WASHINGTON PROJECT CONSULTANTS
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Port Townsend, WA 98368
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STORMWATER REPORT

Property Additions

Owner: **Peter West**
Location: **Rainier Street Commercial - Wolcott Short Plan Lot 3**
Parcel: **#001094033**
Report by: **Marc A Horton, PE**
Date: **November 2, 2025**

11/2/25

Attachments:

Attachment 1 **Site Location**
Attachment 2 **Site Plan (from Element Design)**
Attachment 3 **NRCS Soils Report**
Attachment 4 **City of Port Townsend Application Materials**
Attachment 5 **Ecology Manual Flow Chart for New Development**
Attachment 6 **Construction SWPPP**
Attachment 7 **Ecology Manual Wetlands Protection Flow Chart**
Attachment 8 **WWHM12 Model Results**
Attachment 9 **Typical Bioretention Profile**

Proposed Development & Report Summary:

This report addresses stormwater management for a proposed commercial building, access, and parking to be built on Lot 3 of Wolcott Short Plat (Rainier Street), Port Townsend. This mixed-use / commercial lot is 0.86 Ac (37,243 sf). The proposed building will be 2600 sf. Site parking and access, sidewalks, etc. will add approximately 5700 sf of impervious surface, bringing the total stormwater management area of approximately 8300 sf (0.18 ac) of new impervious surface.

The location of this parcel and topography is shown on **Attachment 1**. A Site plan with proposed features is shown as **Attachment 2.**

Site history, topography, soils, surrounding conditions were all considered in selection of the stormwater management approach. These considerations have led to an approach that primarily uses a bio-retention facility for storage and treatment of stormwater. The feature proposed in this report will infiltrate 93% of inflow based on the Western Washington

Hydraulic Model (WWHM 2012). Any overflow will go to a dispersion area leading to the site's wetland buffer and a wetland.

Existing Conditions:

This site is part of the "Sims Way - Rainier Business Park." The parcel is bounded by Rainier Street on the east, an undeveloped street (6th Street) on the north, and by mixed-use commercial property on south and west boundaries. The commercial parcel on the south has been developed.

A category 4 wetland on the northern portion of the property and other setbacks will limit the development envelope to about 25% of the property, This is shown on the attached site plan (**Attachment 2**). The development envelope was a product of a Critical Area Report utilizing buffer averaging – prepared by Wetland Resources, Inc. (November 2022). This report is on file with the city.

The topography of the site provides a slope to the north-northeast across the property with a general drainage culminating at the wetland. The developable area has a slope to the northeast at about 10-15%.

Soils & Geology

The NRCS (Natural Resources Conservation Service) soil survey for this site location indicates that the soils for this site are CmC - Clallam Gravelly Sandy Loam. These soils are well drained, but have a restrictive layer at 20 to 40 inches below the surface. Consequently, the water table can be expected at that same depth. These soils are in Hydrologic Soil Group D and have a low capacity to transmit water because of the restrictive layer (0.06 inches per hour K_{sat}).

The NRCS Soils report is provided as **Attachment 3**.

Regulatory Framework

The requirements for stormwater management for the City of Port Townsend are essentially the Ecology's Western Washington Stormwater Management Manual (Ecology Manual). The City's Design Standards (1997) have a stormwater section. However, much of this section is generally considered to be outdated in terms of management controls and options. The city standards reference the Ecology Manual, but the manual has been routinely updated with the latest version in 2024 This manual and its guidance will be used for this project.

The city has developed a worksheet related to stormwater – The "Lot Coverage vs. Impervious Surfaces Worksheet." This document appears to be directed toward residential projects. Regardless, it has been completed for this project as **Attachment 4**. The Ecology Manual provides specific guidance on Minimum Requirements for stormwater management. One example is the "Flow Chart for New Development." This flow chart has been completed for this project as **Attachment 5**. The result shows that all 9 Minimum Requirements must be addressed as described below:

- **Minimum Requirement #1: Preparation of Stormwater Site Plans**
  A Stormwater Site Plan is provided as page 5 of this report
- **Minimum Requirement #2: Construction Stormwater Pollution Prevention**
  Activity under this requirement will be limited because of the type of activity, the soils, and slope of the property. However, as required by the Checklist, a TESC (Temporary Erosion and Sediment Control plan (Stormwater Pollution Prevention Plan - SWPPP) is provided. (**Attachment 6**)
- **Minimum Requirement #3: Source Control of Pollution**
  Pollution Source Control is required on this project because it involves a "pollution generating surface" (parking). There will be no other sources of pollution. Stormwater from parking will be treated as required by the Manual.
- **Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls**
  This project will not significantly affect any natural drainage systems. There is a Class 4 wetland on the property which has been addressed in a separate report noted above. Wetland buffers will be protected, and enhanced. There are no discrete drainages serving the wetland, and overall flow to the wetland area should not be significantly affected. (See Minimum Requirements 7 & 8)
- **Minimum Requirement #5: On-site Stormwater Management**
  This report provides the rationale and design for management of stormwater on this property consistent with this requirement, and will meet Requirement 4 (above).
- **Minimum Requirement #6: Runoff Treatment**
  Runoff treatment will be provided to most impervious surfaces (over 90%). Some runoff at the entry from Rainier Street will flow to the Street, but most of the driveway and parking area will be collected and treated in a bio-retention facility designed to treat 92% of the flow.
- **Minimum Requirement #7: Flow Control**
  Flow control is not required for this project. The size of the bio-retention facility will assure that the combined flow from the developed property will not increase the flow beyond 0.15 cfs over pre-development conditions.
- **Minimum Requirement #8: Wetlands Protection**
  The Ecology Manual provides a flow chart guiding compliance with the Wetlands Protection Requirement. This chart is provided as **Attachment 7**. According to the flow chart, General Protection and Protection from Pollutants are required. Both of these requirements are met with this project by meeting Requirements 1-5.
- **Minimum Requirement #9: Operation and Maintenance**
  The bio-retention basin will not require routine maintenance except for vegetation managment. However, catch basins within the collections system should be routinely inspected and cleaned as necessary to protect the basin.

Design

Because of the soils in the area, infiltration is not an option. Because of the pollution generating surface (parking lot), treatment is required, indicating use of a bioretention feature. A typical profile is provided as **Attachment 8**.

Site constraints and the need to keep the facility out of the wetland buffer dictate the general location and shape of the treatment unit.

Ecology's 2012 Hydraulic Model was used to size the facility. Roof and other impervious surface will all be routed through this facility. This will be almost all of the runoff with the exception of the driveway approach off Rainier Street, and some from sidewalk entry along Rainier Street.

The basin size is to be 50 feet long, and 3 feet wide (bottom). With side slopes of 2:1, the overall footprint of this facility will be 9 feet by 56 feet. The model results are provided as **Attachment 9**, and show that the treatment level will be at the required 91% level (Minimum Requirement #6). An overflow will be needed, but no wider than 2 feet and with an elevation 6" below the top of the basin. The overflow should go to a 10 foot dispersion trench oriented with the ground contours.

A piping system with catch basins will carry runoff from the parking and drive areas to the facility. The number and location of catch basins will be decided by the site designer or civil engineer.

A Stormwater Site Plan has been prepared and is provided as Page 5 of this report.

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SIXTH STREET - UNDEVELOPED R.O.W.

CATEGORY IV WETLAND

PL 238.94'

NEIGHBORING M-C PROPERTY

PL 94.45'

PARCEL: 001094033
AREA: 0.855 ACRES (37,243 SQFT)

Typical Catch Basin
(location by designer/civil engineer)

Bioretention Feature

WETLAND BUFFER

WETLAND AVERAGING BUFFER

UTILITY EASEMENT

PL 147'

RAINIER STREET

12' 4' 8'

COVERED ENTRY
4x10 40 SQFT

6 PARKING

ADA

15' WETLAND SETBACK

4' WIDE CONCRETE WALKWAY

SIDEWALK

PROPOSED MIXED USE
BLDG 84x32 2600 SQFT

32'

63'

BIKE RACK

GRAVEL PARKING LOT 70x54
3500 SQFT

PL 56.21'

10' SETBACK

GARBAGE ENCLOSURE 8x4

5' SETBACK

RECESSED

30'

15' WIDE PAVED ACCESS ROAD
1800 SQFT

PL 270.66'

24' WIDE ACCESS & UTILITY EASEMENT

BOLLARDS

TRANSFORMER

NEIGHBORING M-C PROPERTY

CAR WASH DRIVEWAY

N

Stomwater Site Plan

Stormwater features added by Marc A. Horton PE to original drawing (9/30/25) developed by Element Design

MARC A. HORTON
STATE OF WASHINGTON
47850
PROFESSIONAL ENGINEER
11/2/25

PROPERTY DETAILS

SITE ADDRESS:	RAINIER STREET PORT TOWNSEND, WA
PARCEL ID:	001094033
PROPERTY DESCRIPTION:	WOLCOTT SHORT PLAT LOT 3 SUBJ TO EASE
ZONING:	M-C - MIXED COMMERCIAL - LIGHT MANUFACTURING
LOT AREA:	37,243 SQFT

0' 10' 20'

RAINIER STREET
PRELIMINARY SITE PLAN
DRAWING SCALE: 1"=20'
DATE: 9-30-2025

Attachment 1

Parcel Location

elementdesign
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jesse@elementdesign.studio
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1891 S Jacob Miller Rd
Port Townsend, WA 98368

Attachment 2

SIXTH STREET - UNDEVELOPED R.O.W.

CATEGORY IV WETLAND

PL 238.94'

NEIGHBORING M-C
PROPERTY

PL 94.45'

PARCEL: 001094033
AREA: 0.855 ACRES (37,243 SQFT)

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WETLAND AVERAGING BUFFER

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4' WIDE CONCRETE WALKWAY

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PROPOSED MIXED USE
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63'

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3500 SQFT

PL 56.21'

10' SETBACK

GARBAGE ENCLOSURE 8x4

14'

5' SETBACK

RECESSED

30'

15' WIDE PAVED ACCESS ROAD
1800 SQFT

PL 270.66'

24' WIDE ACCESS & UTILITY EASEMENT

BOLLARDS

TRANSFORMER

CAR WASH DRIVEWAY

NEIGHBORING M-C
PROPERTY

N

PROPOSED SITE PLAN

PROPERTY DETAILS

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PARCEL ID:	001094033
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0' 10' 20'

RAINIER STREET
PRELIMINARY SITE PLAN
DRAWING SCALE: 1"=20'
DATE: 9-30-2025

Attachment 3

Soil Map—Jefferson County Area, Washington

Map Scale: 1:983 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 45 90 180 270

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 1:20,000.

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: Jefferson County Area, Washington
Survey Area Data: Version 22, Aug 29, 2023

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

Date(s) aerial images were photographed: Jul 31, 2022—Aug 8, 2022

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
CmC	Clallam gravelly sandy loam, 0 to 15 percent slopes	4.5	100.0%
Totals for Area of Interest		**4.5**	**100.0%**

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Report—Physical Soil Properties

Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–Jefferson County Area, Washington														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
CmC—Clallam gravelly sandy loam, 0 to 15 percent slopes														
Clallam	0-3	-68-	-22-	5-10- 15	0.85-0.98 -1.10	4.00-9.00-14.00	0.08-0.10-0. 11	0.0- 1.5- 2.9	3.0- 4.0- 5.0	.10	.15	3	5	56
	3-23	-68-	-22-	5-10- 15	0.90-1.03 -1.15	4.00-9.00-14.00	0.06-0.08-0. 10	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.10	.28			
	23-60	-69-	-24-	5- 8- 10	1.70-1.85 -2.00	0.01-0.20-0.42	0.00-0.00-0. 00	0.0- 1.5- 2.9	0.5- 0.5- 1.0	.20	.37			

Data Source Information

Soil Survey Area: Jefferson County Area, Washington
Survey Area Data: Version 22, Aug 29, 2023

Attachment 4

Lot Coverage and Impervious Surfaces - Worksheets for Applicants

Lot Coverage and Impervious Surface Calculations are similar, but not the same. This worksheet is designed to help you clarify the difference and help you determine the correct numbers to use on our applications.

LOT COVERAGE = STRUCTURAL FOOTPRINTS

Lot coverage is defined as "the total ground coverage of all buildings or structures on a site measured from the outside of exterior walls or supporting members, including accessory buildings or structures, but **not** to include at-grade off-street parking lots, deck areas, terraces, swimming pools, pool deck areas, walkways, roadways or driveways" (Port Townsend Municipal Code 17.08.040).

Calculate the Total Lot Coverage of the Proposed Structures:

All building *footprints* (in square feet) including:

	Existing	Proposed	TOTAL
House Commercial Bld		2600	2600
Garage			
Covered Porch			
Accessory Dwelling Unit			
Deck over 30" Above Ground			
Shed			
Exterior Stairs			
Other:			

TOTAL Lot Coverage of structures: 2600 **square feet**

Calculate the Lot Coverage Percentage:

Divide the Total Lot Coverage (above) 2600 square feet
by the Square Footage of the Property: 37243 square feet
And multiply by 100 to equal the

TOTAL percentage of lot coverage: 6.9 **%.**

IMPERVIOUS SURFACES = STRUCTURAL FOOTPRINTS PLUS IMPERVIOUS

Calculate the Total Impervious Surface of the Proposed Project:

Commercial Bld
~~House Roof~~ area: 2600 square feet

Garage Roof area: _____ square feet

Covered Porch Roof area: _____ square feet

Other Structure Roof area: _____ square feet

Decks and patios and other structures over 30" in Height that ***do not allow rainwater between the slats/surface***: _____ square feet

Driveway, Sidewalk & gravel/compacted areas: 5700 square feet

TOTAL Impervious Surface Area: 8300 square feet

Calculate the Impervious Surface Percentage:

Divide the Total Impervious Surface Area (above) 8300 square feet

By the Square Footage of the Property 37243 square feet

And multiply by 100 to equal the

TOTAL percentage of impervious surface 22 %.

SURFACES

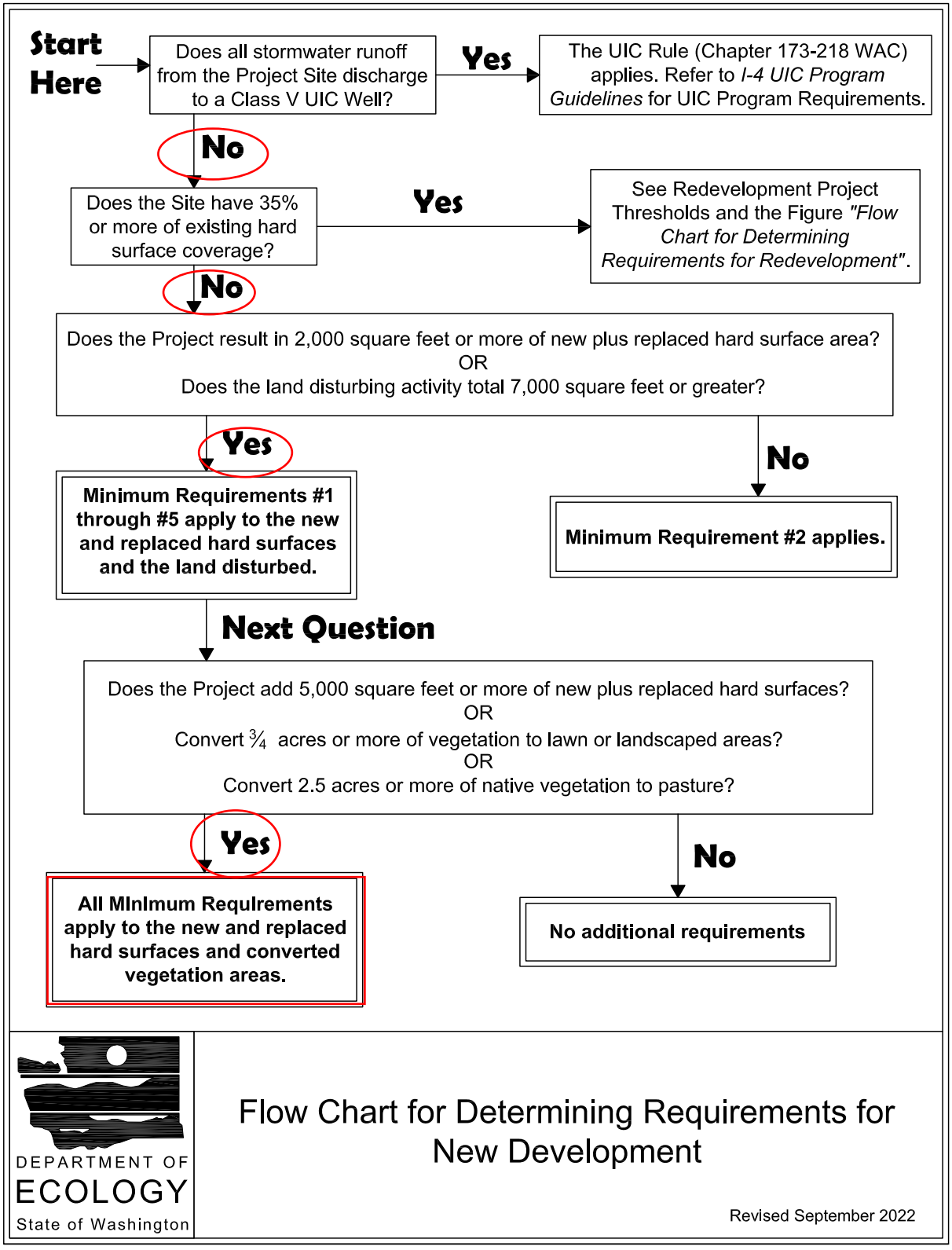
"Impervious surfaces" means areas or surfaces that cannot be easily penetrated by rain or surface water runoff. These areas include structures and roof projections, impervious decks, roads, driveways, and surfaces which substantially reduce and alter the natural filtration characteristics of the soil." *(Port Townsend Municipal Code 19.05.020)*

If your building proposal increases the area of impervious surfaces, it may result in stormwater impacts. Refer to the City's Engineering Design Standards: https://cityofpt.us/publicworks/page/engineering-and-construction. Stormwater methods can include infiltration trenches, dry wells, and rain gardens. Downspouts that flow into splash blocks can only be used for properties where there is a minimum of 50 feet of a vegetated path between the splash blocks and the edge of the property.

If the impervious surface is over 40%, an engineered stormwater drainage plan is required. You will need to retain a Civil Engineer to prepare and stamp drawings to be submitted with the public works permit. Drawings must include specifications of on-site stormwater methods.

If the impervious surface is under 40%, you may conduct your own perc test and submit an on-site stormwater drainage plan with your application for review and approval by city staff. Ask staff for the handout for guidance on conducting a perc test, or go online to www.cityofpt.us to the City's Engineering Design Standards, Chapter 4 Section 5 *Drainage Plan, Contents and Standard Procedures for Medium Impact Projects*.

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



CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

COMMERCIAL BUILDING – RAINIER STREET PORT TOWNSEND - (PARCEL 001094033)

Page References - 2024 Stormwater Management Manual for Western Washington

(BMP=Best Management Practice)

1. PROJECT DESCRIPTION

Construction of a commercial building (2600 sf) and entrance / parking (5700 sf)

2. SITE DESCRIPTION

Size of Parcel(s):37243 sf

Topography: Slope to NE 10 to 15%

Soils: Clallam Gravelly Sandy Loam (Group D)

Vegetation: Building area – cleared: Class 4 wetand and buffer - scrub

Drainage(s) and Water Features: Class 4 Wetland – North part of parcel

Adjacent Property and Development: S parcel developed / remainder undeveloped

3. ELEMENTS

Element 1: Preserve Vegetation / Mark Clearing Limits

- BMP C101: Preserving Natural Vegetation (p.312)
- BMP C102: Buffer Zones (p.314)
- BMP C103: High Visibility Fence (p.315)
- BMP C233: Silt Fence (p.414)

All of these features need to be deployed as much as possible. Wetland buffer enhancement needs to follow the developed plan.

Element 2: Establish Construction Access

No measures are necessary since the existing site has a stabilized entrance, and the driveway / parking development should provide adequate construction site parking.

Element 3: Control Flow Rates

No measures should be necessary since this site is small, and runoff (if any) should be small and not need control measures.

Element 4: Install Sediment Controls

Similar to flow control, sediment control should not be necessary, especially with the use of a silt fence to protect the buffer (Element 1)

Element 5: Stabilize Soils

- BMP C120: Temporary and Permanent Seeding (p.325)
- BMP C121: Mulching (p.331)
- BMP C122: Nets and Blankets (p.335)
- BMP C123: Plastic Covering (p.340)
- BMP C124: Sodding (p.342)
- BMP C125: Topsoiling / Composting (p.343)

These measures should be deployed as necessary depending on the size and nature of any exposed soils and timing of work.

Element 6: Protect Slopes

No measures are necessary since there will not be any severe slopes to protect.

Element 7: Protect Drain Inlets

No measures are necessary as all runoff will be maintained on-site and there will be no drains except as developed as part of the project.

Element 8: Stabilize Channels and Outlets

There are no channels or outlets to protect – no measures are necessary.

Element 9: Control Pollutants

- BMP C151: Concrete Handling (p.359)
- BMP C152: Sawcutting and Surfacing Pollution Prevention (p.360)
- BMP C153: Material Delivery, Storage and Containment (p.361)
- BMP C154: Concrete Washout Area (p.363)
- See Volume IV (p.541) – Source Control BMPs

These measures need to be used as necessary where pollutants are generated during specific project activity.

Element 10: Control Dewatering

There will be no dewatering – no measures are required.

Element 11: Maintain BMPs

- BMP C150: Materials on Hand (p.357)
- BMP C160: Certified Erosion and Sediment Control Lead (p.371)

These BMPs are good for any project and should be implemented.

Element 12: Manage the Project

- BMP C150: Materials on Hand (p.357)
- BMP C160: Certified Erosion and Sediment Control Lead (p.371)
- BMP C162: Scheduling (p.372)

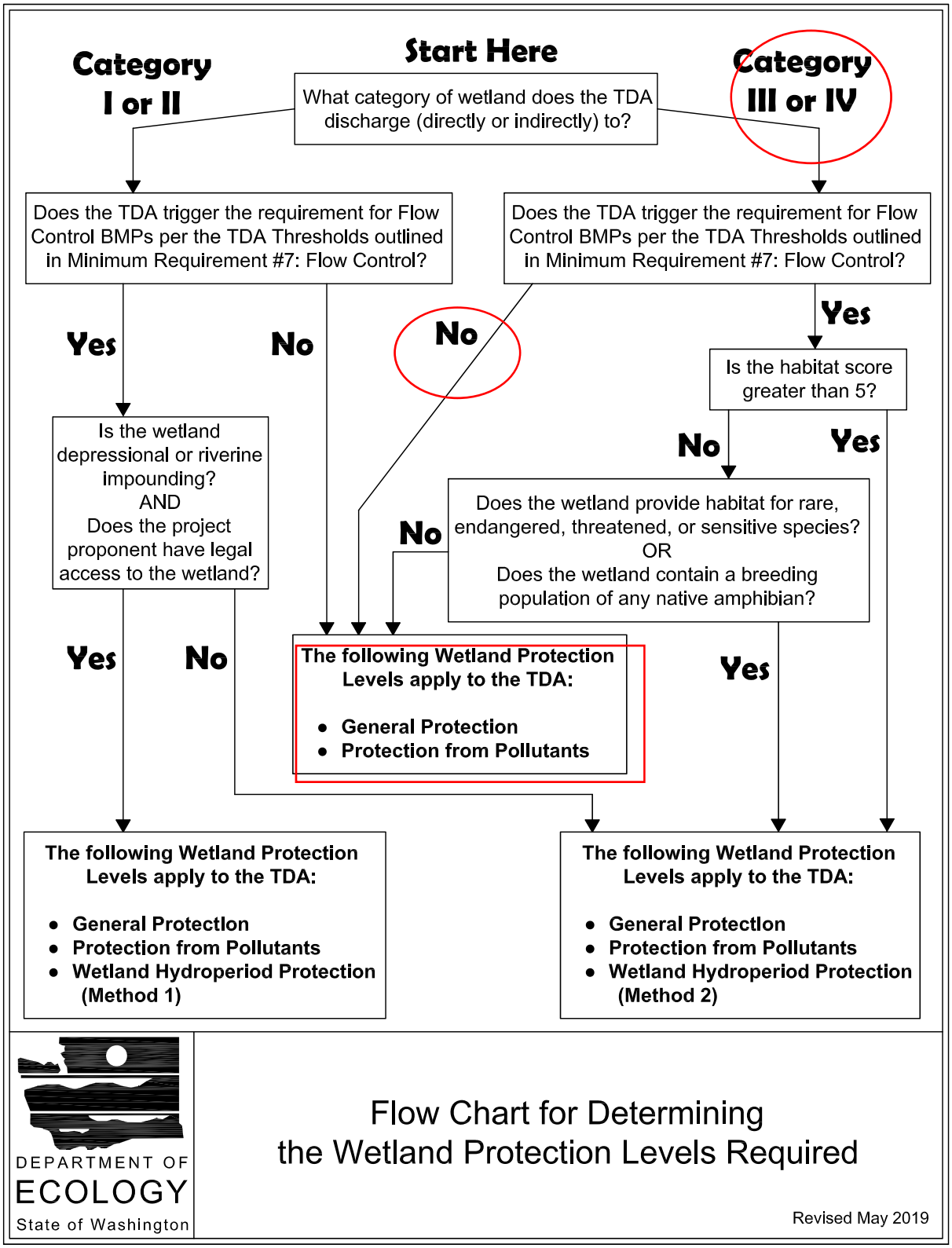
Similar to Element 11, these BMPs are good for any project and should be employed.

Element 13: Protect Low Impact Development (LID) BMPs

- BMP C102: Buffer Zones (p.314)
- BMP C103: High Visibility Fence (p.315)
- BMP C233: Silt Fence (p.414)

These BMPs are part of this project and should be protected during construction.

Figure I-3.5: Flow Chart for Determining Wetland Protection Level Requirements



WWHM2012

PROJECT REPORT

General Model Information

Project Name:	West Commercial
Site Name:	West Commercial
Site Address:	
City:	
Report Date:	11/1/2025
Gage:	Port Angeles
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.800
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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	0.19
Pervious Total	0.19
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.19

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.06
DRIVEWAYS FLAT	0.04
SIDEWALKS FLAT	0.01
PARKING FLAT	0.08
Impervious Total	0.19
Basin Total	0.19

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1		

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length: 50.00 ft.
Bottom Width: 3.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW 12 in/hr
Material thickness of second layer: 0
Material type for second layer: Sand
Material thickness of third layer: 0
Material type for third layer: SMMWW 12 in/hr
Infiltration On
Infiltration rate: 1.27
Infiltration safety factor: 0.5
Wetted surface area On
Total Volume Infiltrated (ac-ft.): 12.739
Total Volume Through Riser (ac-ft.): 1.194
Total Volume Through Facility (ac-ft.): 13.933
Percent Infiltrated: 91.43
Total Precip Applied to Facility: 0.371
Total Evap From Facility: 0.16
Underdrain not used
Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0034	0.0000	0.0000	0.0000
0.0330	0.0034	0.0001	0.0000	0.0000
0.0659	0.0034	0.0001	0.0000	0.0000
0.0989	0.0034	0.0002	0.0000	0.0000
0.1319	0.0034	0.0002	0.0001	0.0001
0.1648	0.0034	0.0003	0.0001	0.0001
0.1978	0.0034	0.0003	0.0001	0.0001
0.2308	0.0034	0.0004	0.0002	0.0002
0.2637	0.0034	0.0004	0.0003	0.0003
0.2967	0.0034	0.0005	0.0004	0.0004
0.3297	0.0034	0.0005	0.0006	0.0006
0.3626	0.0034	0.0006	0.0007	0.0007
0.3956	0.0034	0.0006	0.0009	0.0009
0.4286	0.0034	0.0007	0.0012	0.0012
0.4615	0.0034	0.0007	0.0014	0.0014
0.4945	0.0034	0.0008	0.0017	0.0017
0.5275	0.0034	0.0008	0.0020	0.0020
0.5604	0.0034	0.0009	0.0022	0.0022
0.5934	0.0034	0.0009	0.0022	0.0022
0.6264	0.0034	0.0010	0.0022	0.0022
0.6593	0.0034	0.0010	0.0022	0.0022
0.6923	0.0034	0.0011	0.0022	0.0022
0.7253	0.0034	0.0011	0.0022	0.0022
0.7582	0.0034	0.0012	0.0022	0.0022
0.7912	0.0034	0.0012	0.0022	0.0022

0.8242	0.0034	0.0013	0.0022	0.0022
0.8571	0.0034	0.0013	0.0022	0.0022
0.8901	0.0034	0.0014	0.0022	0.0022
0.9231	0.0034	0.0015	0.0022	0.0022
0.9560	0.0034	0.0015	0.0022	0.0022
0.9890	0.0034	0.0016	0.0022	0.0022
1.0220	0.0034	0.0016	0.0022	0.0022
1.0549	0.0034	0.0017	0.0022	0.0022
1.0879	0.0034	0.0017	0.0022	0.0022
1.1209	0.0034	0.0018	0.0022	0.0022
1.1538	0.0034	0.0018	0.0022	0.0022
1.1868	0.0034	0.0019	0.0022	0.0022
1.2198	0.0034	0.0019	0.0022	0.0022
1.2527	0.0034	0.0020	0.0022	0.0022
1.2857	0.0034	0.0020	0.0022	0.0022
1.3187	0.0034	0.0021	0.0022	0.0022
1.3516	0.0034	0.0021	0.0022	0.0022
1.3846	0.0034	0.0022	0.0022	0.0022
1.4176	0.0034	0.0022	0.0022	0.0022
1.4505	0.0034	0.0023	0.0022	0.0022
1.4835	0.0034	0.0023	0.0022	0.0022
1.5000	0.0034	0.0024	0.0022	0.0022

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
1.5000	0.0034	0.0024	0.0000	0.0208	0.0001
1.5330	0.0036	0.0025	0.0000	0.0208	0.0002
1.5659	0.0038	0.0026	0.0000	0.0217	0.0003
1.5989	0.0039	0.0027	0.0000	0.0222	0.0004
1.6319	0.0041	0.0029	0.0000	0.0227	0.0005
1.6648	0.0043	0.0030	0.0000	0.0231	0.0006
1.6978	0.0044	0.0031	0.0000	0.0236	0.0007
1.7308	0.0046	0.0033	0.0000	0.0240	0.0008
1.7637	0.0048	0.0034	0.0000	0.0245	0.0009
1.7967	0.0049	0.0036	0.0000	0.0250	0.0011
1.8297	0.0051	0.0038	0.0000	0.0254	0.0012
1.8626	0.0053	0.0039	0.0000	0.0259	0.0013
1.8956	0.0054	0.0041	0.0000	0.0263	0.0014
1.9286	0.0056	0.0043	0.0000	0.0268	0.0015
1.9615	0.0058	0.0045	0.0000	0.0272	0.0016
1.9945	0.0059	0.0047	0.0000	0.0277	0.0017
2.0275	0.0061	0.0049	0.0000	0.0282	0.0018
2.0604	0.0063	0.0051	0.0000	0.0286	0.0019
2.0934	0.0065	0.0053	0.0000	0.0291	0.0020
2.1264	0.0066	0.0055	0.0000	0.0295	0.0022
2.1593	0.0068	0.0057	0.0000	0.0300	0.0023
2.1923	0.0070	0.0060	0.0000	0.0304	0.0024
2.2253	0.0072	0.0062	0.0000	0.0309	0.0025
2.2582	0.0073	0.0064	0.0000	0.0314	0.0026
2.2912	0.0075	0.0067	0.0000	0.0318	0.0027
2.3242	0.0077	0.0069	0.0000	0.0323	0.0028
2.3571	0.0079	0.0072	0.0000	0.0327	0.0030
2.3901	0.0081	0.0074	0.0000	0.0332	0.0031
2.4231	0.0082	0.0077	0.0000	0.0337	0.0032
2.4560	0.0084	0.0080	0.0000	0.0341	0.0033
2.4890	0.0086	0.0083	0.0000	0.0346	0.0034
2.5220	0.0088	0.0086	0.0000	0.0350	0.0035
2.5549	0.0090	0.0088	0.0000	0.0355	0.0037

2.5879	0.0092	0.0091	0.0000	0.0359	0.0038
2.6209	0.0094	0.0095	0.0000	0.0364	0.0039
2.6538	0.0095	0.0098	0.0000	0.0369	0.0040
2.6868	0.0097	0.0101	0.0000	0.0373	0.0042
2.7198	0.0099	0.0104	0.0000	0.0378	0.0043
2.7527	0.0101	0.0107	0.0000	0.0382	0.0044
2.7857	0.0103	0.0111	0.0000	0.0387	0.0045
2.8187	0.0105	0.0114	0.0000	0.0391	0.0046
2.8516	0.0107	0.0118	0.0000	0.0396	0.0048
2.8846	0.0109	0.0121	0.0000	0.0401	0.0049
2.9176	0.0111	0.0125	0.0000	0.0405	0.0050
2.9505	0.0113	0.0129	0.0000	0.0410	0.0051
2.9835	0.0115	0.0132	0.0000	0.0414	0.0052
3.0000	0.0116	0.0134	0.0000	0.0417	0.0000

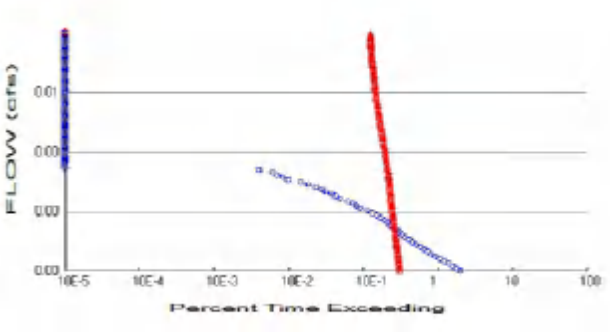
Surface retention 1

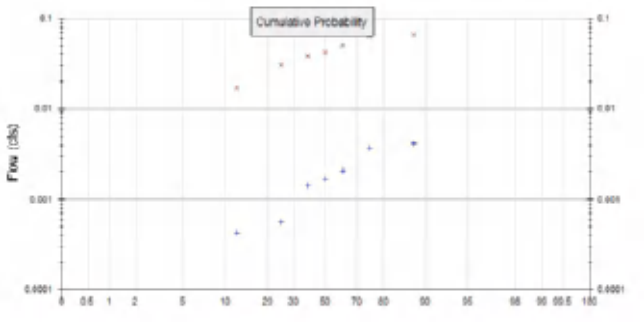
Element Flows To:

Outlet 1	Outlet 2
	Bioretention 1

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.19
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.19

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.001262
5 year	0.00283
10 year	0.004278
25 year	0.0066
50 year	0.008702
100 year	0.011131

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.063467
5 year	0.090157
10 year	0.105689
25 year	0.123035
50 year	0.134482
100 year	0.144826

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.000	0.065
1950	0.002	0.039
1951	0.002	0.017
1952	0.000	0.000
1953	0.001	0.031
1954	0.004	0.064
1955	0.004	0.051
1956	0.001	0.042

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0041	0.0654
2	0.0037	0.0636
3	0.0020	0.0509
4	0.0017	0.0416
5	0.0014	0.0389
6	0.0006	0.0308
7	0.0004	0.0173
8	0.0003	0.0000

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0006	5526	841	15	Pass
0.0007	4870	833	17	Pass
0.0008	4305	830	19	Pass
0.0009	3820	823	21	Pass
0.0010	3365	815	24	Pass
0.0010	2905	803	27	Pass
0.0011	2510	801	31	Pass
0.0012	2206	794	35	Pass
0.0013	1997	789	39	Pass
0.0014	1808	781	43	Pass
0.0014	1598	772	48	Pass
0.0015	1402	765	54	Pass
0.0016	1248	761	60	Pass
0.0017	1125	750	66	Pass
0.0018	996	745	74	Pass
0.0019	907	737	81	Pass
0.0019	830	728	87	Pass
0.0020	775	721	93	Pass
0.0021	710	714	100	Pass
0.0022	642	711	110	Pass
0.0023	580	705	121	Fail
0.0023	537	701	130	Fail
0.0024	469	695	148	Fail
0.0025	417	689	165	Fail
0.0026	365	682	186	Fail
0.0027	312	677	216	Fail
0.0028	252	672	266	Fail
0.0028	222	668	300	Fail
0.0029	200	661	330	Fail
0.0030	171	648	378	Fail
0.0031	135	645	477	Fail
0.0032	118	639	541	Fail
0.0032	104	636	611	Fail
0.0033	87	632	726	Fail
0.0034	76	625	822	Fail
0.0035	64	623	973	Fail
0.0036	50	620	1240	Fail
0.0036	40	615	1537	Fail
0.0037	27	608	2251	Fail
0.0038	23	602	2617	Fail
0.0039	19	599	3152	Fail
0.0040	17	594	3494	Fail
0.0041	11	588	5345	Fail
0.0041	0	579	n/a	Fail
0.0042	0	571	n/a	Fail
0.0043	0	567	n/a	Fail
0.0044	0	560	n/a	Fail
0.0045	0	556	n/a	Fail
0.0045	0	550	n/a	Fail
0.0046	0	543	n/a	Fail
0.0047	0	536	n/a	Fail
0.0048	0	531	n/a	Fail
0.0049	0	524	n/a	Fail
0.0050	0	515	n/a	Fail

0.0050	0	513	n/a	Fail
0.0051	0	508	n/a	Fail
0.0052	0	502	n/a	Fail
0.0053	0	497	n/a	Fail
0.0054	0	490	n/a	Fail
0.0054	0	483	n/a	Fail
0.0055	0	473	n/a	Fail
0.0056	0	465	n/a	Fail
0.0057	0	462	n/a	Fail
0.0058	0	456	n/a	Fail
0.0058	0	449	n/a	Fail
0.0059	0	445	n/a	Fail
0.0060	0	440	n/a	Fail
0.0061	0	433	n/a	Fail
0.0062	0	430	n/a	Fail
0.0063	0	427	n/a	Fail
0.0063	0	420	n/a	Fail
0.0064	0	416	n/a	Fail
0.0065	0	413	n/a	Fail
0.0066	0	411	n/a	Fail
0.0067	0	410	n/a	Fail
0.0067	0	405	n/a	Fail
0.0068	0	404	n/a	Fail
0.0069	0	399	n/a	Fail
0.0070	0	393	n/a	Fail
0.0071	0	390	n/a	Fail
0.0072	0	388	n/a	Fail
0.0072	0	388	n/a	Fail
0.0073	0	383	n/a	Fail
0.0074	0	380	n/a	Fail
0.0075	0	378	n/a	Fail
0.0076	0	374	n/a	Fail
0.0076	0	371	n/a	Fail
0.0077	0	365	n/a	Fail
0.0078	0	361	n/a	Fail
0.0079	0	357	n/a	Fail
0.0080	0	357	n/a	Fail
0.0080	0	354	n/a	Fail
0.0081	0	352	n/a	Fail
0.0082	0	349	n/a	Fail
0.0083	0	348	n/a	Fail
0.0084	0	347	n/a	Fail
0.0085	0	346	n/a	Fail
0.0085	0	344	n/a	Fail
0.0086	0	343	n/a	Fail
0.0087	0	342	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

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.

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
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

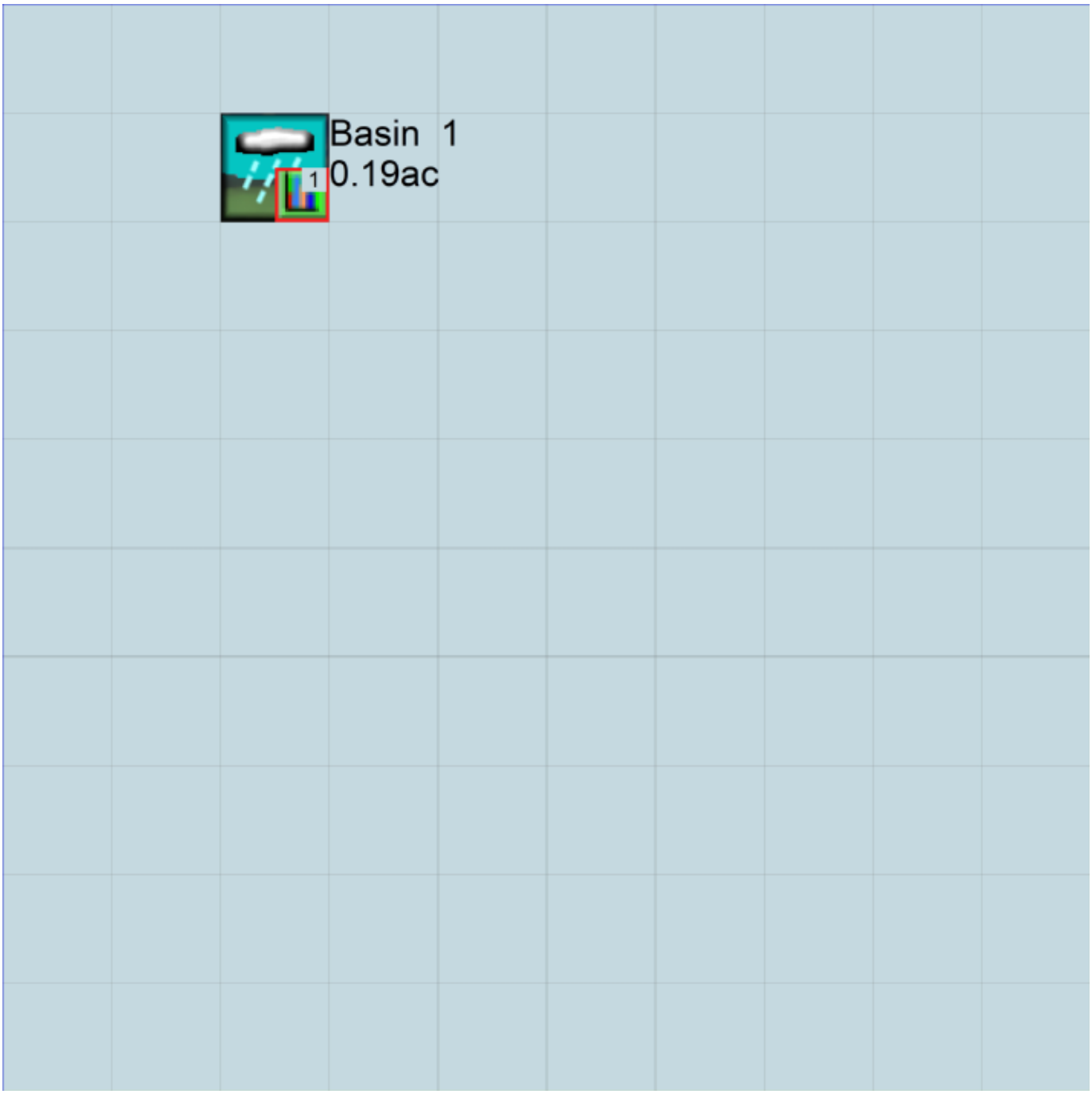
PERLND Changes

No PERLND changes have been made.

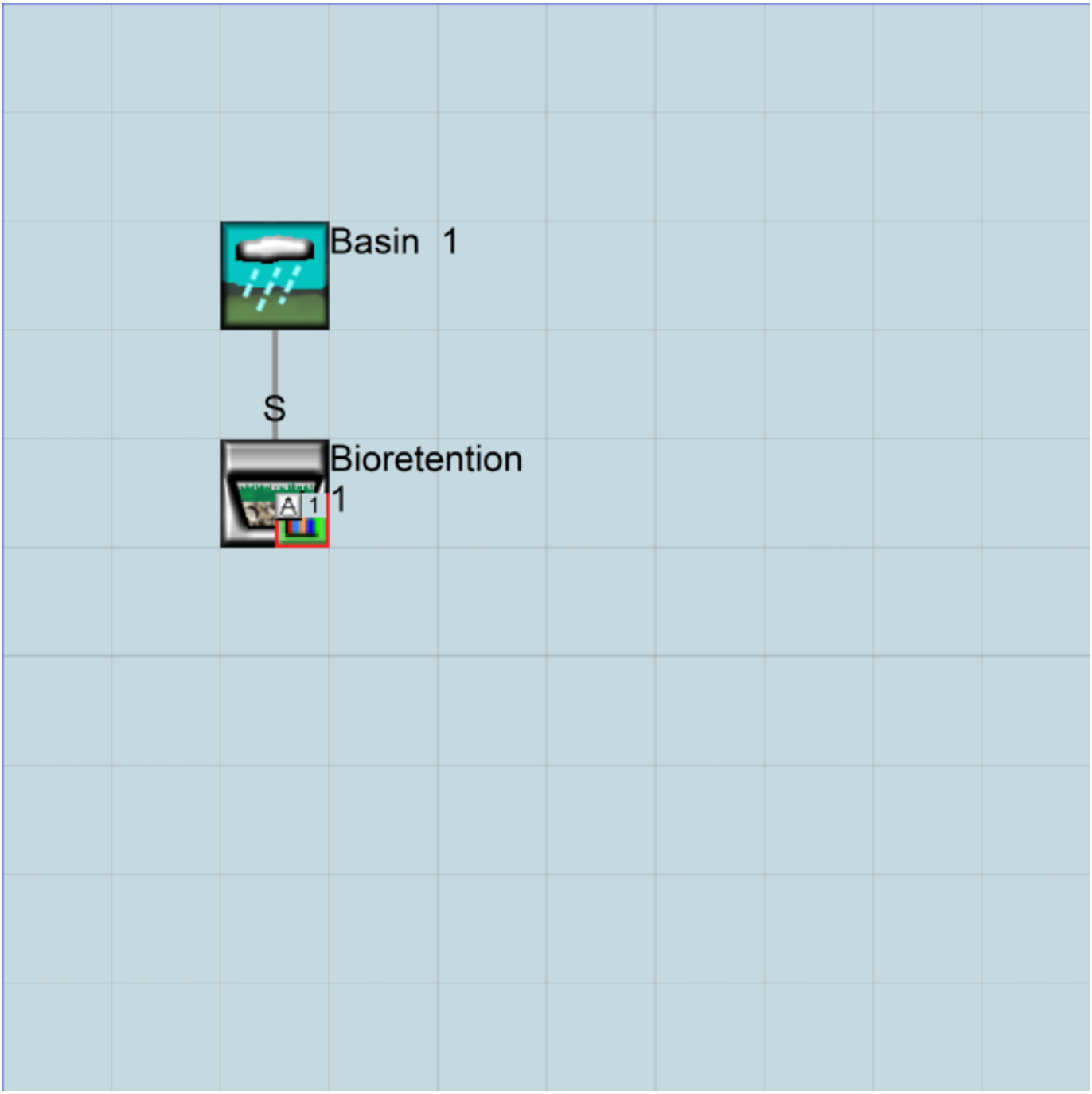
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 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   West Commercial.wdm
MESSU       25   PreWest Commercial.MES
            27   PreWest Commercial.L61
            28   PreWest Commercial.L62
            30   POCWest Commercial1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      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           ***
   11     C, Forest, Mod          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 ***
   11         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  *********
   11         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 ***
   11         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
   11              0       4.5      0.08       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11           0.2       0.5      0.35         6       0.5       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
   11             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  11                        0.19     COPY   501     12
PERLND  11                        0.19     COPY   501     13
PERLND  11                        0.19     COPY   501     14

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

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

```
WDM      2 PREC     ENGL    0.8             IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76            IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

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

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

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

  MASS-LINK       14
PERLND     PWATER AGWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   14


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 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   West Commercial.wdm
MESSU       25   MitWest Commercial.MES
            27   MitWest Commercial.L61
            28   MitWest Commercial.L62
            30   POCWest Commercial1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       4
      IMPLND       5
      IMPLND       8
      IMPLND      11
      GENER        2
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Surface retention  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 ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  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
    <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
    5      DRIVEWAYS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
   11      PARKING/FLAT           1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
```

```
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
    8              0         0
   11              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
    8              0         0
   11              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   4                       0.06     RCHRES   1      5
IMPLND   5                       0.04     RCHRES   1      5
IMPLND   8                       0.01     RCHRES   1      5
IMPLND  11                       0.08     RCHRES   1      5

******Routing******
IMPLND   4                       0.06     COPY     1     15
IMPLND   5                       0.04     COPY     1     15
IMPLND   8                       0.01     COPY     1     15
IMPLND  11                       0.08     COPY     1     15
RCHRES   1                          1     RCHRES   2      8
RCHRES   2                          1     COPY   501     17
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
GENER    2 OUTPUT TIMSER      .0011111     RCHRES   1     EXTNL  OUTDGT 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     Surface retentio-006    3    1    1    1   28    0    1
    2     Bioretention  1         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
    2         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
    2         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  6  0  0       0  1  0  0  0       2  1  2  2  2
    2        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       0.0       0.0
    2              2      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  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            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
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Target Variable Names
***                  addr or                        addr or
***                 <------>                       <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                               v2m2           =  40.43
*** Compute remaining available pore space
  GENER   2                               vpo2           =  v2m2
  GENER   2                               vpo2          -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                               vpo2           =  0.0
END IF
*** Infiltration volume
```

```
  GENER   2                                v2d2           =  vpo2
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   47    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.003444  0.000000  0.000000  0.000000
  0.032967  0.003444  0.000052  0.000000  0.000000
  0.065934  0.003444  0.000104  0.000000  0.000012
  0.098901  0.003444  0.000156  0.000000  0.000025
  0.131868  0.003444  0.000208  0.000000  0.000052
  0.164835  0.003444  0.000260  0.000000  0.000092
  0.197802  0.003444  0.000311  0.000000  0.000147
  0.230769  0.003444  0.000363  0.000000  0.000221
  0.263736  0.003444  0.000415  0.000000  0.000314
  0.296703  0.003444  0.000467  0.000000  0.000429
  0.329670  0.003444  0.000519  0.000000  0.000569
  0.362637  0.003444  0.000571  0.000000  0.000735
  0.395604  0.003444  0.000623  0.000000  0.000929
  0.428571  0.003444  0.000675  0.000000  0.001155
  0.461538  0.003444  0.000727  0.000000  0.001414
  0.494505  0.003444  0.000779  0.000000  0.001708
  0.527473  0.003444  0.000831  0.000000  0.002040
  0.560440  0.003444  0.000883  0.000000  0.002205
  0.593407  0.003444  0.000934  0.000000  0.002205
  0.626374  0.003444  0.000986  0.000000  0.002205
  0.659341  0.003444  0.001038  0.000000  0.002205
  0.692308  0.003444  0.001090  0.000000  0.002205
  0.725275  0.003444  0.001142  0.000000  0.002205
  0.758242  0.003444  0.001194  0.000000  0.002205
  0.791209  0.003444  0.001246  0.000000  0.002205
  0.824176  0.003444  0.001298  0.000000  0.002205
  0.857143  0.003444  0.001350  0.000000  0.002205
  0.890110  0.003444  0.001402  0.000000  0.002205
  0.923077  0.003444  0.001454  0.000000  0.002205
  0.956044  0.003444  0.001506  0.000000  0.002205
  0.989011  0.003444  0.001557  0.000000  0.002205
  1.021978  0.003444  0.001609  0.000000  0.002205
  1.054945  0.003444  0.001661  0.000000  0.002205
  1.087912  0.003444  0.001713  0.000000  0.002205
  1.120879  0.003444  0.001765  0.000000  0.002205
  1.153846  0.003444  0.001817  0.000000  0.002205
  1.186813  0.003444  0.001869  0.000000  0.002205
  1.219780  0.003444  0.001921  0.000000  0.002205
  1.252747  0.003444  0.001973  0.000000  0.002205
  1.285714  0.003444  0.002025  0.000000  0.002205
  1.318681  0.003444  0.002077  0.000000  0.002205
  1.351648  0.003444  0.002128  0.000000  0.002205
  1.384615  0.003444  0.002180  0.000000  0.002205
  1.417582  0.003444  0.002232  0.000000  0.002205
  1.450549  0.003444  0.002284  0.000000  0.002205
  1.483516  0.003444  0.002336  0.000000  0.002205
  1.500000  0.003444  0.002408  0.000000  0.002205
  END FTABLE  2
  FTABLE      1
   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.003444  0.000000  0.000000  0.000000  0.000103
  0.032967  0.003604  0.000116  0.000000  0.020833  0.000103
  0.065934  0.003766  0.000238  0.000000  0.021749  0.000206
  0.098901  0.003928  0.000364  0.000000  0.022207  0.000310
  0.131868  0.004092  0.000497  0.000000  0.022665  0.000415
  0.164835  0.004256  0.000634  0.000000  0.023123  0.000520
  0.197802  0.004421  0.000777  0.000000  0.023581  0.000626
  0.230769  0.004586  0.000926  0.000000  0.024038  0.000732
  0.263736  0.004753  0.001080  0.000000  0.024496  0.000838
```

```
  0.296703  0.004920  0.001239  0.000000  0.024954  0.000945
  0.329670  0.005088  0.001404  0.000000  0.025412  0.001053
  0.362637  0.005257  0.001575  0.000000  0.025870  0.001161
  0.395604  0.005426  0.001751  0.000000  0.026328  0.001270
  0.428571  0.005597  0.001932  0.000000  0.026786  0.001379
  0.461538  0.005768  0.002120  0.000000  0.027244  0.001488
  0.494505  0.005940  0.002313  0.000000  0.027701  0.001598
  0.527473  0.006113  0.002511  0.000000  0.028159  0.001709
  0.560440  0.006286  0.002716  0.000000  0.028617  0.001820
  0.593407  0.006461  0.002926  0.000000  0.029075  0.001932
  0.626374  0.006636  0.003142  0.000000  0.029533  0.002044
  0.659341  0.006812  0.003363  0.000000  0.029991  0.002157
  0.692308  0.006989  0.003591  0.000000  0.030449  0.002270
  0.725275  0.007167  0.003824  0.000000  0.030907  0.002384
  0.758242  0.007345  0.004064  0.000000  0.031364  0.002498
  0.791209  0.007524  0.004309  0.000000  0.031822  0.002613
  0.824176  0.007704  0.004560  0.000000  0.032280  0.002728
  0.857143  0.007885  0.004817  0.000000  0.032738  0.002844
  0.890110  0.008067  0.005080  0.000000  0.033196  0.002960
  0.923077  0.008249  0.005348  0.000000  0.033654  0.003077
  0.956044  0.008432  0.005623  0.000000  0.034112  0.003194
  0.989011  0.008616  0.005904  0.000000  0.034570  0.003312
  1.021978  0.008801  0.006192  0.034569  0.035028  0.003430
  1.054945  0.008987  0.006485  0.136453  0.035485  0.003549
  1.087912  0.009173  0.006784  0.275387  0.035943  0.003669
  1.120879  0.009360  0.007090  0.441409  0.036401  0.003788
  1.153846  0.009548  0.007401  0.627270  0.036859  0.003909
  1.186813  0.009737  0.007719  0.826090  0.037317  0.004030
  1.219780  0.009927  0.008043  1.030827  0.037775  0.004151
  1.252747  0.010117  0.008374  1.234286  0.038233  0.004273
  1.285714  0.010308  0.008710  1.429395  0.038691  0.004395
  1.318681  0.010500  0.009053  1.609623  0.039148  0.004518
  1.351648  0.010693  0.009403  1.769522  0.039606  0.004642
  1.384615  0.010886  0.009758  1.905359  0.040064  0.004766
  1.417582  0.011081  0.010120  2.015818  0.040522  0.004890
  1.450549  0.011276  0.010489  2.102770  0.040980  0.005015
  1.483516  0.011472  0.010864  2.172110  0.041438  0.005141
  1.500000  0.011570  0.011054  2.263538  0.041667  0.005203
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    0.8            RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     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***
RCHRES   2 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL       REPL
RCHRES   2 HYDR   O      1 1        1      WDM   1001 FLOW     ENGL       REPL
RCHRES   2 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL       REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL       REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1004 STAG     ENGL       REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1005 FLOW     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        8
RCHRES     OFLOW  OVOL   2                RCHRES         INFLOW IVOL
  END MASS-LINK    8

  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
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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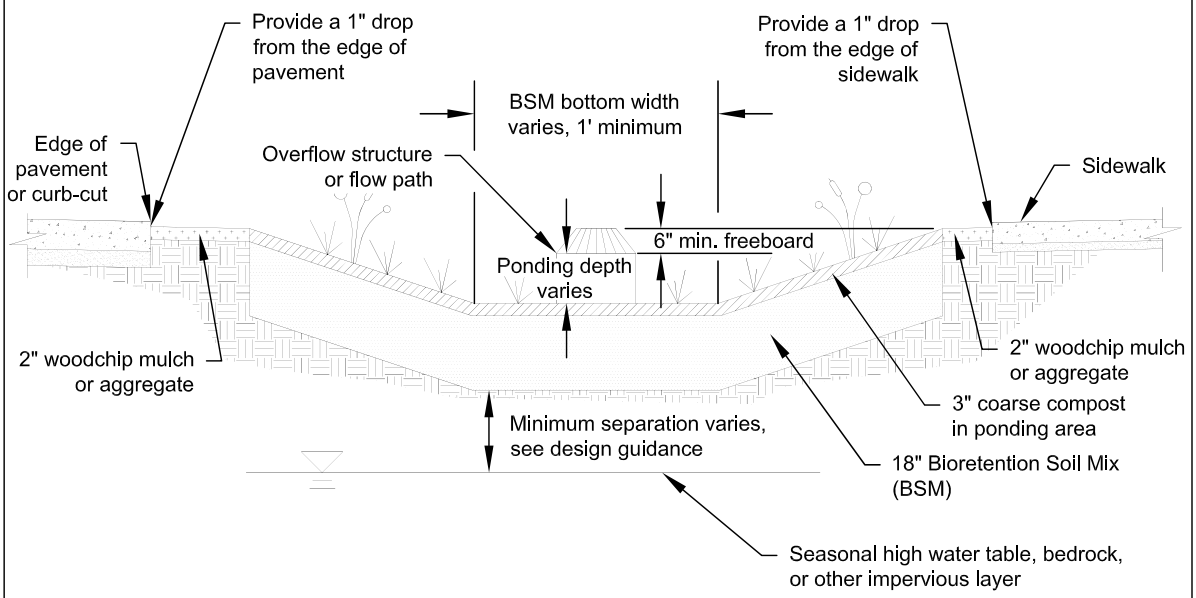
Figure V-5.16: Typical Bioretention



Note: See **BMP T7.30: Bioretention** for further details regarding design, installation, and maintenance of bioretention.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Typical Bioretention

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