing at Hawks Prairie site is located on four parcels that contain a total of 10.69 acres. The project is located within The Landing Hawks Prairie, north of the Kiddie Academy and south of LA Fitness off Martin Way E and Galaxy Dr NE. The proposed construction includes replacing a 0.1-acre portion of an existing tree tract with a new building and sidewalk and expanding existing vegetated islands to replace the pervious area removed for the new building and sidewalk. Approximately 0.2 acres will be disturbed, but less than 5,000 SF of impervious surface will be added. Specifically, the proposed site improvements/construction activities for this project include the following:

- Site preparation, grading, and erosion control activities
- Construction of new building
- Construction of vegetated islands
- Construction/installation of on-site stormwater management BMPs
- Extension of available utilities (i.e., water, sewer, etc.)

A site vicinity map of the proposed project location, an Existing and Proposed Basin Map, and a worksheet for determining the number of Core Requirements for this project has been prepared and is enclosed as **Appendix 3**. Core requirements 1-5 are required for this project. Table 1 below describes the land use of the disturbed area of the parcel. The proposed project will not increase the total impervious area within the project limits.

LAND TYPE DESIGNATIONS	AREA (ACRES)	% OF TOTAL AREA
Total Disturbed On-Site Area	**0.20**	**100**
Existing Pervious Surface	0.10	50.00
Existing Impervious Surface	0.10	50.00
Proposed Pervious Surface	0.10	50.00
Proposed Impervious Surface	0.10	50.00

Table 1: Land Type Designations Existing vs. Proposed

1.1 SUMMARY OF COMPLIANCE ON-SITE

The stormwater design complies with the 5 core requirements as follows:

Core Requirement #1 – Preparation of Stormwater Site Plans – This summary is contained within the Drainage Report.

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

Core Requirement #3 – Source Control of Pollution – All source control BMPs have been evaluated for feasibility and are identified in the Maintenance and Source Control Manual.

Core Requirement #4 – Preservation of Natural Drainage Systems and Outfalls – Currently, it appears that the stormwater runoff infiltrates on site. Any stormwater runoff that does not infiltrate within the pervious area, sheet flows to an existing drainage ditch and is collected by a catch basin. The stormwater runoff is then conveyed to an underground infiltration trench where the stormwater runoff will infiltrate. After construction, the stormwater runoff from the proposed roof area will infiltrate on site through an infiltration trench sized to meet Core Requirement #5. See Section 4 of this report for more information.

Core Requirement #5 – One-Site Stormwater Management – Using Figure 2.3: Flow Chart for Determining Core Requirement #5 Requirements, the proposed project is a redevelopment triggering core requirements #1-5, therefore the project shall employ the On-Site Stormwater Management BMPs in accordance with List #1. The project will demonstrate compliance with List #1, see below.

Lawn and Landscaped Areas:

- Per Chapter 7 Section 7.4.1, the 2016 SDM, Post Construction Soil Quality and Depth will be utilized to the maximum extent practicable. See landscape plans for details.

Roofs:

- Full Dispersion (Chapter 7, Section 7.4.2) or Downspout Infiltration System (Chapter 7, Section 7.4.10): A downspout infiltration system will be implemented on this project site per Section 7.4.10, Table 7.5. The soils on site are considered Type A. Therefore, the infiltration trench will have a 4 ft deep gravel layer and a 261-sf footprint.

Other Hard Surfaces:

- Full Dispersion (Chapter 7, Section 7.4.2): Full Dispersion is infeasible on this site due to the native vegetation to impervious surfaces ratio. A minimum 100 ft flow path of forested or native vegetation cannot be achieved.
- Permeable Pavement (Chapter 7, Section 7.4.6) or Bioretention (Chapter 7, Section 7.4.4): Permeable Pavement and Bioretention are infeasible due to required site setbacks.
- Sheet Flow Dispersion or Concentrated Flow Dispersion (Chapter 7, Section 7.4.2): Sheet or Concentrated Flow Dispersion is infeasible due to require site setbacks and minimum flow paths.

2. EXISTING CONDITIONS DESCRIPTION

2.1 EXISTING ON-SITE CONDITIONS

The subject site is +/- 10.69 acres in size. In 1990, the land was cleared but undeveloped. The parcels adjacent to Martin Way E were a storage yard. Development on the northern parcels began in 2009 while development on the southern parcels occurred in 2013. In 2021, the parcels currently have eight commercial buildings surrounded by parking lots and vegetated islands. See the figures below.

Figure 1: Existing Conditions (1990)

Figure 2: Existing Conditions (2021)

2.2 CRITICAL AREAS

Flood Zones: The project parcel is located with Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 53067C0192E. According to the FIRM Map the project parcel is located within Zone X. Zone X is determined to be an area of minimal flood hazard. See **Appendix 3** for the FIRM Map.

Wellhead Protection Areas: According to Figure 8B.1 of the SDM, the proposed project is not located within the wellhead protection area. See **Appendix 3** for the Wellhead Protection Area Map.

Critical Aquifer Recharge Areas: According to Figure 8B.2 of the SDM, the proposed project is located within the Category I Critical Aquifer Recharge Area. See **Appendix 3** for the Critical Aquifer Recharge Area Map.

2.2.1 On-Site Soils Information

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, the soils on the site were classified to be Spanaway gravelly sandy loam. The soils belong to hydrologic soil group A with a high infiltration rate between 1.98 and 5.95 in/hr.

A geotechnical investigation was not required or performed.

3. VICINITY ANALYSIS AND SUBBASIN DESCRIPTION

There are no known flooding or bank overtopping problems, and no steep slopes are located near the project site. The project site is located within the Category I Critical Aquifer Recharge Area therefore requiring enhanced treatment; however, no new pollution generating impervious surfaces will be constructed with this project and treatment is not required. There are no known fuel tanks on-site.

3.1 QUALITATIVE UPSTREAM ANALYSIS

All of the surrounding roadways and parking lots to the building site have curbing along both sides. Stormwater collection, conveyance, and infiltration systems are located through all of the roadways and parking lots as well. Therefore, stormwater runoff from the roadways and parking lots adjacent to the parcel are collected by catch basins. No stormwater runoff is conveyed onto the parcel from the adjacent areas.

3.2 QUALITATIVE/QUANTITATIVE DOWNSTREAM ANALYSIS

All of the stormwater runoff generated by the developed site will be collected and infiltrated on site. Currently, the stormwater runoff sheet flows from the south to the north of the proposed building site into a drainage ditch connected to a catch basin and into the existing on-site, underground stormwater infiltration facility. The proposed rood downspout infiltration system will divert the quantity of stormwater entering the existing system and infiltrate it within a downspout infiltration trench sized to meet Core Requirement #5. If the infiltration trench fails, the stormwater will sheet flow across the parking lot to the existing catch basins and stormwater systems, as it does today.

4. FLOW CONTROL AND WATER QUALITY FACILITY SIZING

4.1 SUMMARY SECTION

Following Figure 2.2 (See **Appendix 3**), this project classifies as a redevelopment that triggers Core Requirements 1 through 5. The site has 35% or more of existing impervious coverage, and the project will add more than 2,000 S.F. of new impervious surfaces but less than 5,000 S.F. See **Drainage Control Plan Attachment No. 1** for the proposed stormwater facility locations and details. See **Appendix 3** for the basin map.

4.1.1 Performance Standards and Goals

Following Figure 2.2 – Flow Chart for Determining Requirements for Redevelopment, the project site triggers the use of Core Requirements #1-5. All of the stormwater from the roof of the proposed building will be infiltrated on-site. Runoff treatment is not required since Core Requirement #7 was not triggered.

4.1.2 Flow Control System

Flow control will be provided for the project through the use of a gravel infiltration trench. The infiltration trench will be located in the drive aisles to the west of the proposed building location.

4.1.3 Water Quality System

Core Requirement #6 is not triggered by this project; therefore, runoff treatment is not required. This project will remove 0.1 acres of pollution generating impervious surfaces (PGIS) and replace it with landscaping areas. Additionally, the project will create 0.1 acres of non-pollution generating impervious surface (roof).

5. AESTHETIC CONSIDERATIONS FOR FACILITIES

All of the proposed stormwater systems will be below ground.

6. CONVEYANCE SYSTEM ANALYSIS AND DESIGN

The piped conveyance system is sized to convey the developed conditions 25-year return period peak runoff. All roof drain lines, and area drain lines are a minimum of 6-inch in diameter and designed at a minimum slope of 0.5%. According to flowmaster, a 6-inch pipe installed at a slope of 0.5% has a capacity of 0.52 cfs. The 25-year return period runoff from the roof is 0.08 cfs which is below the maximum capacity of 0.52 cfs.

7. COVENANTS, DEDICATIONS, EASEMENTS

It is the City of Lacey's policy that the property owner(s) shall maintain their stormwater drainage facilities. Thus, Landing at Hawks Prairie, LLC will be responsible for maintaining and ensuring that all installed drainage facilities are functioning in accordance with their design purposes. Landing at Hawks Prairie, LLC will keep a copy of the maintenance plan at the project site. The Maintenance and Source Control Manual is a standalone document submitted separately from the Stormwater Site Plan and the Establishment of Maintenance Covenant is included as **Attachment 5**.

It is important to note that only slow-release fertilizers shall be applied for the life of the development at a maximum amount of 4 lbs. of nitrate as Nitrogen annually and no more than 1 lb. per application for every 1,000 square feet of turf grass. Only fertilizer formulas with a minimum of 50% water insoluble form of nitrogen are permitted for use. Approved water insoluble forms of nitrogen include sulfur and/or polymer coated fertilizers, Isobutylidene Diurea (IBDU), Methylene Urea and Ureaform, and organic fertilizers registered with Washington Department of Agriculture.

8. AGREEMENTS AND GUARANTEES

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

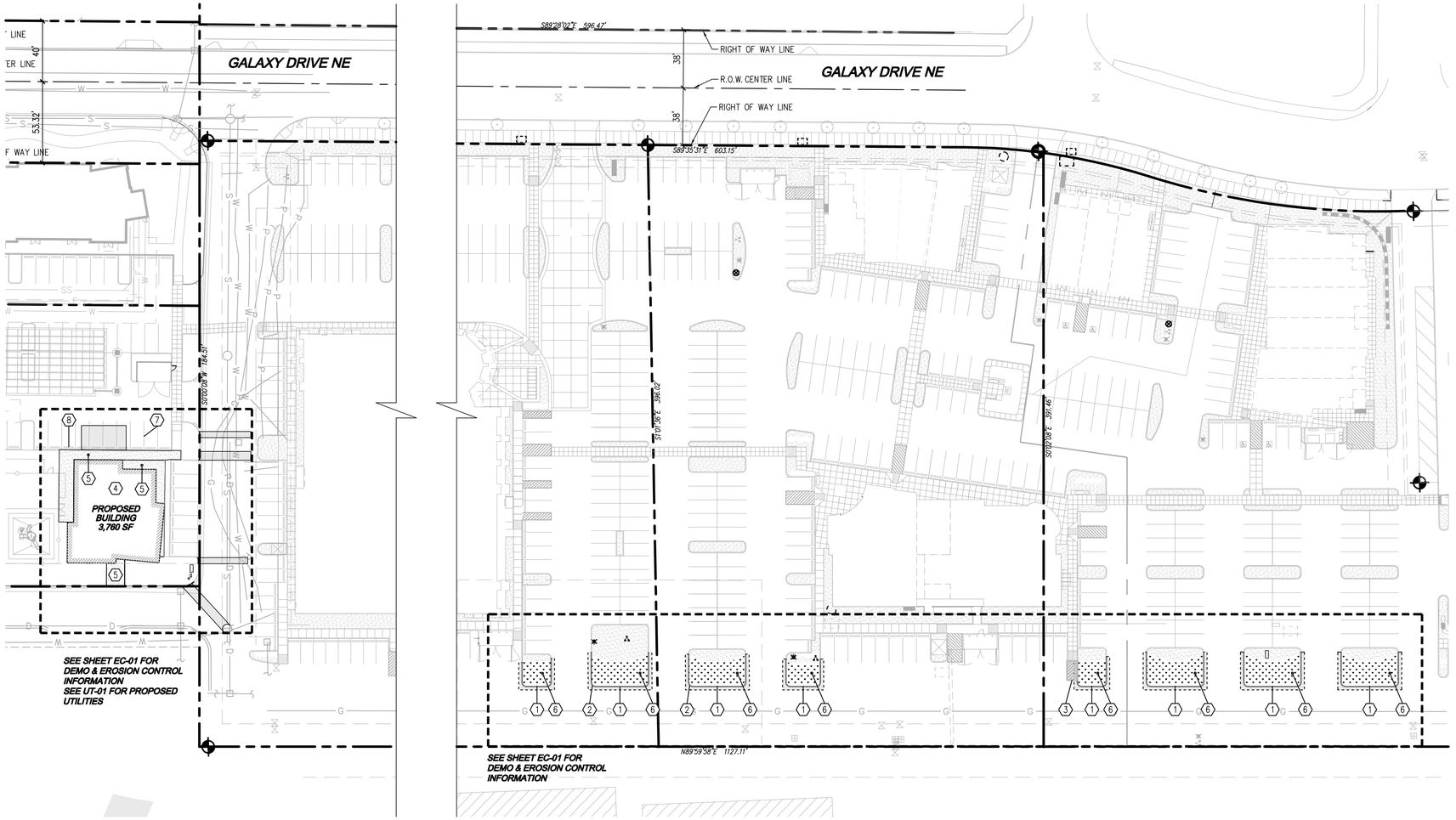
9. OTHER PERMITS OR CONDITIONS PLACED ON THE PROJECT

There are no other known required permits at this time.

END OF STORMWATER SITE PLAN

DRAINAGE CONTROL PLAN
ATTACHMENT 1
SITE DEVELOPMENT DRAWINGS

SEC 11, TWN 18, RGE 1W, W.M.



SITE PLAN LEGEND

- PROPOSED BUILDING
- PROPOSED LANDSCAPE AREA
- PROPOSED ASPHALT PAVING AREA
- PROPOSED CONCRETE SIDEWALK AREA
- PROPOSED TRAFFIC CURB

SITE PLAN NOTES

1. INSTALL NEW TRAFFIC CURB
2. PAINT CURB FIRE TRUCK RED & STENCIL "NO PARKING FIRELANE" ON CURB FACE. MATCH ORIGINAL PAINT LIMITS
3. 4" WIDE WHITE STRIPING @ 45° PAINT 2 COATS TRAFFIC WHITE WITH 7MIL DFT PER COAT (TYP.)
4. PROPOSED BUILDING
5. PROPOSED CEMENT CONCRETE SIDEWALK W/INTEGRAL CURB
6. LANDSCAPING BY OTHERS
7. 4" WIDE WHITE PARKING STALL STRIPE PAINT 2 COATS TRAFFIC WHITE WITH 7MIL DFT PER COAT (TYP.)
8. RE-INSTALL PARKING WHEEL STOPS (TYP.)

N

SCALE: 1" = 40'

40' 0 40' 80'

UTILITY NOTE

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

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

REVISIONS

NO.	DATE	DESCRIPTION	BY

LDC
Surveying
Engineering
Planning
Woodinville
Olympia
Kent
1411 State Avenue NE, #200
Olympia, WA 98506
T 425.806.1869
F 425.482.2893
www.LDCcorp.com

MSGS ARCHITECTS

THE LANDING AT HAWKS PRAIRIE PHASE II - NEW BUILDING

OVERALL SITE PLAN

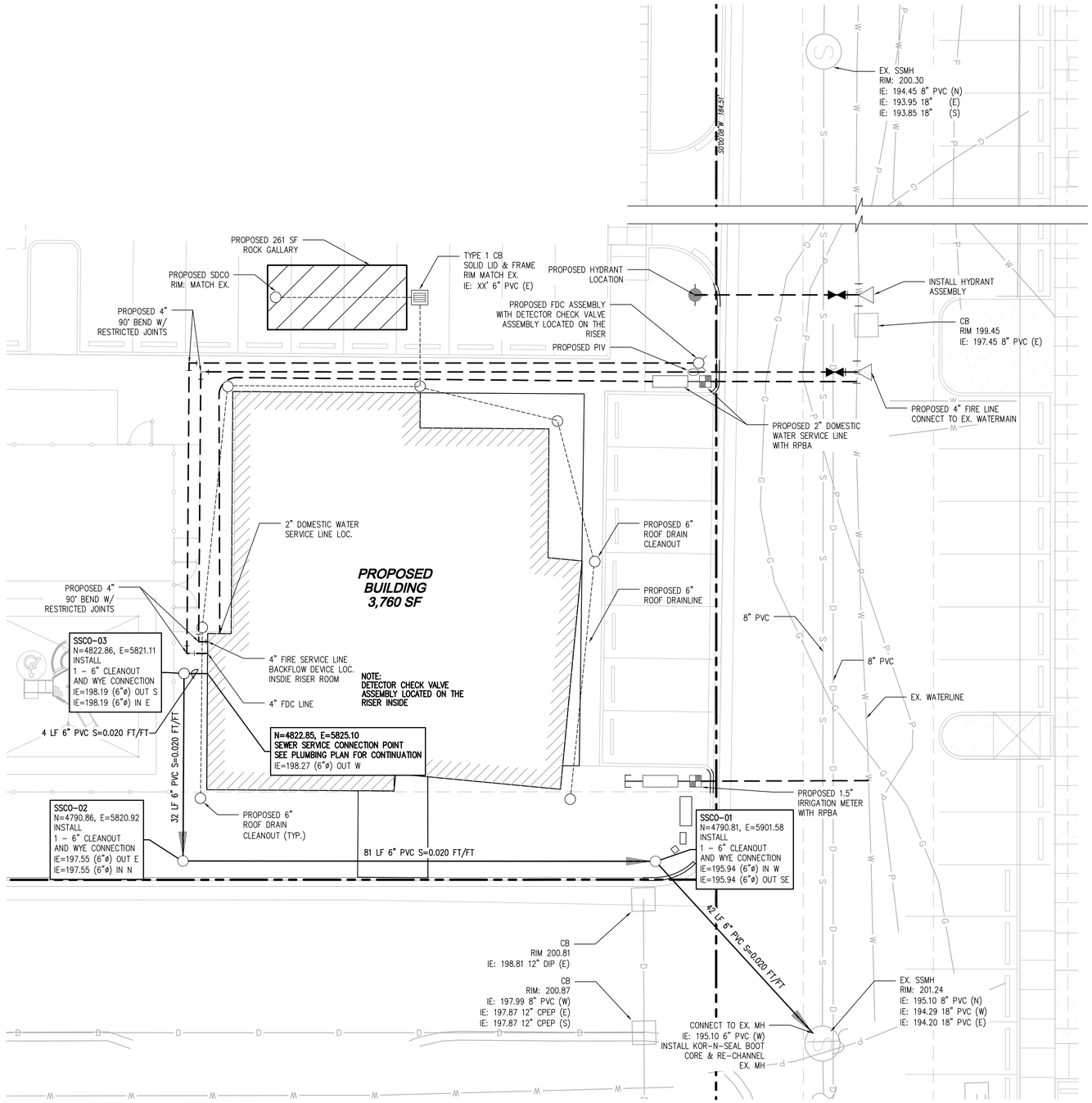
ROSS D. JARITS
STATE OF WASHINGTON
43666
REGISTERED PROFESSIONAL ENGINEER
DATE

JOB NUMBER:	C22213
DRAWING NAME:	SP-01
DESIGNER:	R.WEEDEN
DRAFTING BY:	A.WHITE
DATE:	JUNE 2022
SCALE:	1" = 40'
JURISDICTION:	

SP-01

SHEET 1 OF 2

SEC 11, TWN 18, RGE 1W, W.M.

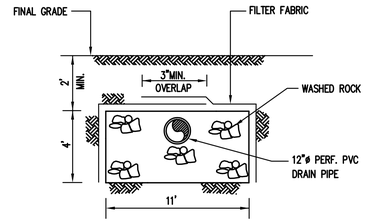


SCALE: 1" = 10'

10' 0 10' 20'

LEGEND

SYMBOL	DESCRIPTION
	WATER PIPE
	SEWER PIPE
	FIRE HYDRANT
	VALVE
	FIRE DEPARTMENT CONNECTION
	WATER METER
	RPBA
	SEWER CLEANOUT
	TYPE 1 CB



ROCK GALLERY DETAIL
NTS

UTILITY NOTE

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REVISIONS

NO.	DATE	DESCRIPTION	BY

LDC | Surveying Engineering Planning
Woodinville | Olympia | Kent
1411 State Avenue NE, #200
Olympia, WA 98506
T 425.806.1869 F 425.482.2893
www.LDCcorp.com

MSGS ARCHITECTS

THE LANDING AT HAWKS PRAIRIE PHASE II - NEW BUILDING

UTILITIES PLAN

ROSS D. JARITS — STATE OF WASHINGTON — 43668 — REGISTERED PROFESSIONAL ENGINEER — DATE

JOB NUMBER:	C22213
DRAWING NAME:	UT-01
DESIGNER:	R.WEEDEN
DRAFTING BY:	A.WHITE
DATE:	JULY 2022
SCALE:	1" = 10'
JURISDICTION:	LACEY WA

UT-01

SHEET 2 OF 2

Drawing: P:\Civil\2022\C22-213 The Landing at Hawks Prairie\Drawings\Preliminary_Archive\C22213-UT-01.dwg Plotted: Jun 30, 2022 – 10:54am

DRAINAGE CONTROL PLAN
ATTACHMENT 2
CONSTRUCTION SWPPP REPORT

LDC | Surveying Engineering Planning

Construction Stormwater General Permit

Stormwater Pollution Prevention Plan (SWPPP)

for

Landing at Hawks Prairie, LLC
1120, 1200, 1300, 1370 Galaxy Dr NE

Prepared for:
The Washington State Department Ecology
Southwest Regional Office

Permittee/Owner	Developer	Operator Contractor

Certified Erosion and Sediment Control Lead (CESCL)

Name	Organization	Contact Phone Number

SWPPP Prepared By

Name	Organization	Contact Phone Number
Ross Jarvis, PE	LDC, Inc.	(425) 806-1869

Project Construction Dates

Activity/Phase	Approximate Start Date	Approximate End Date
The Landing at Hawks Prairie	03/01/2023	12/31/2023

SWPPP Preparation Date

July 2022

Construction Stormwater Pollution Prevention Plan (SWPPP)

The Landing at Hawks Prairie
Lacey, Washington

July 2022

LDC | Surveying Engineering Planning

Construction SWPPP

Project Information

Project:	**The Landing at Hawks Prairie**
Site Address:	1120, 1200, 1300, 1370 Galaxy Dr NE Lacey, WA 98516
Owner/Applicant:	**MSGS Architects** 510 Capitol Way South Olympia, WA 98501 Contact Name: Garner Miller Contact Phone: 360.943.6774 x112

Reviewing Agency

Jurisdiction:	City of Lacey

Project Representative

Prepared by:	**LDC, Inc.** 1411 State Ave. NE Suite 200 Olympia, WA 98506 425.806.1869
Contact:	Ross Jarvis, PE RJarvis@ldccorp.com
Project Reference:	C22-213

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1. NARRATIVE

1.1 STORMWATER BMPS

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

Total Disturbed Area: 0.20 acres

Property Use: GC – General Commercial

Parcel Number: 11811430400, 82730000100, 82730000200, 82730000300

Section, Township, Range: Section 11, Township 18N, Range 1W, W.M.

1.1.1 *Element #1 –Mark Clearing Limits*

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

- BMP C101: Preserving Natural Vegetation
- BMP C103: High Visibility Plastic or Metal Fence
- BMP C233: Silt Fence

1.1.2 *Element #2 – Establish Construction Access*

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

Construction access will be granted from the existing development. The contractor will repair any damages to the existing development that occur throughout construction.

- BMP C105: Stabilized Construction Entrance/Exit
- BMP C106: Wheel Wash
- BMP C107: Construction Road/Parking Area Stabilization

1.1.3 *Element #3 – Control Flow Rates*

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

- BMP C235: Wattles

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

1.1.4 *Element #4 – Install Sediment Controls*

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

- BMP C233: Silt Fence
- BMP C235: Wattles

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

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

1.1.5 *Element #5 – Stabilize Soils*

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

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

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

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

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C122: Nets and Blankets
- BMP C124: Sodding
- BMP C125: Topsoiling
- BMP C140: Dust Control
- BMP C209: Outlet Protection

1.1.6 *Element #6 – Protect Slopes*

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

- BMP C130: Surface Roughening
- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C204: Pipe Slope Drains
- BMP C205: Subsurface Drains

1.1.7 *Element #7 – Protect Drain Inlets*

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

- BMP C220: Storm Drain Inlet Protection

1.1.8 *Element #8 – Stabilize Channels and Outlets*

All temporary on-site conveyance channels shall be constructed and stabilized to prevent erosion. Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent to streambanks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems. The following BMPs will be implemented where appropriate:

- BMP C202: Channel Lining
- BMP C209: Outlet Protection

1.1.9 *Element #9 – Control Pollutants*

All pollutants, including waste materials, that occur on-site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater. Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle. Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations shall be followed for application rates and procedures. No pH-Modifying sources will be present on-site.

Three source control BMPs will apply to this project:

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

In addition, the following BMPs shall be implemented where appropriate:

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

1.1.10 *Element #10 – Control Dewatering*

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

Highly turbid or otherwise contaminated de-watering water, such as from equipment operation shall be handled separately from stormwater at the site. Some disposal options, depending on site constraints, may include: 1) transport off-site in vehicle, such as a vacuum flush truck, for

legal disposal in a manner that does not pollute state waters, 2) on-site treatment using chemical treatment or other suitable treatment technologies such as Baker tanks or approved equal, or 3) sanitary sewer discharge with local sewer purveyor's approval if there is no other option.

1.1.11 *Element #11 – Maintain BMPs*

All 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 each BMP's specifications. Visual monitoring of the BMPs will be conducted per the inspection schedule in Section 6.

All temporary erosion and sediment control BMPs shall be removed within 30 days after the 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.

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

1.1.12 *Element #12 – Manage the Project*

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

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

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

Phasing

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

Inspection and Monitoring

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

conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. This person has the necessary skills to:

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

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

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

Maintaining an Updated SWPPP

This SWPPP shall be retained on-site or within reasonable access to the site.

The SWPPP shall be modified whenever there is a change in the construction activities that has, or could have, a significant effect on the discharge of pollutants to waters of the state.

The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

1.1.13 *Element #13 – Protect Low Impact Development BMPs*

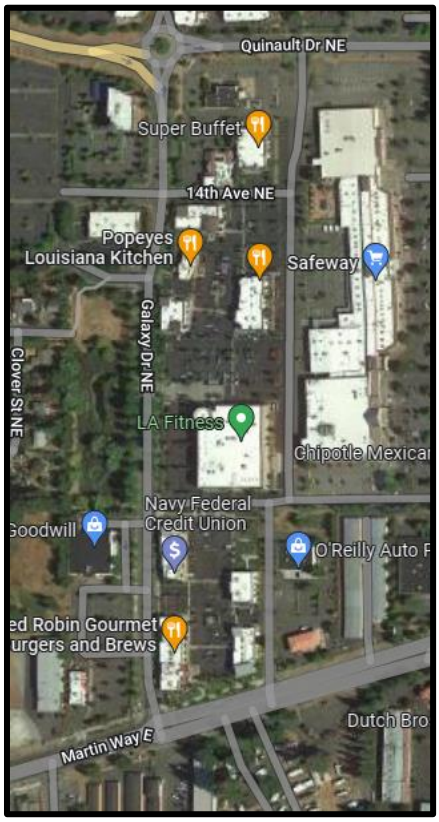
All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repairs shall be completed in accordance with the practices, procedures, and materials for each respective BMP. This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

- BMP C233: Silt Fence

1.2 PROJECT DESCRIPTION

The project is located in the shopping center bounded by Galaxy Dr NE and Martin Way E, Lacey Washington. See Vicinity Map below.

Figure 1) Vicinity Map



The proposed construction includes one building, as well as sidewalks, utilities, stormwater improvements, and expanding existing planter islands disturbing approximately 0.197 acres of the total 10.79 acres.

1.3 EXISTING SITE CONDITIONS

EXISTING DRAINAGE SYSTEM

Currently, the stormwater runoff sheet flows into a drainage ditch onsite. The drainage ditch conveys the stormwater runoff to a catch basin and subsequently an existing on-site underground infiltration facility.

EXISTING TOPOGRAPHY AND VEGETATION

Topography within the property is flat. The project area is substantially developed with a parking lot. The proposed site of the new building is a tree tract.

1.4 ADJACENT AREAS

The project is located within The Landing Hawk's Prairie, north of the Kiddie Academy and south of LA Fitness off Martin Way E and Galaxy Dr NE.

1.5 CRITICAL AREAS

Flood Zones: The project parcel is located with Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 53067C0192E. According to the FIRM Map, the project parcel is located within Zone X. Zone X is determined to be an area of minimal flood hazard. See **Appendix 3** of the Stormwater Site Plan for the FIRM Map.

Critical Aquifer Recharge Areas (CARA): According to Figure 8B.2 of the SDM, the proposed project is located within a Critical Aquifer Recharge Area Category I.

1.6 SOIL

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, the soils on the site were classified to be Spanaway gravelly sandy loam. The soils belong to hydrologic soil group A with a high infiltration rate between 1.98 and 5.95 in/hr.

A geotechnical investigation was not required.

For more information see the **Drainage Control Plan Attachment No. 3** for the NRCS soils report.

1.7 POTENTIAL EROSION

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

1.8 CONSTRUCTION PHASING

The BMP implementation schedule will be driven by the construction schedule. The key milestones for each segment are as follows:

- **03/01/2023:** Mobilize equipment on-site
- **03/01/2023:** Mobilize and store all erosion and sediment control (ESC) and soil stabilization products (Store Materials On Hand BMP C150)
- **03/01/2023:** Install ESC measures include stormwater management facility if applicable

- **03/08/2023:** Begin implementing soil stabilization and sediment control BMPs throughout the site for the duration of the wet season. Implement Element #12 BMPs and manage site to minimize soil disturbance.
- **03/08/2023:** Site inspections and monitoring conducted weekly and for applicable rain events as detailed in Section 1.13 of this SWPPP
- **03/15/2023:** Begin clearing and grubbing
- **05/01/2023: Dry season starts**
- **10/15/2023: Wet season starts**
- **12/31/2023:** Construction end, full site cleanup and restoration

1.9 CONSTRUCTION SCHEDULE

Estimated Construction Start Date: March 2023

Estimated Construction End Date: December 2023

1.10 FINANCIAL/OWNERSHIP RESPONSIBILITIES

Landing at Hawk's Prairie, LLC will be the owner of the site and will have full responsibility financially. If or when a new owner takes over the site, the new owner will have full financial responsibilities of the site.

1.11 ENGINEERING CALCULATIONS

Since the project only triggers core requirements 1 through 5, Table 7.5 was used to size the infiltration trench per Section 7.4.10 of the SDM. These calculations have been provided in the Stormwater Site Plan **Appendix 1** prepared by LDC, Inc. dated June 2022.

1.12 POLLUTION PREVENTION TEAM

1.12.1 *Roles and Responsibilities*

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

- Certified Erosion and Sediment Control Lead – Primary contractor contact, responsible for site inspections (BMPs, visual monitoring, sampling, etc.); to be called upon in case of failure of any ESC measures.
- Project Engineer – For projects with engineered structures only (sediment pond/traps, sand filters, etc.): site representative for the owner that is the project's supervising engineer responsible for inspections and issuing instructions and drawings to the contractor's site supervisor or representative.

- Emergency Owner Contact – Individual that is the site owner or representative of the site owner to contacted in the case of an emergency.

- Monitoring Personnel – Personnel responsible for conducting water quality monitoring; for most sites this person is also the CESCL.

1.12.2 *Team Members*

Title	Name (s)	Phone Number
Certified Erosion and Sedimentation Control Lead (CESCL)		
General Contractor		
Project Engineer	Ross Jarvis – LDC, Inc.	425.806.1869
Emergency Owner Contact		
Emergency Ecology Contact	Southwest Regional Office	360.407.6300
Non-Emergency Ecology Contact	Carol Serdar	360.407.6269
Monitoring Personnel	See CESCL	

1.13 SITE INSPECTIONS AND MONITORING

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

- A record of the implementation of the SWPPP and other permit requirements

- Site inspections; and,

- Stormwater quality monitoring.

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

1.13.1 *Site Inspection*

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

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

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

1.13.2 *Site Inspection Frequency*

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

1.13.3 *Site Inspection Documentation*

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

1.14 STORMWATER QUALITY MONITORING

1.14.1 *Turbidity*

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

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

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

2. Assess whether additional BMPs should be implemented, and document modified BMPs in the SWPPP as necessary.

3. Sample discharge daily util the discharge is 25 NTU or lower.

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

1. Notify ecology by phone within 24 hours of analysis (see Section 1.12.2 of this SWPPP for contact information).

2. Continue sampling daily until the discharge is 25 NTU or lower. Initiate additional treatment BMPs such as off-site treatment, infiltration, filtration and chemical treatment within 24 hours, and implement those additional treatment BMPs as soon as possible, but within a minimum of 7 days.

3. Describe inspection results and remedial actions taken in the site log book and in monthly discharge monitoring reports described in Section 1.15 of this SWPPP.

1.14.2 *pH*

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

1.15 RECORDKEEPING

1.15.1 *Site Log Book*

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

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

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

1.15.2 *Records Retention*

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

1.15.3 *Access to Plans and Records*

All applicable documentation, including but not limited to the SWPPP, General Permit, Notice of Authorization letter, and Site Log Book will be retained on site or within reasonable access to the site and will be made immediately available upon request to Ecology or the local jurisdiction. A copy of this SWPPP will be provided to Ecology within 14 days of receipt of written request for the SWPPP from Ecology. Any other information requested by Ecology will be submitted within a reasonable time. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with the general permit condition S5.G.

1.15.4 *Updating the SWPPP*

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

1.16 REPORTING

1.16.1 *Notification of Noncompliance*

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

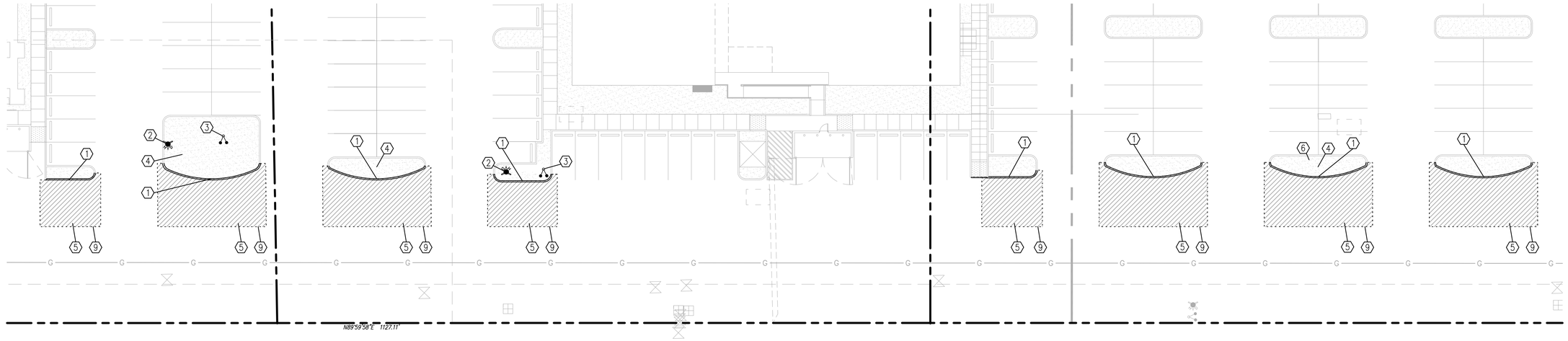
1. Ecology will be immediately notified of the failure to comply.

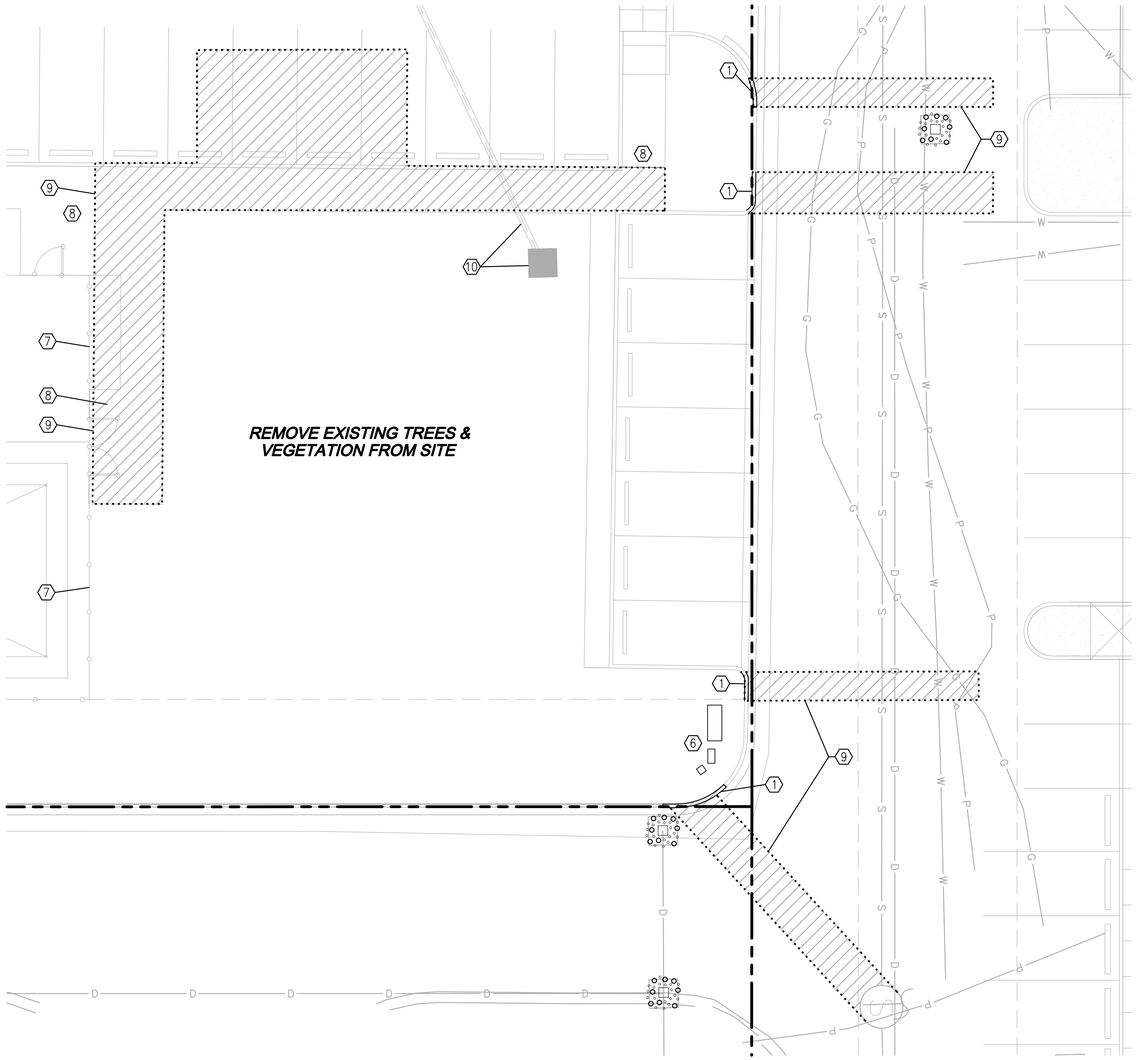
2. Immediate action will be taken to control the noncompliance issue and to correct the problem. If applicable, sampling and analysis of any noncompliance will be repeated immediately and submitted to Ecology within five days of becoming aware of the violation.

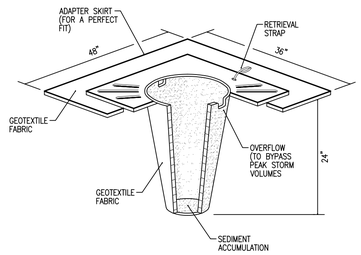
3. A detailed report describing the noncompliance will be submitted to Ecology within five days, unless requested earlier by Ecology.

APPENDIX A
EROSION CONTROL AND GRADING PLANS

SEC 11, TWN 18, RGE 1W, W.M.







STORM DRAIN INLET PROTECTION
NOT TO SCALE

LEGEND

- STORM DRAIN INLET PROTECTION
- SAWCUT LINE
- EXISTING CURB
- REMOVE & DISPOSE OF EX. SIDEWALK, CURBS & ASPHALT PAVEMENT

(X) NOTES

1. REMOVE & DISPOSE OF EXISTING CEMENT CONCRETE CURB TO NEAREST JOINT
2. PROTECT IN-PLACE HYDRANT ASSEMBLY
3. PROTECT IN-PLACE FIRE DEPARTMENT CONNECTION
4. PROTECT IN-PLACE EX. LIGHTPOLE & BASE
5. REMOVE EX. ASPHALT PAVING & BASE
6. PROTECT IN-PLACE MONUMENT SIGN
7. PROTECT IN-PLACE PLAYGROUND FENCE
8. PROTECT IN-PLACE EX. SIDEWALK
9. SAWCUT AT LIMITS (TYP.)
10. REMOVE & DISPOSE OF EXISTING STORM STRUCTURE CAP AND PLUG EXISTING STORM LINE, FILL WITH CDF

N

SCALE: 1" = 10'
10' 0 10' 20'

N

SCALE: 1" = 20'
20' 0 20' 40'

UTILITY NOTE

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

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

REVISIONS

NO.	DATE	DESCRIPTION	BY

LDC | Surveying Engineering Planning
Woodinville | Olympia | Kent
Olympia, WA 98506
T 425.806.1869 | F 425.482.2893
www.LDCcorp.com

MSGS ARCHITECTS

THE LANDING AT HAWKS PRAIRIE PHASE II - NEW BUILDING

DEMOLITION & TESC PLAN

ROSS D. JARVIS — STATE OF WASHINGTON — 43668 — REGISTERED PROFESSIONAL ENGINEER — DATE

JOB NUMBER:	C22213
DRAWING NAME:	EC-01
DESIGNER:	R.WEEDEN
DRAFTING BY:	A.WHITE
DATE:	JULY 2022
SCALE:	AS SHOWN
JURISDICTION:	LACEY, WA

EC-01

SHEET 1 OF 1

Drawing: P:\Civil\2022\C22-213 The Landing at Hawks Prairie\Drawings\Preliminary_Archive\C22213-EC-01.dwg Plotted: Jun 30, 2022 - 10:32am

APPENDIX B
CONSTRUCTION BMPS

BMP C101: Preserving Natural Vegetation

Purpose

The purpose of preserving natural vegetation is to reduce erosion wherever practicable. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers can hold up to about 50 percent of all rain that falls during a storm. Up to 20 to 30 percent of this rain may never reach the ground but is taken up by the tree or evaporates. Another benefit is that the rain held in the tree can be released slowly to the ground after the storm.

Conditions of Use

- Natural vegetation must be preserved on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas.

- As required by the city or other agencies.

Design and Installation Specifications

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved. City ordinances to save natural vegetation and trees should be reviewed.

- Fence or clearly mark areas around trees that are to be saved. It is preferable to keep ground disturbance away from the trees at least as far out as the dripline.

Plants need protection from three kinds of injuries:

- **Construction Equipment:** This injury can be above or below the ground level. Damage results from scarring, cutting of roots, and compaction of the soil. Placing a fenced buffer zone around plants to be saved prior to construction can prevent construction equipment injuries.

- **Grade Changes**: Changing the natural ground level will alter grades, which affects the plant's ability to obtain the necessary air, water, and minerals. Minor fills usually do not cause problems although sensitivity between species does vary and should be checked. Trees can typically tolerate fill of 6 inches or less. For shrubs and other plants, the fill should be less.

When there are major changes in grade, it may become necessary to supply air to the roots of plants. This can be done by placing a layer of gravel and a tile system over the roots before the fill is made. A tile system protects a tree from a raised grade. The tile system should be laid out on the original grade leading from a dry well around the tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

Lowering the natural ground level can seriously damage trees and shrubs. The highest percentage of the plant roots are in the upper 12 inches of the soil and cuts of only 2 to 3 inches can cause serious injury. To protect the roots it may be necessary to terrace the immediate area around the plants to be saved. If roots are exposed, construction of retaining walls may be needed to keep the soil in place. Plants can also be preserved by leaving them on an undisturbed, gently sloping mound. To increase the chances for survival, it is best to limit grade changes and other soil disturbances to areas outside the dripline of the plant.

- **Excavations:** Protect trees and other plants when excavating for drainfields, power, water, and sewer lines. Where possible, the trenches should be routed around trees and large shrubs. When this is not possible, it is best to tunnel under them. This can be done with hand tools or with power augers. If it is not possible to route the trench around plants to be saved, then the following should be observed:

  - Cut as few roots as possible. When you have to cut, cut clean. Paint cut root ends with a wood dressing like asphalt base paint if roots will be exposed for more than 24 hours.

  - Backfill the trench as soon as possible.

  - Tunnel beneath root systems as close to the center of the main trunk to preserve most of the important feeder roots.

Some problems that can be encountered with a few specific trees are:

- Maple, dogwood, red alder, western hemlock, western red cedar, and Douglas-fir do not readily adjust to changes in environment and special care should be taken to protect these trees.

- The windthrow hazard of Pacific silver fir and Pacific madrone is high, while that of western hemlock is moderate. The danger of windthrow increases where dense stands have been thinned. Other species (unless they are on shallow, wet soils less than 20 inches deep) have a low windthrow hazard.

- Cottonwoods, maples, and willows have water-seeking roots. These can cause trouble in sewer lines and infiltration fields. On the other hand, they thrive in high moisture conditions that other trees would not.

- Thinning operations in pure or mixed stands of grand fir, Pacific silver fir, noble fir, Sitka spruce, western red cedar, western hemlock, Pacific dogwood, and red alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

Maintenance Standards

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

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

BMP C103: High Visibility Fence

Purpose

Fencing is intended to:

- Restrict clearing to approved limits
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed
- Limit construction traffic to designated construction entrances, exits or internal roads
- Protect areas where marking with flagging/survey tape may not provide adequate protection

Conditions of Use

To establish clearing limits plastic, fabric, or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared
- As necessary to control vehicle access to and on the site

Design and Installation Specifications

- High visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least 4 feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every 6 inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high visibility orange. The fence tensile strength shall be 360 pounds/feet using the American Society for Testing and Materials (ASTM) D4595 testing method.
- If appropriate install fabric silt fence in accordance with BMP C233 to act as high visibility fence. Except that the silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.
- Metal fences are the least preferred but might be appropriate to address security concerns. Metal fencing shall be designed and installed according to the manufacturer's specifications.
- Metal fences shall be at least 4 feet high and must be highly visible.
- Fences shall not be wired or stapled to trees.

Maintenance Standards

- If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Entrance/Exit

Purpose

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

Conditions of Use

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

Design and Installation Specifications

- See Figure 5.1 for details. Note: the 100 foot minimum length of the entrance shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100 feet).

- Construct stabilized construction entrances 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. For single-family residential lots pad may be reduced in length to fit site, to no less than 20 feet long, and in depth, to 6 inches thick with 4-inch to 6-inch quarry spalls, provided that performance standards are still met.

- Do not use crushed concrete, cement, or calcium chloride for construction entrance stabilization because these products raise pH levels in stormwater and concrete discharge to surface 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 following standards:

    - Grab Tensile Strength (ASTM D4751): 200 psi minimum

    - Grab Tensile Elongation (ASTM D4632): 30 percent maximum

    - Mullen Burst Strength (ASTM D3786-80a): 400 psi minimum

    - AOS (ASTM D4751): 20 to 45 (U.S. standard sieve size)

- Fencing (see BMP C103) shall be installed as necessary to restrict traffic to the construction entrance.

- Whenever possible, the entrance shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.

Maintenance Standards

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

- On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized entrances 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.

- Construction entrances should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction entrance 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.

- If the entrance 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 entrance, or the installation of a 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 may be required. 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 as these sweepers create dust and throw soil into nearby 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 entrance(s), fencing (see BMP C103) 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.

Approved as Equivalent

Ecology has approved specific products as able to meet the requirements of BMP C105. However, the products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. The list of products is available on Ecology's web site at <www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html>.

If a project wishes to use any of the "approved as equivalent" BMPs in the City of Lacey, the project owner or representative must obtain approval for use of the BMP from the city on a case-by-case basis (i.e., for each project or site) before use.

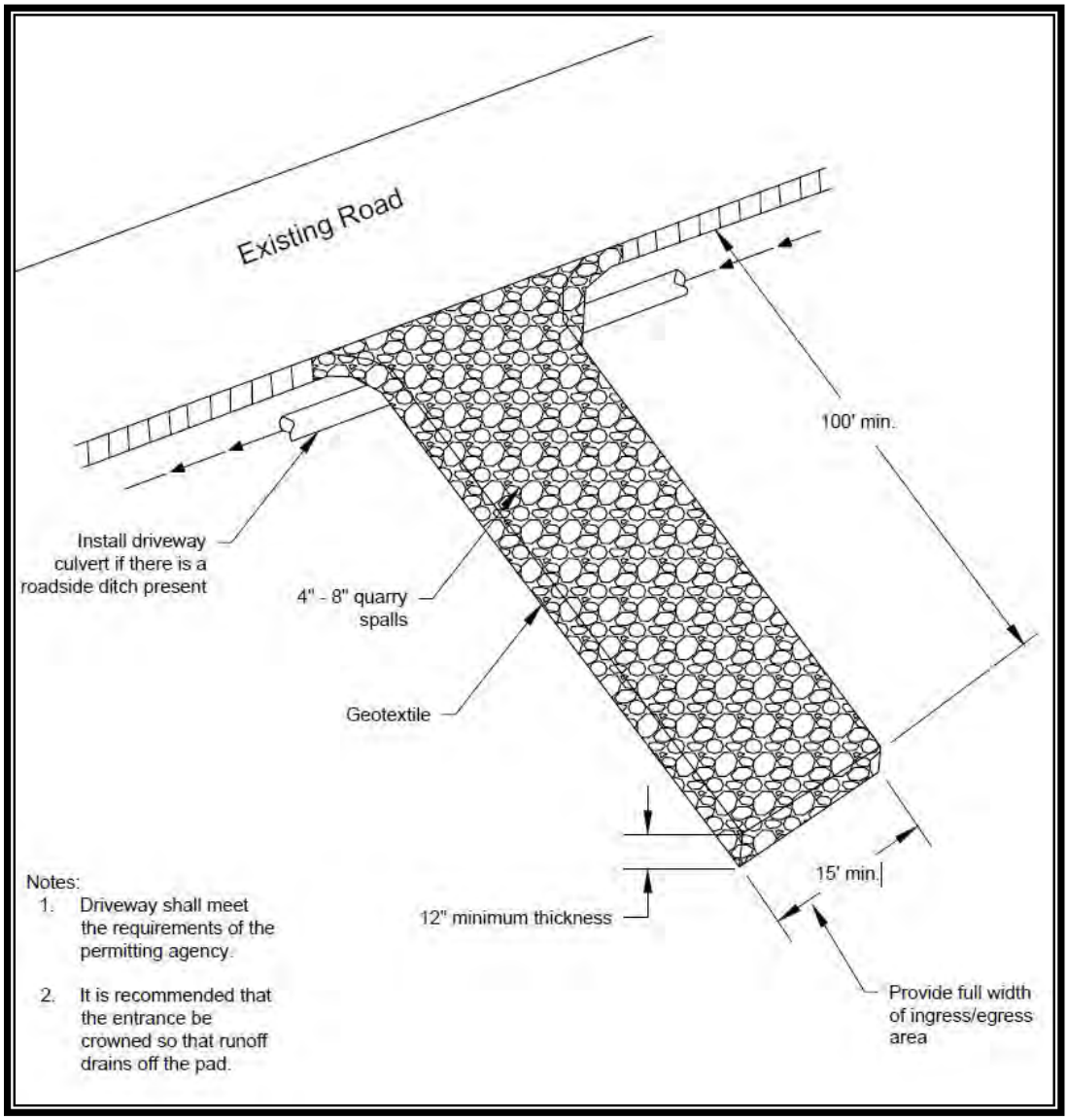


Figure 5.1. Stabilized Construction Entrance.

BMP C231: Brush Barrier

Purpose

The purpose of brush barriers is to reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Brush barriers may be used downslope of all disturbed areas of less than 0.25 acre.
- Brush barriers are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a brush barrier, rather than by a sediment pond, is when the area draining to the barrier is small.
- Brush barriers shall only be installed on contours.

Design and Installation Specifications

- Height 2 feet (minimum) to 5 feet (maximum).
- Width 5 feet at base (minimum) to 15 feet (maximum).
- Filter fabric (geotextile) may be anchored over the brush berm to enhance the filtration ability of the barrier. Ten-ounce burlap is an adequate alternative to filter fabric.
- Chipped site vegetation, wood-based mulch (hog fuel), or other suitable mulch material can be used to construct brush barriers.
- A 100 percent biodegradable installation can be constructed using 10-ounce burlap held in place by wooden stakes. Figure 5.19 depicts a typical brush barrier.

Maintenance Standards

- There shall be no signs of erosion or concentrated runoff under or around the barrier. If concentrated flows are bypassing the barrier, it must be expanded or augmented by toed-in filter fabric.
- The dimensions of the barrier must be maintained.

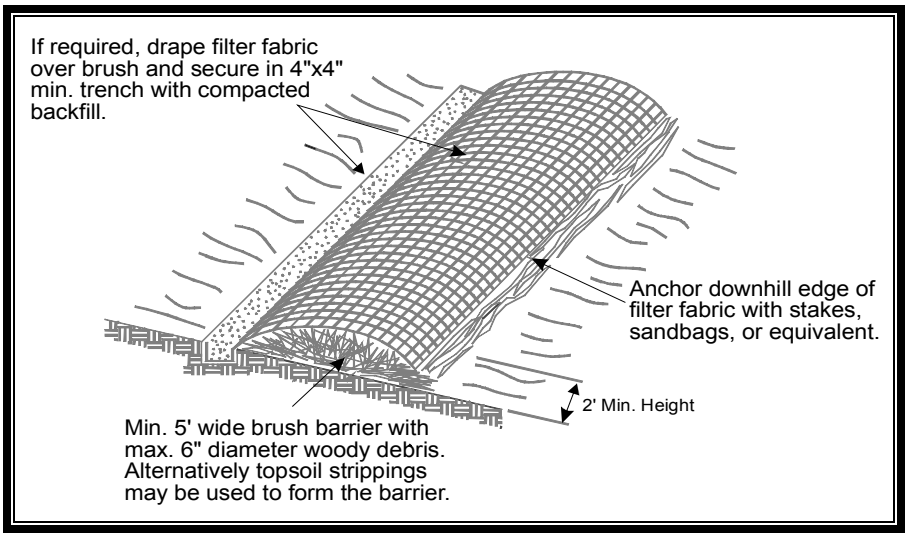


Figure 5.19. Brush Barrier.

BMP C233: Silt Fence

Purpose

Use of a 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. See Figure 5.20 for details on silt fence construction.

Conditions of Use

- Silt fence may be used downslope of all disturbed areas.
- Silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Convey any concentrated flows through the drainage system to a sediment pond.
- 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.

Design and Installation Specifications

- Use in combination with sediment basins or other BMPs.
- Maximum slope steepness (normal [perpendicular] to fence line) 1H:1V.
- Maximum sheet or overland flow path length to the fence of 100 feet.
- Do not allow flows greater than 0.5 cubic feet per second.
- The geotextile used shall meet the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table 5.11).

Table 5.11. Geotextile Standards.

Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for film wovens (U.S. #30 sieve). 0.30 mm maximum for all other geotextile types (U.S. #50 sieve). 0.15 mm minimum for all fabric types (U.S. #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

- Standard strength fabrics must be supported with wire mesh, chicken wire, 2-inch by 2-inch wire, safety fence, or jute mesh to increase the strength of the fabric to the 180 lbs minimum threshold. Silt fence materials are available that have synthetic mesh backing attached.

- Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0°F to 120°F.

- Include the following standard notes for silt fence on construction plans and specifications:

    - The contractor shall install and maintain temporary silt fences at the locations shown in the plans.

    - Construct silt fences in areas of clearing, grading, or drainage prior to starting those activities.

    - The silt fence shall have a 2-foot minimum and 2.5-foot maximum height above the original ground surface.

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

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

    - Support the filter 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 upslope side of the posts with the filter fabric upslope of the mesh.

    - 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 pounds grab tensile strength. The polymeric mesh must be as resistant to the same level of ultraviolet radiation as the filter fabric it supports.

    - Bury the bottom of the filter fabric 4 inches min. below the ground surface. Backfill and tamp soil in place over the buried portion of the filter fabric, so that no flow can pass beneath the fence and scouring cannot occur. The wire or polymeric mesh shall extend into the ground 3 inches min.

- Drive or place the fence posts into the ground 18 inches minimum. A 12-inch minimum 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.

- 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 dimensions of 2-inch by 2-inch minimum width and a 3-foot minimum length. Wood posts shall be free of defects such as knots, splits, or gouges.

  - No. 6 steel reinforcement bar 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 pounds/feet.

  - Other steel posts having equivalent strength and bending resistance to the post sizes listed above.

- 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.

- If the fence must cross contours, with the exception of the ends of the fence, place gravel 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.

  - Gravel check dams shall be approximately 1 foot deep at the back of the fence. Gravel 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.

  - Gravel check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. Gravel check dams shall be located every 10 feet along the fence where the fence must cross contours.

- Silt fence installation using the slicing method specification details follow. See also Figure 5.21:
    - The base of both end posts must be at least 2 to 4 inches above the top of the filter fabric on the middle posts for ditch check dams to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.
    - Install posts 3 to 4 feet apart in critical retention areas and 6 to 7 feet apart in standard applications. Install posts 24 inches deep on the downstream side of the silt fence, and as close as possible to the filter fabric, enabling posts to support the filter fabric from upstream water pressure.
    - Install posts with the nipples facing away from the filter fabric.
    - Attach the filter fabric to each post with three ties, all spaced within the top 8 inches of the filter fabric. Attach each tie diagonally 45 degrees through the filter 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.
    - Wrap approximately 6 inches of fabric around the end posts and secure with three ties.
    - No more than 24 inches of a 36-inch filter fabric is allowed above ground level, 12 inches must be buried.
- Compact the soil immediately next to the filter 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 fabric deeper into the ground if necessary.

Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the fence to a sediment pond.
- Check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or 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 filter fabric that has deteriorated due to ultraviolet breakdown.

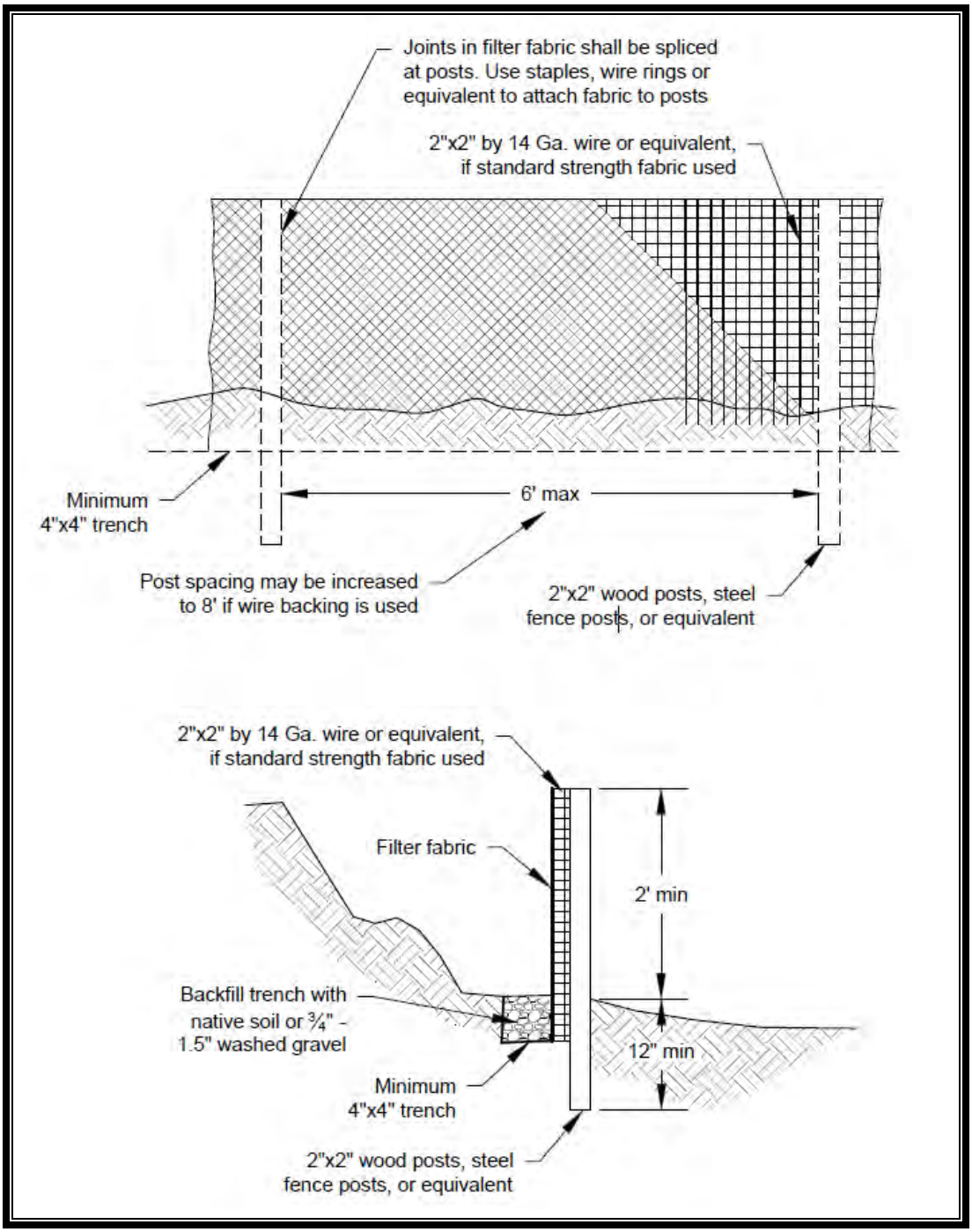


Figure 5.20. Silt Fence.

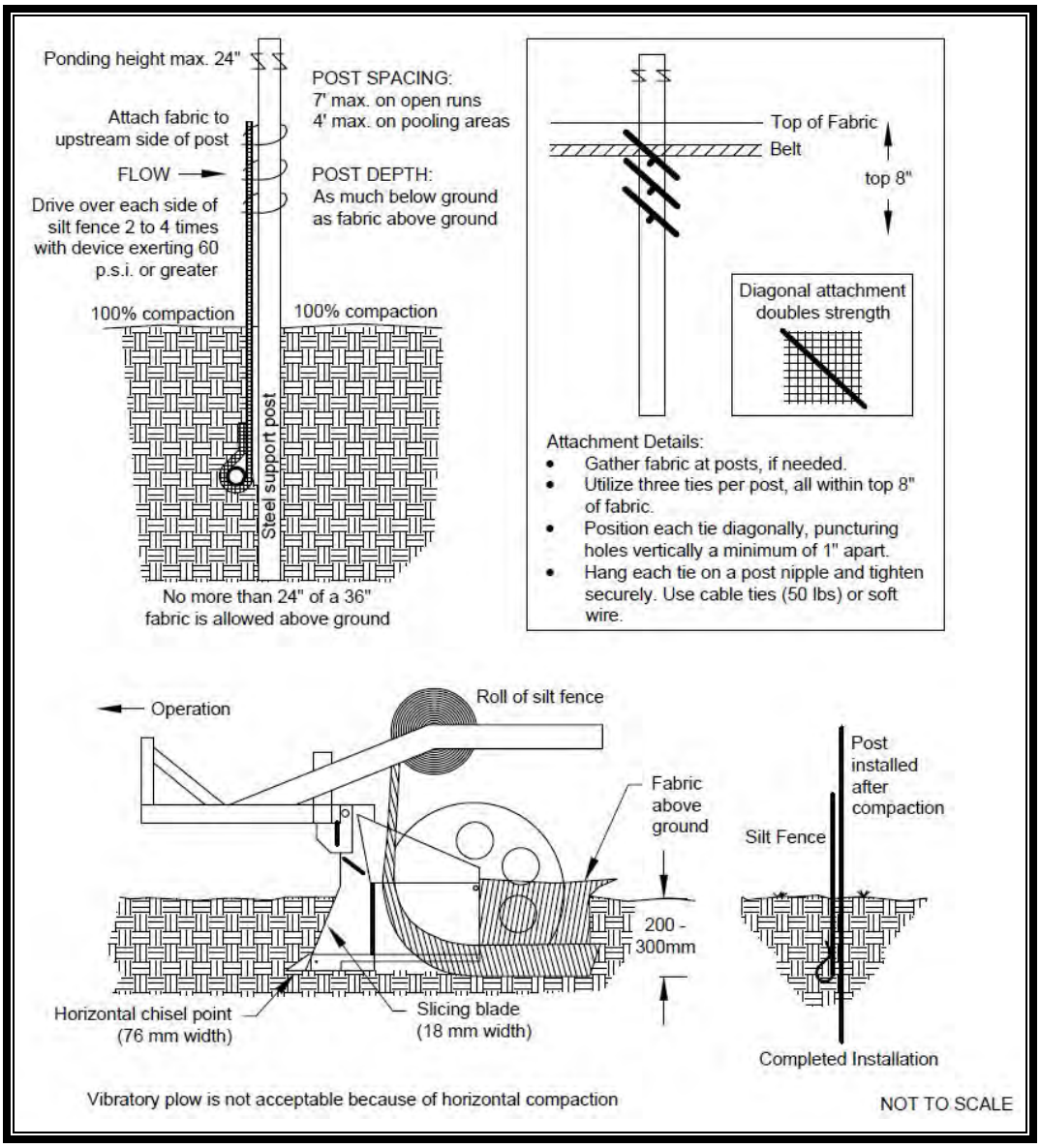


Figure 5.21. Silt Fence Installation by Slicing Method.

BMP C235: Wattles

Purpose

Wattles are temporary erosion and sediment control barriers consisting of straw, compost, or other material that is wrapped in biodegradable tubular plastic or similar encasing material. They reduce the velocity and can spread the flow of rill and sheet runoff, and can capture and retain sediment. Wattles are typically 8 to 10 inches in diameter and 25 to 30 feet in length. Wattles are placed in shallow trenches and staked along the contour of disturbed or newly constructed slopes. See Figure 5.22 for typical construction details.

Conditions of Use

- Use wattles:
    - In disturbed areas that require immediate erosion protection
    - On exposed soils during the period of short construction delays, or over winter months
    - On slopes requiring stabilization until permanent vegetation can be established.
- The material used dictates the effectiveness period of the wattle. Typically, wattles are effective for one to two wet seasons.
- Prevent rilling beneath wattles by properly entrenching and abutting wattles together to prevent water from passing between them.

Design Criteria

- Install wattles perpendicular to the flow direction and parallel to the slope contour.
- Narrow trenches shall be dug across the slope on contour to a depth of 3 to 5 inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, the trenches shall be dug to a depth of 5 to 7 inches, or one-half to two-thirds of the thickness of the wattle.
- Start building trenches and installing wattles from the base of the slope and work up. Spread excavated material evenly along the uphill slope and compacted using hand tamping or other methods.
- Construct trenches on contours at intervals of 10 to 25 feet apart depending on the steepness of the slope, soil type, and rainfall. The steeper the slope, the closer together the trenches.

- Install the wattles snugly into the trenches and abut tightly end to end. Do not overlap the ends.

- Install stakes at each end of the wattle, and at 4-foot centers along entire length of wattle.

- If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.

- Wooden stakes should be approximately 0.75 by 0.75 by 24 inches min. Willow cuttings or 0.375-inch rebar can also be used for stakes. Note: rebar must be removed at end of project if used, while other fasteners maybe permitted to remain if all parts of the wattles are biodegradable and shown in plans for permanent erosion control.

Maintenance Standards

- Stakes should be driven through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle.

- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall on steep sandy soils.

- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted or water has scoured beneath the wattles.

Approved as Equivalent

Ecology has approved specific products as able to meet the requirements of BMP C235. However, the products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. The list of products is available on Ecology's web site at <www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html>.

If a project wishes to use any of the "approved as equivalent" BMPs in the City of Lacey, the project owner or representative must obtain approval for use of the BMP from the city on a case-by-case basis (i.e., for each project or site) before use.

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils with a well-established vegetative cover. This 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 with straw or an erosion control blanket until 75 percent grass cover is established.
- Where the term "fully established" is used to describe vegetative cover or plantings, it shall be understood to mean that healthy vegetation covers 90 percent of exposed soil.
- Inspect 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) that will prevent erosion.

Design and Installation Specifications

- Seed retention/detention ponds as required.
- Install channels intended for vegetation before starting major earthwork and hydroseeded with a Bonded Fiber Matrix (BFM). For vegetated channels that will have high flows, install erosion control blankets over hydroseed. Before allowing water to flow in vegetated channels, establish 75 percent vegetation cover. If

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

- Confirm the installation of all required surface water control measures to prevent seed from washing away.

- The seedbed should be firm and rough. All soil shall be roughened no matter what the slope. If compaction is required for engineering purposes, slopes must be track walked before seeding. Backblading or smoothing of slopes greater than 4:1 is not allowed if they are to be seeded.

- New and more effective restoration-based landscape practices rely on deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical the subgrade should be initially ripped 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 the rototilling process should be done in multiple lifts, or the prepared soil system shall be prepared properly and then placed to achieve the specified depth.

- Organic matter is the most appropriate form of "fertilizer" because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form. A natural system typically releases 2 to 10 percent of its nutrients annually. Chemical fertilizers have since been formulated to simulate what organic matter does naturally.

- In general, 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer can be used at a rate of 90 pounds per acre. Slow-release fertilizers shall be used because they are more efficient and have fewer environmental impacts. It is recommended that areas being seeded for final landscaping conduct soil tests to determine the exact type and quantity of fertilizer needed. This will prevent the over-application of fertilizer. Fertilizer must not be added to the hydromulch machine and agitated more than 20 minutes before it is to be used. If agitated too much, the slow-release coating is destroyed.

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

- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. See BMP C121: Mulching for specifications.

- On steep slopes, BFM or Mechanically Bonded Fiber Matrix (MBFM) products should be used. BFM/MBFM products are applied at a minimum rate of

3,000 pounds per acre of mulch with approximately 10 percent tackifier. Application is made so that a minimum of 95 percent soil coverage is achieved. Numerous products are available commercially and should be installed per manufacturer's instructions. Most products require 24 to 36 hours to cure before a rainfall and cannot be installed on wet or saturated soils. Generally, these products come in 40- to 50-pound bags and include all necessary ingredients except for seed and fertilizer.

- BFMs and MBFMs have some advantages over blankets:
  - No surface preparation required
  - Can be installed via helicopter in remote areas
  - On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety
  - They are at least $1,000 per acre cheaper installed.
- In most cases, the shear strength of blankets is not a factor when used on slopes, only when used in channels. BFMs and MBFMs are good alternatives to blankets in most situations where vegetation establishment is the goal.
- 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 also postconstruction soil quality and depth in Chapter 7, Section 7.4.1.
- When installing seed via hydroseeding operations, only about one-third 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:

  1. Phase 1 – Install all seed and fertilizer with 25 to 30 percent mulch and tackifier onto soil in the first lift.
  2. Phase 2 – Install the rest of the mulch and tackifier over the first lift.

  Or, enhance vegetation by:

  1. Installing the mulch, seed, fertilizer, and tackifier in one lift.
  2. Spread or blow straw over the top of the hydromulch at a rate of 800 to 1,000 pounds per acre.
  3. 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 BFM or Mechanically Bonded Fiber Matrix (MBFM) (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 the tables below include recommended mixes for both temporary and permanent seeding, and rates are provided as pounds of pure live seed per acre.
- Other mixes may be appropriate, depending on the soil type and hydrology of the area. Consult the local revegetation experts or the local conservation district for their recommendations because the appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the city may be used.
- Table 5.3 represents the standard mix for areas requiring a temporary vegetative cover.

Table 5.3. Temporary Erosion Control Seed Mix.

Common Name	Species	Pounds Pure Live Seed per Acre
Spike bentgrass	*Agrostis exarata*	0.1
California brome	*Bromus carinatus*	10.5
Tufted hairgrass	*Deschampsia cespitosa*	0.4
Blue wildrye	*Elymus glaucus*	11.4
California oatgrass	*Danthonia californica*	6.0
Native red fescue	*Festuca rubra* var. *rubra*	2.5
Meadow barley	*Hordeum brachyantherum*	8.2
Total		**39.1**

- Table 5.4 lists a recommended mix for landscaping seed.

Table 5.4. Landscaping Seed Mix.

Common Name	Species	Pounds Pure Live Seed per Acre
Sideoats grama	*Bouteloua curtipendula*	7.3
California oatgrass	*Danthonia californica*	6.6
Native red fescue	*Festuca rubra* var. *rubra*	4.2
Prairie Junegrass	*Koeleria macrantha*	0.9
Total		**19.0**

- Table 5.5 lists a low-maintenance turf seed mix that may be used in dry situations where there is little to no watering.

Table 5.5. Low-Growing Turf Seed Mix.

Common Name	Species	Pounds Pure Live Seed per Acre
Hard fescue	*Festuca brevipila*	3.1
Sheep fescue	*Festuca ovina*	3.1
Native red fescue	*Festuca rubra* var. *rubra*	3.5
Prairie Junegrass	*Koeleria macrantha*	0.6
Total		**10.2**

- Table 5.6 lists a mix for bioswales and other intermittently wet areas.

Table 5.6. Bioswale Seed Mix.

Common Name	Species	Pounds Pure Live Seed per Acre
American sloughgrass	*Beckmannia syzigachne*	0.9
Tufted hairgrass	*Deschampsia cespitosa*	0.6
Blue wildrye	*Elymus glaucus*	11.4
Native red fescue	*Festuca rubra* var. *rubra*	2.8
Meadow barley	*Hordeum brachyantherum*	9.8
Northwestern mannagrass	*Glyceria occidentalis*	5.2
Total		**30.7**

- Table 5.7 lists a low-growing seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.

Table 5.7. Low Growing Wet Area Seed Mix.

Common Name	Species	Pounds Pure Live Seed per Acre
California brome	*Bromus carinatus*	10.5
Columbia brome	*Bromus vulgaris*	8.7
Tufted hairgrass	*Deschampsia cespitosa*	0.4
California oatgrass	*Danthonia californica*	5.0
Native red fescue	*Festuca rubra* var. *rubra*	2.4
Western manna grass	*Glyceria occidentalis*	3.5
Meadow barley	*Hordeum brachyantherum*	8.2
Total		**38.5**

- Table 5.8 lists a recommended meadow seed mix that is intended 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.

Table 5.8. Meadow Seed Mix.

Common Name	Species	Pounds Pure Live Seed per Acre
Common yarrow	*Achillea millefolium*	0.07
Pearly everlasting	*Anaphalis margartacae*	0.01
California brome	*Bromus carinatus*	7.84
California oatgrass	*Danthonia californica*	3.73
Blue wildrye	*Elymus glaucus*	7.60
Idaho fescue	*Festuca idahoensis*	1.74
Native red fescue	*Festuca rubra* var. *rubra*	1.88
Sickle keeled lupine	*Lupinus albicaulis*	2.22
Fowl bluegrass	*Poa palustris*	0.36
Total		**22.9**

Maintenance Standards

- Reseed any seeded areas that fail to establish at least 80 percent cover (100 percent cover for areas that receive sheet or concentrated flows). If reseeding is ineffective, an alternate method, such as sodding, mulching, or nets/blankets, shall be used. If winter weather prevents adequate grass growth, this time limit may be relaxed at the discretion of the city when sensitive areas would otherwise be protected.

- 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 Equivalent

Ecology has approved specific products as able to meet the requirements of BMP C120. However, the products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. The list of products is available on Ecology's web site at <www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html>.

If a project wishes to use any of the "approved as equivalent" BMPs in the City of Lacey, the project owner or representative must obtain approval for use of the BMP from the city on a case-by-case basis (i.e., for each project or site) before use.

BMP C121: Mulching

Purpose

Mulching soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There is an enormous variety of mulches that can be used. This section discusses only the most common types of mulch.

Conditions of Use

As a temporary cover measure, mulch shall be used:

- For fewer than 30 days on disturbed areas that require cover.
- At all times for seeded areas, especially during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.
- Mulch may be applied at any time of the year and must be refreshed periodically.
- For seeded areas, mulch may be made up of 100 percent: cottonseed meal; fibers made of wood, recycled cellulose, hemp, kenaf; compost; or blends of these. Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers. Any mulch or tackifier product used shall be installed per manufacturer's instructions. Generally, mulches come in 40- to 50-pound bags. Seed and fertilizer are added at time of application.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see Table 5.9. Always use a 2-inch minimum mulch thickness; increase the thickness until the ground is 95 percent covered (i.e., not visible under the mulch layer). Note: Thicknesses may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.

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

Table 5.9. Mulch Standards and Guidelines.

Mulch Material	Quality Standards	Application Rates	Remarks
Straw	Air-dried; free from undesirable seed and coarse material.	2″ to 3″ thick; five bales per 1,000 sq. ft. or 2 to 3 tons per acre	Cost-effective protection when applied with adequate thickness. Hand-application generally requires greater thickness than blown straw. The thickness of straw may be reduced by half when used in conjunction with seeding. In windy areas straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier as even light winds will blow it away. Straw, however, has several deficiencies that should be considered when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and it has no significant long-term benefits. It should also not be used within the ordinary high water elevation of surface waters (due to flotation).
Hydromulch	No growth inhibiting factors.	Approx. 25 to 30 lbs per 1,000 sq. ft. or 1,500 to 2,000 lbs per acre	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about 0.75 to 1 inch clog hydromulch equipment. Fibers should be kept to less than 0.75 inch.
Compost	No visible water or dust during handling. Must be produced per WAC 173-350, Solid Waste Handling Standards, but may have up to 35% biosolids.	2″ thick min.; approx. 100 tons per acre (approx. 800 lbs per yard)	More effective control can be obtained by increasing thickness to 3 inches. Excellent mulch for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Compost used for mulch has a coarser size gradation than compost used for BMP C125 or the postconstruction soil quality and depth BMP see Chapter 7, Section 7.4.1. It is more stable and practical to use in wet areas and during rainy weather conditions. Do not use near wetlands or near phosphorous impaired water bodies.
Chipped Site Vegetation	Average size should be several inches. Gradations from fines to 6 inches in length for texture, variation, and interlocking properties.	2″ thick min.	This is a cost-effective way to dispose of debris from clearing and grubbing, and it eliminates the problems associated with burning. Generally, it should not be used on slopes above approx. 10 percent because of its tendency to be transported by runoff. It is not recommended within 200 feet of surface waters. If seeding is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment.
Wood-based Mulch or Wood Straw	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.	2″ thick min.; approx. 100 tons per acre (approx. 800 lbs per cubic yard)	This material is often called “hog fuel” or “hogged fuel.” The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).
Wood Strand Mulch	A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.	2″ thick min.	Cost-effective protection when applied with adequate thickness. A minimum of 95 percent of the wood strand shall have lengths between 2 and 10 inches, with a width and thickness between one-sixteenth and three-eighths inch. The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life. Sawdust or wood shavings shall not be used as mulch. (WSDOT Standard Specification 9-14.4(4).

Coarse Compost

- Mulch may be applied at any time of the year and must be refreshed periodically
- Minimum Percent passing 3-inch sieve openings 100 percent
- Minimum Percent passing 1-inch″ sieve openings 90 percent
- Minimum Percent passing 0.75-inch sieve openings 70 percent
- Minimum Percent passing 0.25-inch sieve openings 40 percent

Mulch used within the ordinary high water mark of surface waters must be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material.

Maintenance Standards

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

BMP C123: Plastic Covering

Purpose

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Conditions of Use

- Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.
- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. Note: The relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than 6 months) applications.
- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on-site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- While plastic is inexpensive to purchase, the added cost of installation, maintenance, removal, and disposal make this an expensive material, up to $1.50 to $2 per square yard.
- Whenever plastic is used to protect slopes install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to covey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.
- Other uses for plastic include:
    - Temporary ditch liner
    - Pond liner in temporary sediment pond
    - Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored
    - Emergency slope protection during heavy rains
    - Temporary drainpipe (“elephant trunk”) used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:
    - Run plastic up and down slope, not across slope.

  - Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.
  - Minimum of 8-inch overlap at seams.
  - On long or wide slopes, or slopes subject to wind, tape all seams.
  - Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
  - Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
  - Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil which causes extreme erosion.
  - Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.

- Plastic sheeting shall have a minimum thickness of 6 mil.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

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

Approved as Equivalent

Ecology has approved specific products as able to meet the requirements of BMP C123. However, the products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. The list of products is available on Ecology's web site at <www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html>.

If a project wishes to use any of the "approved as equivalent" BMPs in the City of Lacey, the project owner or representative must obtain approval for use of the BMP from the city on a case-by-case basis (i.e., for each project or site) before use.

BMP C124: Sodding

Purpose

The purpose of sodding is to establish permanent turf for immediate erosion protection and to stabilize drainage ways where concentrated overland flow will occur.

Conditions of Use

Sodding may be used in the following areas:

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

Design and Installation Specifications

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

The following steps are recommended for sod installation:

- Shape and smooth the surface to final grade in accordance with the approved grading plan. The swale needs to be overexcavated 4 to 6 inches below design elevation to allow room for placing soil amendment and sod.
- Amend 4 inches (minimum) of compost into the top 8 inches of the soil if the organic content of the soil is less than 10 percent or the permeability is less than 0.6 inches per hour. See <www.ecy.wa.gov/programs/swfa/organics/soil.html> for further information.
- Fertilize according to the supplier's recommendations.
- Work lime and fertilizer 1 to 2 inches into the soil, and smooth the surface.
- Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit. Stagger joints at least 12 inches. Staple on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.
- Roll the sodded area and irrigate.
- When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance Standards

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

BMP C125: Topsoiling/Composting

Purpose

Topsoiling and composting provide a suitable growth medium for final site stabilization with vegetation. While not a permanent cover practice in itself, topsoiling and composting are an integral component of providing permanent cover in those areas where there is an unsuitable soil surface for plant growth. Use this BMP in conjunction with other BMPs such as seeding, mulching, or sodding. Note that this BMP is functionally the same as the postconstruction soil quality and depth BMP (see Chapter 7, Section 7.4.1), which is required for all disturbed areas that will be developed as lawn or landscaped areas at the completed project site.

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

Conditions of Use

- Permanent landscaped areas shall contain healthy topsoil that reduces the need for fertilizers, improves overall topsoil quality, provides for better vegetal health and vitality, improves hydrologic characteristics, and reduces the need for irrigation.

- Leave native soils and the duff layer undisturbed to the maximum extent practicable. Stripping of existing, properly functioning soil system and vegetation for the purpose of topsoiling during construction is not acceptable. Preserve existing soil systems in undisturbed and uncompacted condition if functioning properly.

- Areas that already have good topsoil, such as undisturbed areas, do not require soil amendments.

- Restore, to the maximum extent practicable, native soils disturbed during clearing and grading to a condition equal to or better than the original site condition's moisture-holding capacity. Use on-site native soil, incorporate amendments into on-site soil, or importing blended topsoil to meet this requirement.

- Topsoiling is a required procedure when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.

- Beware of where the topsoil comes from, and what vegetation was on site before disturbance, invasive plant seeds may be included and could cause problems for establishing native plants, landscaped areas, or grasses.

- Topsoil from the site will contain mycorrhizal bacteria that are necessary for healthy root growth and nutrient transfer. These native mycorrhiza are acclimated

to the site and will provide optimum conditions for establishing grasses. Use commercially available mycorrhiza products when using off-site topsoil.

Design and Installation Specifications

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

- Maximize the depth of the topsoil wherever possible to provide the maximum possible infiltration capacity and beneficial growth medium. Topsoil shall have:
    - A minimum depth of 8 inches. Scarify subsoils below the topsoil layer at least 4 inches with some incorporation of the upper material to avoid stratified layers, where feasible. Ripping or restructuring the subgrade may also provide additional benefits regarding the overall infiltration and interflow dynamics of the soil system.
    - A minimum organic content of 10 percent dry weight in planting beds, and 5 percent organic matter content in turf areas. Incorporate organic amendments to a minimum 8-inch depth except where tree roots or other natural features limit the depth of incorporation.
    - A pH between 6.0 and 8.0 or matching the pH of the undisturbed soil.
    - If blended topsoil is imported, then fines shall be limited to 25 percent passing through a U.S. #200 sieve.
    - Mulch planting beds with 2 inches of organic material.
- Accomplish the required organic content, depth, and pH by returning native topsoil to the site, importing topsoil of sufficient organic content, and/or incorporating organic amendments.
    - When using the option of incorporating amendments to meet the organic content requirement, use compost that meets the composted material specification for bioretention (see Chapter 7, Section 7.4.4), with the exception that the compost may have up to 35 percent biosolids or manure.
    - Sections three through seven of the document entitled *Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington* provide useful guidance for implementing whichever option is chosen. The document includes guidance for preapproved default strategies and guidance for custom strategies. As of this printing the document can be found at: <www.soilsforsalmon.org/pdf/Soil_BMP_Manual.pdf>.
- The final composition and construction of the soil system will result in a natural selection or favoring of certain plant species over time. For example,

incorporation of topsoil may favor grasses, while layering with mildly acidic, high-carbon amendments may favor more woody vegetation.

- Allow sufficient time in scheduling for topsoil spreading prior to seeding, sodding, or planting.

- Take care when applying top soil to subsoils with contrasting textures. Sandy topsoil over clayey subsoil is a particularly poor combination, as water creeps along the junction between the soil layers and causes the topsoil to slough. If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method to prevent a lack of bonding is to actually work the topsoil into the layer below for a depth of at least 6 inches.

- Field exploration of the site shall be made to determine if there is surface soil of sufficient quantity and quality to justify stripping. Topsoil shall be friable and loamy (loam, sandy loam, silt loam, sandy clay loam, and clay loam). Avoid areas of natural groundwater recharge.

- Stripping shall be confined to the immediate construction area. A 4-inch to 6-inch stripping depth is common, but depth may vary depending on the particular soil. All surface runoff control structures shall be in place prior to stripping.

- Do not place topsoil while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding.

- In any areas requiring grading, remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas. Stockpiled topsoil is to be reapplied to other portions of the site where feasible.

- Locate the topsoil stockpile so that it meets specifications and does not interfere with work on the site. It may be possible to locate more than one pile in proximity to areas where topsoil will be used.

Stockpiling of topsoil shall occur in the following manner:

- Side slopes of the stockpile shall not exceed 2H:1V

- Between October 1 and April 30:

    - An interceptor dike with gravel outlet and silt fence shall surround all topsoil

    - Within 2 days, complete erosion control seeding, or covering stockpiles with clear plastic, or other mulching materials.

- Between May 1 and September 30:
    - An interceptor dike with gravel outlet and silt fence shall surround all topsoil if the stockpile will remain in place for a longer period of time than active construction grading.
    - Within 7 days, complete erosion control seeding, or covering stockpiles with clear plastic, or other mulching materials.
- When native topsoil is to be stockpiled and reused the following should apply to ensure that the mycorrhizal bacterial, earthworms, and other beneficial organisms will not be destroyed:
    - Re-install topsoil within 4 to 6 weeks
    - Do not allow the saturation of topsoil with water
    - Do not use plastic covering.

Maintenance Standards

- Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded.
- Establish soil quality and depth toward the end of construction and once established, protect from compaction, such as from large machinery use, and from erosion.
- Plant and mulch soil after installation.
- Leave plant debris or its equivalent on the soil surface to replenish organic matter.
- Reduce and adjust, where possible, the use of irrigation, fertilizers, herbicides and pesticides, rather than continuing to implement formerly established practices.

BMP 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

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

Design and Installation Specifications

Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.

- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.

- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.

- Sprinkle the site with water until surface is wet. Repeat as needed. To prevent carryout of mud onto street, refer to Stabilized Construction Entrance (BMP C105).

- 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. Oil based products are prohibited from use as a dust suppressant. The city may approve other dust palliatives such as calcium chloride or PAM.

- PAM (BMP C126) 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 actually reduce the quantity of water needed for dust control. Use of PAM could be a cost-effective dust control method.

Techniques that can be used for unpaved roads and lots include:

- Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.

- Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
- Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than 075 mm) to 10 to 20 percent.
- Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
- Encourage the use of alternate, paved routes, if available.
- Restrict use of paved roadways by tracked vehicles and heavy trucks to prevent damage to road surface and base.
- Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
- Pave unpaved permanent roads and other trafficked areas.
- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Limit dust-causing work on windy days.

Contact your Puget Sound Clean Air Agency <www.pscleanair.org> for guidance and training on other dust control measures. Compliance with Puget Sound Clean Air Agency guidance and BMPs constitutes compliance with this BMP.

Maintenance Standards

- Respray area as necessary to keep dust to a minimum.

BMP C130: Surface Roughening

Purpose

Surface roughening aids in the establishment of vegetative cover, reduces runoff velocity, increases infiltration, and provides for sediment trapping through the provision of a rough soil surface. Horizontal depressions are created by operating a tiller or other suitable equipment on the contour or by leaving slopes in a roughened condition by not fine grading them.

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

Conditions of Use

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

Design and Installation Specifications

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, contour furrows, and tracking. See Figure 5.5 for tracking and contour furrows. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each “step” catches material that sloughs from above, and provides a level site where vegetation can become established. Stairs must be wide enough to work with standard earth moving equipment. Stair steps must be on contour or gullies will form on the slope.
- Areas that will be mowed (these areas should have slopes less steep than 3H:1V) may have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on the contour.
- Graded areas with slopes steeper than 3H:1V but less than 2H:1V shall be roughened before seeding. This can be accomplished in a variety of ways,

including "track walking," or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.

- Tracking is done by operating equipment up and down the slope to leave horizontal depressions in the soil.

Maintenance Standards

- Areas that are graded in this manner should be seeded as quickly as possible.
- Regular inspections should be made of the area. If rills appear, they should be regraded and reseeded immediately.

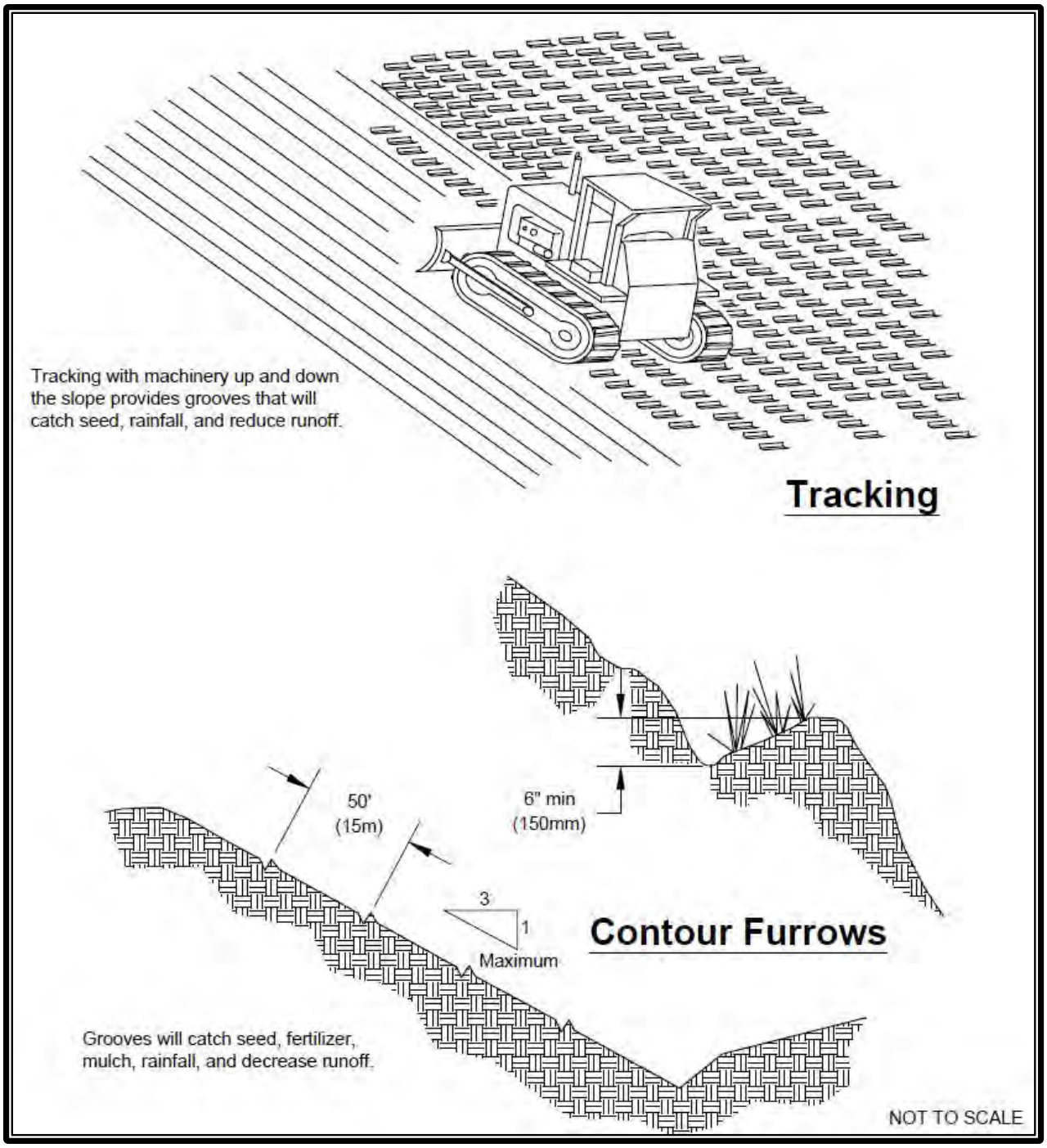


Figure 5.5. Surface Roughening by Tracking and Contour Furrows.

BMP C204: Pipe Slope Drains

Purpose

To use a pipe to convey stormwater anytime water needs to be diverted away from or over bare soil to prevent gullies, channel erosion, and saturation of slide-prone soils.

Conditions of Use

Pipe slope drains should be used when a temporary or permanent stormwater conveyance is needed to move the water down a steep slope to avoid erosion. See also Figure 5.12.

On highway projects, pipe slope drains should be used at bridge ends to collect runoff and pipe it to the base of the fill slopes along bridge approaches. These can be designed into a project and included as bid items. Another use on road projects is to collect runoff from pavement and pipe it away from side slopes. These are useful because there is generally a time lag between having the first lift of asphalt installed and the curbs, gutters, and permanent drainage installed. Used in conjunction with sand bags, or other temporary diversion devices, these will prevent massive amounts of sediment from leaving a project.

Water can be collected, channeled with sand bags, Triangular Silt Dikes, berms, or other material, and piped to temporary sediment ponds.

Pipe slope drains can be:

- Connected to new catch basins and used temporarily until all permanent piping is installed.
- Used to drain water collected from aquifers exposed on cut slopes and take it to the base of the slope.
- Used to collect clean runoff from plastic sheeting and direct it away from exposed soil.
- Installed in conjunction with silt fence to drain collected water to a controlled area.
- Used to divert small seasonal streams away from construction. They have been used successfully on culvert replacement and extension jobs. Large flex pipe can be used on larger streams during culvert removal, repair, or replacement.
- Connected to existing downspouts and roof drains and used to divert water away from work areas during building renovation, demolition, and construction projects.

There are now several commercially available collectors that are attached to the pipe inlet and help prevent erosion at the inlet.

Design and Installation Specifications

Size the pipe to convey the flow. The capacity for temporary drains shall be sufficient to handle the peak flow from a 10-year, 24-hour storm event assuming a NRCS Type 1A rainfall distribution resolved to 10-minute time steps,. Alternatively, use 1.6 times the 10-year, 1-hour time step flow indicated by an approved continuous runoff model. If a 15-minute (or less) time step is used, no correction factor is required.

- Use care in clearing vegetated slopes for installation.
- Re-establish cover immediately on areas disturbed by installation.
- Use temporary drains on new cut or fill slopes.
- Use diversion dikes or swales to collect water at the top of the slope.
- Ensure that the entrance area is stable and large enough to direct flow into the pipe.
- Dike material shall be compacted to 90 percent modified proctor to prevent piping of water through the berm. The entrance area is a common failure location.
- The entrance shall consist of a standard flared end section for culverts 12 inches and larger with a minimum 6-inch metal toe plate to prevent runoff from undercutting the pipe inlet. The slope of the entrance shall be at least 3 percent. Sand bags may also be used at pipe entrances as a temporary measure.
- The soil around and under the pipe and entrance section shall be thoroughly compacted to prevent undercutting.
- The flared inlet section shall be securely connected to the slope drain and have watertight connecting bands.
- Slope drain sections shall be securely fastened together, fused or have gasketed watertight fittings, and shall be securely anchored into the soil.
- Thrust blocks must be installed anytime 90 degree or sharper bends are utilized. Depending on size of pipe and flow, these can be constructed with sand bags, straw bales staked in place, T-posts and wire, or ecology blocks.
- Pipe needs to be secured along its full length to prevent movement. This can be done with steel T-posts and wire. A post is installed on each side of the pipe and the pipe is wired to them. This should be done every 10 to 20 feet of pipe length or so, depending on the size of the pipe and quantity of water to be diverted.
- Interceptor dikes shall be used to direct runoff into a slope drain. The height of the dike shall be at least 1 foot higher at all points than the top of the inlet pipe.

- The area below the outlet must be stabilized with a riprap apron (see BMP C209 Outlet Protection, for the appropriate outlet material).

- If the pipe slope drain is conveying sediment-laden water, direct all flows into the sediment trapping facility.

- Materials specifications for any permanent piped system are listed in Chapter 6, Section 6.3.5, and shall be approved by the city.

Maintenance Standards

- Check inlet and outlet points regularly, especially after storms.

- The inlet must be free of undercutting, and no water should be going around the point of entry. If there are problems, the headwall shall be reinforced with compacted earth or sand bags.

- The outlet point must be free of erosion and installed with appropriate outlet protection.

- For permanent installations, inspect pipe periodically for vandalism and physical distress such as slides and windthrow.

- Normally the pipe slope is so steep that clogging is not a problem with smooth wall pipe; however, debris may become lodged in the pipe.

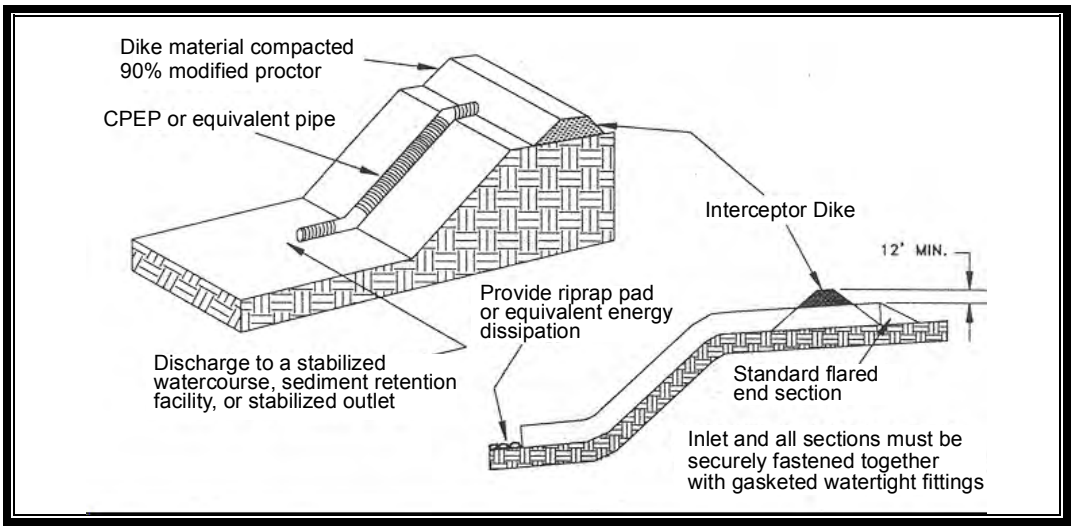


Figure 5.12. Pipe Slope Drain.

BMP C205: Subsurface Drains

Purpose

To intercept, collect, and convey groundwater to a satisfactory outlet, using a perforated pipe or conduit below the ground surface. Subsurface drains are also known as "French drains." The perforated pipe provides a dewatering mechanism to drain excessively wet soils, provide a stable base for construction, improve stability of structures with shallow foundations, or to reduce hydrostatic pressure to improve slope stability.

Conditions of Use

Use when excessive water must be removed from the soil. The soil permeability, depth to water table and impervious layers are all factors which may govern the use of subsurface drains.

Design and Installation Specifications

- **Relief drains** are used either to lower the water table in large, relatively flat areas, improve the growth of vegetation, or to remove surface water.
    - They are installed along a slope and drain in the direction of the slope
    - They can be installed in a grid pattern, a herringbone pattern, or a random pattern.
- **Interceptor drains** are used to remove excess groundwater from a slope, stabilize steep slopes, and lower the water table immediately below a slope to prevent the soil from becoming saturated.
    - Interceptor drains are installed perpendicular to a slope and drain to the side of the slope
    - They usually consist of a single pipe or series of single pipes instead of a patterned layout.
- **Depth and spacing of interceptor drains –** The depth of an interceptor drain is determined primarily by the depth to which the water table is to be lowered or the depth to a confining layer. For practical reasons, the maximum depth is usually limited to 6 feet, with a minimum cover of 2 feet to protect the conduit.
    - The soil should have depth and sufficient permeability to permit installation of an effective drainage system at a depth of 2 to 6 feet.
    - An adequate outlet for the drainage system must be available either by gravity or by pumping.
    - The quantity and quality of discharge needs to be accounted for in the receiving stream (additional detention may be required).

- This standard does not apply to subsurface drains for building foundations or deep excavations.

- The capacity of an interceptor drain is determined by calculating the maximum rate of groundwater flow to be intercepted. Therefore, it is good practice to make complete subsurface investigations, including hydraulic conductivity of the soil, before designing a subsurface drainage system.

- **Size of drain –** Size subsurface drains to carry the required capacity without pressure flow. Minimum diameter for a subsurface drain is 4 inches.

  - The minimum velocity required to prevent silting is 1.4 feet/second. The line shall be graded to achieve this velocity at a minimum. The maximum allowable velocity using a sand-gravel filter or envelope is 9 feet/second.

  - Filter material and fabric shall be used around all drains for proper bedding and filtration of fine materials. Envelopes and filters should surround the drain to a minimum of 3-inch thickness.

  - The outlet of the subsurface drain shall empty into a sediment pond through a catch basin. If free of sediment, it can then empty into a receiving channel, swale, or stable vegetated area adequately protected from erosion and undermining.

  - The trench shall be constructed on a continuous grade with no reverse grades or low spots.

  - Soft or yielding soils under the drain shall be stabilized with gravel or other suitable material.

  - Backfilling shall be done immediately after placement of the pipe. No sections of pipe shall remain uncovered overnight or during a rainstorm. Backfill material shall be placed in the trench in such a manner that the drain pipe is not displaced or damaged.

  - Do not install permanent drains near trees to avoid the tree roots that tend to clog the line. Use solid pipe with watertight connections where it is necessary to pass a subsurface drainage system through a stand of trees.

- **Outlet –** Ensure that the outlet of a drain empties into a channel or other watercourse above the normal water level.

  - Secure an animal guard to the outlet end of the pipe to keep out rodents.

  - Use outlet pipe of corrugated metal, cast iron, or heavy-duty plastic without perforations and at least 10 feet long. Do not use an envelope or filter material around the outlet pipe, and bury at least two-thirds of the pipe length.

  - When outlet velocities exceed those allowable for the receiving stream, outlet protection must be provided.

Maintenance Standards

- Subsurface drains shall be checked periodically to ensure that they are free-flowing and not clogged with sediment or roots.

- The outlet shall be kept clean and free of debris.

- Trees located too close to a subsurface drain often clog the system with their roots. If a drain becomes clogged, relocate the drain or remove the trees as a last resort. Drain placement should be planned to minimize this problem.

- Where drains are crossed by heavy vehicles use steel plate or boards to prevent the lines from being crushed. After work is complete the line shall be checked to ensure that it was not crushed.

BMP C206: Level Spreader

Purpose

To provide a temporary outlet for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope. To convert concentrated runoff to sheet flow and release it onto areas stabilized by existing vegetation or an engineered filter strip.

Conditions of Use

Used when a concentrated flow of water needs to be dispersed over a large area with existing stable vegetation.

Items to consider are:

1. What is the risk of erosion or damage if the flow may become concentrated?
2. Is an easement required if discharged to adjoining property?
3. Will most of the flow discharge to groundwater and not contribute to surface flow?
4. Is there an unstable area downstream that cannot accept additional groundwater?

Use only where the slopes are gentle, the water volume is relatively low, and the soil will adsorb most of the low flow events.

- Design and Installation Specifications
- Use above undisturbed areas that are stabilized by existing vegetation.
- If the level spreader has any low points, flow will concentrate, create channels and may cause erosion.
- Discharge area below the outlet must be uniform with a slope flatter than 5H:1V.
- Outlet to be constructed level in a stable, undisturbed soil profile (not on fill).
- The runoff shall not reconcentrate after release unless intercepted by another downstream measure.
- The grade of the channel for the last 20 feet of the dike or interceptor entering the level spreader shall be less than or equal to 1 percent. The grade of the level spreader shall be 0 percent to ensure uniform spreading of storm runoff.
- A 6-inch high gravel berm placed across the level lip shall consist of washed crushed rock, 2- to 4-inch or 0.75-inch to 1.5-inch size.

- The spreader length shall be determined by estimating the peak flow expected from the 10-year, 24-hour design storm event assuming a NRCS Type 1A rainfall distribution resolved to 10-minute time steps. Alternatively, use the peak flow from a 10-year, 15-minute (or less) time step using an approved continuous runoff model. The length of the spreader shall be a minimum of 15 feet for 0.1 cubic feet per second and shall increase by 10 feet for each 0.1 cubic feet per second thereafter to a maximum of 0.5 cubic feet per second per spreader. Use multiple spreaders for higher flows.

- The width of the spreader must be at least 6 feet.

- The depth of the spreader as measured from the lip must be at least 6 inches and be uniform across the entire length.

- Level spreaders shall be setback 100 feet minimum from the property line unless there is an easement for flow or the flow is directed to a natural drainage course.

- Level spreaders, when installed every so often in grassy swales, keep the flows from concentrating. Materials that can be used include sand bags, lumber, logs, concrete, and pipe. To function properly, the material needs to be installed level and on contour. Figures 5.13 and 5.14 provide a cross-section and a detail of a level spreader. A capped perforated pipe could also be used as a spreader.

Maintenance Standards

- The spreader should be inspected after every runoff event to ensure that it is functioning correctly.

- The contractor should avoid the placement of any material on the structure and shall prevent construction traffic from crossing over the structure.

- If the spreader is damaged by construction traffic, it shall be immediately repaired.

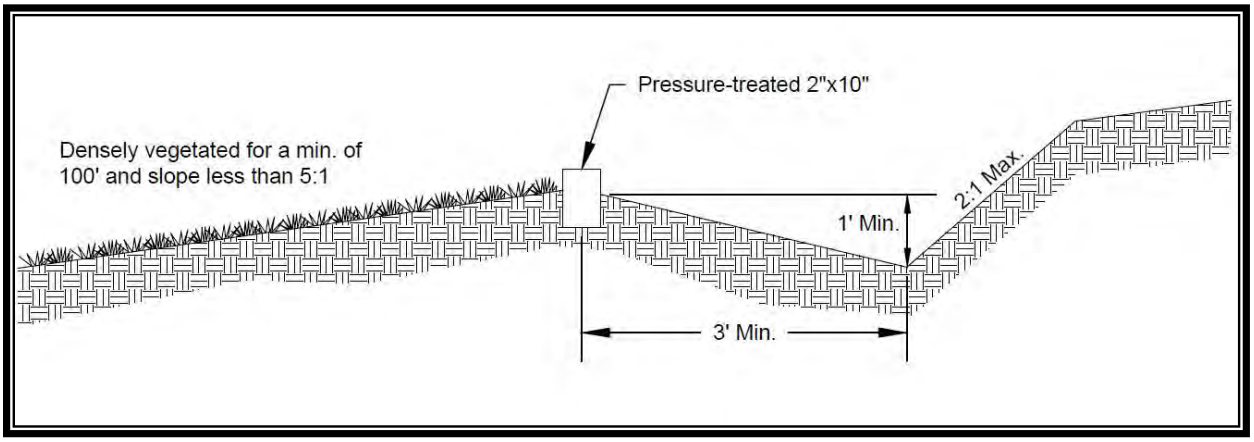


Figure 5.13. Cross-Section of Level Spreader.

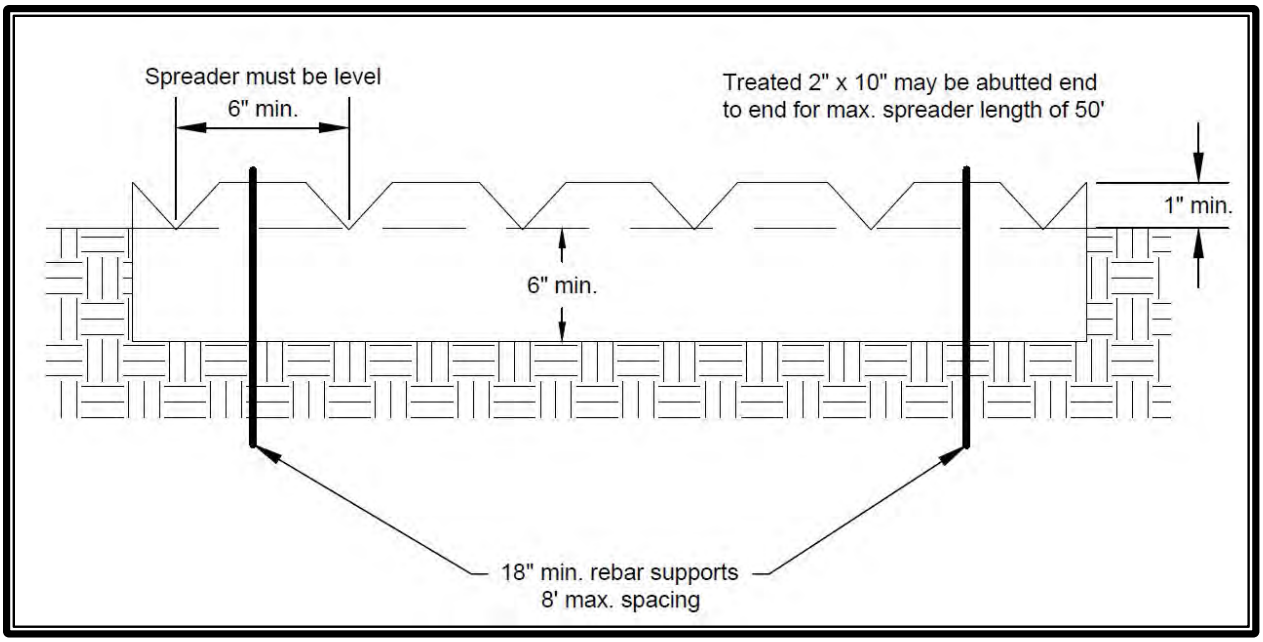


Figure 5.14. Detail of Level Spreader.

BMP C207: Check Dams

Purpose

Construction of small dams across a swale or ditch reduces the velocity of concentrated flow and dissipates energy at the check dam.

Conditions of Use

- Where temporary channels or permanent channels are not yet vegetated, channel lining is infeasible, and/or velocity checks are required.

- Check dams may not be placed in streams unless approved by the WDFW. Check dams may not be placed in wetlands without approval from the appropriate permitting agency.

- Do not place check dams below the expected backwater from any salmonid bearing water between October 1 and May 31 to ensure that there is no loss of high flow refuge habitat for overwintering juvenile salmonids and emergent salmonid fry.

Design and Installation Specifications

- Construct rock check dams from appropriately sized rock. The rock used must be large enough to stay in place given the expected design flow through the channel. The rock must be placed by hand or by mechanical means (no dumping of rock to form dam) to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges.

- Check dams may also be constructed of either rock or pea-gravel filled bags. Numerous products are also available for this purpose. They tend to be reusable, quick and easy to install, effective, and cost efficient. Straw bales are not an allowed construction material.

- Place check dams perpendicular to the flow of water.

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

- Before installing check dams, impound and bypass upstream water flow away from the work area. Options for bypassing include pumps, siphons, or temporary channels.

- Check dams in association with sumps work more effectively at slowing flow and retaining sediment than just a check dam alone. A deep sump should be provided immediately upstream of the check dam.

- In some cases, if carefully located and designed, check dams can remain as permanent installations with very minor regrading. They may be left as either spillways, in which case accumulated sediment would be graded and seeded, or as check dams to prevent further sediment from leaving the site.

- The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

- Keep the maximum height at 2 feet at the center of the dam.

- Keep the center of the check dam at least 12 inches lower than the outer edges at natural ground elevation.

- Keep the side slopes of the check dam at 2H:1V or flatter.

- Key the stone into the ditch banks and extend it beyond the abutments a minimum of 18 inches to avoid washouts from overflow around the dam.

- Use filter fabric foundation under a rock or sand bag check dam. If a blanket ditch liner is used, filter fabric is not necessary. A piece of organic or synthetic blanket cut to fit will also work for this purpose.

- In the case of grass-lined ditches and swales, all check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale—unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

- Ensure that channel appurtenances, such as culvert entrances below check dams, are not subject to damage or blockage from displaced stones. Figure 5.15 depicts a typical rock check dam.

Maintenance Standards

- Check dams shall be monitored for performance and sediment accumulation during and after each runoff producing rainfall. Sediment shall be removed when it reaches one-half the sump depth.

- Anticipate submergence and deposition above the check dam and erosion from high flows around the edges of the dam.

- If significant erosion occurs between dams, install a protective riprap liner in that portion of the channel.

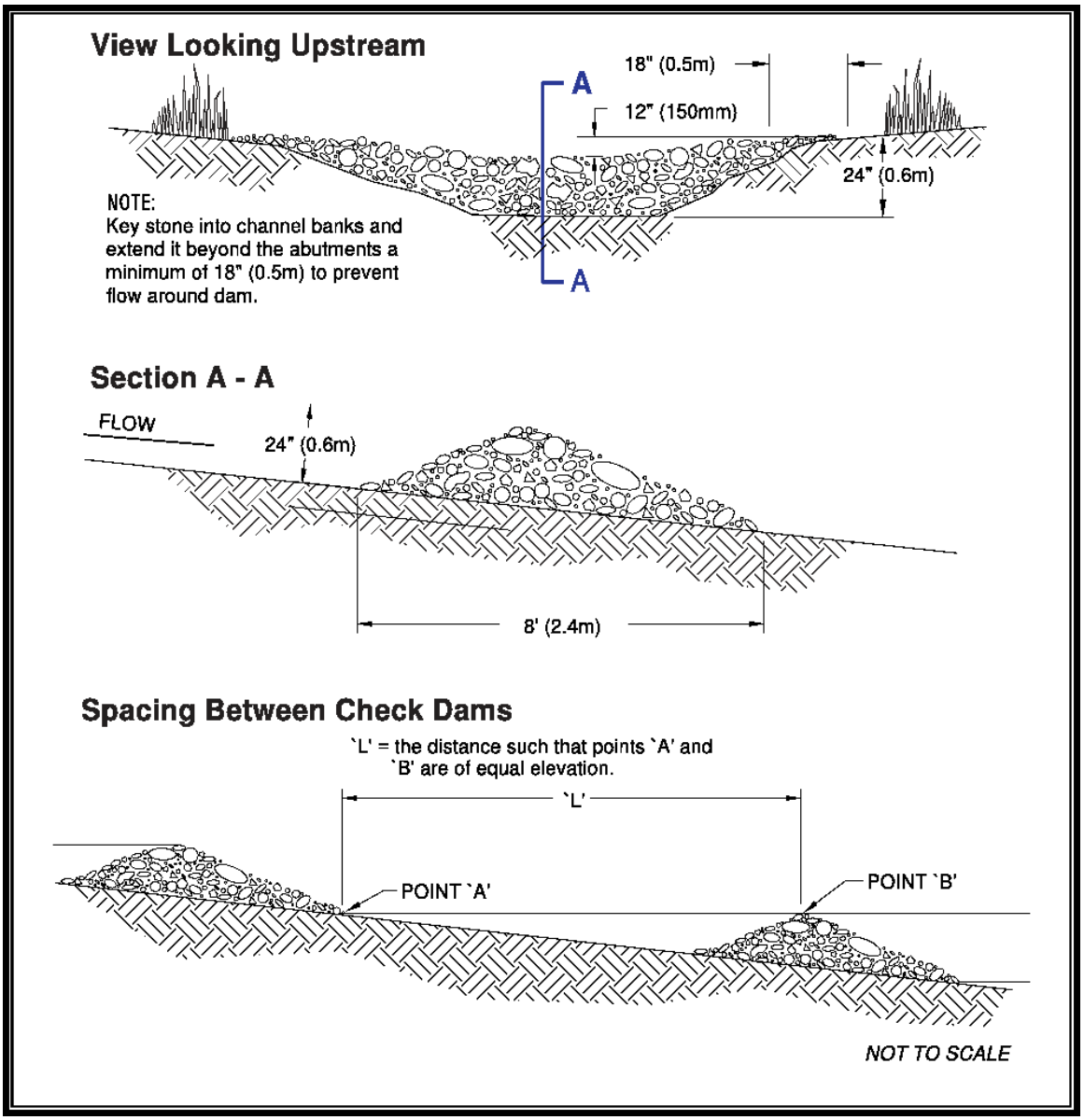


Figure 5.15. Check Dams.

BMP C220: Storm Drain Inlet Protection

Purpose

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

Conditions of Use

Use storm drain inlet protection at inlets that are operational before permanent stabilization of the disturbed drainage area. If these BMPs are used on active roadways, projects shall install appropriate traffic control to ensure vehicle and pedestrian traffic is not exposed to the roadway obstructions. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless conveying runoff entering catch basins to a sediment pond or trap.

Also use inlet protection for lawn and yard drains on new home construction. These small and numerous drains coupled with lack of gutters in new home construction can add significant amounts of sediment into the roof drain system. If possible delay installing lawn and yard drains until just before landscaping or cap these drains to prevent sediment from entering the system until completion of landscaping. Consider erosion protection methods around each finished lawn and yard drain until area is stabilized.

Table 5.10 lists several options for inlet protection. All of the methods for storm drain inlet protection tend to plug and require a high frequency of maintenance. Limit drainage areas to 1 acre or less. Possibly provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

Table 5.10. 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 will occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area Requirement: 30- by 30-feet/acre
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No		Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with a wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Lock and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap			18-month expected life.

Design and Installation Specifications

- **Excavated Drop Inlet Protection:** An excavated impoundment around the storm drain. Sediment settles out of the stormwater prior to entering the storm drain.
    - Provide a depth of 1 to 2 feet as measured from the crest of the inlet structure
    - Slope sides of excavation no steeper than 2H:1V
    - Minimum volume of excavation 35 cubic yards
    - Shape basin to fit site with longest dimension oriented toward the longest inflow area
    - Install provisions for draining to prevent standing water problems
    - Clear the area of all debris
    - Grade the approach to the inlet uniformly
    - Drill weep holes into the side of the inlet
    - Protect weep holes with screen wire and washed aggregate
    - Seal weep holes when removing structure and stabilizing area
    - Build a temporary dike, if necessary, to the down slope side of the structure to prevent bypass flow.
- **Block and Gravel Filter:** A barrier formed around the storm drain inlet with standard concrete blocks and gravel. See also Figure 5.16.
    - Provide a height of 1 to 2 feet above inlet
    - Recess the first row 2 inches into the ground for stability
    - Support subsequent courses by placing a 2 by 4 through the block opening
    - Do not use mortar
    - Lay some blocks in the bottom row on their side for dewatering the pool
    - Place hardware cloth or comparable wire mesh with 0.5-inch openings over all block openings
    - Place washed rock, 0.75- to 3-inch diameter, just below the top of blocks on slopes of 2H:1V or flatter.

- **Gravel and Wire Mesh Filter:** A gravel barrier placed over the top of the inlet. This structure does not provide an overflow.
    - Use a hardware cloth or comparable wire mesh with 0.5-inch openings
    - Use coarse aggregate
    - Provide a height 1 foot or more, 18 inches wider than inlet on all sides
    - 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 gravel over the entire inlet opening and extend at least 18 inches on all sides.
- **Catch Basin Filters:** Use inserts designed by manufacturers for construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. To reduce maintenance requirements, combine a catch basin filter with another type of inlet protection. The combination of inlet protection and filters may provide flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way.
    - Provides 5 cubic feet of storage
    - Requires dewatering provisions
    - Provides a high-flow bypass that will not clog under normal use at a construction site
    - Insert the catch basin filter in the catch basin just below the grating.
- **Curb Inlet Protection with Wooden Weir:** Barrier formed around a curb inlet with a wooden frame and gravel.
    - Use wire mesh with 0.5-inch openings
    - Use extra strength filter cloth
    - Construct a frame
    - Attach the wire and filter fabric to the frame
    - Pile coarse washed aggregate against wire/fabric
    - Place weight on frame anchors.

- **Block and Gravel Curb Inlet Protection:** Barrier formed around an inlet with concrete blocks and gravel. See Figure 5.17.
    - Use wire mesh with 0.5-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 2 by 4 stud through the outer holes of each spacer block to align the front blocks.
    - Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
    - Place wire mesh over the outside vertical face.
    - Pile coarse aggregate against the wire to the top of the barrier.
- **Curb and Gutter Sediment Barrier:** Sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure 5.18.
    - 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 outside of the berm sized to sediment trap standards for protecting a culvert inlet.

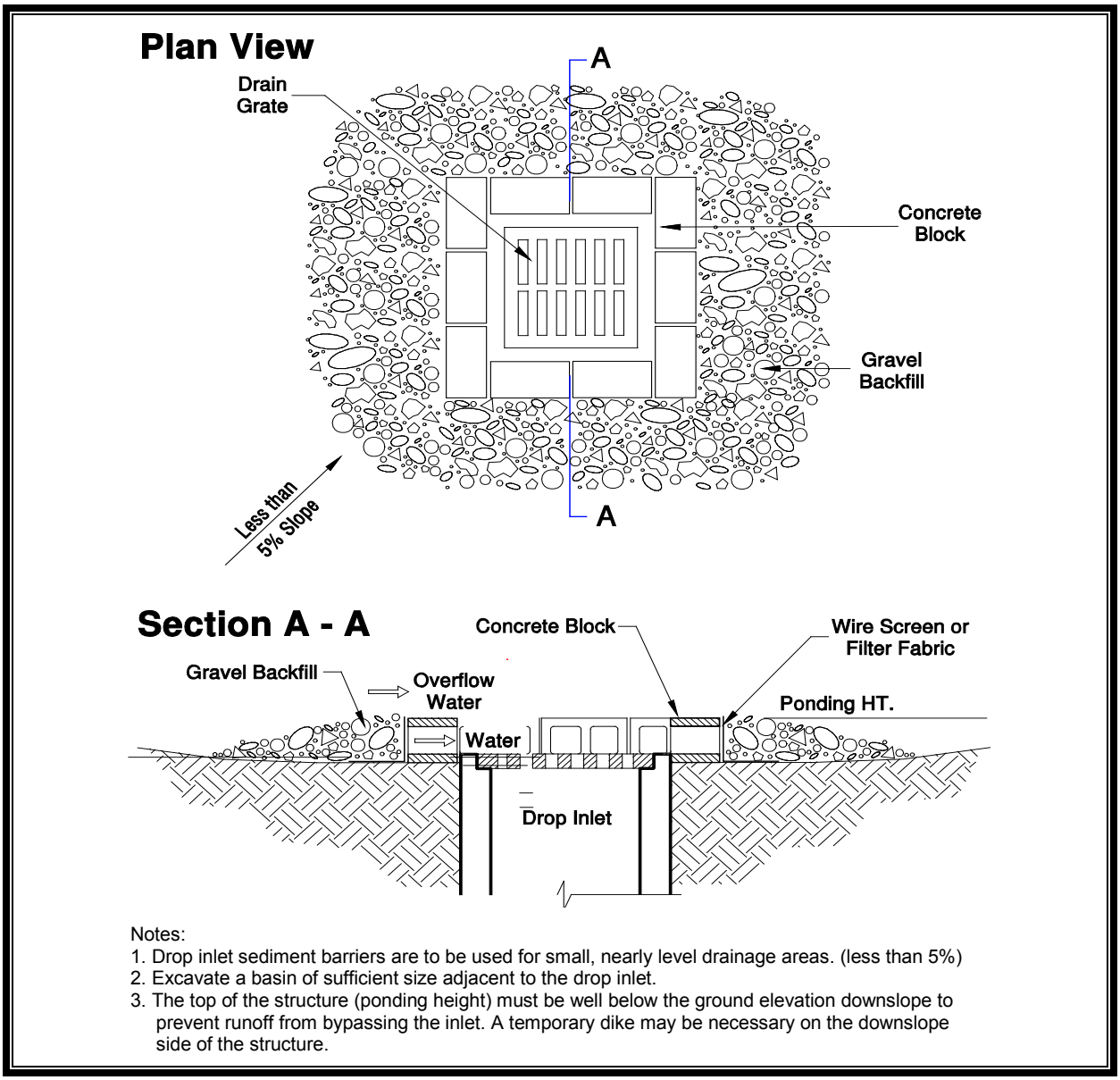
Maintenance Standards

- Inspect catch basin filters frequently, especially after storm events. Clean or replace clogged inserts. For systems with clogged stone filters pull away from the inlet and clean or replace. An alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.
- Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

Approved as Equivalent

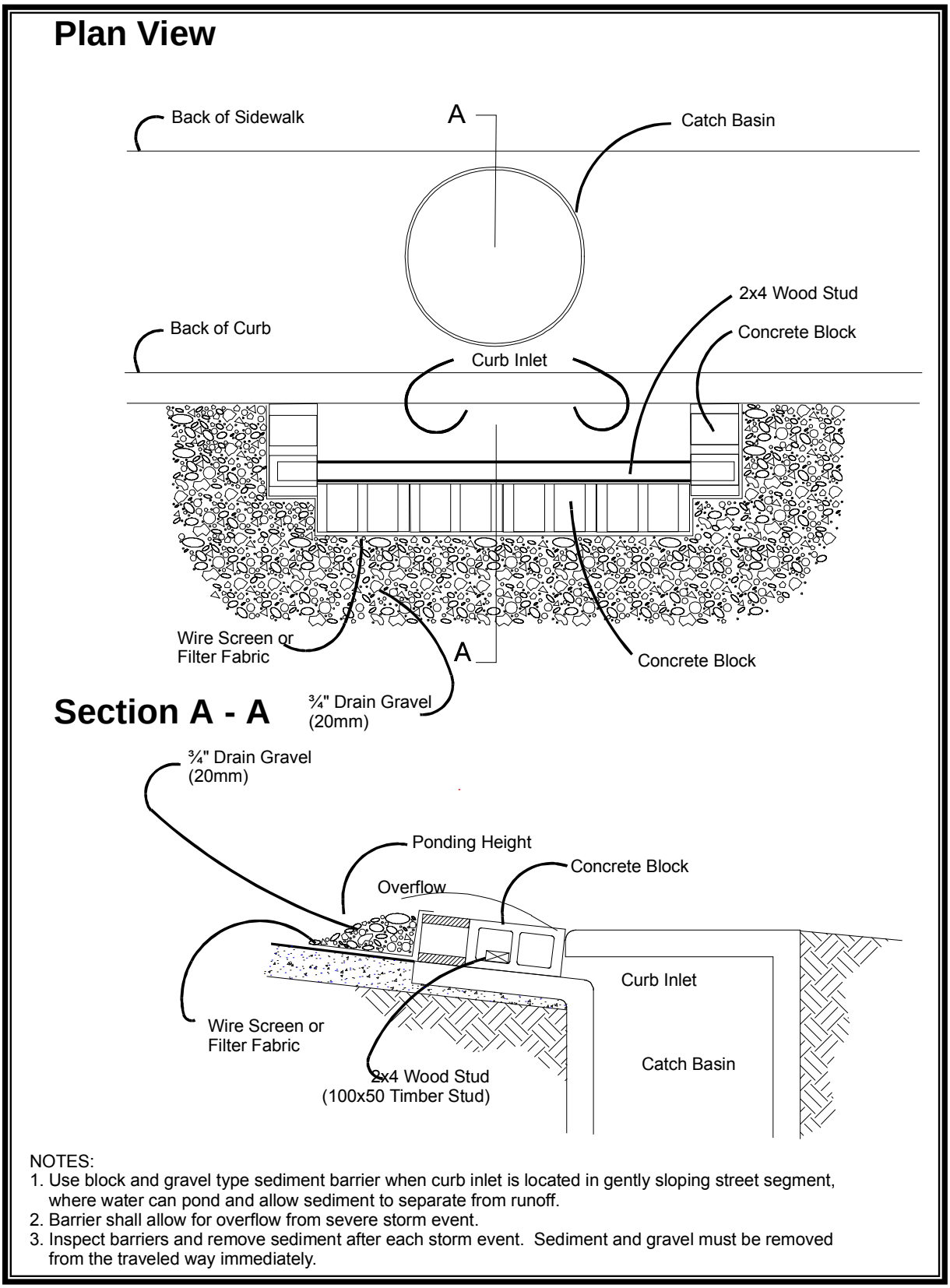
Ecology has approved specific products as able to meet the requirements of BMP C220. However, the products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. The list of products is available on Ecology's web site at <www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html>.

If a project wishes to use any of the "approved as equivalent" BMPs in the City of Lacey, the project owner or representative must obtain approval for use of the BMP from the city on a case-by-case basis (i.e., for each project or site) before use.



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

Figure 5.16. Block and Gravel Filter



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

Figure 5.17. Block and Gravel Curb Inlet Protection.

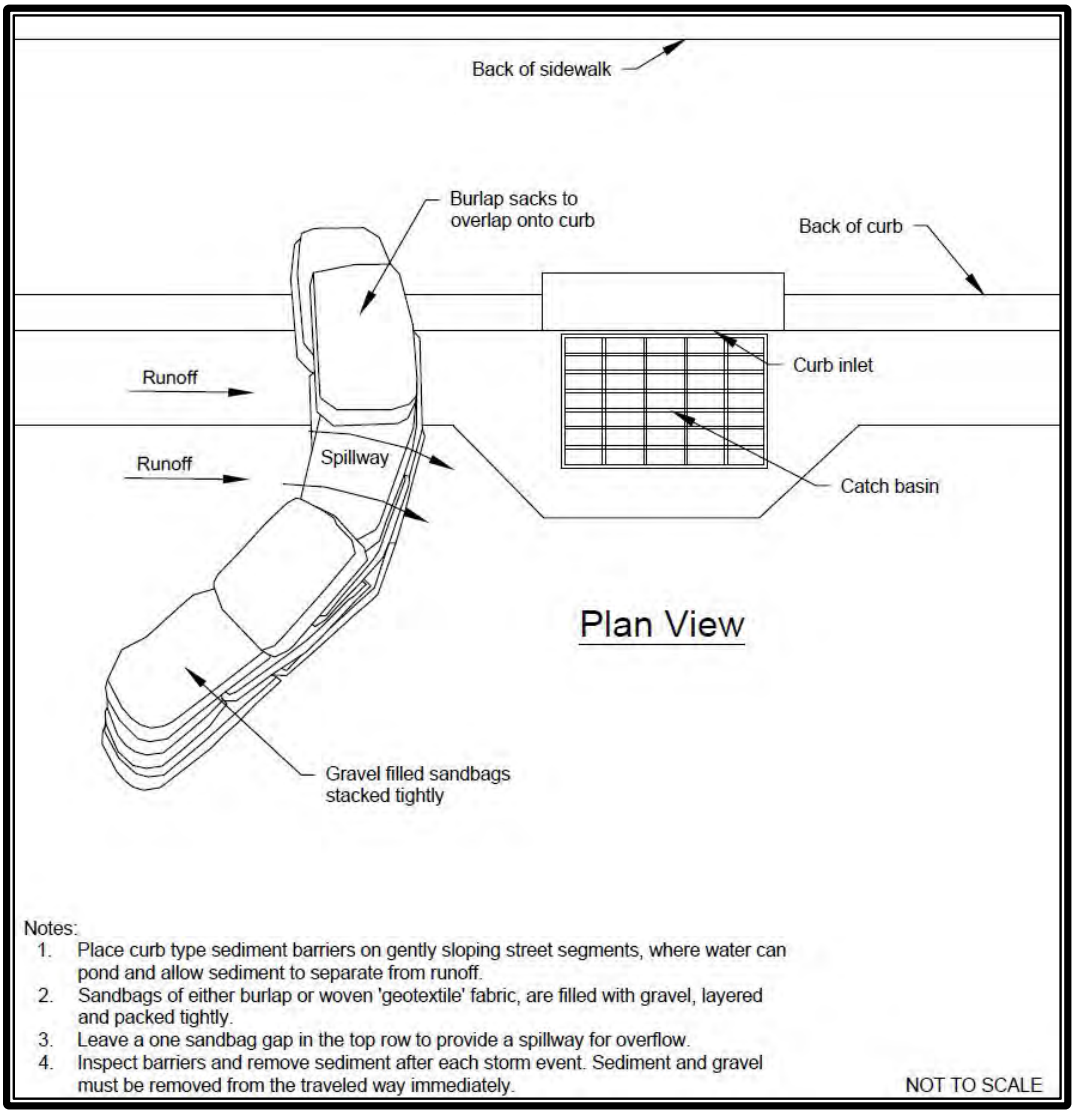


Figure 5.18. Curb and Gutter Barrier.

BMP C202: Channel Lining

Purpose

To protect channels by providing a channel liner using either blankets or riprap.

Conditions of Use

When natural soils or vegetated stabilized soils in a channel are not adequate to prevent channel erosion.

- When a permanent ditch or pipe system is to be installed and a temporary measure is needed.

- In almost all cases, synthetic and organic coconut blankets are more effective than riprap for protecting channels from erosion. Blankets can be used with and without vegetation. Blanketed channels can be designed to handle any expected flow and longevity requirement. Some synthetic blankets have a predicted life span of 50 years or more, even in sunlight.

- Other reasons why blankets are better than rock include the availability of blankets over rock. In many areas of the state, rock is not easily obtainable or is very expensive to haul to a site. Blankets can be delivered anywhere. Rock requires the use of dump trucks to haul and heavy equipment to place. Blankets usually only require laborers with hand tools, and sometimes a backhoe.

- The Federal Highway Administration recommends not using flexible liners whenever the slope exceeds 10 percent or the shear stress exceeds 8 pounds/square foot.

Design and Installation Specifications

- See BMP C122 for information on blankets.

- Since riprap is used where erosion potential is high, construction must be sequenced so that the riprap is put in place with the minimum possible delay.

- Disturbance of areas where riprap is to be placed should be undertaken only when final preparation and placement of the riprap can follow immediately behind the initial disturbance. Where riprap is used for outlet protection, the riprap should be placed before or in conjunction with the construction of the pipe or channel so that it is in place when the pipe or channel begins to operate.

- The designer, after determining the riprap size that will be stable under the flow conditions, shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size. The possibility of drainage structure damage by

children shall be considered in selecting a riprap size, especially if there is nearby water or a gully in which to toss the stones.

- Stone for riprap shall consist of field stone or quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all respects for the purpose intended.

- A lining of engineering filter fabric (geotextile) shall be placed between the riprap and the underlying soil surface to prevent soil movement into or through the riprap. The geotextile must be keyed in at the top of the bank.

- Filter fabric shall not be used on slopes greater than 1.5H:1V as slippage may occur. It should be used in conjunction with a layer of coarse aggregate (granular filter blanket) when the riprap to be placed is 12 inches and larger.

BMP C209: Outlet Protection

Purpose

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

Conditions of Use

Outlet protection is required at the outlets of all ponds, pipes, ditches, or other conveyances, and where runoff is conveyed to a natural or artificial drainage feature such as a stream, wetland, lake, or ditch.

Design and Installation Specifications

- The receiving channel at the outlet of a culvert shall be protected from erosion by rock lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1 foot above the maximum tailwater elevation or 1 foot above the crown, whichever is higher. For large pipes (more than 18 inches in diameter), the outlet protection lining of the channel is lengthened to four times the diameter of the culvert.

- Standard wingwalls, and tapered outlets and paved channels should also be considered when appropriate for permanent culvert outlet protection. (See WSDOT Hydraulics Manual, available through WSDOT Engineering Publications <www.wsdot.wa.gov/Publications/Manuals/index.htm>.)

- Organic or synthetic erosion blankets, with or without vegetation, are usually more effective than rock, cheaper, and easier to install. Materials can be chosen using manufacturer product specifications. ASTM test results are available for most products and the designer can choose the correct material for the expected flow.

- With low flows, vegetation (including sod) can be effective.

- The following shall be used for riprap outlet protection:

    - If the discharge velocity at the outlet is less than 5 feet per second (pipe slope typically less than 10 percent), use 2-inch to 8-inch riprap. Minimum thickness is 1 foot.

    - For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), an engineered energy dissipater shall be used.

- Filter fabric or erosion control blankets shall be used under riprap to prevent scour and channel erosion.

- New pipe outfalls can provide an opportunity for low-cost fish habitat improvements. For example, an alcove of low-velocity water can be created by constructing the pipe outfall and associated energy dissipater back from the stream edge and digging a channel, over-widened to the upstream side, from the outfall. Overwintering juvenile and migrating adult salmonids may use the alcove as shelter during high flows. Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. This work may require a hydraulic project approval (HPA). See Chapter 6, Section 6.3.5, for more information on outfall system design.

Maintenance Standards

- Inspect and repair as needed.
- Add rock as needed to maintain the intended function.
- Clean energy dissipater if sediment builds up.

BMP C151: Concrete Handling

Purpose

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

Conditions of Use

Any time concrete is used, utilize these management practices. Concrete construction projects include, but are not limited to, the following:

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

Design and Installation Specifications

Ensure that washout of concrete trucks, chutes, pumps, and internals is performed at an approved off-site location or in designated concrete washout areas, in accordance with BMP C154. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams.

Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete on site, except in designated concrete washout areas.

- Wash off hand tools including, but not limited to, screeds, shovels, rakes, floats, and trowels into formed areas only.
- Wash equipment difficult to move, such as concrete pavers in areas that do not directly drain to natural or constructed stormwater conveyances.
- Do not allow washdown from areas, such as concrete aggregate driveways, to drain directly to natural or constructed stormwater conveyances.

- Contain washwater and leftover product in a lined container when no formed areas are available. Dispose of contained concrete in a manner that does not violate groundwater or surface water quality standards.

- Always use forms or solid barriers for concrete pours, such as pilings, within 15 feet of surface waters.

- Refer to BMPs C252 and C253 for pH adjustment requirements.

- Refer to the CSWGP for pH monitoring requirements if the project involves one of the following activities:

    - Significant concrete work (greater than 1,000 cubic yards poured concrete or recycled concrete used over the life of a project)

    - The use of engineered soils amended with (but not limited to) Portland cement-treated base, cement kiln dust or fly ash.

- Discharging stormwater to segments of water bodies on the 303(d) list (Category 5) for high pH.

Maintenance Standards

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

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose

Sawcutting 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 surface waters of the State is prohibited. Use this BMP to minimize and eliminate process water and slurry from entering waters of the State.

Conditions of Use

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

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

Design and Installation Specifications

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance including stormwater systems. This may require temporarily blocking catch basins.
- Dispose of collected slurry and cuttings in a manner that does not violate groundwater 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 process water in a manner that does not violate groundwater or surface water quality standards.

- Handle and dispose cleaning waste material and demolition debris in a manner that does not cause contamination of water. 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 vacuum trucks.

BMP C153: Material Delivery, Storage, and Containment

Purpose

Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on site, store materials in a designated area, and install secondary containment.

Conditions of Use

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

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

Design and Installation Specifications

The following steps should be taken to minimize risk:

- Temporary storage area should be located away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Material Safety Data Sheets (MSDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers.
- Hazardous material storage on site should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the wet weather season (October 1 to April 30), consider storing materials in a covered area.
- Materials should be stored in secondary containments, such as earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, in secondary containment.

- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.

Material Storage Areas and Secondary Containment Practices:

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain 10 percent of the total enclosed container volume of all containers, or 110 percent of the capacity of the largest container within its boundary, whichever is greater.
- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (October 1 to April 30), each secondary containment facility shall be covered during non-working days, prior to and during rain events.
- Keep material storage areas clean, organized and equipped with an ample supply of appropriate spill cleanup material (spill kit).
- The spill kit shall include, at a minimum:
    - 1 water resistant nylon bag
    - 3 oil absorbent socks 3 inches by 4 feet
    - 2 oil absorbent socks 3 inches by 10 feet
    - 12 oil absorbent pads 17 inches by 19 inches
    - 1 pair splash resistant goggles
    - 3 pair nitrile gloves
    - 10 disposable bags with ties
    - Instructions

BMP C154: Concrete Washout Area

Purpose

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

Conditions of Use

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

- Concrete is used as a construction material.
- It is not possible to dispose of all concrete wastewater and washout off site (ready mix plant, etc.).
- Concrete trucks, pumpers, or other concrete coated equipment are washed on site.
- Note: If fewer than 10 concrete trucks or pumpers need to be washed out on site, the washwater may be disposed of in a formed area awaiting concrete or an upland disposal site where it will not contaminate surface or groundwater. The upland disposal site shall be at least 50 feet from sensitive areas such as storm drains, open ditches, or water bodies, including wetlands.

Design and Installation Specifications

Implementation:

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

- Perform washout of concrete trucks at an approved off-site location or in designated concrete washout areas only.
- Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams.
- Do not allow excess concrete to be dumped on site, except in designated concrete washout areas.
- 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.

Education:

- Discuss the concrete management techniques described in this BMP with the ready-mix concrete supplier before any deliveries are made.

- Educate employees and subcontractors on the concrete waste management techniques described in this BMP.

- Arrange for contractor's superintendent or CESCL to oversee and enforce concrete waste management procedures.

- A sign should be installed adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.

Contracts:

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

Location and Placement:

- Locate washout area at least 50 feet from sensitive areas such as storm drains, open ditches, or water bodies, including wetlands.

- Allow convenient access for concrete trucks, preferably near the area where the concrete is being poured.

- If trucks need to leave a paved area to access washout, prevent track-out with a pad of rock or quarry spalls (see BMP C105). These areas should be far enough away from other construction traffic to reduce the likelihood of accidental damage and spills.

- The number of facilities you install will depend on the expected demand for storage capacity.

- On large sites with extensive concrete work, washouts must be placed in multiple locations for ease of use by concrete truck drivers.

On-site Temporary Concrete Washout Facility, Transit Truck Washout Procedures:

- Temporary concrete washout facilities shall be located a minimum of 50 feet from sensitive areas including storm drain inlets, open drainage facilities, and water courses. See Figures 5.7 and 5.8.

- Concrete washout facilities shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

- Washout of concrete trucks shall be performed in designated areas only.

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

- Once concrete wastes are washed into the designated 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.

- Temporary Above-Grade Concrete Washout Facility:

    - Temporary concrete washout facility (type above grade) shall be constructed as shown on the details below, with a recommended minimum length and minimum width of 10 feet, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.

    - Plastic lining material shall be a minimum of 10 mil polyethylene sheeting and must be free of holes, tears, or other defects that compromise the impermeability of the material.

- Temporary Below-Grade Concrete Washout Facility:

    - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details below, with a recommended minimum length and minimum width of 10 feet. The quantity and volume must be sufficient to contain all liquid and concrete waste generated by washout operations.

    - Lath and flagging shall be commercial type.

    - Plastic lining material shall be a minimum of 10 mil polyethylene sheeting and must be free of holes, tears, or other defects that compromise the impermeability of the material.

    - 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 BMPs are in place prior to the commencement of concrete work.
- During periods of concrete work, inspect daily to verify continued performance.
  - Check overall condition and performance
  - Check remaining capacity (percent full)
  - If using self-installed washout facilities, verify plastic liners are intact and sidewalls are not damaged
  - If using prefabricated containers, check for leaks.
- Washout facilities shall be maintained to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75 percent full.
- If the washout 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 use sanitary sewer without a permit that must be obtained either from the City of Lacey Wastewater Utility Department at (360) 491-5600, or the LOTT Clean Water Alliance at (360) 664-2333. The city manages the collection and conveyance of wastewater to the LOTT Clean Water Alliance Wastewater Treatment Plant. Note that a permit may need to be obtained by either or both entity(ies) depending on the nature of the discharge.
  - Place a secure, non-collapsing, non-water collecting cover over the concrete washout facility prior to predicted wet weather to prevent accumulation and overflow of precipitation.
  - Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused on site or hauled away for disposal or recycling.
- When you remove materials from the self-installed concrete washout, 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 Temporary Concrete Washout Facilities:

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

- Materials used to construct temporary concrete washout facilities 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 temporary concrete washout facilities shall be backfilled, repaired, and stabilized to prevent erosion.

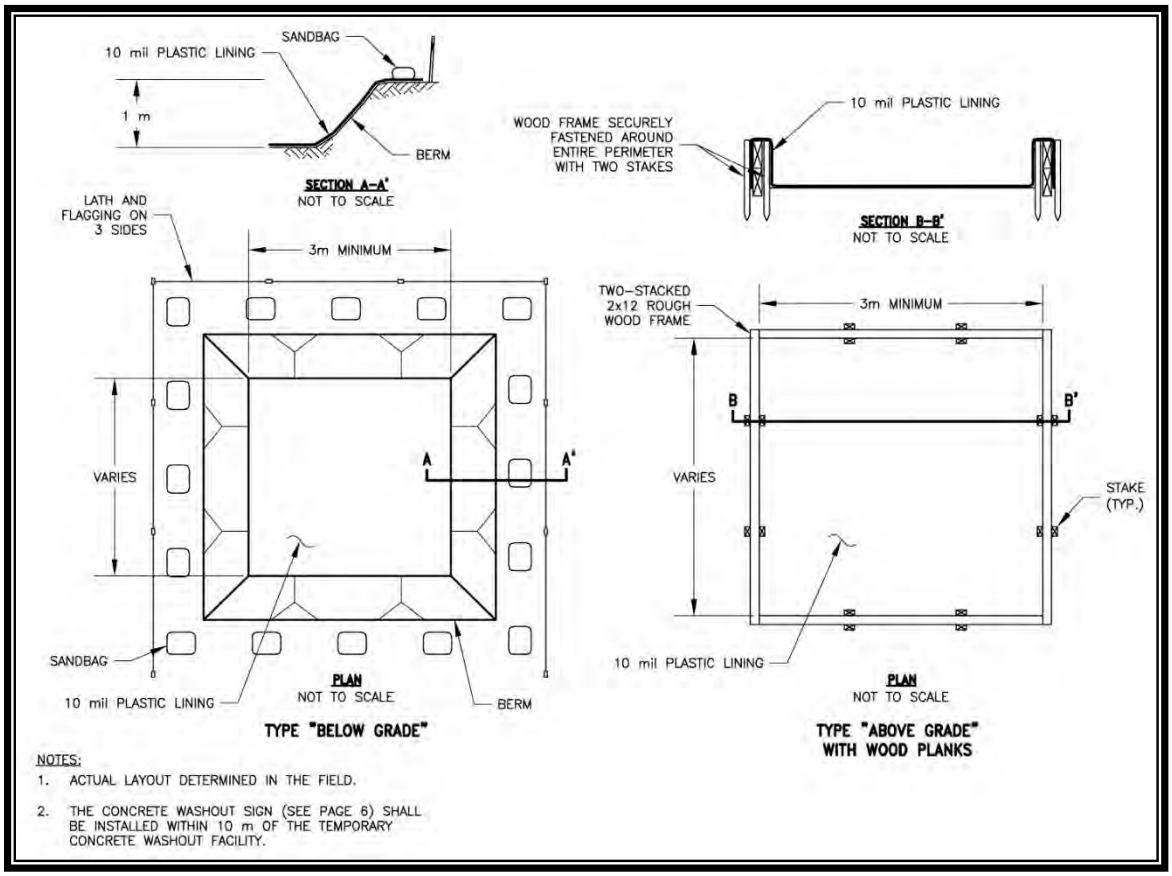


Figure 5.7a. Concrete Washout Area.

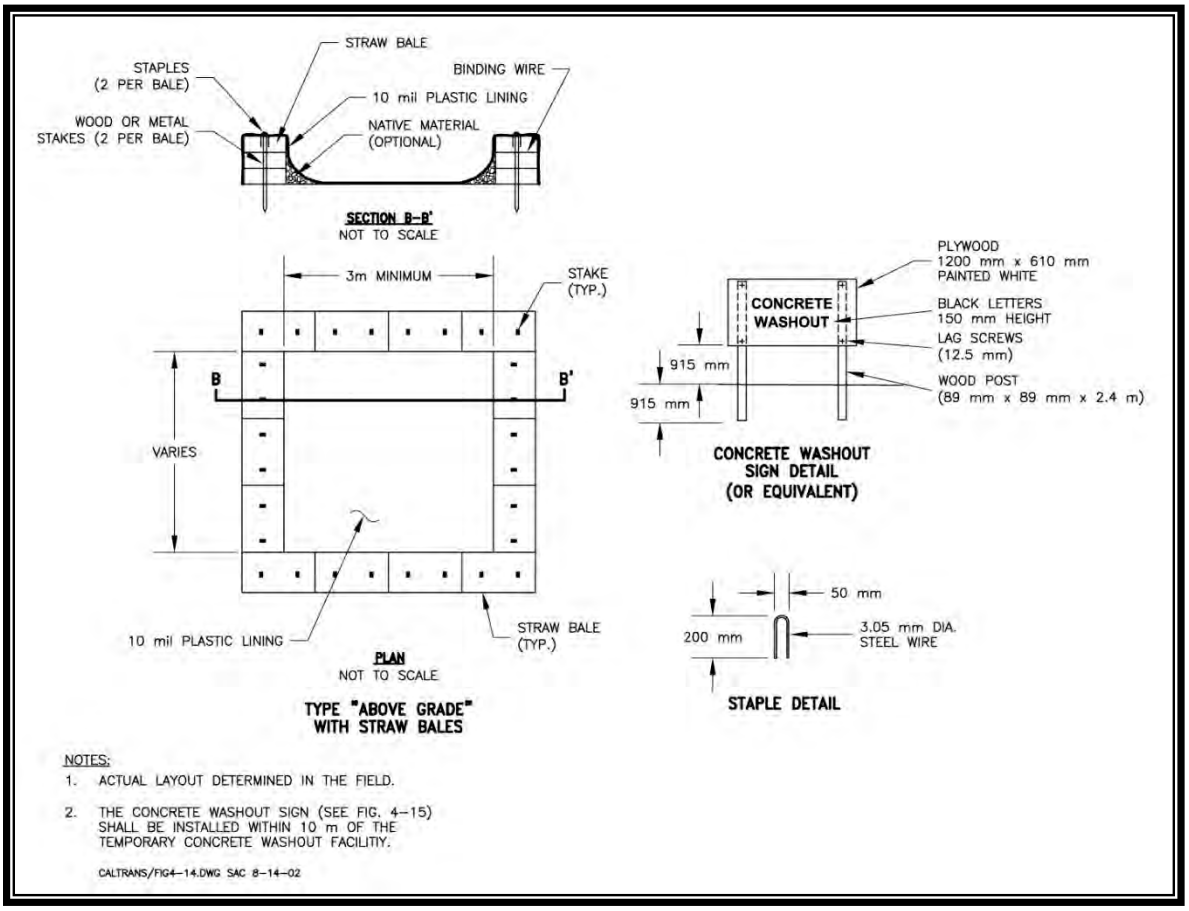


Figure 5.7b. Concrete Washout Area.

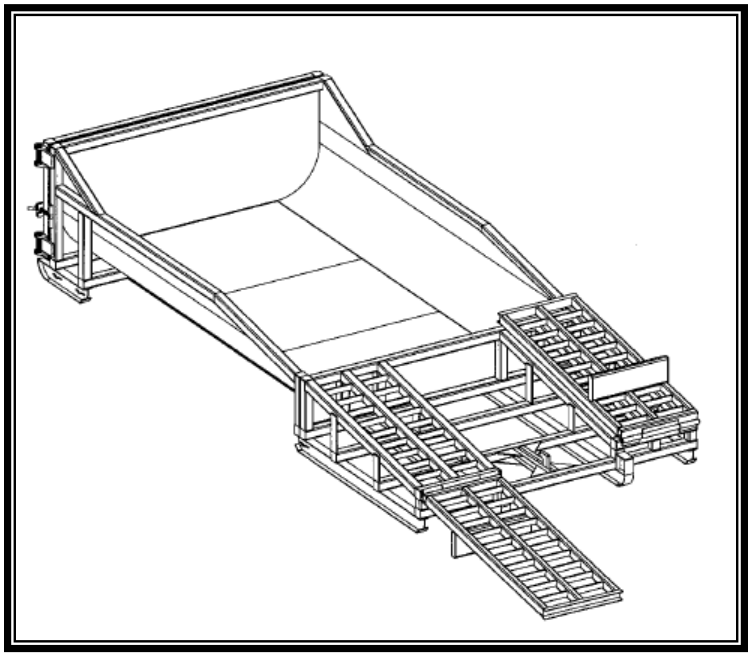


Figure 5.8. Prefabricated Concrete Washout Container with Ramp.

BMP C160: Certified Erosion and Sediment Control Lead

Purpose

The project applicant designates at least one person as the responsible representative in charge of erosion and sediment control, and water quality protection. The designated person shall be the CESCL who is responsible for ensuring compliance with all local, state, and federal Construction SWPPP and water quality requirements.

Conditions of Use

A CESCL shall be made available on projects required to prepare a Construction SWPPP and that discharge stormwater to surface waters of the State.

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum training and certification requirements established by Ecology (see details below)

- Ecology will maintain a list of erosion and sediment control training and certification providers at: <www.ecy.wa.gov/programs/wq/stormwater/cescl.html>

OR

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

Specifications

Certification shall remain valid for 3 years.

- The CESCL shall have authority to act on behalf of the contractor or developer and shall be available, or on call, 24 hours per day throughout the period of construction.

- The Construction SWPPP shall include the name, telephone number, email address, fax number, and address of the designated CESCL.

- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region.

Duties and responsibilities of the CESCL shall include, but are not limited to the following:

- Maintaining permit file on site at all times which includes the Construction SWPPP and any associated permits and plans.

- Directing BMP installation, inspection, maintenance, modification, and removal.
- Updating all project drawings and the Construction SWPPP with changes made.
- Completing any sampling requirements including reporting results using WebDMR.
- Keeping daily logs, and inspection reports. Inspection reports must include:
    - Inspection date/time.
    - Weather information; general conditions during inspection and approximate amount of precipitation since the last inspection.
    - A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:
        - Locations of BMPs inspected
        - Locations of BMPs that need maintenance
        - Locations of BMPs that failed to operate as designed or intended
        - Locations of where additional or different BMPs are required
    - Visual monitoring results, including a description of discharged stormwater. The presence of suspended sediment, turbid water, discoloration, and oil sheen shall be noted, as applicable.
    - Any water quality monitoring performed during inspection.
    - General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.
- Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.

BMP C200: Interceptor Dike and Swale

Purpose

Provide a ridge of compacted soil, or a ridge with an upslope swale, at the top or base of a disturbed slope or along the perimeter of a disturbed construction area to convey stormwater. Use the dike and/or swale to intercept the runoff from unprotected areas and direct it to areas where erosion can be controlled. This can prevent storm runoff from entering the work area or sediment-laden runoff from leaving the construction site.

Conditions of Use

Where the runoff from an exposed site or disturbed slope must be conveyed to an erosion control facility which can safely contain the stormwater:

- Locate upslope of a construction site to prevent runoff from entering disturbed area
- When placed horizontally across a disturbed slope, it reduces the amount and velocity of runoff flowing down the slope
- Locate downslope to collect runoff from a disturbed area and direct water to a sediment basin.

Design and Installation Specifications

- Dike and/or swale and channel must be stabilized with temporary or permanent vegetation or other channel protection during construction.
- Channel requires a positive grade for drainage; steeper grades require channel protection and check dams.
- Review construction for areas where overtopping may occur.
- Can be used at top of new fill before vegetation is established.
- May be used as a permanent diversion channel to carry the runoff.
- Subbasin tributary area shall be 1 acre or less.
- Design capacity for the peak flow from a 10-year, 24-hour storm event assuming a NRCS Type 1A rainfall distribution resolved to 10-minute time steps, for temporary facilities. Alternatively, use 1.6 times the 10-year, 1-hour time step flow indicated by an approved continuous runoff model. If a 15-minute (or less) time step is used, no correction factor is required. For conveyance systems that will also serve on a permanent basis see design standards in Chapter 6.

- **Interceptor dikes** shall meet the following criteria:
  - Top Width: 2 feet minimum.
  - Height: 1.5 feet minimum on berm.
  - Side Slope: 2H:1V or flatter.
  - Grade: Depends on topography; however, dike system minimum is 0.5 percent, maximum is 1 percent
  - Compaction: Minimum of 90 percent ASTM D698 standard proctor.
  - Horizontal Spacing of Interceptor Dikes:

Average Slope	Slope Percent	Flowpath Length
>20H:1V or flatter	3% to <5%	300 feet
(>10 to 20)H:1V	5% to <10%	200 feet
(>4 to 10)H:1V	10% to <25%	100 feet
(2 to 4)H:1V	25% to 50%	50 feet

  - Stabilization depends on velocity and reach:
    - Slopes *less than* 5 *percent*: Seed and mulch applied within 5 days of dike construction (see *BMP C121, Mulching*).
    - Slopes 5 *to* 40 *percent*: Dependent on runoff velocities and dike materials. Stabilization must be done immediately using either sod or riprap or other measures to avoid erosion.
  - The upslope side of the dike shall provide positive drainage to the dike outlet. No erosion shall occur at the outlet. Provide energy dissipation measures as necessary. Sediment-laden runoff must be released through a sediment trapping facility.
  - Minimize construction traffic over temporary dikes. Use temporary cross culverts for channel crossing.
- **Interceptor swales** shall meet the following criteria:
  - Bottom Width: 2-foot minimum; the cross-section bottom shall be level.
  - Depth: 1-foot minimum.
  - Side Slope: 2H:1V or flatter.

- Grade: Maximum 5 percent, with positive drainage to a suitable outlet (such as a sediment pond).
- Stabilization: Seed as per *BMP C120, Temporary and Permanent Seeding,* or *BMP C202, Channel Lining*, 12 inches thick of riprap pressed into the bank and extending at least 8 inches vertical from the bottom.

- Inspect diversion dikes and interceptor swales once a week and after every rainfall. Immediately remove sediment from the flow area.
- Damage caused by construction traffic or other activity must be repaired before the end of each working day.
- Check outlets and make timely repairs as needed to avoid gully formation. When the area below the temporary diversion dike is permanently stabilized, remove the dike and fill and stabilize the channel to blend with the natural surface.

BMP C201: Grass-Lined Channels

Purpose

To provide a channel with a vegetative lining for conveyance of runoff. See Figure 5.9 for typical grass-lined channels.

Conditions of Use

This practice applies to construction sites where concentrated runoff needs to be contained to prevent erosion or flooding.

- When a vegetative lining can provide sufficient stability for the channel cross-section and at lower velocities of water (normally dependent on grade). This means that the channel slopes are generally less than 5 percent and space is available for a relatively large cross-section.

- Typical uses include roadside ditches, channels at property boundaries, outlets for diversions, and other channels and drainage ditches in low areas.

- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a bonded fiber matrix (BFM). The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod must be installed in the bottom of the ditch in lieu of hydromulch and blankets.

Design and Installation Specifications

- Locate the channel where it can conform to the topography and other features such as roads.

- Locate them to use natural drainage systems to the greatest extent possible.

- Avoid sharp changes in alignment or bends and changes in grade.

- Do not reshape the landscape to fit the drainage channel.

- The maximum design velocity shall be based on soil conditions, type of vegetation, and method of revegetation, but at no times shall velocity exceed 5 feet/second. The channel shall not be overtopped by the peak runoff from a 10-year, 24-hour storm event assuming a NRCS Type 1A rainfall distribution resolved to 10-minute time steps. Alternatively, use 1.6 times the 10-year, 1-hour time step flow indicated by an approved continuous runoff model to determine a flow rate which the channel must contain. If a 15-minute (or less) time step is used, no correction factor is required.

- Where the grass-lined channel will also function as a permanent stormwater conveyance facility, the channel must meet the drainage conveyance requirements defined in Chapter 6.

- An established grass or vegetated lining is required before the channel can be used to convey stormwater, unless stabilized with nets or blankets.

- If design velocity of a channel to be vegetated by seeding exceeds 2 feet/second, a temporary channel liner is required. Geotextile or special mulch protection such as straw or netting provides stability until the vegetation is fully established. See Figure 5.10.

- Check dams shall be removed once the grass roots and aboveground biomass have grown enough to stabilize soils and sufficiently protect the swale bottom and side slopes from erosion. Check dams will remain when swale slopes are greater than 4 percent for long term erosion protection. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

- If vegetation is established by sodding, the permissible velocity for established vegetation may be used and no temporary liner is needed.

- Do not subject grass-lined channel to sedimentation from disturbed areas. Use sediment-trapping BMPs upstream of the channel.

- **V-shaped grass channels** generally apply where the quantity of water is small, such as in short reaches along roadsides. The V-shaped cross-section is least desirable because it is difficult to stabilize the bottom where velocities may be high.

- **Trapezoidal grass channels** are used where runoff volumes are large and slope is low so that velocities are nonerosive to vegetated linings. (Note: it is difficult to construct small parabolic shaped channels.)

- Subsurface drainage, or riprap channel bottoms, may be necessary on sites that are subject to prolonged wet conditions due to long duration flows or a high water table.

- Provide outlet protection at culvert ends and at channel intersections.

- Grass channels, at a minimum, must carry peak runoff for temporary construction drainage facilities from the 10-year, 24-hour storm without eroding. Where flood hazard exists, increase the capacity according to the potential damage.

- Grassed channel side slopes generally are constructed 3H:1V or flatter to aid in the establishment of vegetation and for maintenance.

- Construct channels a minimum of 0.2 foot larger around the periphery to allow for soil bulking during seedbed preparations and sod buildup.

Maintenance Standards

- During the establishment period, check grass-lined channels after every rainfall.
- After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs.
- It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.
- Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.

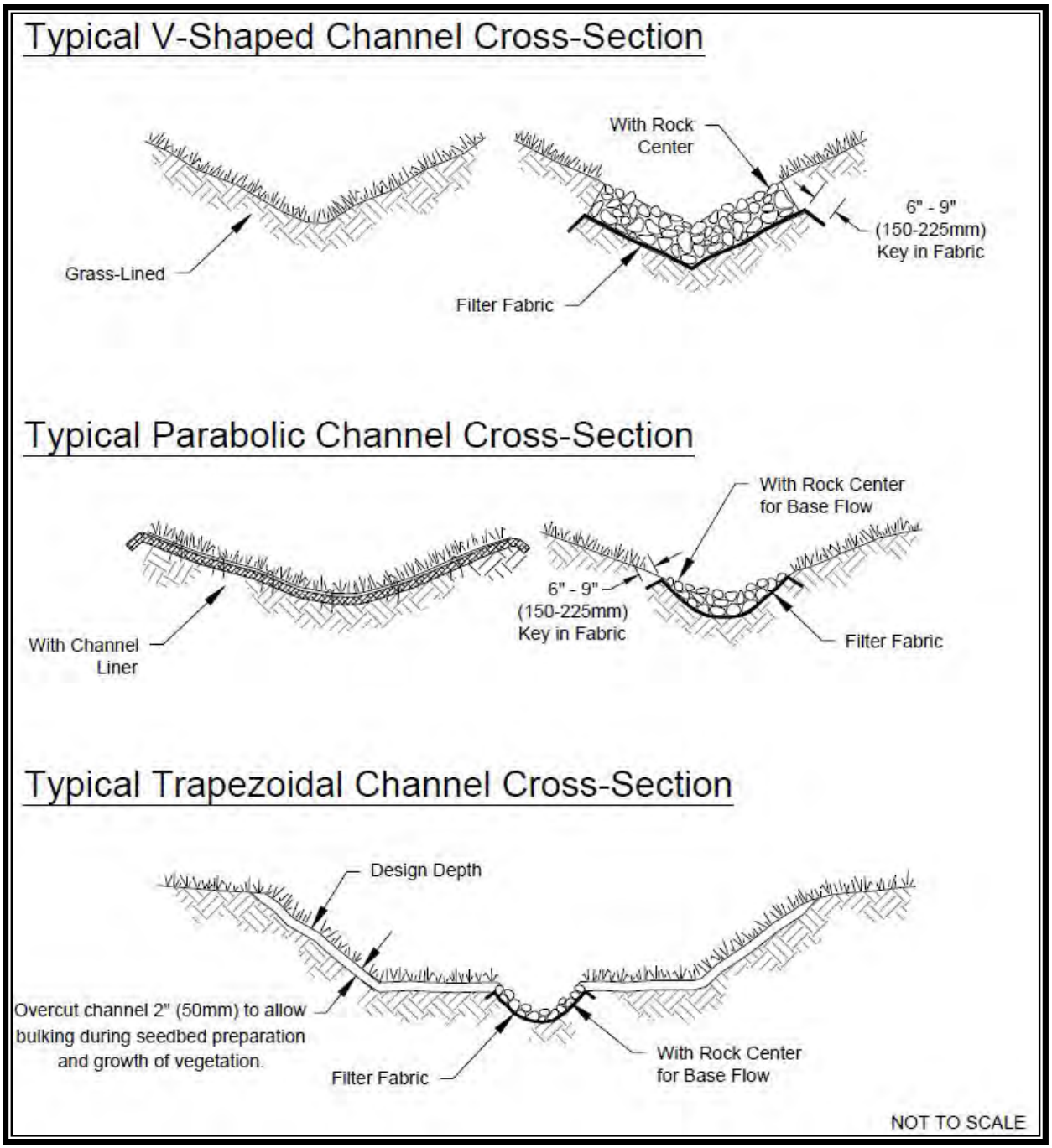


Figure 5.9. Typical Grass-Lined Channels.

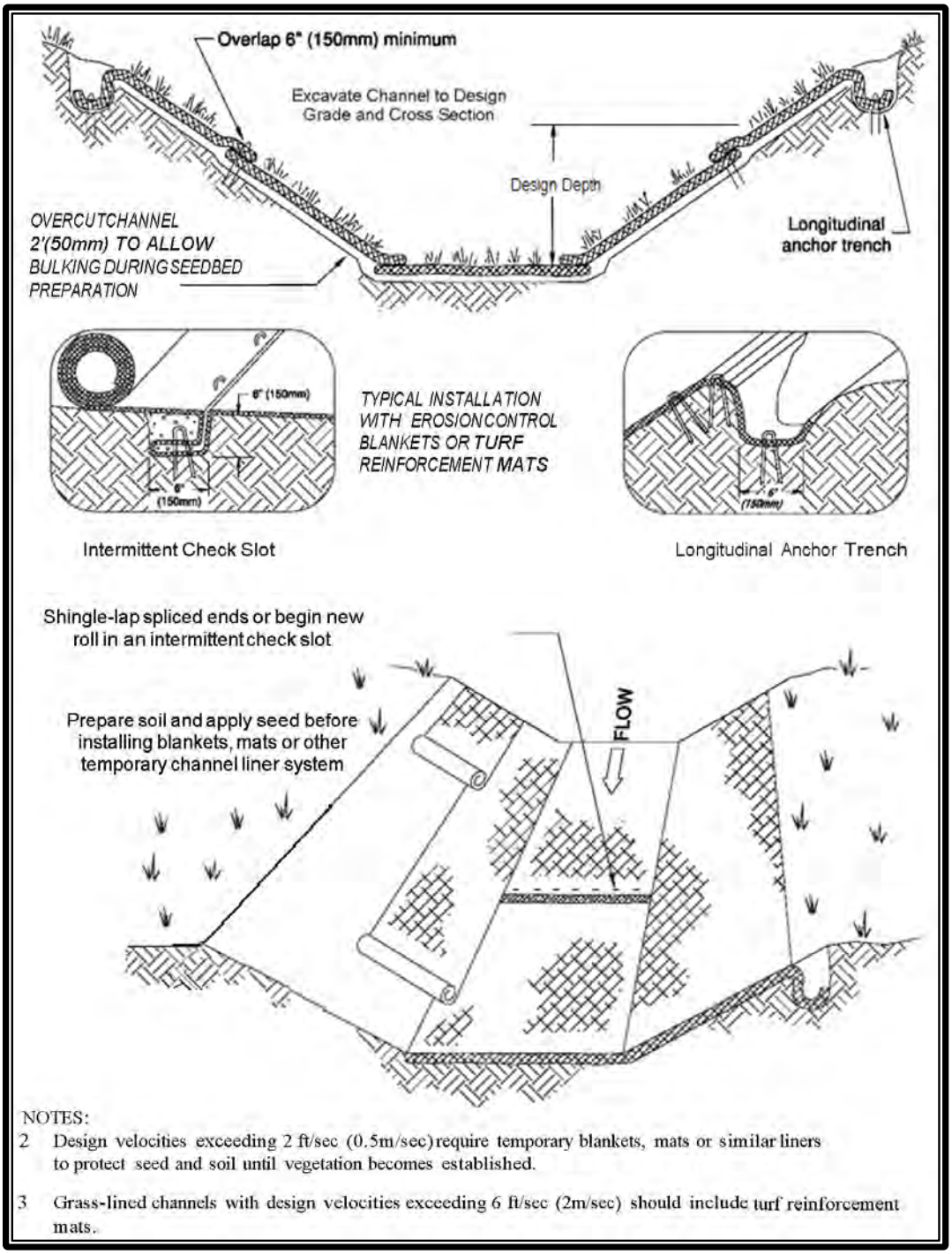


Figure 5.10. Temporary Channel Liners.

BMP C208: Triangular Silt Dike (TSD) (Geotextile-Encased Check Dam)

Purpose

Triangular silt dikes may be used as check dams, for perimeter protection, for temporary soil stockpile protection, for drop inlet protection, or as a temporary interceptor dike.

Conditions of Use

- May be used on soil or pavement with adhesive or staples
- TSDs have been used to build temporary:
  - Sediment ponds
  - Diversion ditches
  - Concrete washout facilities
  - Curbing
  - Water bars
  - Level spreaders
  - Berms.

Design and Installation Specifications

- Made of urethane foam sewn into a woven geosynthetic fabric.
- It is triangular, 10 inches to 14 inches high in the center, with a 20-inch to 28-inch base. A 2–foot apron extends beyond both sides of the triangle along its standard section of 7 feet. A sleeve at one end allows attachment of additional sections as needed.
- Install with ends curved up to prevent water from flowing around the ends.
- The fabric flaps and check dam units are attached to the ground with wire staples. Wire staples should be No. 11 gauge wire and should be 200 millimeters to 300 millimeters in length.
- When multiple units are installed, the sleeve of fabric at the end of the unit shall overlap the abutting unit and be stapled.
- Check dams should be located and installed as soon as construction will allow.
- Check dams should be placed perpendicular to the flow of water.

- When used as check dams, the leading edge must be secured with rocks, sandbags, or a small key slot and staples.

- In the case of grass-lined ditches and swales, check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

Maintenance Standards

- Triangular silt dams shall be inspected for performance and sediment accumulation during and after each runoff producing rainfall. Sediment shall be removed when it reaches one-half the height of the dam.

- Anticipate submergence and deposition above the triangular silt dam and erosion from high flows around the edges of the dam. Immediately repair any damage or any undercutting of the dam.

APPENDIX C
SITE INSPECTION FORMS (AND SITE LOG)

Stormwater/Erosion Control Inspection Form								
DATE:			TIME:			CONTACT:		
SITE:						ACRES:		
LOCATION:								
WEATHER:								
PERMIT ON SITE			PERMIT NO.					
SWPPP ON SITE			CONTRACTOR:					
Best Management Practices in the SWPPP:								
Control BMPs	In Plan	Properly installed	Treatment BMPs	In Plan		Properly Installed		Other:
Preserv Nat Veg			Intercept Dike/Swale					
Buffer Zones			Grass Lines Swales					
High Vis Fence			Channel Lining					
Stake & Wire Fence			Water bars					
Stabilized Entrance			Pipe Slope Drains					
Wheel Wash			Subsurface Drains					
Road/Pk Area Stable			Level Spreader					
Temp/Perm Seeding			Check Dams					
Mulching			Triangular Silt Dike					
Nets/Blankets			Outlet Protection					
Plastic Covering			Sto Drain Inlet Protec					
Sodding			Straw Bale Barrier					
Topsoiling			Brush Barrier					
Polyacrylamides			Gravel Filter Berm					
Surface roughing			Silt Fence					
Gradient Terraces			Vegetated Strip					
Dust Control			Straw Wattles					
Materials On Hand			Sediment trap					
Concrete Handling			Temp Sed Pond					
Sawcut & Surface			SW Chem Treatment					
Erosion Control Lead			SW Filtration					
Pay Erosion Work			Is the site stabilized?		Partially			
Scheduling			Turbid Water is being discharged?					
Small Project			Receiving Water:					
Water Quality Samples Taken?			Results:	pH	TUR	CON	TEM	Other:
Sample ID:			LOC:					
Sample ID:			LOC:					
Sample ID:			LOC:					
This site is IN/OUT of compliance with the terms of the SWPPP & Permit.								
Summary of remedial action(if needed):								
I certify under penalty of law that this report is true, accurate and complete, to the best of my knowledge and belief.								
Name:			Title:					
Signature:								

DRAINAGE CONTROL PLAN
ATTACHMENT 3
SOILS REPORT

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Thurston County Area, Washington

June 22, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,340 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 45 90 180 270

Feet
0 150 300 600 900

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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: Thurston County Area, Washington
Survey Area Data: Version 15, 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: Jul 18, 2020—Jul 30, 2020

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
110	Spanaway gravelly sandy loam, 0 to 3 percent slopes	14.5	100.0%
Totals for Area of Interest		**14.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Thurston County Area, Washington

110—Spanaway gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2ndb6
Elevation: 330 to 1,310 feet
Mean annual precipitation: 35 to 65 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Spanaway and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Spanaway

Setting

Landform: Terraces, outwash plains
Parent material: Volcanic ash over gravelly outwash

Typical profile

H1 - 0 to 15 inches: gravelly sandy loam
H2 - 15 to 20 inches: very gravelly loam
H3 - 20 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: R002XA006WA - Puget Lowlands Prairie
Forage suitability group: Droughty Soils (G002XS401WA)
Other vegetative classification: Droughty Soils (G002XS401WA)
Hydric soil rating: No

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DRAINAGE CONTROL PLAN
ATTACHMENT 4
MAINTENANCE AND SOURCE CONTROL MANUAL
(NOT INCLUDED, ATTACHED SEPERATELY)

DRAINAGE CONTROL PLAN
ATTACHMENT 5
ESTABLISHMENT OF MAINTENANCE COVENANT
NOT INCLUDED AT THIS TIME

APPENDIX 1
DESIGN CALCULATIONS

Infiltration Trench Design Using Table 7.5 of SDM

Ksat = 1.98 to 5.95 in/hr per NRCS soils report
Soil Type = A

Roof Area = 3670 SF

Use Ksat = 4 in/hr
Use trench gravel thickness = 4 ft

Area of trench bottom per 100SF of roof factor = 71

Minimum bottom area of trench = 3670 SF / 71 = 261 SF

Table 7.5. Sizing Table for Downspout Infiltration Trenches and Drywells.

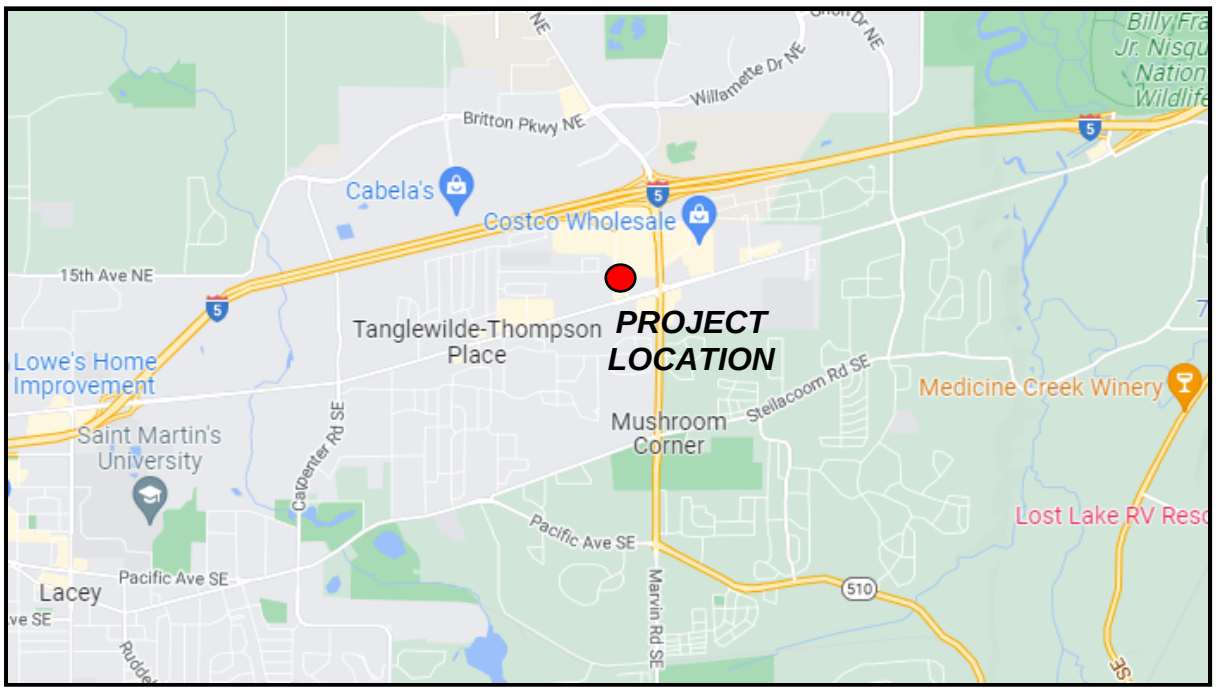
Trench Gravel Thickness (ft)	Square Feet of Trench Bottom per 1,000 Square Feet of Roof Area for Various Soil Types				
	Type A Soils, 60 in/hr	Type A Soils, 12 in/hr	Type A Soils, 4 in/hr	Type B Soils, 2 in/hr	Type C Soils, 1 in/hr
2.0	24	58	101	144	206
2.5	21	52	90	129	184
3.0	19	46	80	114	163
3.5	18	43	75	107	153
4.0	17	41	71	102	146
4.5	16	38	66	94	134
5.0	15	36	63	90	129

APPENDIX 2

SOIL MANAGEMENT PLAN (NOT REQUIRED)

APPENDIX 3

SUPPLEMENTAL REPORTS AND INFORMATION



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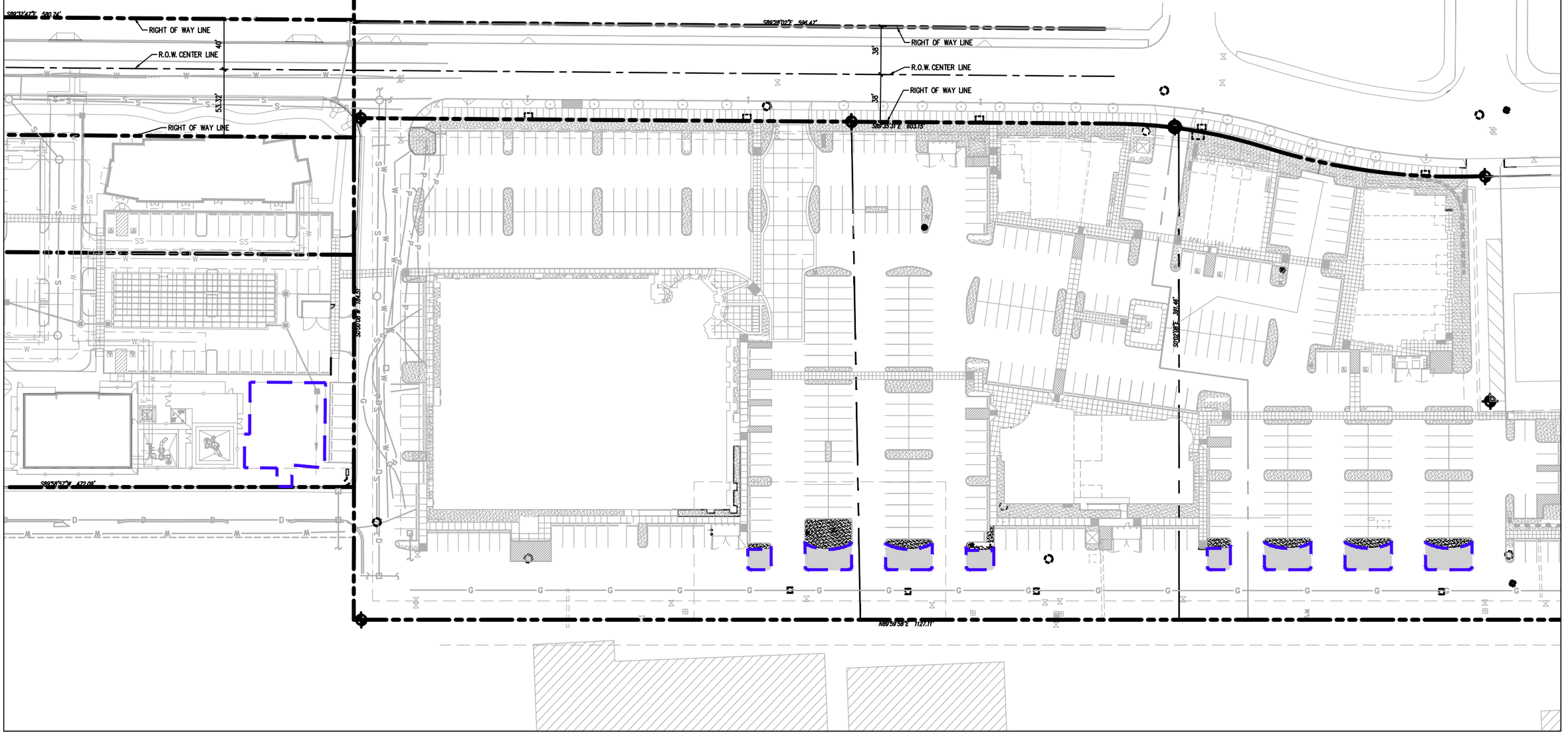
PROPOSED BASIN AREAS:

ASPHALT:	***4300 SF***
PERVIOUS:	***4300 SF***
TOTAL:	***8600 SF***

SCALE: 1" = 40'

40' 0 40' 80'



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DRAWING NAME:	EX-01
DESIGNER:	AW
DRAFTING BY:	AW
DATE:	06-28-2022
SCALE:	1"=40'
JURISDICTION:	LACEY

LDC Surveying Engineering Planning

Woodinville Olympia Kent

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Olympia, WA 98506

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LANDING AT HAWK'S PRAIRIE, LLC

THE LANDING AT HAWK'S PRAIRIE
EXISTING CONDITIONS MAP

EX-01

SHEET 1 OF 2

Drawing: P:\Civil\2022\C22-213 The Landing at Hawks Prairie\Drawings\Exhibits\Stormwater\C22-213 Ex Conditions Map1.dwg Plotted: Jun 29, 2022 - 11:20am

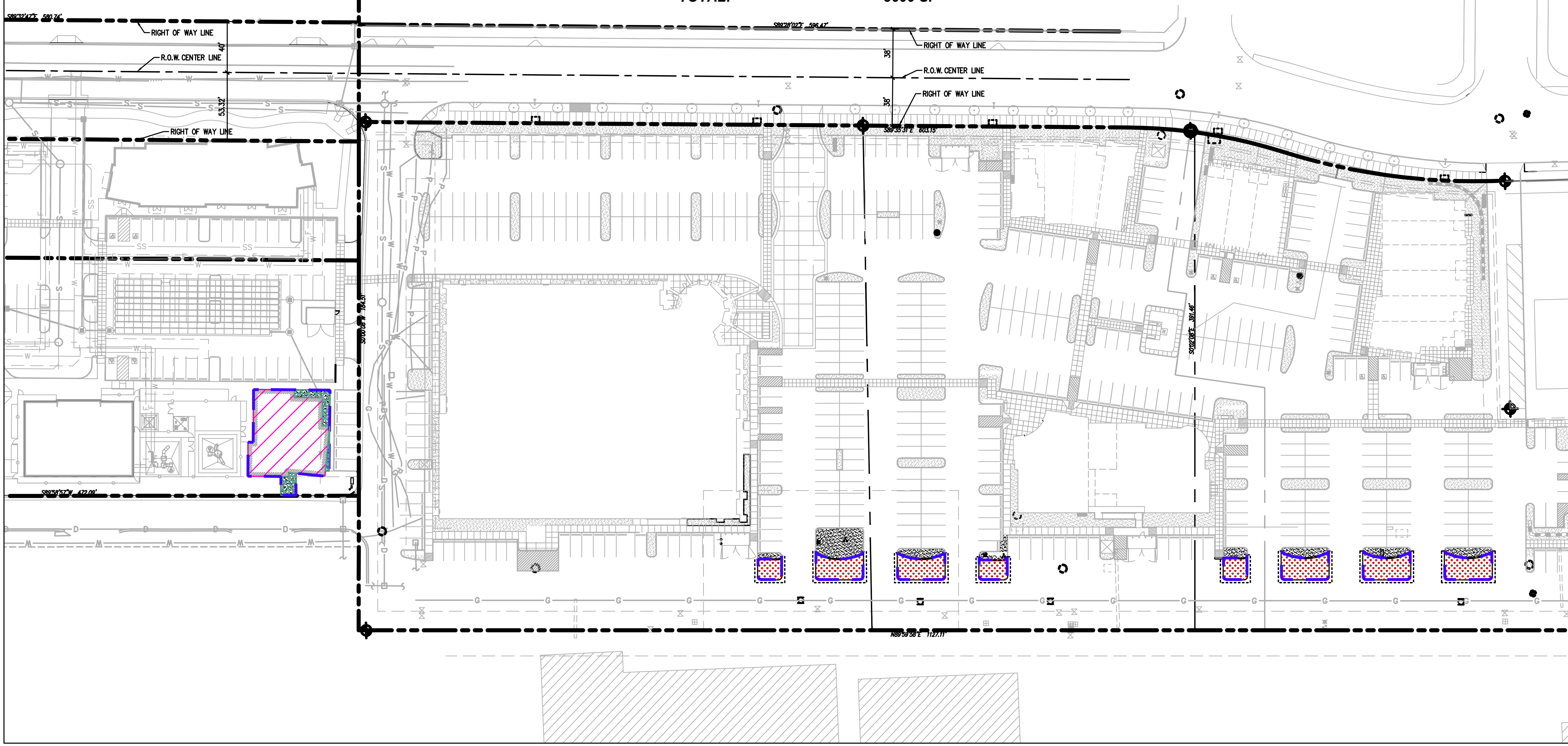
PROPOSED BASIN AREAS:

	ROOF:	3760 SF
	CONCRETE:	540 SF
	PERVIOUS:	4300 SF
	TOTAL:	8600 SF

N

SCALE: 1" = 40'

40' 0 40' 80'



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DRAWING NAME:	EX-02
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SCALE:	1"=40'
JURISDICTION:	LACEY

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LANDING AT HAWK'S PRAIRIE, LLC

THE LANDING AT HAWK'S PRAIRIE
PROPOSED CONDITIONS MAP

EX-02

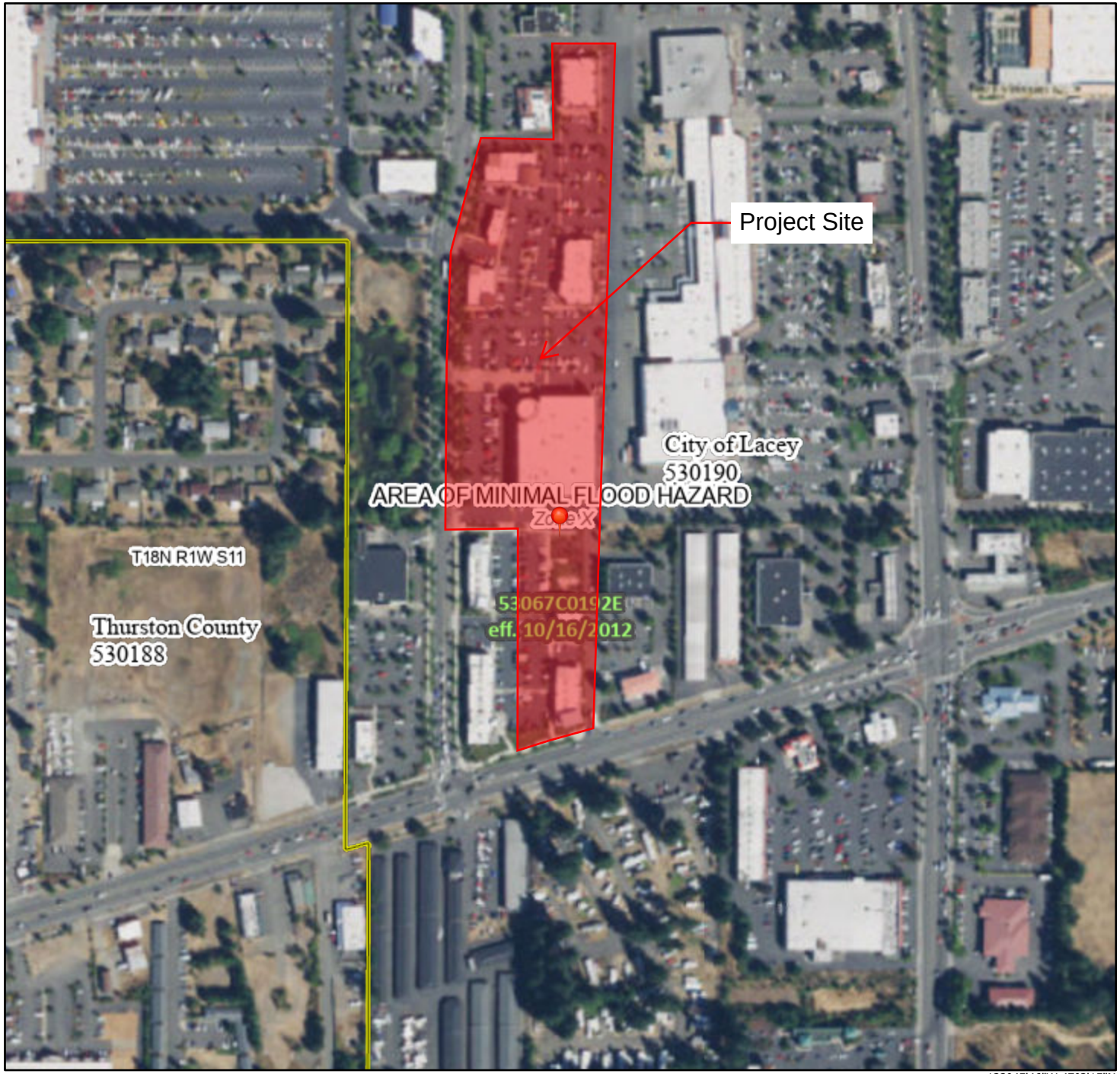
SHEET 2 OF 2

Drawing: P:\Civil\2022\C22-213 The Landing at Hawks Prairie\Drawings\Exhibits\Stormwater\C22-213 Pr. Conditions Map.dwg Plotted: Jun 29, 2022 - 11:23am

National Flood Hazard Layer FIRMette

FEMA

122°46'24"W 47°3'39"N



122°45'46"W 47°3'15"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/23/2022 at 2:37 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

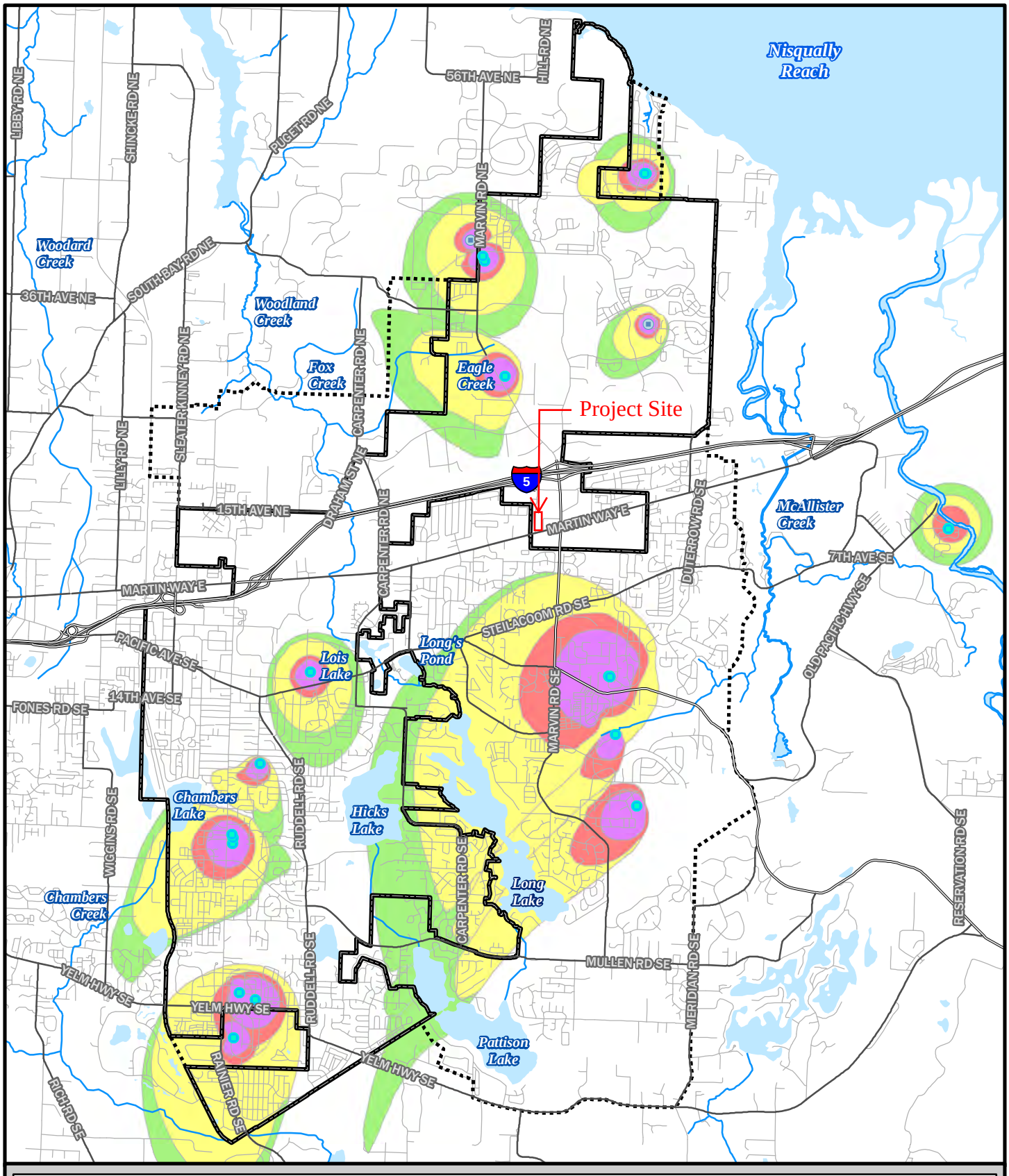


Figure 8B.1. Wellhead Protection Areas.

N

0 3,000 6,000 12,000

Feet

K:\Projects\Y2015\15-06014-000\Project\WHPAs.mxd (6/21/2016)

Legend

- Lacey City Limits
- Urban Growth Management Area (UGMA)
- River
- Waterbody

Production Wells: Future, Active

Wellhead Protection Areas (2013)

- 10-year
- 5-year
- 1-year
- 6-month

CITY OF LACEY

HERRERA

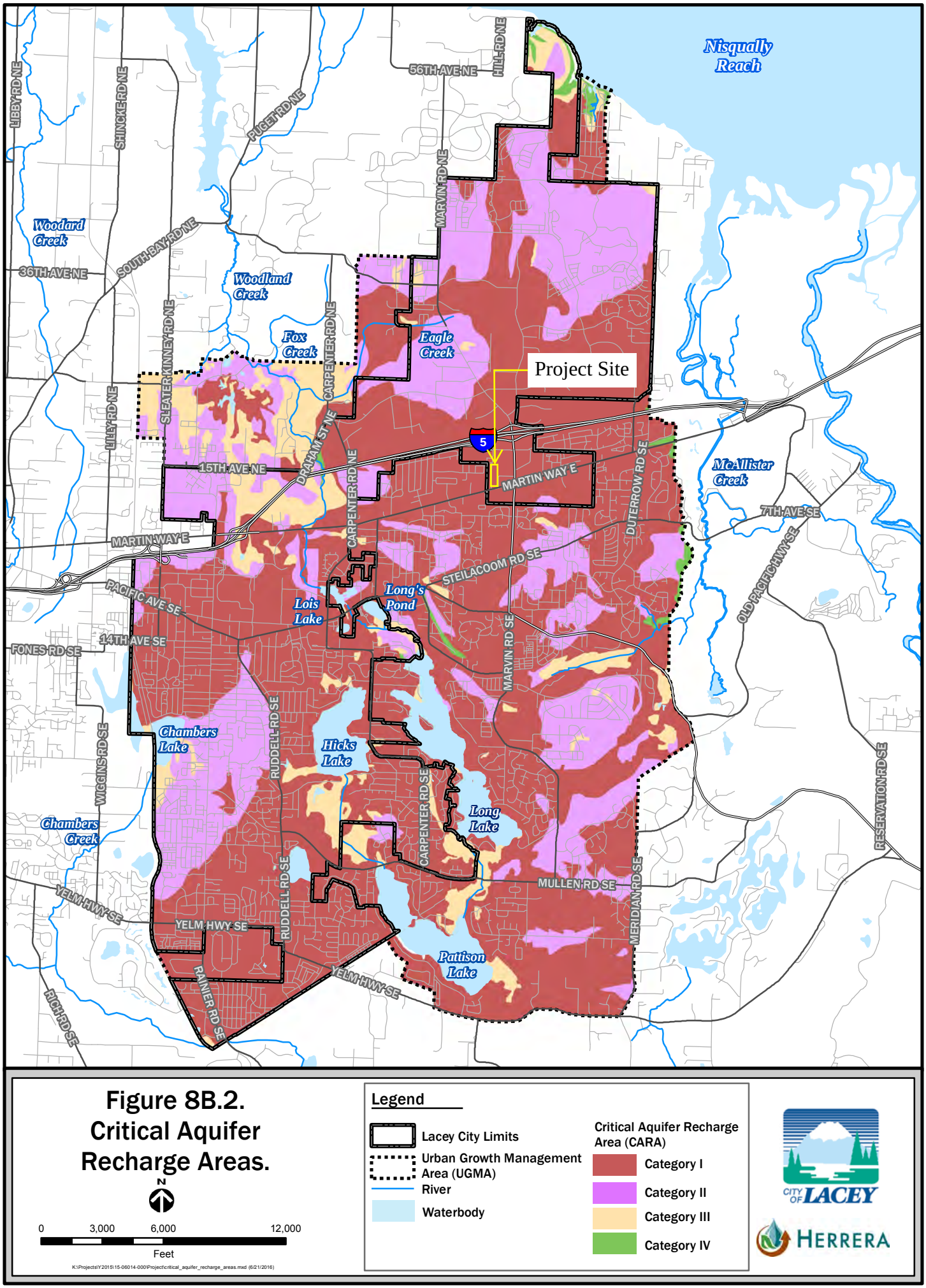


Figure 8B.2. Critical Aquifer Recharge Areas.

N

0 3,000 6,000 12,000

Feet

K:\Projects\Y2015\15-06014-000\Project\critical_aquifer_recharge_areas.mxd (6/21/2016)

Legend

- Lacey City Limits
- Urban Growth Management Area (UGMA)
- River
- Waterbody

Critical Aquifer Recharge Area (CARA)

- Category I
- Category II
- Category III
- Category IV

CITY OF LACEY

HERRERA

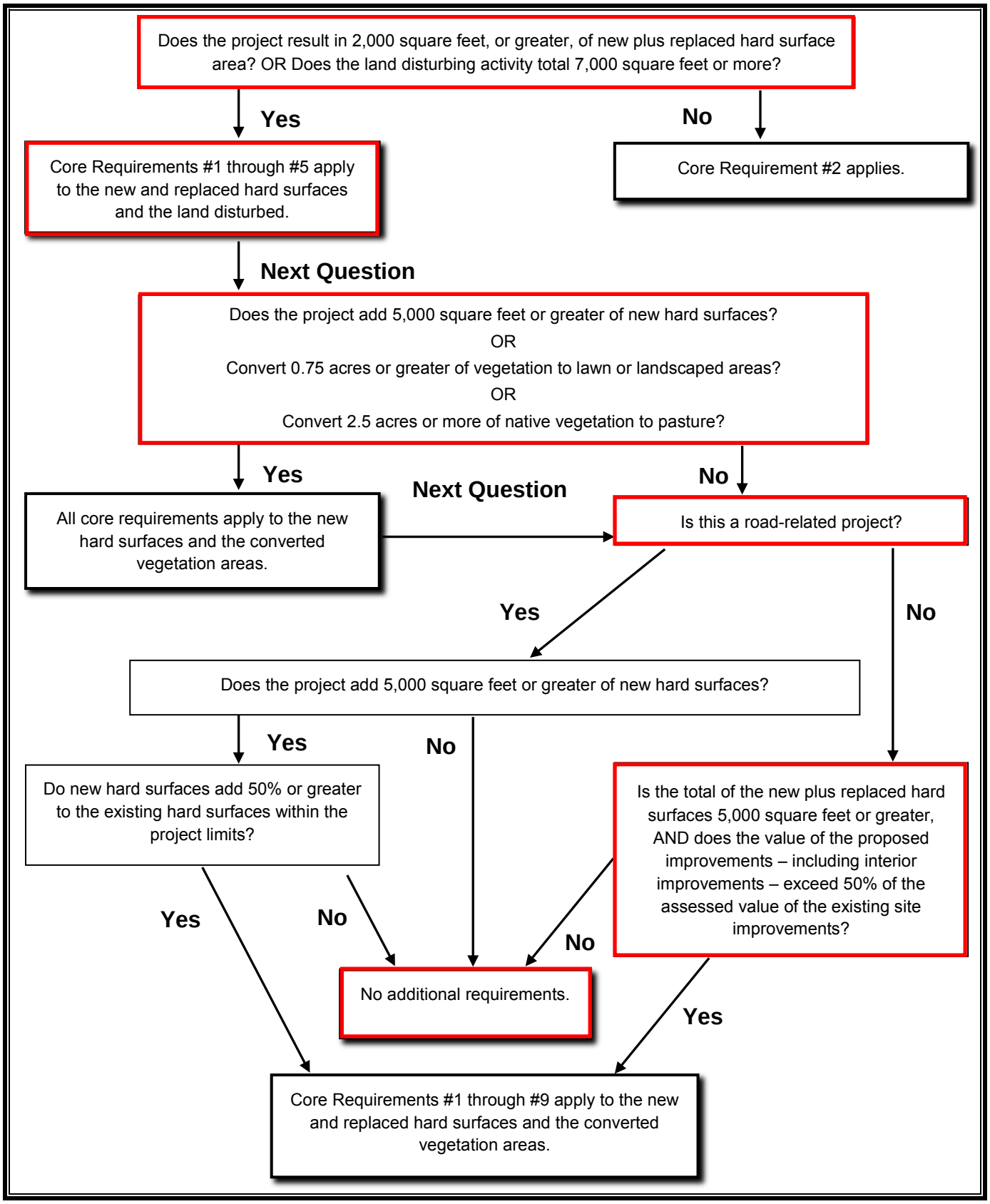


Figure 2.2. Flow Chart for Determining Requirements for Redevelopment.

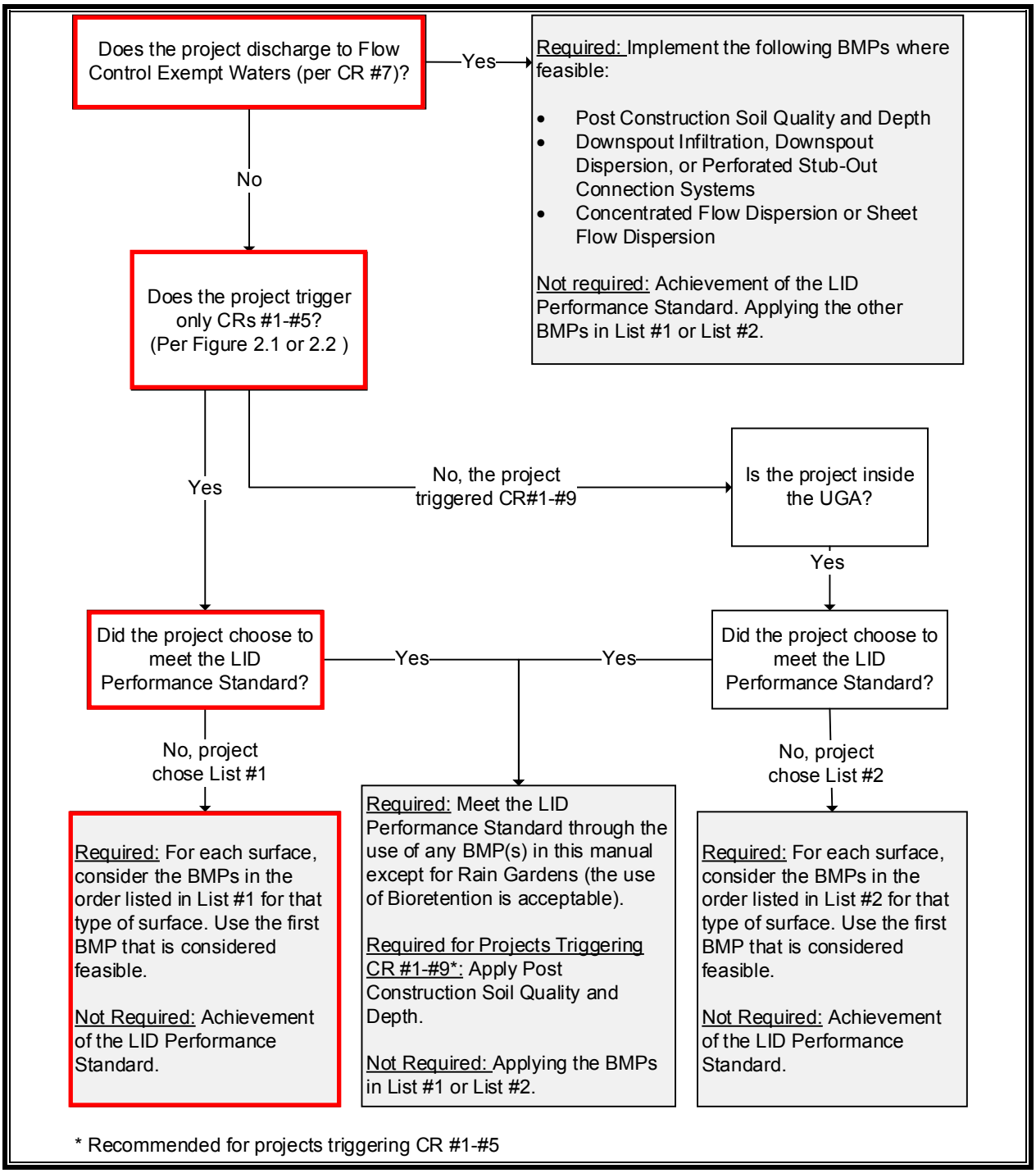


Figure 2.3. Flow Chart for Determining Core Requirement #5 Requirements.