STORMWATER SITE PLAN REPORT

10TH STREET DEVELOPMENT PROJECT
APN's 7845000622, 7845000591, 7845000600 & 7845000571

619 ½ 10th Street SE
Puyallup, Washington 98372

Job #04-173-01

March 29, 2019

Prepared for:
Greg Helle
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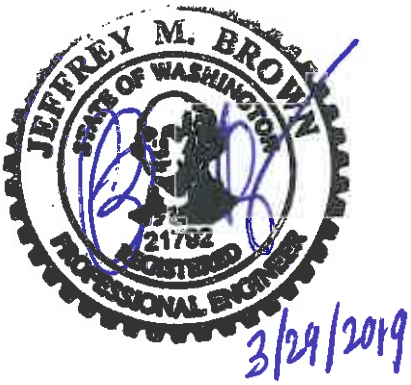
ENGINEER'S CERTIFICATION:

"I hereby state that this Storm Drainage Report for the 10th Street Development Project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Puyallup does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me."



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1. **Vicinity Map**
2. **Existing Conditions Plan**
3. **Site Plan**
4. **Downstream Map**
5. **SCS Soils Summary & Soils Testing**
6. **FIRM Map Panel**
7. **2012 Stormwater Management Manual for Western Washington excerpts**
8. **City of Puyallup BMP Checklists**

APPENDIX B

WWHM 2012 Calculations & Chamber Maxx Details

APPENDIX C

Operation and Maintenance Manual

APPENDIX D

Construction Stormwater Pollution Prevention Plan (SWPPP)

Section 1 – Proposed Project Description

Project Description

The proposed development is for a Boundary Line Adjustment to make the existing four lots into one lot for a multi-family residential project. The existing home and garage on Parcel 7845000591 will be demolished and two (2) four-unit single-story townhomes will be constructed. Each four-unit townhome structure is approximately 3,816 square feet. Open space, both private and shared, storm drainage and parking will be provided.

The site address is 619 ½ 10th Street SE, Puyallup. Washington 98372. The Assessor parcel numbers are 7845000622, 7845000591, 7845000600 and 7845000571. Proposed Lot 1 is 32,479 square feet (0.746 acres), and is located in the SE ¼ of Section 27, Township 20N, Range 4E, W.M. The property zoning is Multiple-Family Residential Use, RM-10. Refer to the Vicinity Map and Site Plan included in Appendix A.

Area Summary/Lot 1

Existing Conditions:

Impervious:	5,742 sq. ft.
Roofs:	1,958 sq. ft.
Patios, walks:	838 sq. ft.
Driveways:	2,946 sq. ft.
Pervious (lawn, shrubs):	26,737 sq. ft.
Total Area:	32,479 sq. ft.

Existing Impervious Coverage: 17.7%

Proposed Conditions:

Impervious:	22,068 sq. ft.
Roofs:	9,304 sq.ft.
Sidewalks:	1,503 sq. ft.
Exist. Driveway	1,419 sq. ft.
Driveway, parking:	9,842 sq. ft.
Pervious (lawn, shrubs):	10,411 sq. ft.
Total Area:	32,479 sq. ft.

New Plus Replaced Hard Surface Area: 20,649 sq. ft.

Applicable Minimum Requirements

The 2012 Stormwater Management Manual for Western Washington as amended in December 2014 (the "Manual") establishes the methodology and design criterial used for this project.

The site has less than 35% existing impervious coverage. In addition, the project proposes to add greater than 5,000 square feet of new plus replaced hard surface area. According to Volume I, Figure I-2.4.1 (see Appendix A) of the Manual, all Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas.

Minimum Requirement #1: Preparation of Stormwater Site Plans

This Stormwater Site Plan has been prepared to satisfy this requirement.

Minimum Requirement #2: Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan has been prepared and is included in Appendix D of this report.

Minimum Requirement #3: Source Control of Pollution

Source Control BMP's by SWPPP element, are described in the Stormwater Pollution Prevention Plan included in Appendix D of this report.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

The pre-developed basin is a single basin that flows from southeast to northwest across the site. Refer to the Downstream Map included in Appendix A.

The developed basin will be very similar as the pre-developed basin, since only limited grading to construct structures, parking areas, and driveways is expected.

Minimum Requirement #5: Onsite Stormwater Management

Projects triggering Minimum Requirements #1 through #9, must meet the requirements in Volume I, Table I-2.5.1 (see Appendix A) of the Manual. According to Table I-2.5.1, new development outside the UGA on a parcel less than 5 acres, are required to meet Low Impact Development Performance Standard, or comply with List #2. This project will comply with List #2.

For each type of surface, consider the BMP's in the order listed for that type of structure.

Lawn and landscaped areas: The project shall meet BMP T5.13, Post-Construction Soil Quality and Depth, and the requirements will be incorporated into the plans.

Roofs: The project shall meet BMP T5.10A, Downspout Full Infiltration Systems, and the requirements will be incorporated into the Plans. Please refer to Section 9 of this report for sizing methodology and calculations.

Other Hard Surfaces (Driveways, Parking Areas): The first option listed is Full Dispersion, BMP T5.30. Full Dispersion is not feasible. A Native Vegetation Flow Path of at least 100 feet in length is not achievable, due to physical site constraints.

The second option listed is BMP T5.15, Permeable Pavements. This option is feasible and will be implemented. Please refer to Section 9 of this report for sizing methodology and calculations.

Minimum Requirement #6: Runoff Treatment

Runoff treatment will be provided through soils below the permeable asphalt pavement in accordance with Volume III, Chapter III-3.3.4 of the Manual.

Minimum Requirement #7: Flow Control

The total effective impervious surface is over 10,000 square feet. In accordance with Volume I, Section I-2.5.7 of the Manual, flow control is required. The existing soils (Type 31A, Puyallup Fine Sandy Loam) located below the subgrade of the pervious asphalt pavement, per soils testing performed for the project, are expected to have a long-term infiltration rate of 1.0 inches per hour. This is adequate to infiltrate stormwater runoff discharged onto the pavement. Please refer to Appendix B of this report for the WWHM 2012 modeling.

Minimum Requirement #8: Wetland Protection

A review of available maps and plans of the study area revealed no presence of wetlands on site or up to a quarter mile downstream of the project.

Minimum Requirement #9: Operation and Maintenance

Please refer to the Operation and Maintenance Manual included in Appendix C.

Section 2 – Existing Conditions Description

The existing site gently slopes to the northwest with slopes in the 0.5 percent range. The existing home and garage on Lot 1 will be demolished. The remainder of the site is lawn with scattered shrubs and trees. Refer to the Existing Conditions Plan included in Appendix A.

Section 3 – Infiltration Rates/Soils Report

Type B soil has a moderate capacity to infiltrate water. Refer to the SCS Soils Summary and Soils Testing included in Appendix A.

Section 4 – Wells and Septic Systems

The site is proposed to be served by a public water system and a public sewer system (City of Puyallup).

Section 5 – Fuel Tanks

There are no known fuel tanks on the site.

Section 6 – Sub-basin Description

There is no known offsite drainage tributary to the project. The existing site gently slopes to the northwest with slopes in the 0.5 percent range. Refer to the Downstream Map included in Appendix A.

Section 7 – Floodplain Analysis

The site is located in Zone X, an area of minimal flood hazard. Refer to the FIRM Map Panel included in Appendix A.

Section 8 – Aesthetic Considerations for Facilities

The project will provide landscaping to enhance the aesthetic aspects of the project.

Section 9 – Facility Sizing and Downstream Analysis

Downstream Analysis

Runoff from the site that does not infiltrate on-site would be expected to sheet flow to the northwest to 10th Street SE right-of-way. Runoff on 10th Street SE would convey to the public storm drain system and would flow north. Refer to the Downstream Map included in Appendix A.

Roof Downspout Drainage

As noted previously, the soil type for the site is Type 31A, Puyallup Fine Sandy Loam. This Type A soil has a moderate capacity to infiltrate water.

Roof downspout full infiltration sizing shall be in accordance with Volume III, Section III-3.1.1 of the Manual. Contech Chamber Maxx infiltration system is proposed, with 20 chambers. See Chamber Maxx details included in Appendix B.

In order to meet the sizing criteria of 100% infiltration utilizing the required WWHM software, a 76' x 11' trench footprint was used which represents the area required for 20 chambers. A 50% total voids is used by calculating the total void in a chamber including the chamber itself and voids within the rocks. An infiltration rate of 1.0 inches per hour was used based on the soils as previously discussed. Please refer to Appendix C of this report for the WWHM modeling.

Or B?

Other Hard Surfaces (Driveways, Parking Areas)

Permeable pavement is proposed for the driveways and parking areas. The permeable pavement shall be in accordance with the City of Puyallup's Worksheet B7 (see Appendix A). The existing soils (Type 31A, Puyallup Fine Sandy Loam) located below the subgrade of the pervious asphalt pavement, per soils testing performed for the project, are expected to have a long-term infiltration rate of 1.0 inche per hour. This is adequate to infiltrate stormwater runoff discharged onto the pavement. Please refer to Appendix C of this report for the WWHM modeling.

Section 10 – Utilities

The Contractor will be responsible to ensure that there are no conflicts between utilities and the proposed stormwater improvements.

Section 11 – Covenants, Dedications, Easements

To be provided by the developer at a later date.

Section 12 – Property Owners' Association Articles of Incorporation

To be provided by the developer at a later date.

Section 13 – Other Permits or Conditions Placed on the Project

Public Road Permit, Utility Permits.

Report Prepared by:

Jeff Brown, P.E.
Company Engineer/Engineer of Record/Senior Design Engineer

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APPENDIX A

Figures, List, & Tables

1. **Vicinity Map**
2. **Existing Conditions Plan**
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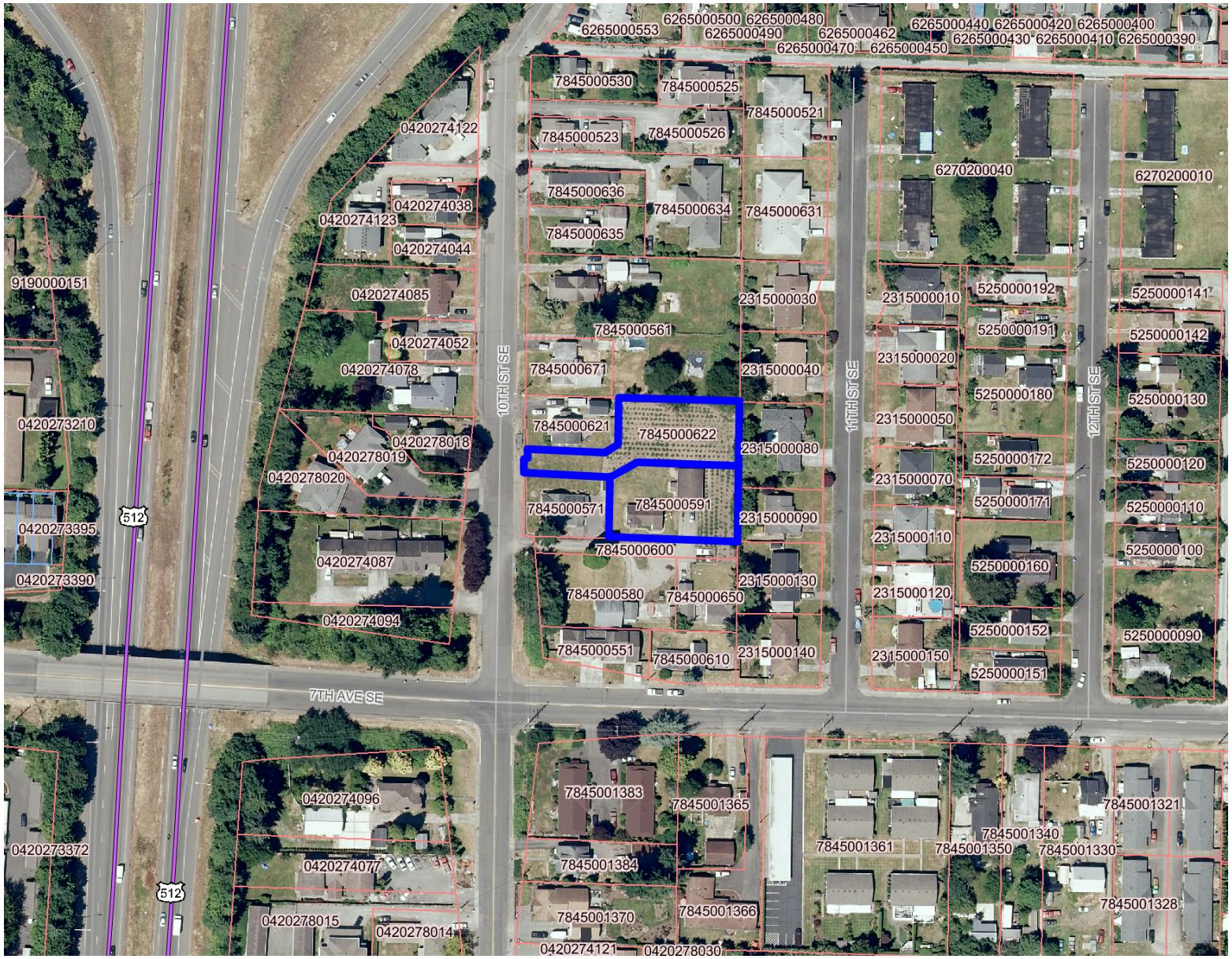
Project Title: Vicinity Map

Client: 10th Street Project

Job No: 04-173-01



The map features are approximate and are intended only to provide an indication of said feature. Additional areas that have not been mapped may be present. This is not a survey. The orthophotos and other data may not align. Pierce County assumes no liability for variations ascertained by actual survey. All data is expressly provided AS IS and WITH ALL FAULTS. Pierce County makes no warranty of fitness for a particular purpose.

Abbey Road GROUP

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Map Legend

Tax Parcels

- Base Parcel
- Condominium
- Other

Roads

- Interstate
- Limited Access State Routes
- Other State Routes
- Ramps
- Major Arterial
- Collector
- Local Access
- Unknown

County - 2014 - Ortho

Scale 1:2,122

0 90 180 ft.

N

Printed: 8/9/17 7:52 AM

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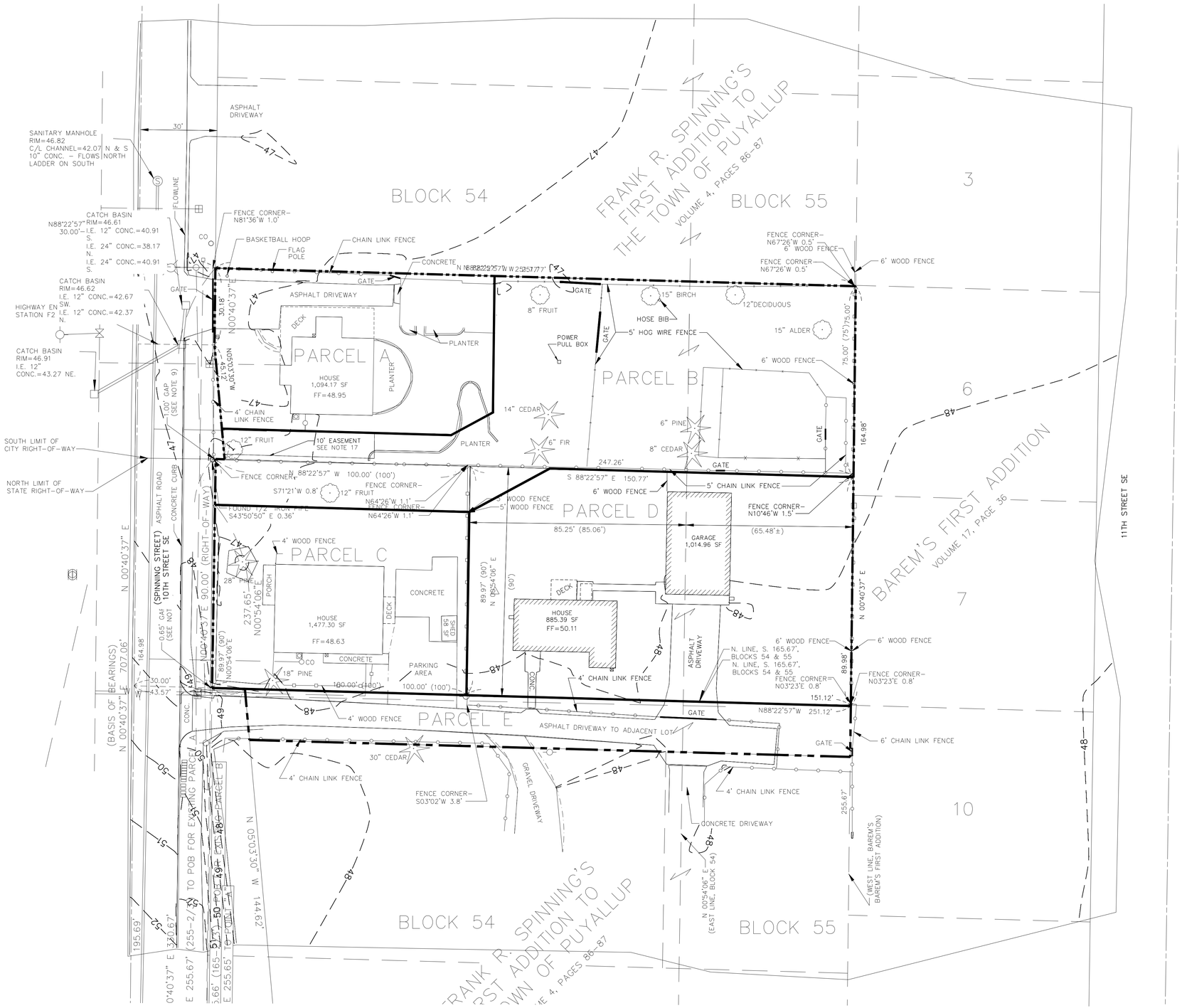
10TH STREET DEVELOPMENT PROJECT

SEC. 27 / TWP. 20 / RGE. 4 E. W.M.

CITY OF PUYALLUP, PIERCE COUNTY, WASHINGTON

EXISTING CONDITIONS



TITLE: 10TH Street Development Project
Existing Conditions
Puyallup, Washington

FOR: Greg Helle
P.O. BOX 280
Puyallup, Washington 98371

RYAN J. JEFFERIES
STATE OF WASHINGTON
CONSTRUCTION

Abbey Road Group Land Development Services Company, LLC
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Abbey Road GROUP

REVISIONS:

BY:	CHK:	APR:	DATE:	PER:

JOB #: 04-173
DESIGNED BY: ARG
DEVELOPMENT REVIEW: Gil Hulsmann
APPROVED BY: Gil Hulsmann
DRAFTED BY: AG
DATE: 12/17/2018
SHEET: C1.03

File: T:\PROJECTS FILES (ACTIVE)\04-173, 10th Street Duplex 2017\DESIGNS\Engineering\2ND SUBMITTAL\04-173-01 Preliminary Set.dwg
Plotted: 2/15/2019 10:03 AM Plotted By: Jeff Brown

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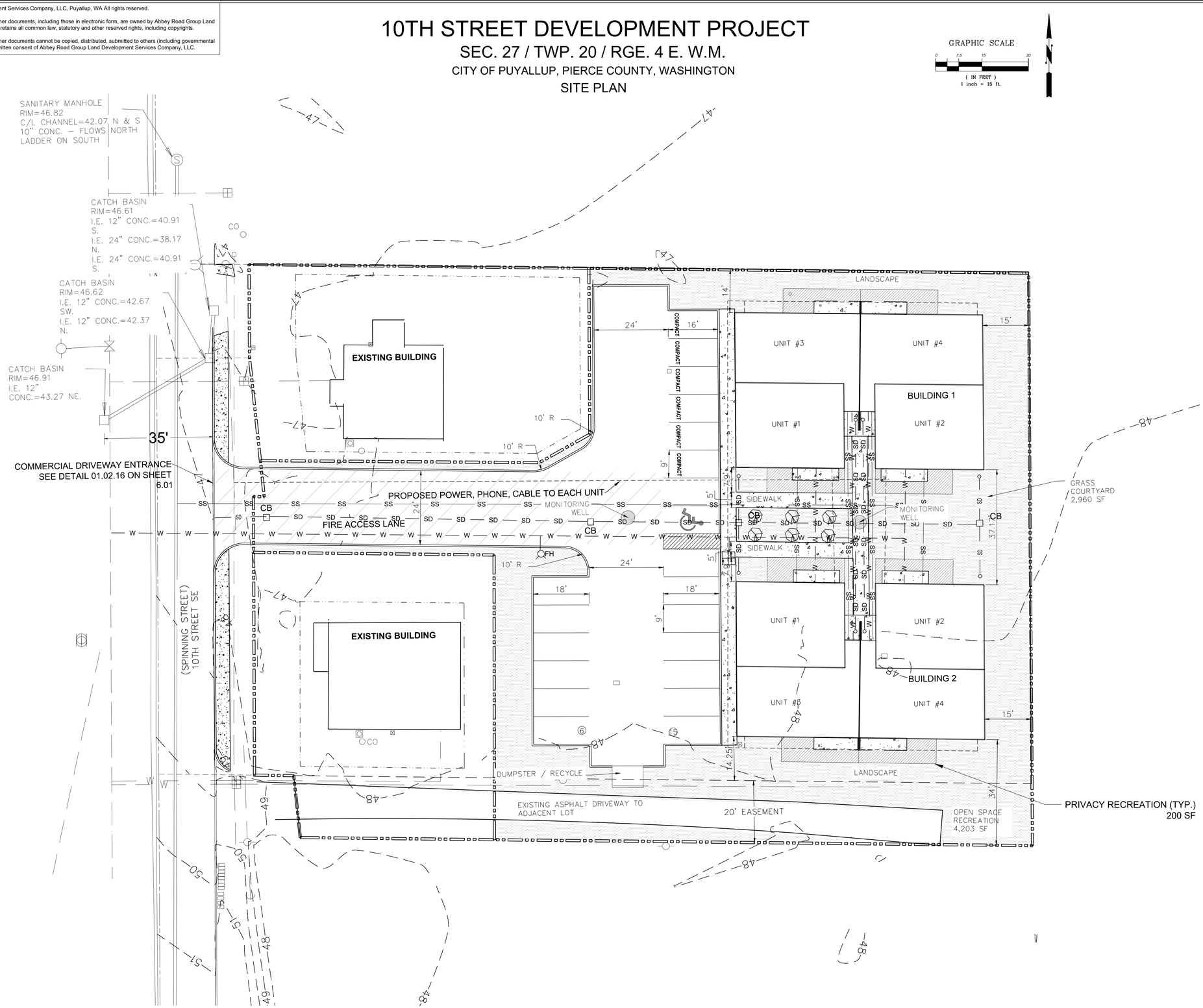
10TH STREET DEVELOPMENT PROJECT

SEC. 27 / TWP. 20 / RGE. 4 E. W.M.

CITY OF PUYALLUP, PIERCE COUNTY, WASHINGTON

SITE PLAN



TITLE: 10TH Street Development Project
Site Plan
Puyallup, Washington

FOR: Greg Helle
P.O. BOX 280
Puyallup, Washington 98371

RYAN J. JEFFERIES
STATE OF WASHINGTON
CERTIFICATE NUMBER
CONSTRUCTION

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SHEET: C2.01

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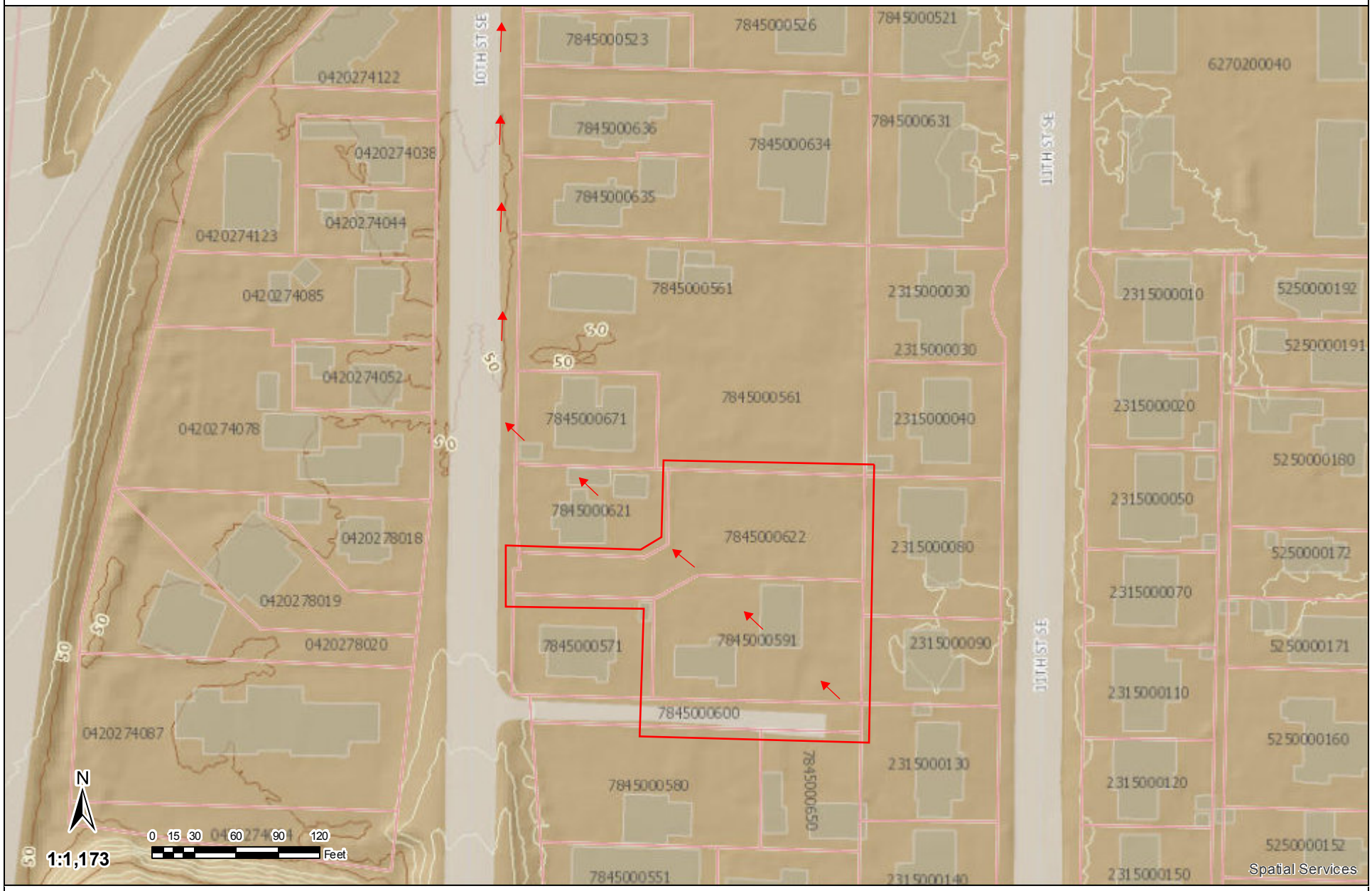
Plotted: 2/15/2019 10:05 AM
Plotted By: Jeff Brown

Downstream Map



Disclaimer: Map features are approximate and have not been surveyed. Additional features not yet mapped may be present.
Pierce County assumes no liability for variations ascertained by formal survey. 2/15/2019

Map Scale: 1:1,210 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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: Pierce County Area, Washington
Survey Area Data: Version 14, Sep 10, 2018

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

Date(s) aerial images were photographed: Jul 8, 2014—Jul 15, 2014

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
31A	Puyallup fine sandy loam	7.2	100.0%
Totals for Area of Interest		**7.2**	**100.0%**

Pierce County Area, Washington

31A—Puyallup fine sandy loam

Map Unit Setting

National map unit symbol: 2hq9
Elevation: 0 to 390 feet
Mean annual precipitation: 35 to 60 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 170 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Puyallup and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Puyallup

Setting

Landform: Flood plains, terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 13 inches: ashy fine sandy loam
H2 - 13 to 29 inches: loamy fine sand
H3 - 29 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Forage suitability group: Droughty Soils (G002XN402WA)
Hydric soil rating: No

Minor Components

Briscot

Percent of map unit: 2 percent
Landform: Depressions

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 14, Sep 10, 2018

National Flood Hazard Layer FIRMette

FEMA

47°11'25.62"N

122°17'11.62"W

122°16'34.17"W

47°11'1.17"N

Feet 1:6,000

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

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

- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 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 2/14/2019 at 12:05:06 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 I-2.4.1 Flow Chart for Determining Requirements for New Development

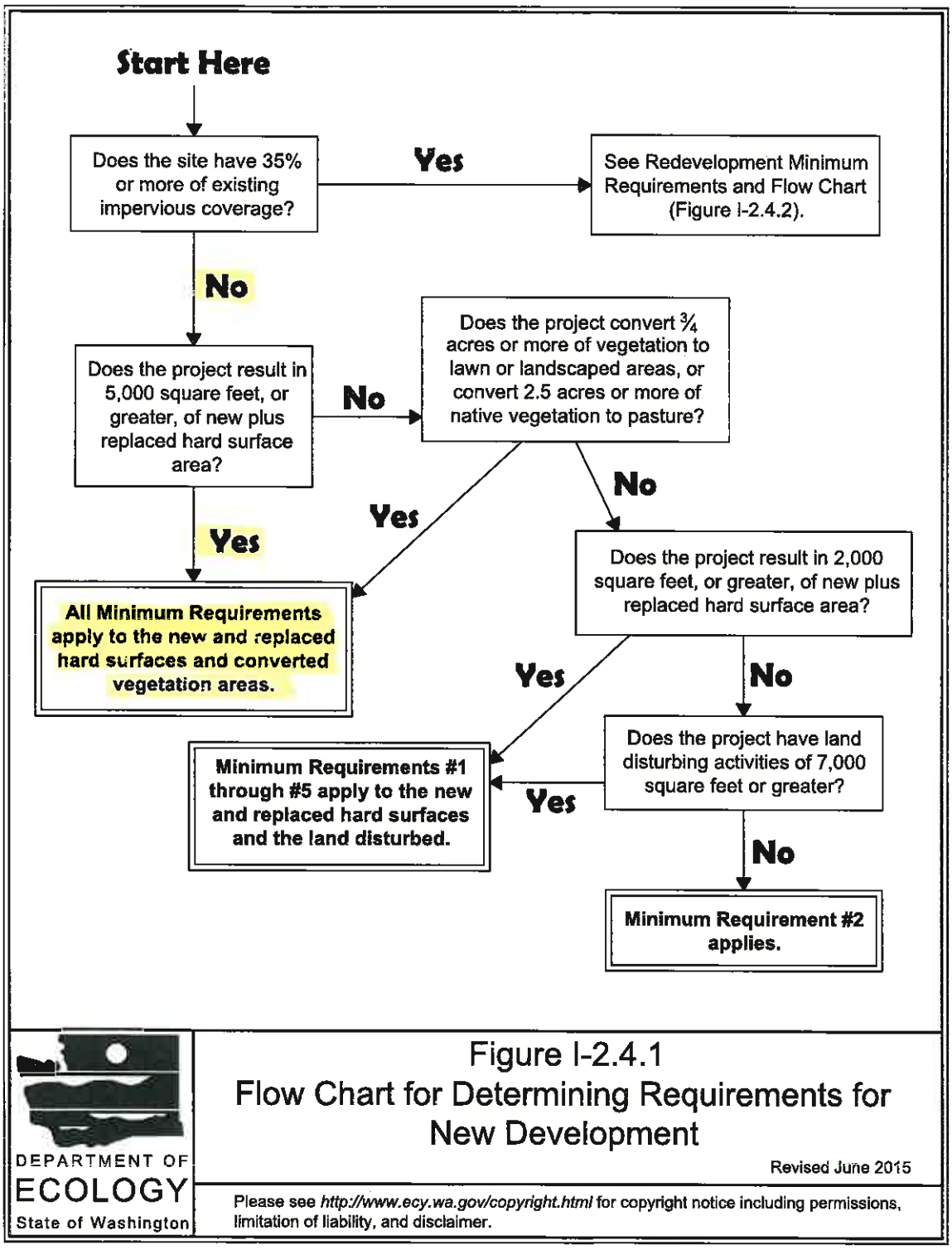


Table I-2.5.1 On-Site Stormwater Management Requirements for Projects Triggering Minimum Requirements #1 - #9

Project Type and Location	Requirement
New development on any parcel inside the UGA, or new development outside the UGA on a parcel less than 5 acres	Low Impact Development Performance Standard and BMP T5.13: Post-Construction Soil Quality and Depth (p.911); or List #2 (applicant option).
New development outside the UGA on a parcel of 5 acres or larger	Low Impact Development Performance Standard and BMP T5.13: Post-Construction Soil Quality and Depth (p.911).
Redevelopment on any parcel inside the UGA, or redevelopment outside the UGA on a parcel less than 5 acres	Low Impact Development Performance Standard and BMP T5.13: Post-Construction Soil Quality and Depth (p.911); or List #2 (applicant option).
Redevelopment outside the UGA on a parcel of 5 acres or larger	Low Impact Development Performance Standard and BMP T5.13: Post-Construction Soil Quality and Depth (p.911).
Note: This table refers to the Urban Growth Area (UGA) as designated under the Growth Management Act (GMA) (Chapter 36.70A RCW) of the State of Washington. If the Permittee is located in a county that is not subject to planning under the GMA, the city limits shall be used.	

Low Impact Development Performance Standard

Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8% of the 2-year peak flow to 50% of the 2-year peak flow. Refer to the Standard Flow Control Requirement section in Minimum Requirement #7 for information about the assignment of the pre-developed condition. Project sites that must also meet minimum requirement #7 – flow control - must match flow durations between 8% of the 2-year flow through the full 50-year flow.

List #1: On-site Stormwater Management BMPs for Projects Triggering Minimum Requirements #1 through #5

For each surface, consider the BMP's in the order listed for that type of surface. Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface. Feasibility shall be determined by evaluation against:

1. **Design criteria, limitations, and infeasibility criteria identified for each BMP in this manual; and**

Management BMP is necessary for that surface. Feasibility shall be determined by evaluation against:

1. **Design criteria, limitations, and infeasibility criteria identified for each BMP in this manual; and**
2. **Competing Needs Criteria listed in Chapter V-5 - On-Site Stormwater Management (p.903).**

Lawn and landscaped areas:

- **Post-Construction Soil Quality and Depth in accordance with BMP T5.13: Post-Construction Soil Quality and Depth (p.911).**

Roofs:

1. **Full Dispersion in accordance with BMP T5.30: Full Dispersion (p.939), or Downspout Full Infiltration Systems in accordance with BMP T5.10A: Downspout Full Infiltration (p.905).**
2. **Bioretention (See BMP T7.30: Bioretention Cells, Swales, and Planter Boxes (p.959)) facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.**
3. **Downspout Dispersion Systems in accordance with BMP T5.10B: Downspout Dispersion Systems (p.905)**
4. **Perforated Stub-out Connections in accordance with BMP T5.10C: Perforated Stub-out Connections (p.905)**

Other Hard Surfaces:

1. **Full Dispersion in accordance with BMP T5.30: Full Dispersion (p.939)**
2. **Permeable pavement[1] in accordance with BMP T5.15: Permeable Pavements (p.917)**
3. **Bioretention BMP's (BMP T7.30: Bioretention Cells, Swales, and Planter Boxes (p.959)) that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.**
4. **Sheet Flow Dispersion in accordance with BMP T5.12: Sheet Flow Dispersion (p.908), or Concentrated Flow Dispersion in accordance with BMP T5.11: Concentrated Flow Dispersion (p.905)**

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[1]This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

Worksheet B3

Downspout Full Infiltration (BMP T5.10A)

This worksheet is to aide in the preparation and submission of a site plan containing downspout full infiltration system. Applicants must submit this completed worksheet if selecting this technology. To complete this worksheet, applicant must:

1. Review infeasibility criteria below to determine if this BMP is feasible.
2. Check that applicable design criteria below is met.
3. Submit Applicable Details.
4. Submit Site plan showing approximate location of technology and relevant setbacks, etc.

{ Downspout Full Infiltration }

{ Dry Well }

{ Step 1: Review Infeasibility Criteria }

If any of the following infeasibility criteria are met, this technology is considered infeasible. Applicant must list the specific infeasibility criteria below on the Stormwater Site Plan (Worksheet A1) and move on to the next BMP technology.

Infeasibility Criteria
The lot(s) or site does not have outwash or loam soils.
There is not at least 3 feet or more of permeable soil from the proposed final grade to the seasonal high groundwater table.
There is not at least 1 foot of clearance from the expected bottom elevation of the infiltration trench or dry well to the seasonal high groundwater table.
Site slopes are steeper than 25% (4:1)
Infiltration system cannot feasibly be located at least 10 feet from any structure, property line, or environmentally sensitive area. (Or other spacing criteria cannot be met)
Infiltration system cannot feasibly be located at least 50 feet from the top of any slope over 40%.
Infiltration system cannot feasibly be located downslope from a septic system drainfield.

{ Step 2: Review Applicable Design Criteria }

Complete the following checklist (list "N/A" where design criteria does not apply).

Design Criteria for Infiltration Trenches		
Applicant	**Reviewer**	**Criteria**
		Project does not trigger any of the infeasibility requirements above.
		Maximum length of trench is less than 100 feet.
		Minimum spacing between trenches is 6 feet.
		Geotechnical analysis included in report if trench is located: On a slope greater than 15% or Within 200 feet of the top of a slope greater than 40% or Within a landslide hazard area
		If trench is located under pavement: Yard drain or catch basin proposed at the end of the trench pipe. Rim elevation of inlet is at least 1' below the surface of the pavement. Overflow has no adverse impact on downhill properties or drainage systems.
		If trench is placed in fill material: Measured infiltration rate of fill material is at least 8 inches per hour Trench length is 60 linear feet per 1,000 square feet of roof area. Note on the plan that a geotechnical engineer must be present on-site for the placement and compaction of fill material for trench.
		The following sizing criteria is met based on the soil type (minimum length of trench in linear feet per 1,000 square feet of roof area) Coarse Sand and Cobbles 20 LF Medium Sand 30 LF Fine Sand, Loamy Sand 75 LF Sandy Loam 125 LF Loam 190 LF

Design Criteria for Drywells		
Applicant	**Reviewer**	**Criteria**
		Project does not trigger any of the infeasibility requirements above.
		Minimum spacing between dry wells is 10 feet.
		Minimum diameter is 48 inches.
		Geotechnical analysis included in report if drywell is located: On a slope greater than 15% or On or above a landslide hazard area.
		The following sizing criteria is met based on the soil type (minimum volume of gravel in cubic feet per 1,000 square feet of roof area) Coarse Sand and Cobbles 60 CF Medium Sands 90 CF

{ Step 3: Submit Applicable Details }

For **infiltration trenches**, use City Standard details 02.05.01-03 located here:

http://www.cityofpuyallup.org/DocumentCenter/Home/View/5514

For **dry wells**, use Department of Ecology detail located here:

http://www.ecy.wa.gov/programs/wq/stormwater/manual/2014SWMMWWinteractive/Content/Resources/Images/Figures/Volume%20III/2014%20Figure%20III-3-1-4.pdf

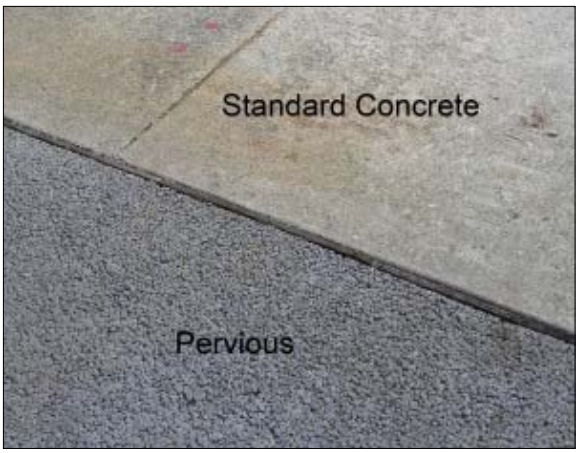
{ Step 4: Submit Site Plan }

Worksheet B7

Permeable Pavement (BMP T5.15)

Permeable Pavement can only be utilized for hard surfaces if full dispersion is infeasible. Applicants must submit this completed worksheet and an accompanying site plan if selecting this technology. To complete this worksheet, applicant must:

1. Review infeasibility criteria below to determine if this BMP is feasible
2. Check that applicable design criteria below is met
3. Select Applicable Details
4. Submit a Site Plan



{ Step 1: Review Infeasibility Criteria }

If any of the following infeasibility criteria are met, this technology is considered infeasible. Applicant must list the specific infeasibility criteria below on the Stormwater Site Plan (Worksheet A1) and move on to the next BMP technology.

Infeasibility Criteria
Note: The Infeasibility criteria listed below does not require written justification from a licensed professional
Cannot feasibly locate outside of an area designated as an erosion hazard, or landslide hazard.
Cannot feasibly locate further than 50 feet from the top of slopes that are greater than 20%.
Cannot feasibly locate further than 100 feet from an area known to have deep soil contamination.
Surface soils are contaminated, and contaminated areas cannot feasibly be removed.
Site is a federal Superfund site or state cleanup site under the Model Toxics Control Act (MTCA) (uncommon)
Cannot feasibly be located further than 100 feet from a closed or active landfill.

Infeasibility Criteria (Cont.)
Cannot feasibly be located further than 100 feet from a drinking water well if the pavement is a pollution-generating surface (e.g. when used for driveways).
Cannot feasibly be located further than 10 feet from a septic system.
Cannot feasibly be located further than 10 feet away from an underground storage tank containing hazardous materials.
Where the site cannot reasonably be designed to have a porous asphalt surface at less than 5 percent slope, or a pervious concrete surface at less than 10 percent slope, or a permeable interlocking concrete pavement surface (where appropriate) at less than 12 percent slope. Grid systems upper slope limit can range from 6 to 12 percent; Check with manufacturer and local supplier.
Where the native soils below a pollution-generating permeable pavement (e.g., road or parking lot) do not meet the soil suitability criteria for providing treatment. See SSC-6 in III-3.3.7 Site Suitability Criteria (SSC). Note: In these instances, the local government has the option of requiring a six-inch layer of media meeting the soil suitability criteria or the sand filter specification as a condition of construction.
The seasonal high ground water or an underlying impermeable/low permeable layer would create saturated conditions within one foot of the bottom of the lowest gravel base course
Where underlying soils are unsuitable for supporting traffic loads when saturated. Soils meeting a California Bearing Ratio of 5% are considered suitable for residential access roads.
Appropriate field testing indicates soils have a measured (a.k.a., initial) native soil saturated hydraulic conductivity less than 0.3 inches per hour and there is no way to gravity connect an underdrain to the public system.
Where replacing existing impervious surfaces unless the existing surface is a non-pollution generating surface over an outwash soil with a saturated hydraulic conductivity of four inches per hour or greater.
Note: The Infeasibility criteria below requires written documentation from an appropriate licensed professional (e.g. engineer, geologist, hydrogeologist)
Professional geotechnical evaluation recommends infiltration not be used due to reasonable concerns about erosion, slope failure, or down gradient flooding.
Cannot feasibly be located outside of an area whose ground water drains into an erosion hazard, or landslide hazard area.
Infiltrating and ponded water below new permeable pavement area would compromise adjacent impervious pavements.
Infiltrating water below a new permeable pavement area would threaten existing below grade basements.
Infiltrating water would threaten shoreline structures such as levees.
Permeable pavement area would be down slope of steep, erosion-prone areas that are likely to deliver sediment.
Fill soils are being used on-site that can become unstable when saturated.
Installation of permeable pavement would threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, or pre-existing road sub-grades.

{ Step 2: Review Applicable Design Criteria }

Complete the following checklist (list "N/A" where design criteria does not apply).

Design Criteria for Permeable Pavement		
Applicant	**Reviewer**	**Criteria**
		Project does not trigger any of the infeasibility requirements above.
		Permeable surface cannot be used for a driveway that crosses a culvert.
		There is no sheet flow from up-gradient areas (**Exception:** incidental pervious areas are allowed to drain to permeable pavement so long as the area does not exceed 5% of the surface area of permeable pavement.)
		Where the proposed surface exceeds 3% slope, calculation and details for check dams is included in submission to the City.
		If an underdrain is used, it must be elevated in a base course of at least 12" of AASHTO #3 stone.
		If used for a roadway, there are adequate facilities for roadway drainage as if road surface was impervious.

{ Step 3: Select Applicable Details }

City of Puyallup is currently developing standard details for permeable driveways and sidewalks that can be used for most projects.

{ Step 4: Submit a Site Plan }

Submit a site plan that contains all of the following information:

- ☐ Scale and North arrow
- ☐ Location, dimensions, and total area of proposed permeable pavement
- ☐ Topographic information that is sufficient enough to show that adjacent areas are not draining onto proposed permeable surface
- ☐ Location of underdrains and cleanouts, if applicable
- ☐ Applicable details from Step 3 above
- ☐ Dimension to nearby property lines, structures, steep slope, lake, wetland, or other impervious surface where applicable

APPENDIX B

WWHM 2012 Calculations

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	04-173 10th St
Site Name:	04-173 10th St
Site Address:	
City:	PUYALLUP
Report Date:	3/1/2019
Gage:	
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2018/10/10
Version:	4.2.16

POC Thresholds

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

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Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
PARKING FLAT	0.48
Impervious Total	0.48
Basin Total	0.48

Element Flows To:

Surface	Interflow	Groundwater

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Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.21
Impervious Total	0.21
Basin Total	0.21

Element Flows To:

Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

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Routing Elements
Predeveloped Routing

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Mitigated Routing

Gravel Trench Bed 1

Bottom Length:	76.00 ft.
Bottom Width:	11.00 ft.
Trench bottom slope 1:	0.01 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	4
Pour Space of material for first layer:	0.5
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	84.451
Total Volume Through Riser (ac-ft.):	0.005
Total Volume Through Facility (ac-ft.):	84.455
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3.5 ft.
Riser Diameter:	18 in.
Element Flows To:	
Outlet 1	Outlet 2

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Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.019	0.000	0.000	0.000
0.0444	0.019	0.000	0.000	0.019
0.0889	0.019	0.000	0.000	0.019
0.1333	0.019	0.001	0.000	0.019
0.1778	0.019	0.001	0.000	0.019
0.2222	0.019	0.002	0.000	0.019
0.2667	0.019	0.002	0.000	0.019
0.3111	0.019	0.003	0.000	0.019
0.3556	0.019	0.003	0.000	0.019
0.4000	0.019	0.003	0.000	0.019
0.4444	0.019	0.004	0.000	0.019
0.4889	0.019	0.004	0.000	0.019
0.5333	0.019	0.005	0.000	0.019
0.5778	0.019	0.005	0.000	0.019
0.6222	0.019	0.006	0.000	0.019
0.6667	0.019	0.006	0.000	0.019
0.7111	0.019	0.006	0.000	0.019
0.7556	0.019	0.007	0.000	0.019
0.8000	0.019	0.007	0.000	0.019
0.8444	0.019	0.008	0.000	0.019
0.8889	0.019	0.008	0.000	0.019
0.9333	0.019	0.009	0.000	0.019
0.9778	0.019	0.009	0.000	0.019
1.0222	0.019	0.009	0.000	0.019

1.0667	0.019	0.010	0.000	0.019
1.1111	0.019	0.010	0.000	0.019
1.1556	0.019	0.011	0.000	0.019
1.2000	0.019	0.011	0.000	0.019
1.2444	0.019	0.011	0.000	0.019
1.2889	0.019	0.012	0.000	0.019
1.3333	0.019	0.012	0.000	0.019
1.3778	0.019	0.013	0.000	0.019
1.4222	0.019	0.013	0.000	0.019
1.4667	0.019	0.014	0.000	0.019
1.5111	0.019	0.014	0.000	0.019
1.5556	0.019	0.014	0.000	0.019
1.6000	0.019	0.015	0.000	0.019
1.6444	0.019	0.015	0.000	0.019
1.6889	0.019	0.016	0.000	0.019
1.7333	0.019	0.016	0.000	0.019
1.7778	0.019	0.017	0.000	0.019
1.8222	0.019	0.017	0.000	0.019
1.8667	0.019	0.017	0.000	0.019
1.9111	0.019	0.018	0.000	0.019
1.9556	0.019	0.018	0.000	0.019
2.0000	0.019	0.019	0.000	0.019
2.0444	0.019	0.019	0.000	0.019
2.0889	0.019	0.020	0.000	0.019
2.1333	0.019	0.020	0.000	0.019
2.1778	0.019	0.020	0.000	0.019
2.2222	0.019	0.021	0.000	0.019
2.2667	0.019	0.021	0.000	0.019
2.3111	0.019	0.022	0.000	0.019
2.3556	0.019	0.022	0.000	0.019
2.4000	0.019	0.023	0.000	0.019
2.4444	0.019	0.023	0.000	0.019
2.4889	0.019	0.023	0.000	0.019
2.5333	0.019	0.024	0.000	0.019
2.5778	0.019	0.024	0.000	0.019
2.6222	0.019	0.025	0.000	0.019
2.6667	0.019	0.025	0.000	0.019
2.7111	0.019	0.026	0.000	0.019
2.7556	0.019	0.026	0.000	0.019
2.8000	0.019	0.026	0.000	0.019
2.8444	0.019	0.027	0.000	0.019
2.8889	0.019	0.027	0.000	0.019
2.9333	0.019	0.028	0.000	0.019
2.9778	0.019	0.028	0.000	0.019
3.0222	0.019	0.029	0.000	0.019
3.0667	0.019	0.029	0.000	0.019
3.1111	0.019	0.029	0.000	0.019
3.1556	0.019	0.030	0.000	0.019
3.2000	0.019	0.030	0.000	0.019
3.2444	0.019	0.031	0.000	0.019
3.2889	0.019	0.031	0.000	0.019
3.3333	0.019	0.032	0.000	0.019
3.3778	0.019	0.032	0.000	0.019
3.4222	0.019	0.032	0.000	0.019
3.4667	0.019	0.033	0.000	0.019
3.5111	0.019	0.033	0.018	0.019
3.5556	0.019	0.034	0.208	0.019
3.6000	0.019	0.034	0.502	0.019

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3.6444	0.019	0.035	0.869	0.019
3.6889	0.019	0.035	1.291	0.019
3.7333	0.019	0.035	1.756	0.019
3.7778	0.019	0.036	2.248	0.019
3.8222	0.019	0.036	2.755	0.019
3.8667	0.019	0.037	3.261	0.019
3.9111	0.019	0.037	3.752	0.019
3.9556	0.019	0.038	4.216	0.019
4.0000	0.019	0.038	4.639	0.019

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Analysis Results

POC 1

POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run.

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POC 2

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

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Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

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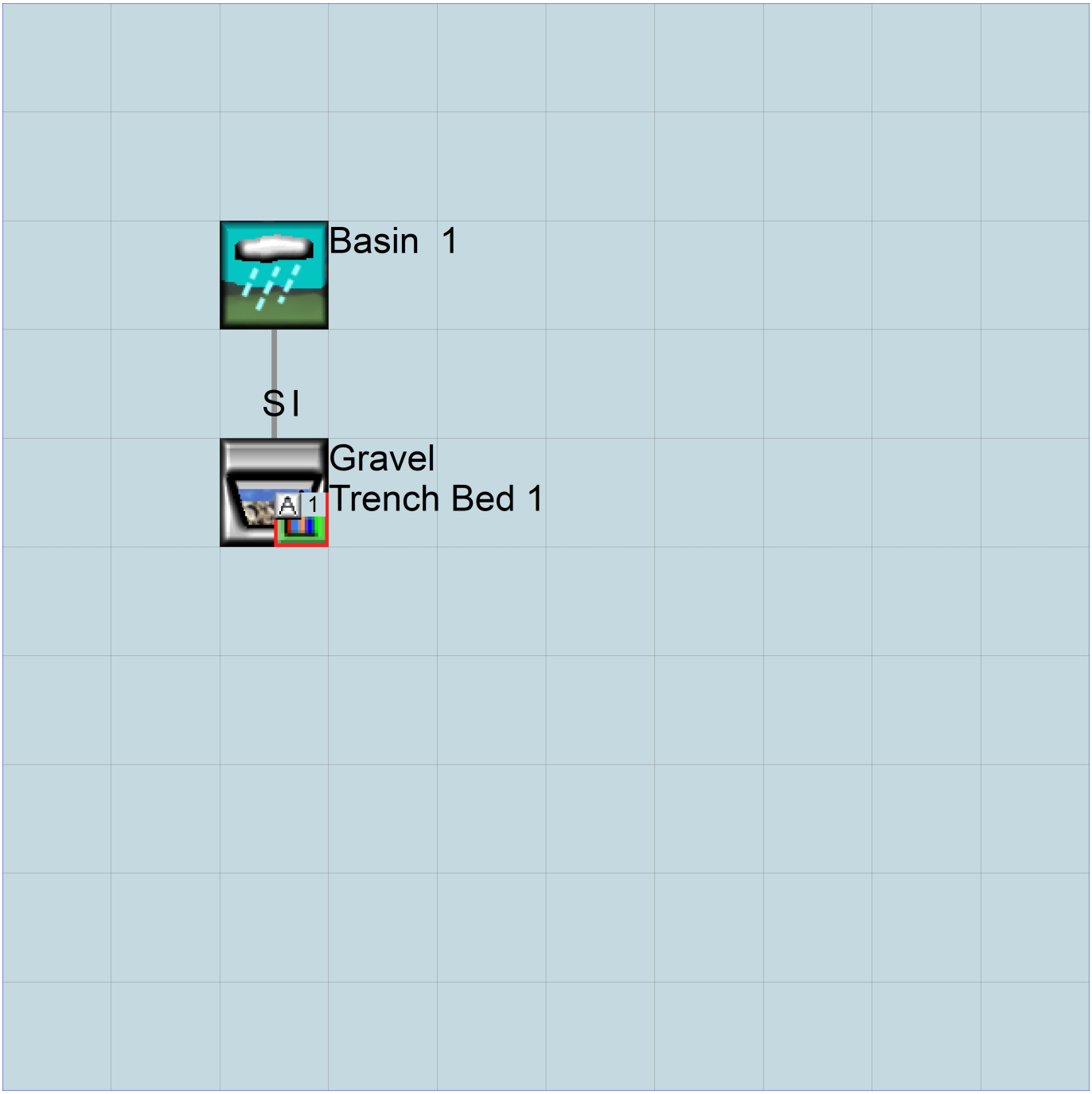
Appendix
Predeveloped Schematic

Mitigated Schematic



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Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   04-173 10th St.wdm
MESSU      25   Mit04-173 10th St.MES
           27   Mit04-173 10th St.L61
           28   Mit04-173 10th St.L62
           30   POC04-173 10th St1.dat
END FILES

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

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

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

  PWAT-PARM1
```

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

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  END PWAT-PARM4

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

END PERLND

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

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

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

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

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

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

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

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```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   4                        0.21     RCHRES   1      5

******Routing******
IMPLND   4                        0.21     COPY     1     15
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                             ***
    1     Gravel Trench Be-009     2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

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

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
```

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FTABLES
FTABLE 1
92 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.019192	0.000000	0.000000	0.000000		
0.044444	0.019192	0.000426	0.000000	0.019352		
0.088889	0.019192	0.000853	0.000000	0.019352		
0.133333	0.019193	0.001279	0.000000	0.019352		
0.177778	0.019193	0.001706	0.000000	0.019352		
0.222222	0.019193	0.002132	0.000000	0.019352		
0.266667	0.019193	0.002559	0.000000	0.019352		
0.311111	0.019193	0.002986	0.000000	0.019352		
0.355556	0.019194	0.003412	0.000000	0.019352		
0.400000	0.019194	0.003839	0.000000	0.019352		
0.444444	0.019194	0.004265	0.000000	0.019352		
0.488889	0.019194	0.004692	0.000000	0.019352		
0.533333	0.019195	0.005118	0.000000	0.019352		
0.577778	0.019195	0.005545	0.000000	0.019352		
0.622222	0.019195	0.005971	0.000000	0.019352		
0.666667	0.019195	0.006398	0.000000	0.019352		
0.711111	0.019196	0.006824	0.000000	0.019352		
0.755556	0.019196	0.007251	0.000000	0.019352		
0.800000	0.019196	0.007678	0.000000	0.019352		
0.844444	0.019196	0.008104	0.000000	0.019352		
0.888889	0.019196	0.008531	0.000000	0.019352		
0.933333	0.019197	0.008957	0.000000	0.019352		
0.977778	0.019197	0.009384	0.000000	0.019352		
1.022222	0.019197	0.009811	0.000000	0.019352		
1.066667	0.019197	0.010237	0.000000	0.019352		
1.111111	0.019198	0.010664	0.000000	0.019352		
1.155556	0.019198	0.011090	0.000000	0.019352		
1.200000	0.019198	0.011517	0.000000	0.019352		
1.244444	0.019198	0.011944	0.000000	0.019352		
1.288889	0.019198	0.012370	0.000000	0.019352		
1.333333	0.019199	0.012797	0.000000	0.019352		
1.377778	0.019199	0.013223	0.000000	0.019352		
1.422222	0.019199	0.013650	0.000000	0.019352		
1.466667	0.019199	0.014077	0.000000	0.019352		
1.511111	0.019200	0.014503	0.000000	0.019352		
1.555556	0.019200	0.014930	0.000000	0.019352		
1.600000	0.019200	0.015357	0.000000	0.019352		
1.644444	0.019200	0.015783	0.000000	0.019352		
1.688889	0.019200	0.016210	0.000000	0.019352		
1.733333	0.019201	0.016637	0.000000	0.019352		
1.777778	0.019201	0.017063	0.000000	0.019352		
1.822222	0.019201	0.017490	0.000000	0.019352		
1.866667	0.019201	0.017917	0.000000	0.019352		
1.911111	0.019202	0.018344	0.000000	0.019352		
1.955556	0.019202	0.018770	0.000000	0.019352		
2.000000	0.019202	0.019197	0.000000	0.019352		
2.044444	0.019202	0.019624	0.000000	0.019352		
2.088889	0.019202	0.020050	0.000000	0.019352		
2.133333	0.019203	0.020477	0.000000	0.019352		
2.177778	0.019203	0.020904	0.000000	0.019352		
2.222222	0.019203	0.021331	0.000000	0.019352		
2.266667	0.019203	0.021757	0.000000	0.019352		
2.311111	0.019204	0.022184	0.000000	0.019352		
2.355556	0.019204	0.022611	0.000000	0.019352		
2.400000	0.019204	0.023038	0.000000	0.019352		
2.444444	0.019204	0.023464	0.000000	0.019352		
2.488889	0.019204	0.023891	0.000000	0.019352		
2.533333	0.019205	0.024318	0.000000	0.019352		
2.577778	0.019205	0.024745	0.000000	0.019352		
2.622222	0.019205	0.025171	0.000000	0.019352		
2.666667	0.019205	0.025598	0.000000	0.019352		
2.711111	0.019206	0.026025	0.000000	0.019352		
2.755556	0.019206	0.026452	0.000000	0.019352		
2.800000	0.019206	0.026879	0.000000	0.019352		
2.844444	0.019206	0.027305	0.000000	0.019352		

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  2.888889  0.019207  0.027732  0.000000  0.019352
  2.933333  0.019207  0.028159  0.000000  0.019352
  2.977778  0.019207  0.028586  0.000000  0.019352
  3.022222  0.019207  0.029013  0.000000  0.019352
  3.066667  0.019207  0.029439  0.000000  0.019352
  3.111111  0.019208  0.029866  0.000000  0.019352
  3.155556  0.019208  0.030293  0.000000  0.019352
  3.200000  0.019208  0.030720  0.000000  0.019352
  3.244444  0.019208  0.031147  0.000000  0.019352
  3.288889  0.019209  0.031574  0.000000  0.019352
  3.333333  0.019209  0.032001  0.000000  0.019352
  3.377778  0.019209  0.032427  0.000000  0.019352
  3.422222  0.019209  0.032854  0.000000  0.019352
  3.466667  0.019209  0.033281  0.000000  0.019352
  3.511111  0.019210  0.033708  0.018652  0.019352
  3.555556  0.019210  0.034135  0.208271  0.019352
  3.600000  0.019210  0.034562  0.502178  0.019352
  3.644444  0.019210  0.034989  0.868991  0.019352
  3.688889  0.019211  0.035416  1.291716  0.019352
  3.733333  0.019211  0.035843  1.756250  0.019352
  3.777778  0.019211  0.036269  2.248837  0.019352
  3.822222  0.019211  0.036696  2.755385  0.019352
  3.866667  0.019211  0.037123  3.261505  0.019352
  3.911111  0.019212  0.037550  3.752915  0.019352
  3.955556  0.019212  0.037977  4.216091  0.019352
  4.000000  0.019212  0.038404  4.639092  0.019352
  4.044444  0.019212  0.039258  5.012517  0.019352
  END FTABLE  1
END FTABLES

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

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

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

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

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Local (360)943-0304

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	04-173 10th Street
Site Name:	10th St development
Site Address:	619 1/2 10th St E
City:	Puyallup, WA
Report Date:	3/1/2019
Gage:	
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

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

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Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Flat	0.533
Pervious Total	0.533
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.533

Element Flows To:

Surface	Interflow	Groundwater

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Mitigated Land Use

Lateral Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	.239

Element Flows To:

Surface	Interflow	Groundwater
Permeable Pavement 1	Permeable Pavement 1	

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Lateral I Basin 1

Bypass:	No
Impervious Land Use	acre
DRIVEWAYS FLAT LAT	0.068

Element Flows To:

Outlet 1	Outlet 2
Permeable Pavement 1	

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Routing Elements
Predeveloped Routing

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Mitigated Routing

Permeable Pavement 1

Pavement Area:0.0172 acre.Pavement Length:40.12 ft.

Pavement Width:	18.72 ft.
	Pavement slope 1:0.005 To 1
Pavement thickness:	0.5
Pour Space of Pavement:	0.3
Material thickness of second layer:	2
Pour Space of material for second layer:	0.2
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	2
Infiltration safety factor:	0.5
Total Volume Infiltrated (ac-ft.):	33.506
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	33.506
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0.764

Element Flows To:

Outlet 1 Outlet 2

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Permeable Pavement Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.017	0.000	0.000	0.000
0.0278	0.017	0.000	0.000	0.017
0.0556	0.017	0.000	0.000	0.017
0.0833	0.017	0.000	0.000	0.017
0.1111	0.017	0.000	0.000	0.017
0.1389	0.017	0.000	0.000	0.017
0.1667	0.017	0.000	0.000	0.017
0.1944	0.017	0.000	0.000	0.017
0.2222	0.017	0.000	0.000	0.017
0.2500	0.017	0.000	0.000	0.017
0.2778	0.017	0.001	0.000	0.017
0.3056	0.017	0.001	0.000	0.017
0.3333	0.017	0.001	0.000	0.017
0.3611	0.017	0.001	0.000	0.017
0.3889	0.017	0.001	0.000	0.017
0.4167	0.017	0.001	0.000	0.017
0.4444	0.017	0.001	0.000	0.017
0.4722	0.017	0.001	0.000	0.017
0.5000	0.017	0.001	0.000	0.017
0.5278	0.017	0.001	0.000	0.017
0.5556	0.017	0.001	0.000	0.017
0.5833	0.017	0.002	0.000	0.017
0.6111	0.017	0.002	0.000	0.017
0.6389	0.017	0.002	0.000	0.017
0.6667	0.017	0.002	0.000	0.017
0.6944	0.017	0.002	0.000	0.017
0.7222	0.017	0.002	0.000	0.017
0.7500	0.017	0.002	0.000	0.017
0.7778	0.017	0.002	0.000	0.017

0.8056	0.017	0.002	0.000	0.017
0.8333	0.017	0.002	0.000	0.017
0.8611	0.017	0.003	0.000	0.017
0.8889	0.017	0.003	0.000	0.017
0.9167	0.017	0.003	0.000	0.017
0.9444	0.017	0.003	0.000	0.017
0.9722	0.017	0.003	0.000	0.017
1.0000	0.017	0.003	0.000	0.017
1.0278	0.017	0.003	0.000	0.017
1.0556	0.017	0.003	0.000	0.017
1.0833	0.017	0.003	0.000	0.017
1.1111	0.017	0.003	0.000	0.017
1.1389	0.017	0.003	0.000	0.017
1.1667	0.017	0.004	0.000	0.017
1.1944	0.017	0.004	0.000	0.017
1.2222	0.017	0.004	0.000	0.017
1.2500	0.017	0.004	0.000	0.017
1.2778	0.017	0.004	0.000	0.017
1.3056	0.017	0.004	0.000	0.017
1.3333	0.017	0.004	0.000	0.017
1.3611	0.017	0.004	0.000	0.017
1.3889	0.017	0.004	0.000	0.017
1.4167	0.017	0.004	0.000	0.017
1.4444	0.017	0.005	0.000	0.017
1.4722	0.017	0.005	0.000	0.017
1.5000	0.017	0.005	0.000	0.017
1.5278	0.017	0.005	0.000	0.017
1.5556	0.017	0.005	0.000	0.017
1.5833	0.017	0.005	0.000	0.017
1.6111	0.017	0.005	0.000	0.017
1.6389	0.017	0.005	0.000	0.017
1.6667	0.017	0.005	0.000	0.017
1.6944	0.017	0.005	0.000	0.017
1.7222	0.017	0.005	0.000	0.017
1.7500	0.017	0.006	0.000	0.017
1.7778	0.017	0.006	0.000	0.017
1.8056	0.017	0.006	0.000	0.017
1.8333	0.017	0.006	0.000	0.017
1.8611	0.017	0.006	0.000	0.017
1.8889	0.017	0.006	0.000	0.017
1.9167	0.017	0.006	0.000	0.017
1.9444	0.017	0.006	0.000	0.017
1.9722	0.017	0.006	0.000	0.017
2.0000	0.017	0.006	0.000	0.017
2.0278	0.017	0.007	0.000	0.017
2.0556	0.017	0.007	0.000	0.017
2.0833	0.017	0.007	0.000	0.017
2.1111	0.017	0.007	0.000	0.017
2.1389	0.017	0.007	0.000	0.017
2.1667	0.017	0.007	0.000	0.017
2.1944	0.017	0.007	0.000	0.017
2.2222	0.017	0.008	0.000	0.017
2.2500	0.017	0.008	0.000	0.017
2.2778	0.017	0.008	0.000	0.017
2.3056	0.017	0.008	0.000	0.017
2.3333	0.017	0.008	0.000	0.017
2.3611	0.017	0.008	0.000	0.017
2.3889	0.017	0.008	0.000	0.017

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2.4167	0.017	0.009	0.000	0.017
2.4444	0.017	0.009	0.000	0.017
2.4722	0.017	0.009	0.000	0.017
2.5000	0.017	0.009	0.000	0.017

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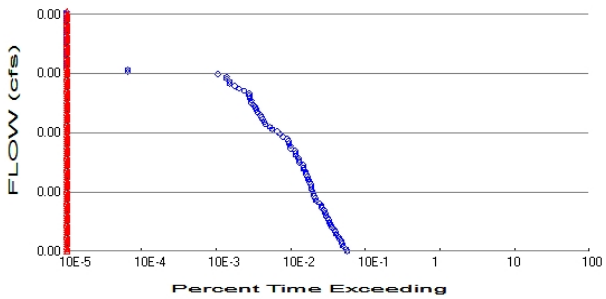
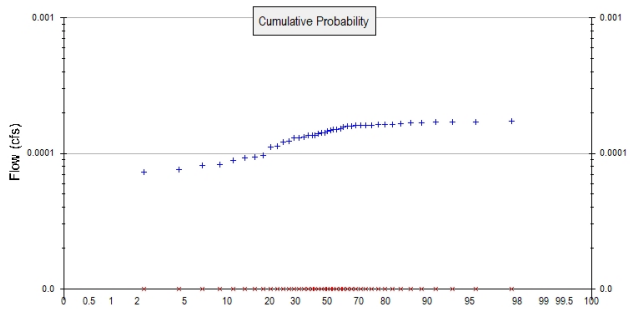
Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.533
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.239
Total Impervious Area: 0.08524

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.000137
5 year	0.000168
10 year	0.000183
25 year	0.000196
50 year	0.000204
100 year	0.00021

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.000	0.000
1903	0.000	0.000
1904	0.000	0.000
1905	0.000	0.000
1906	0.000	0.000
1907	0.000	0.000
1908	0.000	0.000
1909	0.000	0.000
1910	0.000	0.000
1911	0.000	0.000

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1912	0.000	0.000
1913	0.000	0.000
1914	0.000	0.000
1915	0.000	0.000
1916	0.000	0.000
1917	0.000	0.000
1918	0.000	0.000
1919	0.000	0.000
1920	0.000	0.000
1921	0.000	0.000
1922	0.000	0.000
1923	0.000	0.000
1924	0.000	0.000
1925	0.000	0.000
1926	0.000	0.000
1927	0.000	0.000
1928	0.000	0.000
1929	0.000	0.000
1930	0.000	0.000
1931	0.000	0.000
1932	0.000	0.000
1933	0.000	0.000
1934	0.000	0.000
1935	0.000	0.000
1936	0.000	0.000
1937	0.000	0.000
1938	0.000	0.000
1939	0.000	0.000
1940	0.000	0.000
1941	0.000	0.000
1942	0.000	0.000
1943	0.000	0.000
1944	0.000	0.000
1945	0.000	0.000

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Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0002	0.0000
2	0.0002	0.0000
3	0.0002	0.0000
4	0.0002	0.0000
5	0.0002	0.0000
6	0.0002	0.0000
7	0.0002	0.0000
8	0.0002	0.0000
9	0.0002	0.0000
10	0.0002	0.0000
11	0.0002	0.0000
12	0.0002	0.0000
13	0.0002	0.0000
14	0.0002	0.0000
15	0.0002	0.0000
16	0.0002	0.0000
17	0.0002	0.0000
18	0.0002	0.0000
19	0.0002	0.0000
20	0.0001	0.0000

21	0.0001	0.0000
22	0.0001	0.0000
23	0.0001	0.0000
24	0.0001	0.0000
25	0.0001	0.0000
26	0.0001	0.0000
27	0.0001	0.0000
28	0.0001	0.0000
29	0.0001	0.0000
30	0.0001	0.0000
31	0.0001	0.0000
32	0.0001	0.0000
33	0.0001	0.0000
34	0.0001	0.0000
35	0.0001	0.0000
36	0.0001	0.0000
37	0.0001	0.0000
38	0.0001	0.0000
39	0.0001	0.0000
40	0.0001	0.0000
41	0.0001	0.0000
42	0.0001	0.0000
43	0.0001	0.0000
44	0.0000	0.0000

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Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0001	864	0	0	Pass
0.0001	841	0	0	Pass
0.0001	772	0	0	Pass
0.0001	745	0	0	Pass
0.0001	727	0	0	Pass
0.0001	689	0	0	Pass
0.0001	669	0	0	Pass
0.0001	627	0	0	Pass
0.0001	604	0	0	Pass
0.0001	577	0	0	Pass
0.0001	549	0	0	Pass
0.0001	531	0	0	Pass
0.0001	510	0	0	Pass
0.0001	485	0	0	Pass
0.0001	471	0	0	Pass
0.0001	452	0	0	Pass
0.0001	445	0	0	Pass
0.0001	431	0	0	Pass
0.0001	403	0	0	Pass
0.0001	392	0	0	Pass
0.0001	373	0	0	Pass
0.0001	338	0	0	Pass
0.0001	326	0	0	Pass
0.0001	315	0	0	Pass
0.0001	308	0	0	Pass
0.0001	297	0	0	Pass
0.0001	288	0	0	Pass
0.0001	286	0	0	Pass
0.0001	282	0	0	Pass
0.0001	270	0	0	Pass
0.0001	262	0	0	Pass
0.0001	256	0	0	Pass
0.0001	246	0	0	Pass
0.0001	241	0	0	Pass
0.0001	230	0	0	Pass
0.0001	226	0	0	Pass
0.0001	222	0	0	Pass
0.0001	198	0	0	Pass
0.0001	197	0	0	Pass
0.0001	192	0	0	Pass
0.0001	181	0	0	Pass
0.0001	176	0	0	Pass
0.0001	174	0	0	Pass
0.0001	153	0	0	Pass
0.0001	151	0	0	Pass
0.0001	144	0	0	Pass
0.0001	140	0	0	Pass
0.0001	136	0	0	Pass
0.0001	119	0	0	Pass
0.0001	111	0	0	Pass
0.0001	101	0	0	Pass
0.0001	86	0	0	Pass
0.0001	80	0	0	Pass

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0.0001	70	0	0	Pass
0.0001	67	0	0	Pass
0.0001	64	0	0	Pass
0.0001	62	0	0	Pass
0.0001	60	0	0	Pass
0.0001	55	0	0	Pass
0.0001	53	0	0	Pass
0.0002	51	0	0	Pass
0.0002	48	0	0	Pass
0.0002	45	0	0	Pass
0.0002	45	0	0	Pass
0.0002	43	0	0	Pass
0.0002	42	0	0	Pass
0.0002	42	0	0	Pass
0.0002	36	0	0	Pass
0.0002	31	0	0	Pass
0.0002	27	0	0	Pass
0.0002	23	0	0	Pass
0.0002	23	0	0	Pass
0.0002	21	0	0	Pass
0.0002	21	0	0	Pass
0.0002	16	0	0	Pass
0.0002	1	0	0	Pass
0.0002	1	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass

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Water Quality

Water Quality BMP Flow and Volume for POC #1

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

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LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Permeable Pavement 1 POC	☐	8.67			☐	99.52			
Total Volume Infiltrated		8.67	0.00	0.00		99.52	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

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Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

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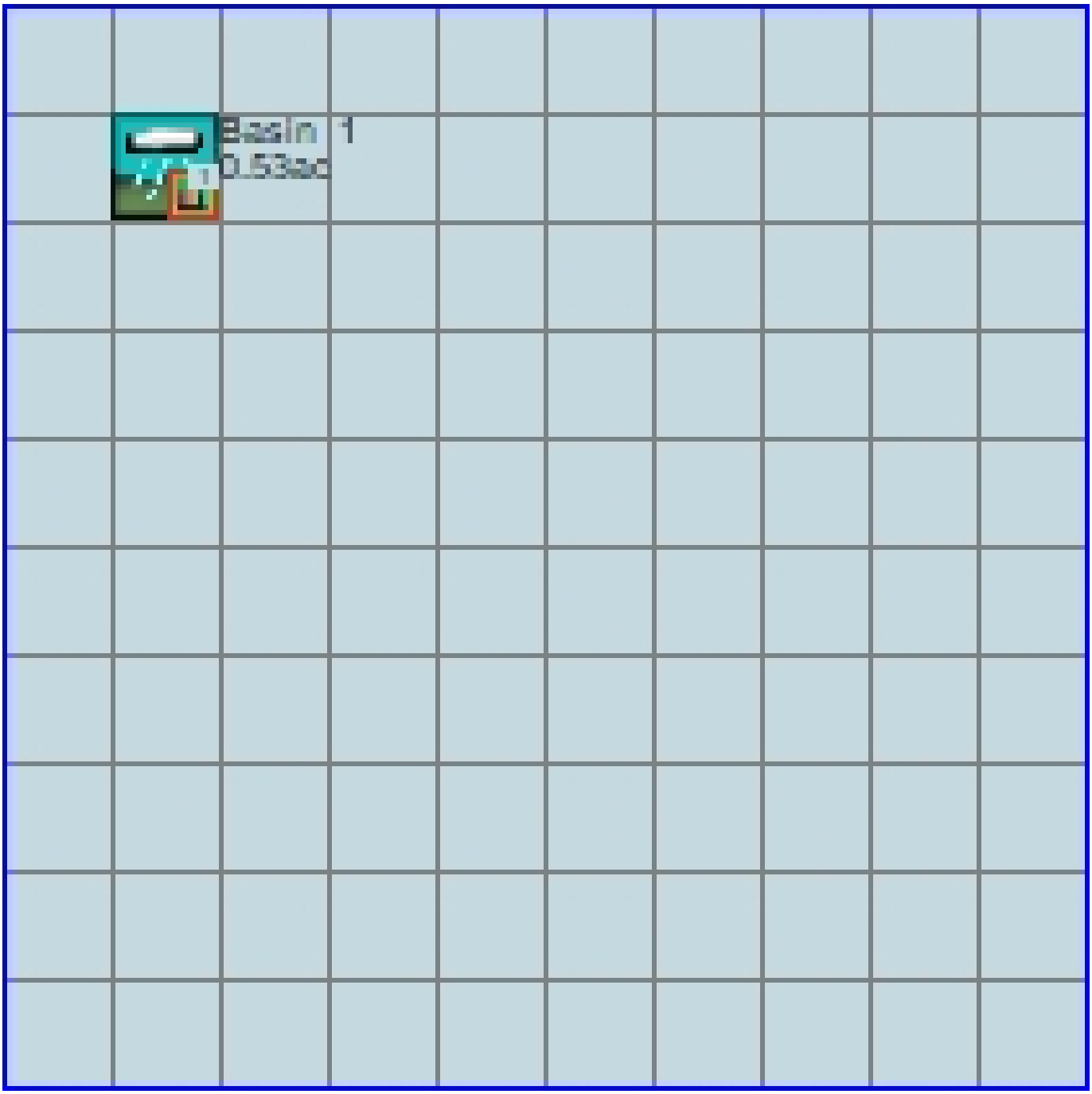
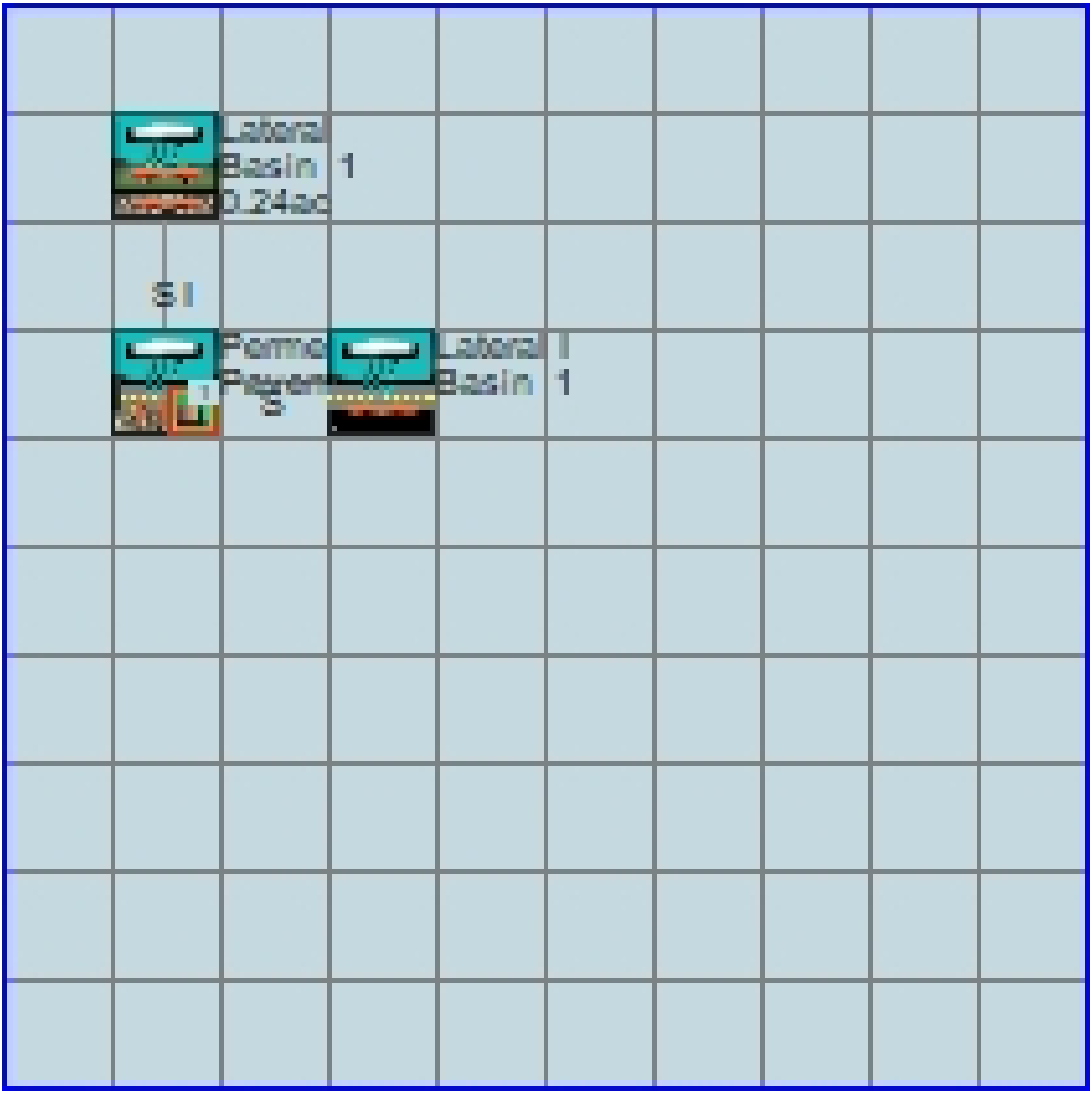
Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   04-173 10th Street.wdm
MESSU      25   Pre04-173 10th Street.MES
           27   Pre04-173 10th Street.L61
           28   Pre04-173 10th Street.L62
           30   POC04-173 10th Street1.dat
END FILES

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

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

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

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```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    1         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    1              0         5         2       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    1              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    1            0.2       0.5      0.35         0       0.7       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    1              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

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```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   1                       0.533     COPY   501     12
PERLND   1                       0.533     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

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

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

END EXT SOURCES

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

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

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


END MASS-LINK

END RUN
```

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Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   04-173 10th Street.wdm
MESSU      25   Mit04-173 10th Street.MES
           27   Mit04-173 10th Street.L61
           28   Mit04-173 10th Street.L62
           30   POC04-173 10th Street1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      38
      IMPLND      18
      IMPLND      16
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -   #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Permeable Pavement  1       MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -   #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -   #                          User  t-series Engl Metr ***
                                            in  out           ***
   38     A/B, Lawn, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -   # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   38         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
```

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```
    # -   # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   38         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -   # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   38         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -   # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   38             0         5       0.8       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -   # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   38             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -   #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   38             0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -   # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   38             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -   #                     User  t-series Engl Metr ***
                                     in  out           ***
   18     DRIVEWAYS/FLAT LAT      1    1    1   27    0
   16      Porous Pavement        1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -   # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   18         0    0    1    0    0    0
   16         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -   # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   18         0    0    4    0    0    0    1    9
   16         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -   # CSNO RTOP  VRS  VNN RTLI     ***
   18         0    0    0    0    0
   16         0    0    0    0    0
  END IWAT-PARM1

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

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```
   18            400      0.01       0.1       0.1
   16            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
   18              0         0
   16              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
   18              0         0
   16              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Lateral Basin  1***
PERLND  38                     13.8631     IMPLND  16     54
PERLND  38                     13.8631     IMPLND  16     55
Lateral I Basin  1***
IMPLND  18                      3.9443     IMPLND  16     53
IMPLND  16                      0.0172     RCHRES   1      5

******Routing******
PERLND  38                     13.8631     COPY     1     12
PERLND  38                     13.8631     COPY     1     13
IMPLND  18                      3.9443     COPY     1     15
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
    1     Permeable Paveme-005    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

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

  HYDR-PARM1
```

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```
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.017240  0.000000  0.000000  0.000000
  0.027778  0.017240  0.000096  0.000000  0.017384
  0.055556  0.017240  0.000192  0.000000  0.017384
  0.083333  0.017240  0.000287  0.000000  0.017384
  0.111111  0.017240  0.000383  0.000000  0.017384
  0.138889  0.017240  0.000479  0.000000  0.017384
  0.166667  0.017240  0.000575  0.000000  0.017384
  0.194444  0.017240  0.000670  0.000000  0.017384
  0.222222  0.017240  0.000766  0.000000  0.017384
  0.250000  0.017240  0.000862  0.000000  0.017384
  0.277778  0.017240  0.000958  0.000000  0.017384
  0.305556  0.017240  0.001054  0.000000  0.017384
  0.333333  0.017240  0.001149  0.000000  0.017384
  0.361111  0.017240  0.001245  0.000000  0.017384
  0.388889  0.017240  0.001341  0.000000  0.017384
  0.416667  0.017240  0.001437  0.000000  0.017384
  0.444444  0.017240  0.001532  0.000000  0.017384
  0.472222  0.017240  0.001628  0.000000  0.017384
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END FTABLES

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<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              RCHRES   1     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS
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```
MASS-LINK
<Volume>    <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK         5
IMPLND      IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK     5

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

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

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

  MASS-LINK        17
RCHRES      OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK    17

  MASS-LINK        53
IMPLND      IWATER SURO                     IMPLND         EXTNL  SURLI
  END MASS-LINK    53

  MASS-LINK        54
PERLND      PWATER SURO                     IMPLND         EXTNL  SURLI
  END MASS-LINK    54

  MASS-LINK        55
PERLND      PWATER IFWO                     IMPLND         EXTNL  SURLI
  END MASS-LINK    55


END MASS-LINK

END RUN
```

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APPENDIX C

Operation and Maintenance Manual

V-4.6 Maintenance Standards for Drainage Facilities

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceedence of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table V-4.5.2(1) Maintenance Standards - Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants	Any evidence of oil,	No contaminants or pol-

Table V-4.5.2(5) Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks. Frame is sit-

Table V-4.5.2(5) Maintenance Standards - Catch Basins (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	ting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into	Mechanism opens with

Table V-4.5.2(5) Maintenance Standards - Catch Basins (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Working	frame have less than 1/2 inch of thread.	proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Table V-4.5.2(6) Maintenance Standards - Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4

Table V-4.5.2(17) Maintenance Standards - Coalescing Plate Oil/Water Separators (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	inlet/outlet pipe.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-4.5.2(18) Maintenance Standards - Catch Basin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Table V-4.5.2(21) Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				up pet waste.
Insect pests	Every site visit associated with vegetation management		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	• Reduce hiding places for pests by removing diseased and dead plants • For infestations, follow IPM protocols (see "Additional Maintenance Resources" section for more information on IPM protocols)

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

IPM - Integrated Pest Management

ISA - International Society of Arboriculture

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				
Permeable	A, S		Runoff from	• Clean deposited soil or

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Pavements, all			adjacent pervious areas deposits soil, mulch or sediment on paving	other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface

Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods:
				• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves)
				• Vacuum/sweep permeable paving installation using:
				  ◦ Walk-behind vacuum (sidewalks)
				  ◦ High efficiency regenerative air or vacuum sweeper (roadways, parking lots)

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				◦ ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.
	A[b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective main-

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				tenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods: ◦ Combined pressure wash and vacuum system calibrated to not dislodge wearing course aggregate. ◦ Hand held pressure washer or power washer with rotating brushes ◦ Pure vacuum sweepers Note: If the annual/biannual routine maintenance standard to clean the pavement surface is conducted using equipment from the list above, corrective maintenance may not be needed.
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding then see above. • Determine source of sediment loading and evaluate whether or not the source

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Pressure wash, vacuum sweep, or use a combination of the two for cleaning moss from pavement surface. May require stiff broom or power brush in areas of heavy moss.
	A		Major cracks or trip hazards and concrete spalling and raveling	• Fill potholes or small cracks with patching mixes • Large cracks and settlement may require cutting and replacing the pavement section. Replace in-kind where feasible. Replacing porous asphalt with conventional asphalt is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function. • Take appropriate pre-

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				cautions during pavement repair and replacement efforts to prevent clogging of adjacent porous materials

Interlocking concrete paver blocks and aggregate pavers		A or B	None (routine maintenance)	Clean pavement surface using one or a combination of the following methods:
				• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves)
				• Vacuum/sweep permeable paving installation using:
				  ◦ Walk-behind vacuum (sidewalks)
				  ◦ High efficiency regenerative air or vacuum sweeper (roadways, parking lots)
				  ◦ ShopVac or brush brooms (small areas)
				Note: Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints. Vacuum surface openings in dry weather to remove dry, encrusted sediment.

	A[b]		Surface is	• Review the overall per-

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
			clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	formance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. • Clogging is usually an issue in the upper 2 to 3 centimeters of aggregate. Remove the upper layer of encrusted sediment, and fines, and/or vegetation from openings and joints between the pavers by mechanical means and/or suction equipment (e.g., pure vacuum sweeper).

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
b				
A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding, then see above. • Determine source of sediment loading and evaluate whether or not the source can be	

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
			reduced/-eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).	
Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry	

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
			• Parking lots and roadways: Vacuum sweep or stiff broom/-power brush for cleaning moss from pavement surface	
A		Paver block missing or damaged	Remove individual damaged paver blocks by hand and replace or repair per manufacturer's recommendations	
A		Loss of aggregate material between paver blocks	Refill per manufacturer's recommendations for interlocking paver sections	
A		Settlement of	May require	

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
		surface	resetting	
Open-celled paving grid with gravel		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A[b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Use vacuum truck to remove and replace top course aggregate • Replace aggregate in paving grid per manufacturer's recommendations
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace gravel • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Loss of	Replenish aggregate material by

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
			aggregate material in paving grid	spreading gravel with a rake (gravel level should be maintained at the same level as the plastic rings or no more than 1/4 inch above the top of rings). See manufacturer's recommendations.
		A	Weeds present	• Manually remove weeds • Presence of weeds may indicate that too many fines are present (refer to Actions Needed under "Aggregate is clogged" to address this issue)
Open-celled paving grid with grass		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A[b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	Rehabilitate per manufacturer's recommendations.

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace grass • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Poor grass coverage in paving grid	• Restore growing medium, reseed or plant, aerate, and/or amend vegetated area as needed • Traffic loading may be inhibiting grass growth; reconsider traffic loading if feasible
		As needed	None (routine maintenance)	Use a mulch mower to mow grass
		A	None (routine maintenance)	• Sprinkle a thin layer of compost on top of grass surface (1/2" top dressing) and sweep it in • Do not use fertilizer
		A	Weeds present	• Manually remove weeds • Mow, torch, or inoculate and replace with preferred vegetation
Inlets/Outlets/Pipes				
Inlet/outlet	A		Pipe is dam-	Repair/replace

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
pipe			aged	
	A		Pipe is clogged	Remove roots or debris
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain (may cause prolonged drawdown period)	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Raised subsurface overflow pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Outlet structure	A, S		Sediment, vegetation, or debris reducing capacity of outlet structure	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
Overflow	B		Native soil is exposed or other signs of erosion damage are present at discharge point	Repair erosion and stabilize surface

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Aggregate Storage Reservoir				
Observation port	A, S		Water remains in the storage aggregate longer than anticipated by design after the end of a storm	If immediate cause of extended ponding is not identified, schedule investigation of subsurface materials or other potential causes of system failure.
Vegetation				
Adjacent large shrubs or trees		As needed	Vegetation related fallout clogs or will potentially clog voids	• Sweep leaf litter and sediment to prevent surface clogging and ponding • Prevent large root systems from damaging subsurface structural components
		Once in May and Once in September	Vegetation growing beyond facility edge onto sidewalks, paths, and street edge	Edging and trimming of planted areas to control groundcovers and shrubs from overreaching the sidewalks, paths and street edge improves appearance and reduces clogging of permeable pavements by leaf litter, mulch and soil.
Leaves, needles, and organic debris		In fall (October to December) after leaf drop (1-3 times, depending on canopy cover)	Accumulation of organic debris and leaf litter	Use leaf blower or vacuum to blow or remove leaves, evergreen needles, and debris (i.e., flowers, blossoms) off of and away from permeable pavement
Note that the inspection and routine maintenance frequencies listed above are recom-				

Table V-4.5.2(22) Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
mended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".				
a Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).				
b Inspection should occur during storm event.				

APPENDIX D

Construction Stormwater Pollution Prevention Plan (SWPPP)

CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

10TH STREET DEVELOPMENT PROJECT
APN's 7845000622, 7845000591, 7845000600 & 7845000571

619 ½ 10th Street SE
Puyallup, Washington 98372

Job #04-173-01

March 29, 2019

Prepared for:
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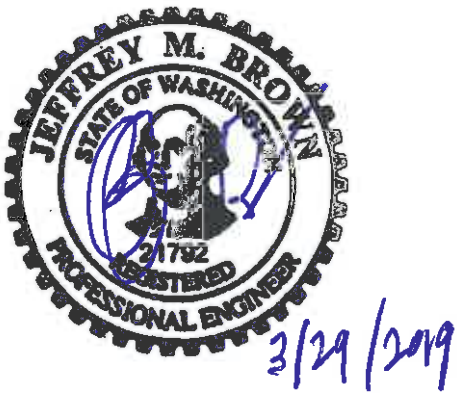
ENGINEER'S CERTIFICATION:

"I hereby state that this Construction Stormwater Pollution Prevention Plan for the 10th Street Development Project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Puyallup does not and will not assume liability for the sufficiency, suitability, or performance of Construction SWPPP BMP's prepared by me."



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BMP C103: High Visibility Fence
BMP C105: Stabilized Construction Entrance / Exit
BMP C120: Temporary and Permanent Seeding
BMP C121: Mulching
BMP C123: Plastic Covering
BMP C140: Dust Control
BMP C151: Concrete Handling
BMP C152: Sawcutting and Surfacing Pollution Prevention
BMP C153: Material Delivery, Storage and Containment
BMP C154: Concrete Washout Area
BMP C160: Certified Erosion and Sediment Control Lead
BMP C162: Scheduling

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BMP C220: Storm Drain Inlet Protection
BMP C233: Silt Fence

I. Data Collection

Topography

The existing site gently slopes to the northwest with slopes in the 0.5 percent range.

Drainage

Please see the Downstream Map included in Appendix A, Figure 4. The existing on-site drainage pattern has been depicted on it.

Soils

Please see the SCS Soils Summary in Appendix A, Figure 5. The soils are mapped as Type 31A, Puyallup Fine Sandy Loam. This Type B soil has a moderate capacity to infiltrate water.

A soils report has not been prepared for the project.

Ground Cover

Existing ground cover consists of grass and scattered shrubs.

Critical Areas

There are no Critical Areas on-site.

Adjacent Areas

The project site is surrounded by single-family residences. Please see the Vicinity Map in Appendix A, Figure 1.

Existing Encumbrances

There are no known encumbrances on the site.

Precipitation Records

The BMP's proposed for the site do not require precipitation records.

II. Data Analysis

Topography

Please see the following in Appendix A:

Downstream Map

The existing site gently slopes to the northwest with slopes in the 0.5 percent range.

Drainage

Please see the Downstream Map included in Appendix A. The existing on-site drainage pattern has been depicted on it.

In proposed conditions, roof runoff will be addressed with downspout infiltration systems. Other hard surfaces (driveways) will be addressed with permeable pavement.

Soils

Please see the SCS Soils Summary in Appendix A, Figure 5. The soils are mapped as Type 31A, Puyallup Fine Sandy Loam. This Type B soil has a moderate capacity to infiltrate water.

Ground Cover

Existing ground cover consists of grass and scattered shrubs.

Critical Areas

There are no Critical Areas on-site.

Adjacent Areas

The project site is surrounded by single-family residences. Please see the Vicinity Map in Appendix A, Figure 1.

Precipitation Records

The BMP's proposed for the site do not require precipitation records.

Timing of Project

Depending upon the status of approval of drawings and permit issuance, at this time it appears that the project may begin construction in the spring of 2019 and finish site activities in the summer of 2019.

III. CONSTRUCTION SWPPP DEVELOPMENT AND IMPLEMENTATION

Elements of Construction SWPPP

1. Preserve Vegetation/Mark Clearing Limits

As the first order of tasks the clearing limits will be marked as shown in the TESC Plan. Clearing limits are also used to limit the construction away from the adjacent property and right of way where construction will not occur.

The following BMP's are proposed.

BMP C103: High Visibility Fence

2. Establish Construction Access

Access and exit of construction vehicles to and from site is limited to one route. The exit point is stabilized with a pad of quarry spalls, to minimize tracking sediment onto roads. A wheel wash area is located at the exit location.

Vacuum sweeper etc will be utilized as necessary to pick up the sediment tracked on to the road. Street washing is not acceptable.

The following BMPs are proposed.

• BMP C105: Stabilized Construction Entrance/Exit

3. Control Flow Rates

The on-site soils are highly conducive to infiltration; therefore, no runoff is anticipated from the project site.

There is no overland runoff discharge proposed or anticipated.

The following BMPs are proposed.

BMP C233: Silt fence

4. Install Sediment Controls

There is no overland runoff discharge proposed or anticipated.

The following BMPs are proposed.

BMP C233: Silt fence

5. Stabilize Soils

To stabilize exposed soils and materials stockpiled, measures such as temporary/permanent seeding, mulching, plastic covering, and dust control are proposed.

Soils must not remain exposed and unworked for more than the time periods set forth below to prevent erosion.

During the dry season (May 1 - Sept. 30): 7 days
During the wet season (October 1 - April 30): 2 days

Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.

Stabilize soil stockpiles from erosion with plastic covering

The following BMPs are proposed.

BMP C120: Temporary and Permanent Seeding
BMP C121: Mulching
BMP C123: Plastic Covering
BMP C140: Dust Control

6. Protect Slopes

Temporary and permanent seeding, mulching and matting, plastic covering measures will be employed to protect slopes.

The following BMPs are proposed.

BMP C120: Temporary and Permanent Seeding
BMP C121: Mulching
BMP C123: Plastic Covering

7. Protect Drain Inlets

There are drainage structures located within the right-of-way and adjacent property that have the potential to receive silt-laden runoff. Therefore, sediment sock types of inlet protection are proposed for these structures.

The following BMP is proposed.

• BMP C220: Storm Drain Inlet Protection

8. Stabilize Channels and Outlets

Since the project does not have a permanent channel type runoff conveyance system, this Element is not relevant.

9. Control Pollutants

Several effective pollution prevention BMPs that provide source control of pollutants, runoff treatment, operational, and structural flow control are proposed to minimize the discharge of pollutants.

On this project the stormwater will be kept from coming in contact with pollutants, waste materials and demolition debris.

All chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment will be provided cover, containment, and protection from vandalism.

A specific area is designated to conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. We propose cleaning contaminated surfaces immediately following any spill incident.

Wheel wash or tire bath wastewater will discharge to a separate on-site holding
Fertilizers and pesticides will be applied in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' label requirements will be followed for application rates and procedures.

Washout of concrete trucks is to be performed off-site or in designated concrete washout areas only. Concrete trucks are not to be washed out onto the ground, or into storm drains, open ditches, streets, or streams. Excess concrete is not to be dumped on site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.

The following BMPs are proposed.

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

10. Control Dewatering

It is anticipated that this element is not relevant to the project.

11. Maintain BMPs

The TESC notes require an Owner designated CESC lead person to be responsible for the TESC measures. The notes also require that as the conditions change, the TESC BMPs would need to be adjusted on-site by the lead person. Also, the lead person is responsible for routine and special inspection when needed. If a BMP requires maintenance the CESC lead is responsible to provide the needed maintenance.

The following BMP is proposed.

BMP C160: Certified Erosion and Sediment Control Lead

12. Manage the Project

Owner is to designate a Certified ESC Lead responsible to Inspect, maintain, and repair all BMPs as needed to assure continued performance of their intended function.
The Certified ESC Lead is also responsible for keeping the Construction SWPPP updated.

The following BMP is proposed.

BMP C160: Certified Erosion and Sediment Control Lead
BMP C162: Scheduling

13. Protect Low Impact Development BMPs

All heavy equipment is to be kept off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

The following BMP is proposed.

BMP C233: Silt Fence
BMP C160: Certified Erosion and Sediment Control Lead

t:\projects files (active)\04-173, 10th street duplex 2017\documents\drainage report\appendices\04-173-01 swppp_2019-03-29.doc

IV. SOURCE CONTROL BMPs

ATTACHED IN UPCOMING PAGES

BMP C103: High Visibility Fence
BMP C105: Stabilized Construction Entrance / Exit
BMP C120: Temporary and Permanent Seeding
BMP C121: Mulching
BMP C123: Plastic Covering
BMP C140: Dust Control
BMP C151: Concrete Handling
BMP C152: Sawcutting and Surfacing Pollution Prevention
BMP C153: Material Delivery, Storage and Containment
BMP C154: Concrete Washout Area
BMP C160: Certified Erosion and Sediment Control Lead
BMP C162: Scheduling

Table 3.1. Source Control BMPs by SWPPP Element

BMP or Element Name	Element #1 Preserve Vegetation/ Mark Clearing Limits	Element #2 Establish Construction Access	Element #5 Stabilize Soils	Element #6 Protect Slopes	Element #8 Stabilize Channels and Outlets	Element #9 Control Pollutants	Element #11 Maintain BMPs	Element #12 Manage the Project	Element #13 Protect Low Impact Development
BMP C101: Preserving Natural Vegetation	✓								
BMP C102: Buffer Zones	✓								✓
BMP C103: High Visibility Plastic or Metal Fence	✓								✓
BMP C105: Stabilized Construction Entrance/ Exit		✓							
BMP C106: Wheel Wash		✓							
BMP C107: Construction Road/Parking Area Stabilization		✓							
BMP C120: Temporary and Permanent Seeding			✓	✓					
BMP C121: Mulching			✓	✓					
BMP C122: Nets and Blankets			✓	✓	✓				
BMP C123: Plastic Covering			✓	✓					
BMP C124: Sodding			✓	✓					
BMP C125: Topsoiling/ Composting			✓						
BMP C126: Polyacrylamide for Soil Erosion Protection			✓						
BMP C130: Surface Roughening			✓	✓					
BMP C131: Gradient Terraces			✓	✓					
BMP C140: Dust Control			✓						
BMP C150: Materials On Hand							✓	✓	
BMP C151: Concrete Handling						✓			
BMP C152: Sawcutting and Surfacing Pollution Prevention						✓			
BMP C153: Material Delivery, Storage, and Containment						✓			
BMP C154: Concrete Washout Area						✓			
BMP C160: Certified Erosion and Sediment Control Lead							✓	✓	
BMP C162: Scheduling								✓	

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 Attachments Section C, Detail 4.0 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-inch 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 onsite. 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. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. The county has reviewed these products for application in Pierce County, and has developed a county-specific list of the approved and prohibited products. This county-specific list can be obtained from Pierce County Planning and Land Services' (PALS) web site: <piercecountywa.org/PALS>. The county web site is updated routinely, but the latest list from Ecology is available on Ecology's web site at <www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html>.

Contact the county if a new Ecology approved product is not listed on the county web site.

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 should 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 should always be used because they are more efficient and have fewer environmental impacts. It is recommended that areas being seeded for final landscaping conduct soil tests to determine the exact type and quantity of fertilizer needed. This will prevent the over-application of fertilizer. Fertilizer should not be added to the hydromulch machine 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 soil preservation and amendment in Volume III, Section 3.1.
- 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.
- Apply these mixes, with the exception of the wetland mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used.
- Consult the local suppliers 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 county may be used.
- Other mixes may be appropriate, depending on the soil type and hydrology of the area.
- Table 3.2 represents the standard mix for areas requiring a temporary vegetative cover.

Table 3.2. Temporary Erosion Control Seed Mix.

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

- Table 3.3 lists a recommended mix for landscaping seed.

Table 3.3. Landscaping Seed Mix.

	% Weight	% Purity	% Germination
Perennial rye blend (*Lolium perenne*)	70	98	90
Chewings and red fescue blend (*Festuca rubra var. commutata* or *Festuca rubra*)	30	98	90

- Table 3.4 lists a turf seed mix in dry situations where there is no need for watering. This mix requires very little maintenance.

Table 3.4. Low-Growing Turf Seed Mix.

	% Weight	% Purity	% Germination
Dwarf tall fescue (several varieties) (*Festuca arundinacea var.*)	45	98	90
Dwarf perennial rye (Barclay) (*Lolium perenne var. Barclay*)	30	98	90
Red fescue (*Festuca rubra*)	20	98	90
Colonial bentgrass (*Agrostis tenuis*)	5	98	90

- Table 3.5 lists a mix for bioswales and other intermittently wet areas.

Table 3.5. Bioswale Seed Mix.[a]

	% Weight	% Purity	% Germination
Tall or meadow fescue (*Festuca arundinacea* or *Festuca elatior*)	75 to 80	98	90
Seaside/Creeping bentgrass (*Agrostis palustris*)	10 to 15	92	85
Redtop bentgrass (*Agrostis alba* or *Agrostis gigantea*)	5 to 10	90	80

[a] *Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix*

- Table 3.6 lists a low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Apply this mixture at a rate of 60 pounds per acre. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.

Table 3.6. Wet Area Seed Mix.[a]

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

[a] *Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix*

- Table 3.7 lists a recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.

Table 3.7. Meadow Seed Mix.

	% Weight	% Purity	% Germination
Redtop or Oregon bentgrass (*Agrostis alba* or *Agrostis oregonensis*)	20	92	85
Red fescue (*Festuca rubra*)	70	98	90
White dutch clover (*Trifolium repens*)	10	98	90

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 county 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. The products did not pass through the Technology Assessment Protocol – Ecology

(TAPE) process. The county has reviewed these products for application in Pierce County, and has developed a county-specific list of the approved and prohibited products. This county-specific list can be obtained from Pierce County Planning and Land Services' (PALS) web site: <piercecountywa.org/PALS>. The county web site is updated routinely, but the latest list from Ecology is available on Ecology's web site at <www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html>. Contact the county if a new Ecology approved product is not listed on the county web site.

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 should be used:

- For less 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 3.8. 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 should be a coarse compost that meets the following size gradations when tested in accordance with the U.S. Composting Council "Test Methods for the Examination of Compost and Composting" (TMECC) Test Method 02.02-B.

Coarse Compost

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

- Minimum Percent passing 3″ sieve openings 100 percent
- Minimum Percent passing 1″ sieve openings 90 percent
- Minimum Percent passing 0.75″ sieve openings 70 percent
- Minimum Percent passing 0.25″ sieve openings 40 percent.

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

Table 3.8. Mulch Standards and Guidelines.

Mulch Material	Quality Standards	Application Rates	Remarks
Straw	Air-dried; free from undesirable seed and coarse material.	2″ to 3″ thick; five bales per 1,000 sf 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 sf 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″. 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 soil preservation and amendment BMP see Volume III, Section 3.1. 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 shall 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.

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

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 onsite 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. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. The county has reviewed these products for application in Pierce

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 onsite and offsite 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 county 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 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 offsite 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 onsite, 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 Construction Stormwater General Permit 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 onsite, 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 onsite 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 should include, at a minimum:

    - 1 water resistant nylon bag
    - 3 oil absorbent socks 3 inches x 4 feet
    - 2 oil absorbent socks 3 inches x 10 feet
    - 12 oil absorbent pads 17 inches x 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 offsite, or performing onsite 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 offsite (ready mix plant, etc.).
- Concrete trucks, pumpers, or other concrete coated equipment are washed onsite.
- Note: If fewer than 10 concrete trucks or pumpers need to be washed out onsite, 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 offsite 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 onsite, 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 Certified Erosion and Sediment Control Lead (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 should depend on the expected demand for storage capacity.
- On large sites with extensive concrete work, washouts should be placed in multiple locations for ease of use by concrete truck drivers.

Onsite 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 Figure 3.5, as well as Attachments Section C, Details 23.0 and 23.1.

- 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 offsite.

- 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) should 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 should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

- 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 should be sufficient to contain all liquid and concrete waste generated by washout operations.

    - Lath and flagging should be commercial type.

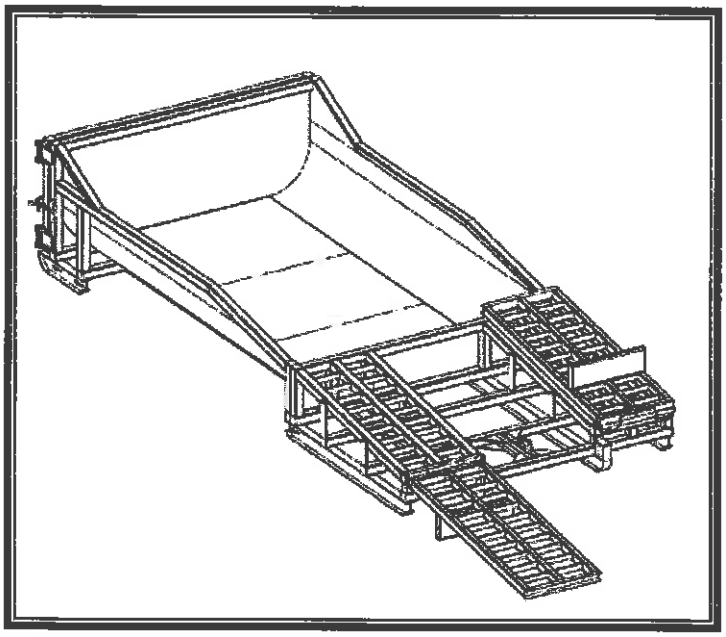


Figure 3.5. Prefabricated Concrete Washout Container with Ramp

- Plastic lining material shall be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
- 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 from the County Industrial Pretreatment Program at (253) 798-3013.
    - 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 onsite 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.

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 disturbing ground 1 acre or larger and that discharge stormwater to surface waters of the State. Projects disturbing less than 1 acre may have a person without CESCL certification conduct inspections; sampling is not required on sites that disturb less than an acre.

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum 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 should 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 C162: Scheduling

Purpose

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

Conditions of Use

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

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

Design Considerations

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

V. RUNOFF CONVEYANCE AND TREATMENT BMPs

ATTACHED IN UPCOMING PAGES

BMP C220: Storm Drain Inlet Protection
BMP C233: Silt Fence

3.2 Runoff Conveyance and Treatment BMPs

This section contains the standards and specifications for Runoff Conveyance and Treatment BMPs. Table 3.10 shows the relationship of the BMPs in Section 3.2 to the Construction Stormwater Pollution Prevention Plan (SWPPP) Elements described in Section 2.3.3.

Table 3.10. Runoff Conveyance and Treatment BMPs by SWPPP Element

BMP or Element Name	Element #3 Control Flow Rates	Element #4 Install Sediment Controls	Element #6 Protect Slopes	Element #7 Protect Storm Drain Inlets	Element #8 Stabilize Channels and Outlets	Element #9 Control Pollutants	Element #10 Control Dewatering	Element #13 Protect Low Impact Development
BMP C200: Interceptor Dike and Swale			✓					✓
BMP C201: Grass-Lined Channels			✓					✓
BMP C202: Channel Lining					✓			
BMP C203: Water Bars	✓		✓				✓	
BMP C204: Pipe Slope Drains			✓					
BMP C205: Subsurface Drains			✓					
BMP C206: Level Spreader			✓				✓	
BMP C207: Check Dams	✓		✓		✓			✓
BMP C208: Triangular Silt Dike (TSD) (Geotextile Encased Check Dam)			✓					✓
BMP C209: Outlet Protection	✓				✓			
BMP C220: Storm Drain Inlet Protection				✓				
BMP C231: Brush Barrier		✓						✓
BMP C232: Gravel Filter Berm		✓						
BMP C233: Silt Fence		✓						✓
BMP C234: Vegetated Strip		✓						✓
BMP C235: Wattles	✓	✓						
BMP C236: Vegetated Filtration							✓	
BMP C240: Sediment Trap	✓	✓						
BMP C241: Temporary Sediment Pond	✓	✓						
BMP C250: Construction Stormwater Chemical Treatment		✓				✓		
BMP C251: Construction Stormwater Filtration		✓				✓		
BMP C252: High pH Neutralization Using CO_2						✓		
BMP C251: pH Control for High pH Water						✓		

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. 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 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 3.11 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 3.11. Storm Drain Inlet Protection.

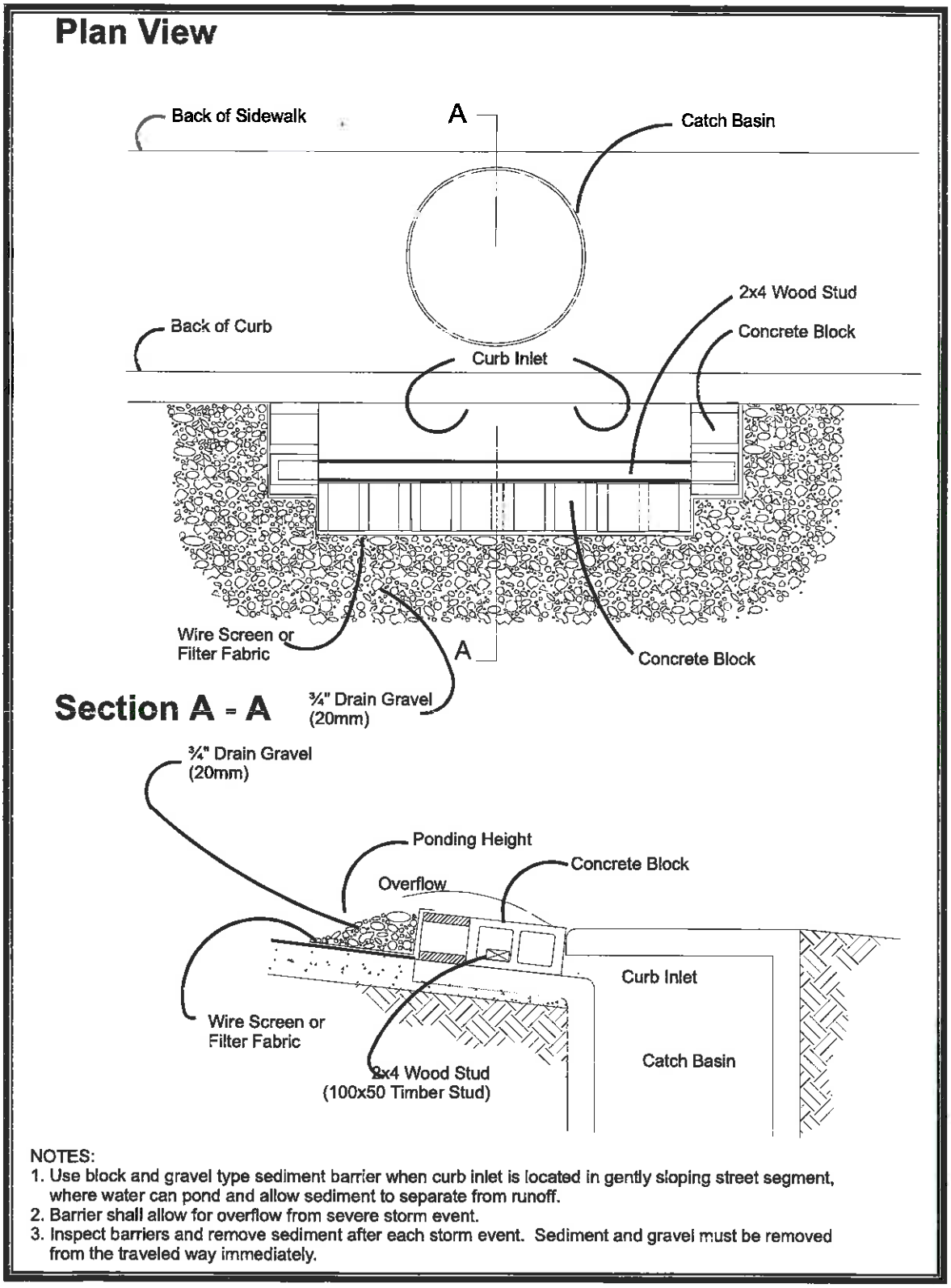
Type of Inlet Protection	Emergency Overflow	Applicable for Paved/Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding will occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area Requirement: 30 x 30-feet/acre
Block and gravel 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 Attachments Section C, Detail 2.0.
    - 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 x 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 one-half-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. See also Attachments Section C, Detail 3.0.
    - Use a hardware cloth or comparable wire mesh with one-half-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.
- **Curb Inlet Protection with Wooden Weir:** Barrier formed around a curb inlet with a wooden frame and gravel.
    - Wire mesh with one-half-inch openings
    - Extra strength filter cloth
    - Construct a frame.
- **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 one-half-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 3.11.
  - 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 x 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 3.12.
  - 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.
- **Inlet Fabric Fence Filter:** Attachments Section C, Detail 1.0 provides an illustration of the use of filter fabric as an inlet protection option.



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 3.11. Block and Gravel Curb Inlet Protection.

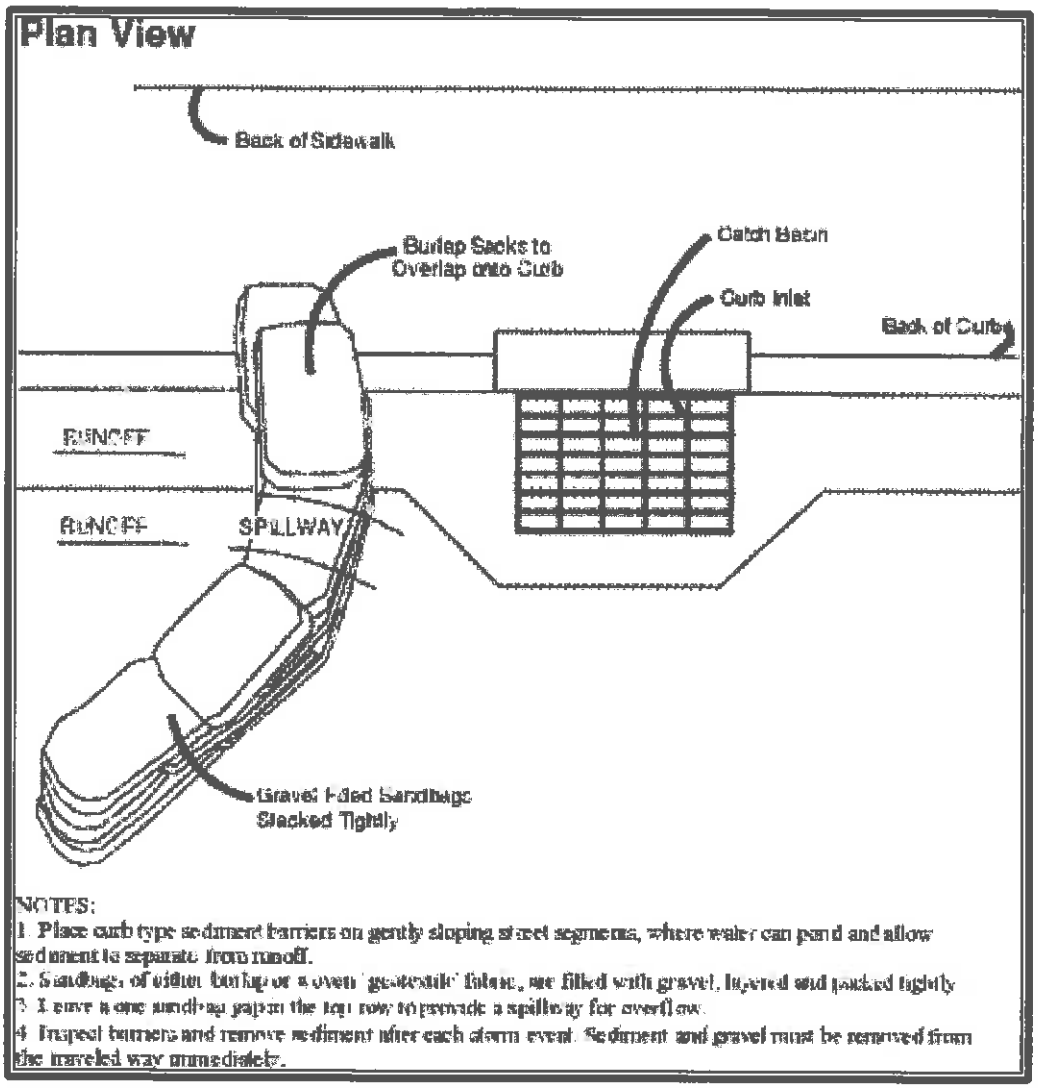


Figure 3.12. Curb and Gutter Barrier.

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. The products did not pass through the Technology Assessment Protocol – Ecology

(TAPE) process. The county has reviewed these products for application in Pierce County, and has developed a county-specific list of the approved and prohibited products. This county-specific list can be obtained from Pierce County Planning and Land Services' (PALS) web site: <piercecountywa.org/PALS>. The county web site is updated routinely, but the latest list from Ecology is available on Ecology's web site at <www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html>. Contact the county if a new Ecology approved product is not listed on the county web site.

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 Attachments Section C, Detail 8.0 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 3.12).
- Standard strength fabrics must be supported with wire mesh, chicken wire, 2-inch x 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.

Table 3.12. Geotextile Standards.

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

- 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 feet min. and 2.5 feet max. 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 up-slope 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 up-slope side of the posts with the filter fabric up-slope 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 8 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-inches by 2-inches wide min. and a 3-feet min. 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:
  - 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.