PRELIMINARY STORM DRAINAGE REPORT

Poulsbo Self Storage

927 Northeast Lincoln Road
Poulsbo, Washington 98370

Prepared for:
Poulsbo Heated Storage
918 South Horton Street, Suite 1000
Seattle, WA 98134

August 02, 2016
Our Job No. 16929

BRANDON LONG CHAISY
STATE OF WASHINGTON
47628
REGISTERED
PROFESSIONAL ENGINEER
8/02/16

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PRELIMINARY STORM DRAINAGE REPORT

Poulsbo Self Storage

Poulsbo, Washington

Our Job. No. 16929

PROJECT ENGINEER'S CERTIFICATION

"I hereby state that this Storm Drainage Report 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 of professional engineers. The analysis has been prepared utilizing procedures and practices specified by the City of Poulsbo and within the standard accepted practices of the industry. I understand that the City of Poulsbo does not and will not assume liability for the sufficiency, suitability or performance of drainage facilities prepared by me."

BRANDON LONG CHANG
STATE OF WASHINGTON
47626
REGISTERED
PROFESSIONAL ENGINEER

8/02/16

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Tab 1.0

1.0 PROJECT OVERVIEW

The proposed Poulsbo Self Storage site is approximately 2.55 acres in total size covering one existing tax parcel. The project site is located in the Northwest 1/4 of the Northeast 1/4 of Section 23, Township 26 North, Range 1 East, Willamette Meridian, City of Poulsbo, Kitsap County, Washington. The site contains tax parcel 232601-1-040-2008. An address for the site has not been assigned yet according to the Pierce County Parcel viewer, but will likely be 927 Northeast Lincoln Road. The site is located south of Lincoln Road NE between 10th Avenue NE and State Route 305. The site is bound to the north by Lincoln Road NE, to the west by a vacant commercial business lot, to the east by 10th Avenue NE and to the south by residential properties. Refer to the attached Figure 1 - Vicinity Map for a map of the project location.

The proposed development includes one new multi-story Self Storage Facility. The project also includes pedestrian amenities, parking and associated utilities including new stormwater detention and water quality treatment facilities. The site is currently vacant and covered in native vegetation. Road improvements associated with this project include widening the west half of 10th Ave Northeast and constructing new curb, gutter, sidewalk and landscaping. Two new site access driveways are proposed along 10th Avenue and an existing access along Lincoln Road shall remain for a total of three access points to the subject property.

There is an existing stream crossing the site along the southwest corner. The site is developed so that runoff is treated and detained and then discharged to the existing stream. Flow control per the 2005 DOE Stormwater Management Manual for Western Washington is used on this site to match pre-developed conditions. The storm drainage collection and treatment system is further discussed in Section 5.0 of this report.

This project will require City of Poulsbo site plan approval, construction plan approval from the City of Poulsbo, and a right-of-way use permit.

1.1 Minimum Requirements

Minimum Requirement No. 1: Preparation of Stormwater Site Plan.

Response: The Stormwater Site Plan has been prepared in accordance with the 2005 DOE Stormwater Management Manual for Western Washington.

Minimum Requirement No. 2: Construction Stormwater Pollution Prevention.

Response: A Construction SWPPP will be prepared and approved prior to construction.

Minimum Requirement No. 3: Source Control Pollution.

Response: Source control will be provided for landscaping/lawn and maintenance of stormwater drainage and treatment systems.

Minimum Requirement No. 4: Preservation of Natural Drainage System and Outfalls.

Response: The existing and proposed project site both discharge stormwater runoff to the existing stream.

Minimum Requirement No. 5: On-Site Stormwater Management.

Response: On-site stormwater management will be handled through the use of catch basins and underground conveyance pipes leading to a detention pond. Rain gardens with underdrains will be incorporated to treat and manage flows for the east portion of the site and for 10th Ave NE.

Infiltration of storm water on-site is not feasible per recommendations from the geotechnical engineer.

Minimum Requirement No. 6: Runoff Treatment.

Response: The pollution generating surfaces will be treated with enhanced treatment practices. The runoff from the eastern basin and 10th Ave NE will be treated in rain gardens and the western basin will be treated with a Filterra biofiltration unit sized according to Washington GULD guidelines for enhanced treatment.

Minimum Requirement No. 7: Flow Control.

Response: Flow control will be achieved through the use of a detention pond.

Minimum Requirement No. 8: Wetlands Protection.

Response: There are no wetlands affected by the developed property.

Minimum Requirement No. 9: Operation and Maintenance.

Response: An operations and maintenance agreement and maintenance manual will be completed prior to permit issuance.

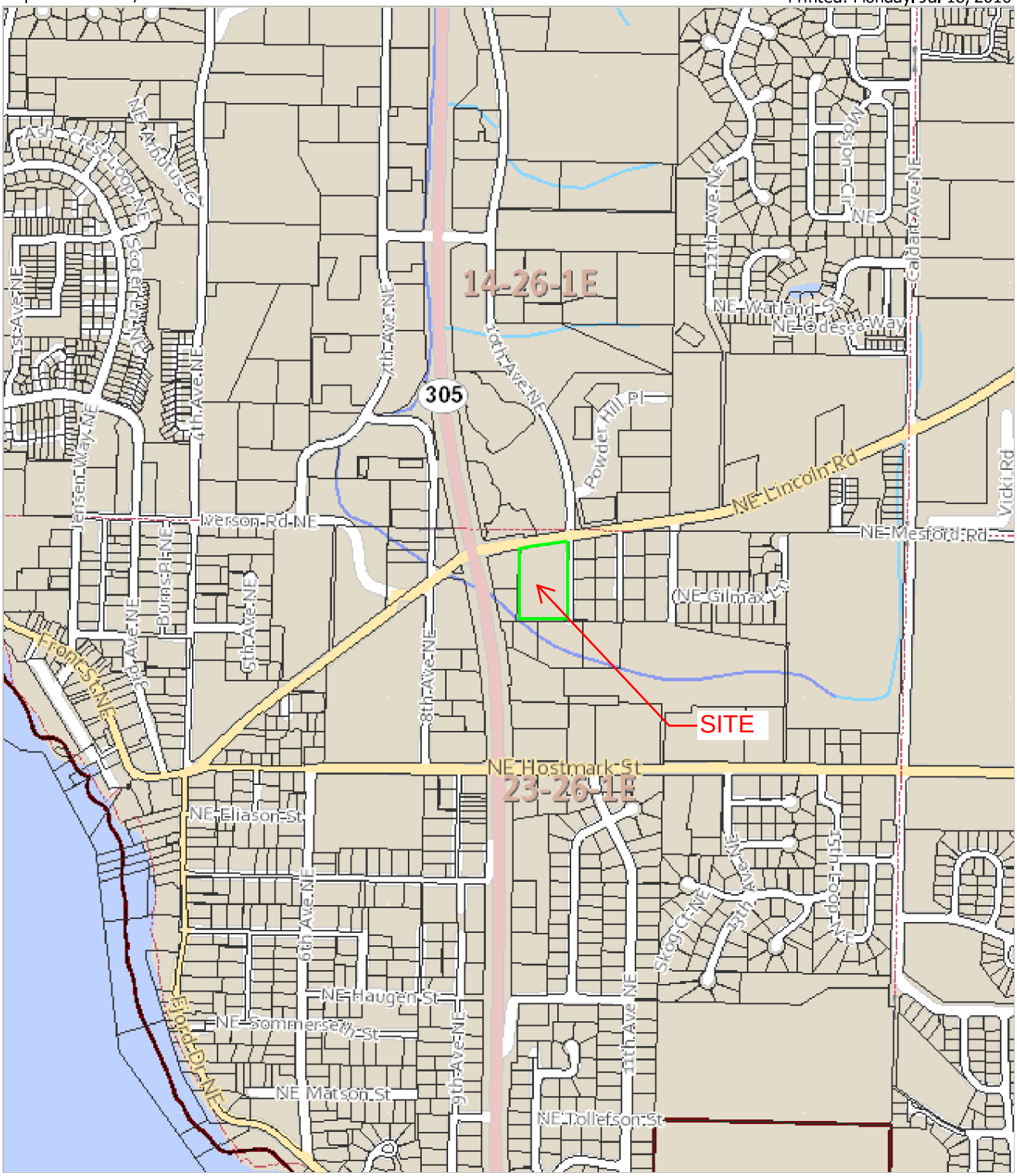
Minimum Requirement No. 10: Agreements and Financial Guarantees.

Response: All required agreements and financial guarantees will be implemented for the proposed project.

Figure 1 Vicinity Map

Map Scale: 1 : 10,000

Printed: Monday, Jul 18, 2016



** This map is not a substitute for field survey **

0 500 1000ft

Vicinity Map

N W E S

Tab 2.0

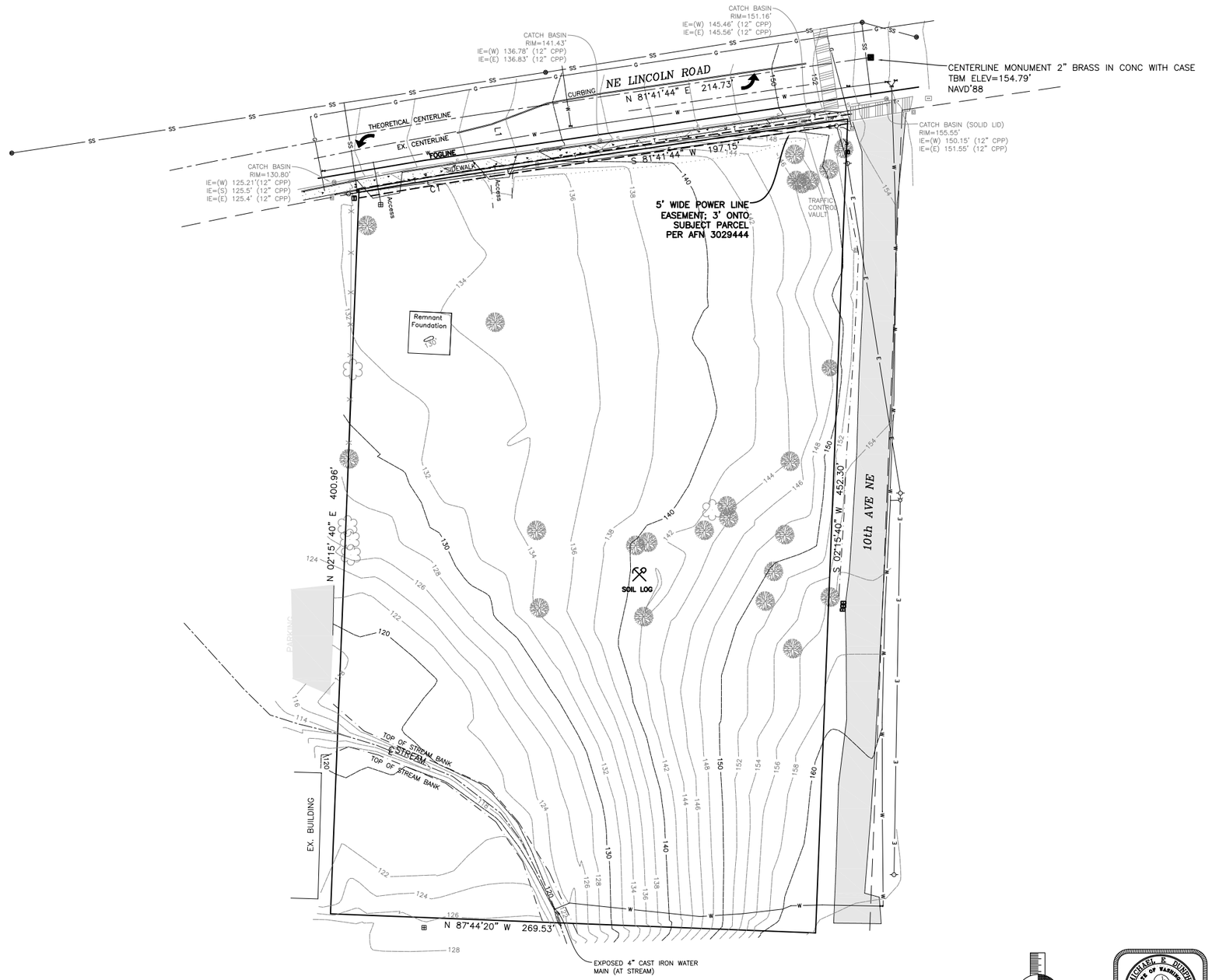
2.0 EXISTING CONDITIONS SUMMARY

Currently, the site is undeveloped and covered in shrubs and trees. There are no existing utilities on site. The site generally slopes from the northeast to the southwest where runoff is collected in the existing stream in the southwest corner of the site. Surface runoff is conveyed to the stream via sheet and shallow channel flow. The stream discharges off-site and flows north west. The soils on site consist of Poulsbo gravelly sandy loam and Ragnar fine sandy loam, the SCS Soils Guide defines the soils as Type "C" and “B” respectively, as shown on Figure 3 – Soils Map. Per recommendations from the geotechnical engineer; infiltration is not feasible in the southeastern area of the project because infiltrated water could flow to the building, and also not feasible at the northwestern area of the property because of the declining slope and building off of the western edge of the property.

The site is not located within a floodplain as shown on the Figure 4 – FEMA Map included in this section.

Basin characteristics and runoff volumes are shown in Section 4.0.

Figure 2 Existing Conditions Map



DATUM

NAVD'88

MICHAEL E. DUNDEY
STATE OF WASHINGTON
40016
PROFESSIONAL LAND SURVEYOR

URBAN SELF STORAGE

TOPOGRAPHY
NE LINCOLN RD, POULSBO, WA

SEC. 23 , TOWNSHIP 26 N., RANGE 1 E., W.M., KITSAP COUNTY, WA

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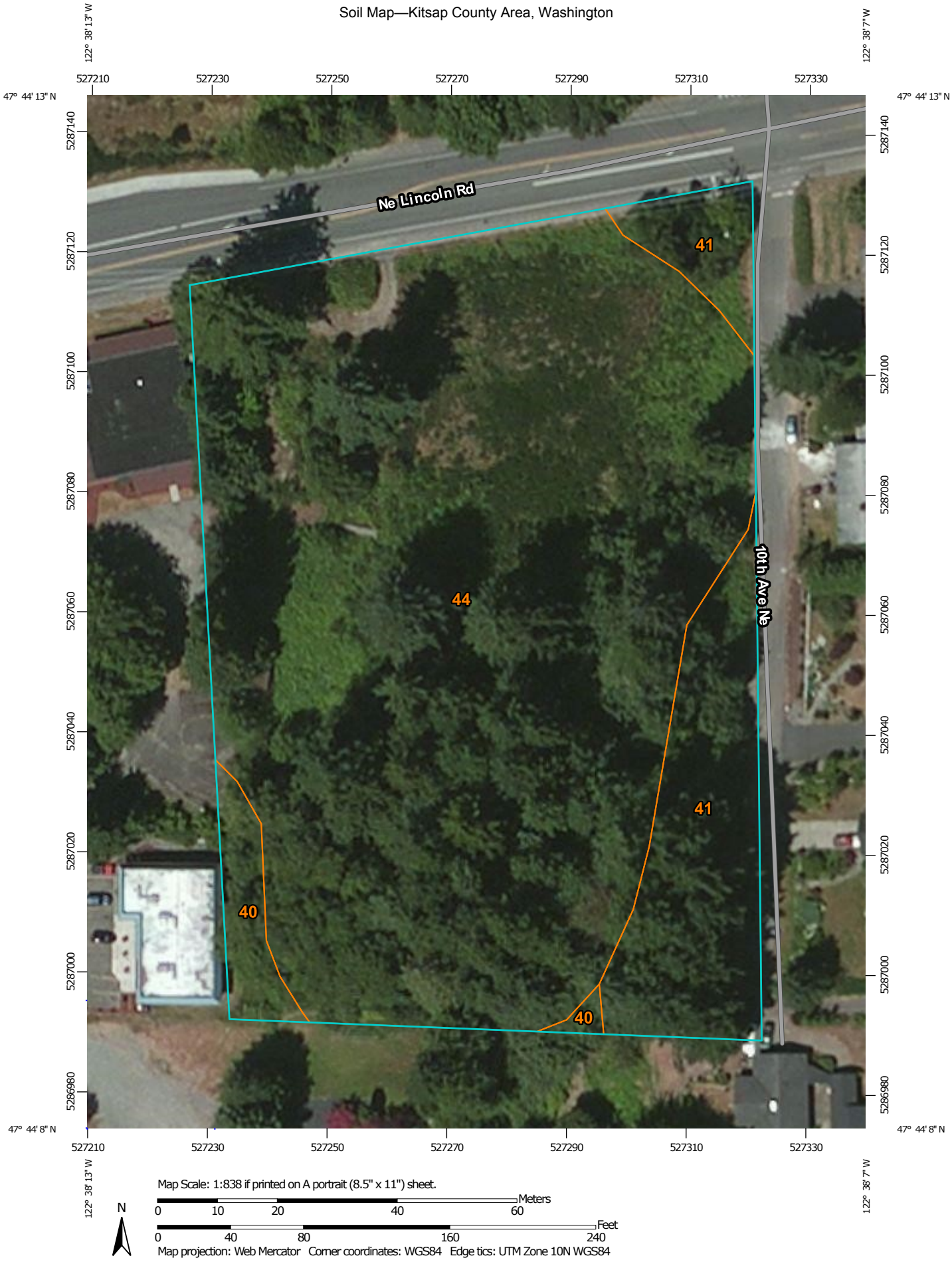
DC SURVEYING

P.O. BOX 1090
POULSBO, WA 98370
PHONE: 360-779-6633
B.I. PHONE: 206-842-6123

DRAWN: TMC	CHECKED: MED	SCALE: 1"=30'	JOB NO.:14-7178
NW 1/4, NE 1/4	DATE: MARCH 2014	SHEET 1 OF 1	FB: 1605/10-19

Figure 3 Soils Map

Soil Map—Kitsap County Area, Washington



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: http://websoilsurvey.nrcs.usda.gov
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: Kitsap County Area, Washington
Survey Area Data: Version 11, Sep 14, 2015

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

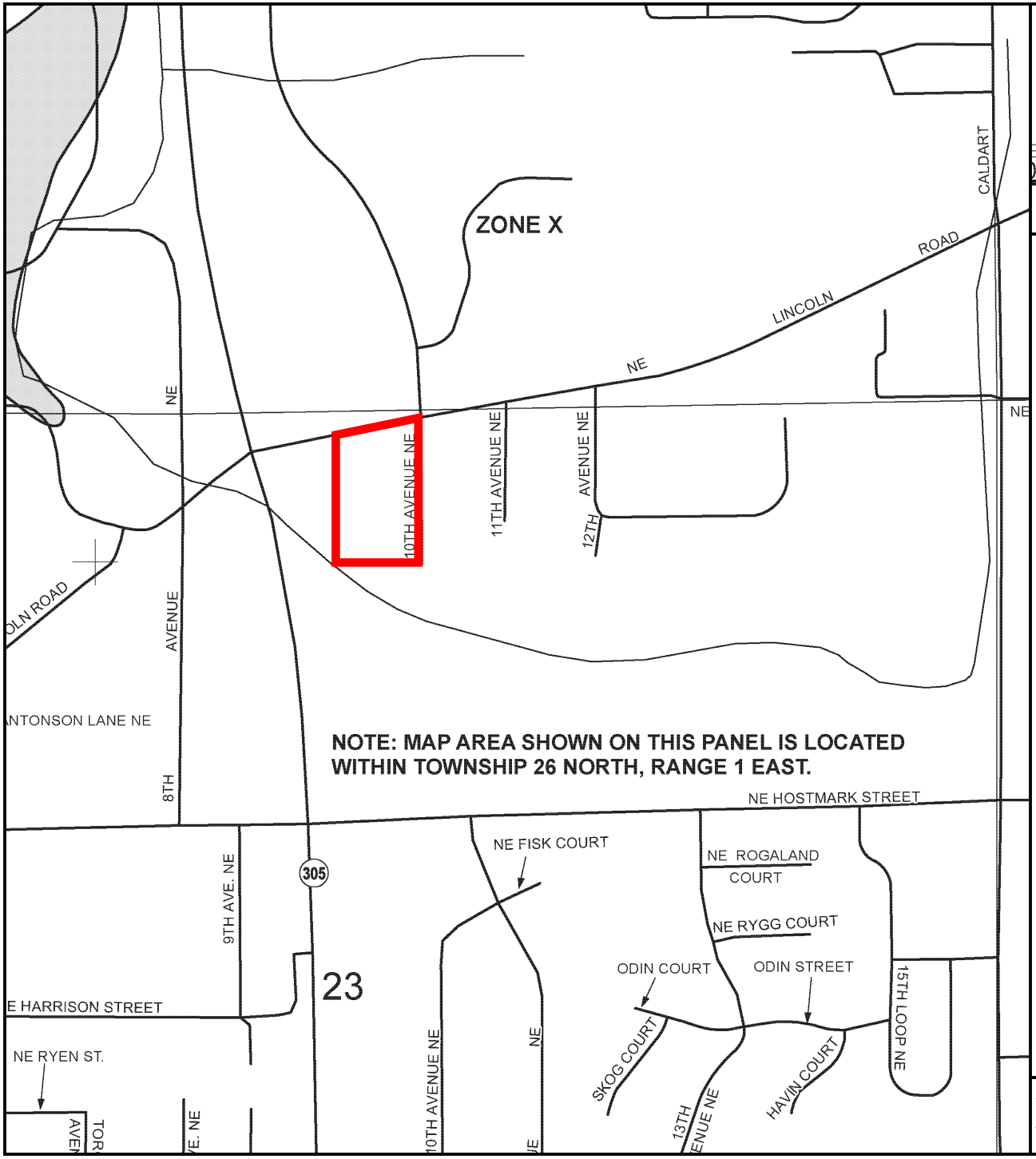
Date(s) aerial images were photographed: Jul 9, 2010—Aug 20, 2011

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

Kitsap County Area, Washington (WA635)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
40	Poulsbo gravelly sandy loam, 6 to 15 percent slopes	0.1	2.8%
41	Poulsbo gravelly sandy loam, 15 to 30 percent slopes	0.4	14.4%
44	Ragnar fine sandy loam, 0 to 6 percent slopes	2.5	82.8%
Totals for Area of Interest		**3.0**	**100.0%**

Figure 4 FEMA Map



MAP SCALE 1" = 500'

250 0 500 1000 FEET

0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

KITSAP COUNTY, WASHINGTON

AND INCORPORATED AREAS

PANEL 207 OF 525

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KITSAP COUNTY	530092	0207	E
POULSBO, CITY OF	530241	0207	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
53035C0207E

MAP REVISED
NOVEMBER 4, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

MAP SCALE 1" = 500'

250 0 500 1000 FEET

0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

KITSAP COUNTY, WASHINGTON

AND INCORPORATED AREAS

PANEL 94 OF 525

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KITSAP COUNTY	530092	0094	E
POULSBO, CITY OF	530241	0094	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
53035C0094E

MAP REVISED
NOVEMBER 4, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Tab 3.0

3.0 OFF-SITE ANALYSIS

The site is bound to the north by Lincoln Road NE, to the west by vacant commercial property, to the east by 10th Avenue NE and to the south by residential property. There is a small upstream basin east of 10th Avenue NE that discharges onto the project site. This upstream basin sheet flows across 10th Avenue NE and onto the subject property near the eastern property boundary. A bypass system will be installed to convey upstream flows around the property and to the stream.

Runoff is discharged to an existing stream at the southwest corner of the property. The stream continues northwesterly approximately 7,500 feet where it discharges into Dogfish Creek near Bond Road NE. From this point, Dogfish Creek discharges into to Liberty Bay less than a mile downstream.

A Level 1 Downstream Analysis has been prepared for the project and discusses the downstream drainage path in more detail.

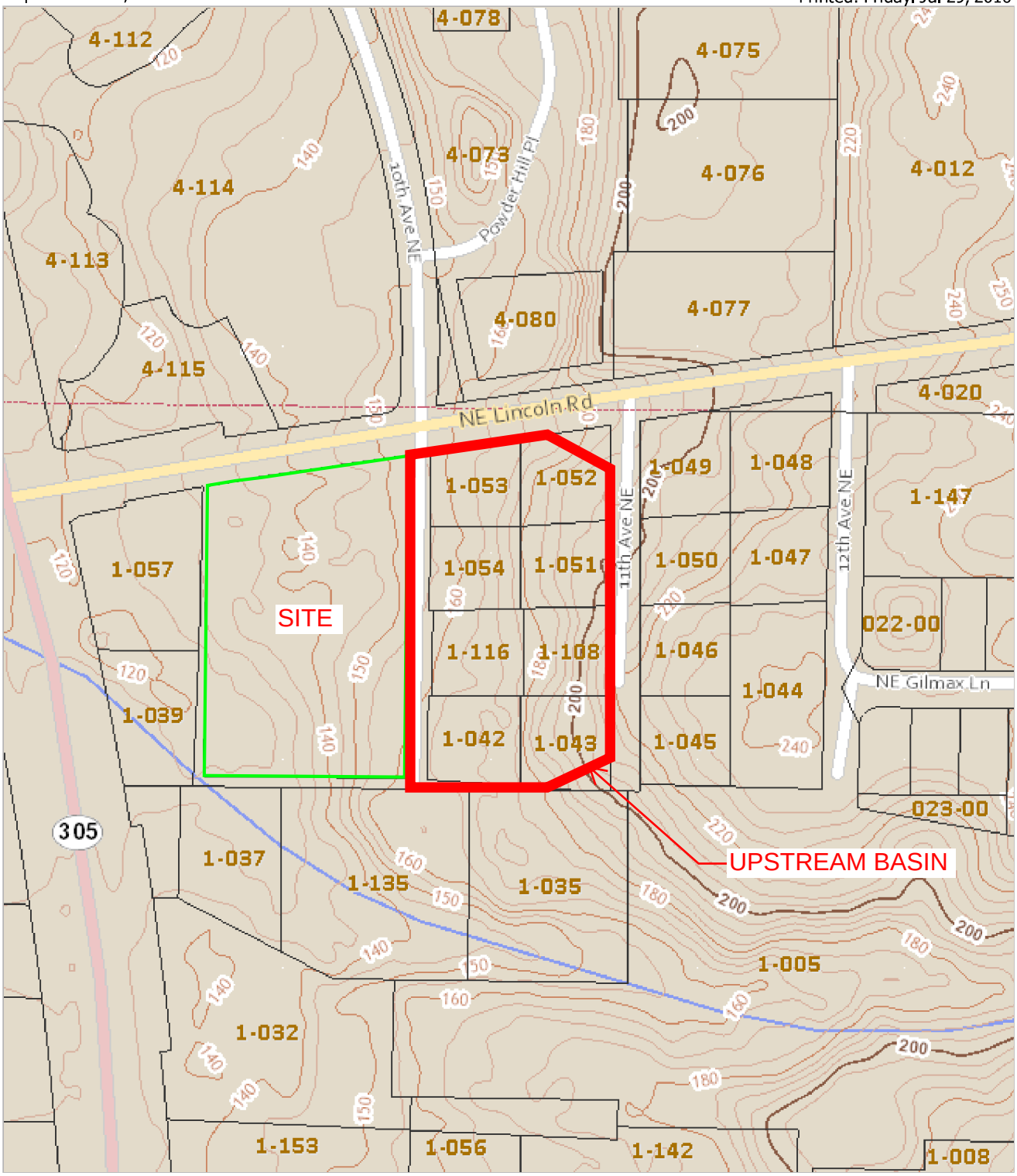
Figure 5 Downstream Drainage Map

Job Number		Scale:	For: POULSBO-STORAGE
16929	Designed KEH Drawn KEH Checked JGH Approved JGH Date 7/19/16	Horizontal 1"=200' Vertical NA	
Sheet 1 of 1		BARGHAUSEN CONSULTING ENGINEERS, INC. 18215 72ND AVENUE SOUTH KENT, WA 98032 (425)251-6222 (425)251-8782 FAX CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES	Title: DOWNSTREAM DRAINAGE MAP

Figure 6 Upstream Drainage Map

Map Scale: 1 : 2,400

Printed: Friday, Jul 29, 2016



** This map is not a substitute for field survey **

0 100 200ft

Comments

N W E S

Tab 4.0

4.0 PERMANENT STORMWATER CONTROL PLAN

4.1 Existing Site Hydrology

The existing project site consists of approximately 1.87 acres of undeveloped land. The project site consists of one drainage basin (Basin 1).

The drainage basin flows to the existing stream in the southwest corner of the project site. All of the stormwater flows north where it is ultimately discharged into Dogfish Creek.

The basin will be modeled as forested for flow control requirements.

See Pre-Developed Basin Table and Figure 6 - Pre-developed Basin Map in this section.

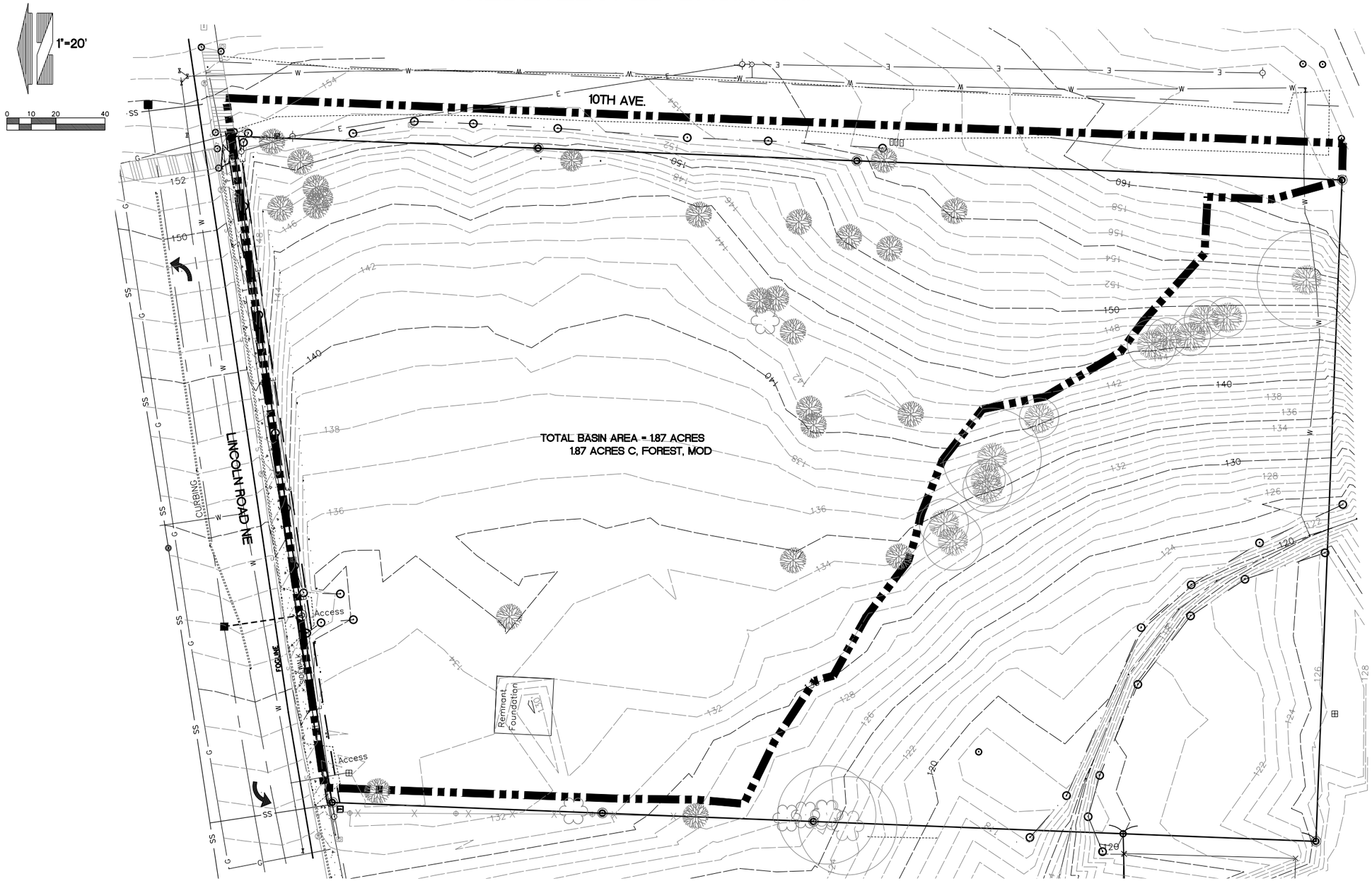
TABLE 1: Pre-Developed Basin Table

Basin No.	Area (Ac)	Forest Area (Ac)	Pasture Area (Ac)	Landscape Area (Ac)	Roof Area (Ac)	Impervious Area (Ac)
1	1.87	1.87	0	0	0	0
Total	1.87					

Basin	2-Yr. Flow (CFS)	10-Year Flow (CFS)	25-year Flow (CFS)	50-year flow (CFS)	100-year Flow (CFS)
1	0.1471	0.3514	0.4923	0.6153	0.7546

Figure 7 Pre-Developed Basin Map

PREDEVELOPED BASIN MAP



No.	Date	By	Ckd.	Appr.	Revision

Title: PREDEVELOPED BASIN MAP POULSBO, WA

For: POULSBO SELF STORAGE

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Designed KEH
Drawn RDC
Checked KEH
Approved JGH
Date 5/16/16

Scale:
Horizontal 1"=20'
Vertical NA

Job Number 16929

Sheet 1 of 1

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4.2 Developed Site Hydrology

The proposal for this project is to construct a multi-story Self Storage Facility with underground parking garage, associated parking/loading spaces, storm drainage, utilities, curb and gutter, sidewalk, landscaping, and access. The total property site is comprised of 2.55 acres. Approximately 1.91 acres of the site will be developed as the stream crossing the property has a 100 foot setback which limits the area available for development. Refer to the developed basin map for the developed conditions on site. There are no upstream flows that are included in the on-site basin. Runoff from upstream of the site will be diverted from the site and directly to the stream. The project site consists of one developed drainage basin. Basin 1 will be routed to a detention pond and discharge out to the existing stream along the southwest property corner.

Minimum Requirement #7 is the requirement to provide flow control for the development project. This requires matching the developed stormwater discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. For requirement #7 the DOE manual requires pre-developed conditions to be modeled as a forested condition. The objective of requirement #7 is to prevent increases in the stream channel erosion rates. As a supplemental guideline, the application of Minimum Requirement #7 – Flow control "should not exacerbate other water quality/quantity problems such as inadequate low flows or inadequate wetland water elevations." (2005 DOE, Volume 1, pg 2-35).

Stormwater discharge will be accomplished through the use of rip-rap to avoid point discharges into the existing stream. This will aid in reducing the potential for erosion and will provide a more natural dispersion of stormwater. Stormwater will be routed to the rip-rap pads after treatment and detention to match current flow conditions.

The parking lots and asphalt driveways will be graded to drain to catch basins located at low points within the parking lot. In the developed condition, drainage is broken into five distinct basins. In the 10th and East Basin, runoff is directed to a rain garden and then to the detention pond via underdrain/overflows structures. The landscape basin consists of the landscaping along the north property line. The west basin consists of the parking lot area on the west side of the building. The south basin is the area used for the detention pond and landscaping to the south of the building. The roof basin is the building roof area which is sent directly to the detention pond. Roof drainage is considered clean therefore may bypass the water quality facilities since it does not require any treatment prior to discharge.

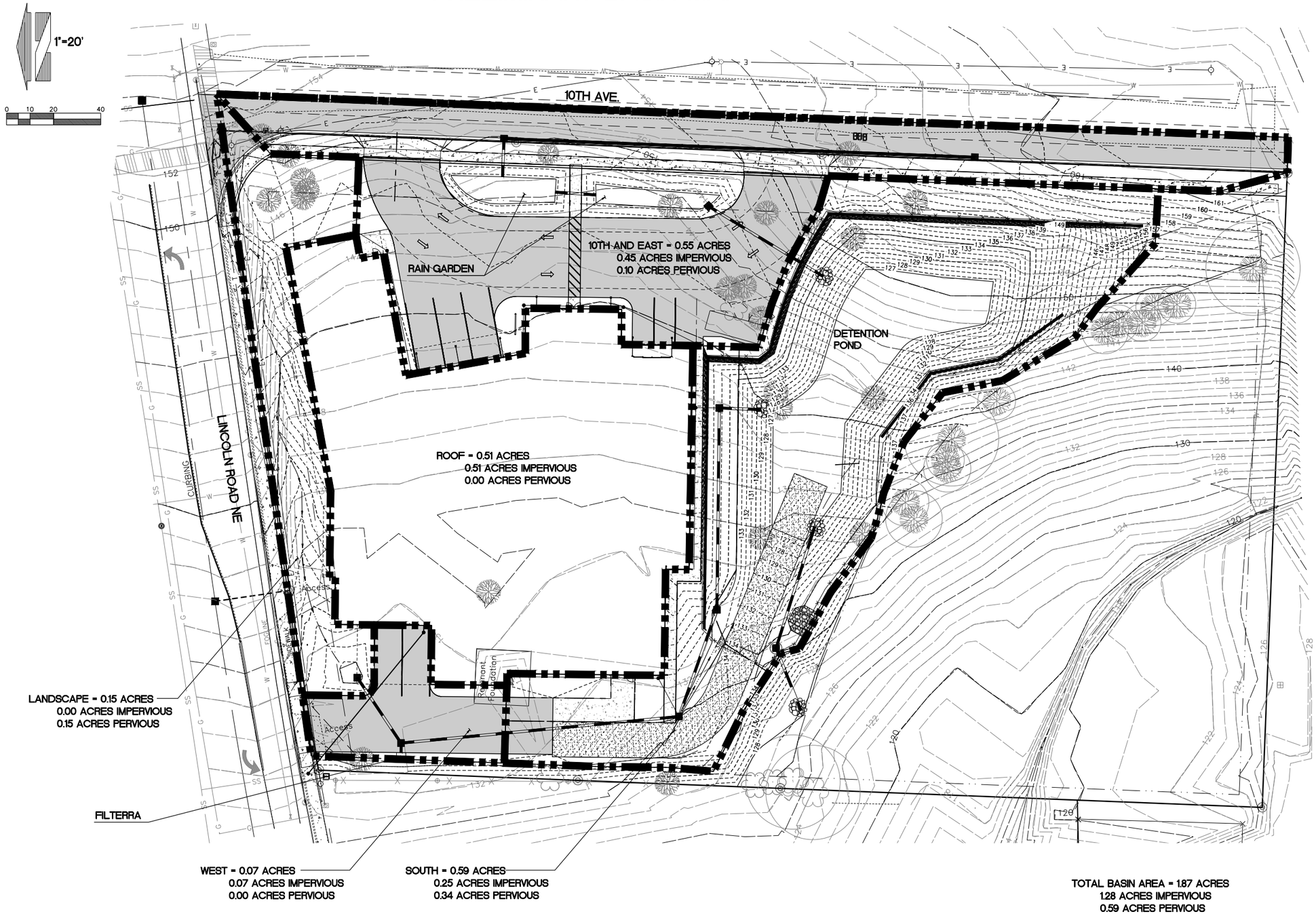
Footing drains will be utilized around the proposed building per recommendations in the geotechnical report. Drains will also be placed at the base of all earth retaining walls. These footing drains will be discharged into the existing stream.

Basin No.	Area (Ac)	Pervious Area (Ac)	Impervious Area (Ac)
10th and East	0.55	0.1	0.45
West	0.07	0	0.07
Landscape	0.15	0.15	0
South	0.59	0.34	0.25
Roof	0.51	0	0.51
Total	1.87	0.59	1.28

Basin	2-Yr. Flow (CFS)	10-Year Flow (CFS)	25-year Flow (CFS)	50-year flow (CFS)	100-year Flow (CFS)
Inflow To Pond	0.7019	1.1258	1.3583	1.5400	1.7292
Discharge From Pond	0.07393	0.1207	0.1495	0.1735	0.1998

Figure 8 Developed Basin Map

PRELIMINARY BASIN MAP



No.	Date	By	Ckd.	Appr.	Revision

Title: PRELIMINARY BASIN MAP POULSBO, WA

For: POULSBO SELF STORAGE

Designed KEH
Drawn RDC
Checked KEH
Approved JGH
Date 5/16/16

Scale:
Horizontal 1"=20'
Vertical NA

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Job Number 16929

Sheet 1 of 1

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4.3 Performance Standards and Goals

The water quality and detention facilities calculations will be designed in accordance with the 2005 Department of Ecology Stormwater Management Manual for Western Washington (SMMWW).

Calculations were done using Western Washington Hydrology Model (WWHM3) to size the detention pond based on the 2005 DOE Standards. Stormwater developed discharge durations shall match pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. Pre-developed condition for the basin is based on historic (forested) conditions.

Discharge to the stream will be achieved through the use of rip-rap pads. The rip-rap pads will help to avoid point discharge to the existing stream which will reduce the potential for erosion. Runoff will have to sheet flow across the existing stream buffer prior to entering the stream which will keep runoff velocities low and times of concentrations across the stream high. Because the flow will match existing conditions (or less) and there are not any erosion problems in the downstream drainage path, no increases to downstream erosion rates are anticipated. This effectively meets the objective of Minimum Requirement #7.

4.4 Flow Control System

Flow control is proposed for all areas of the project. Flow control is based on historic (forested) site conditons.

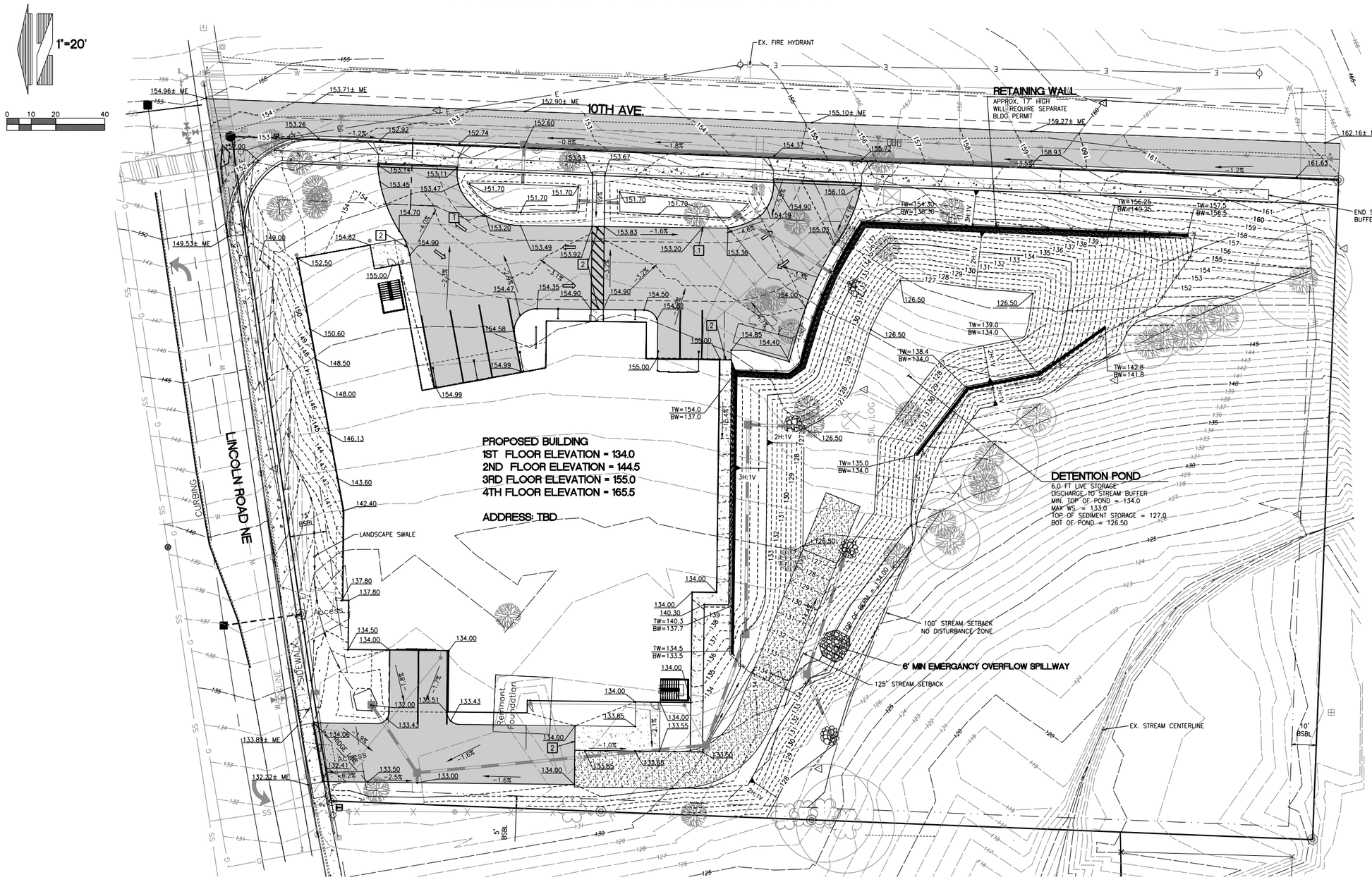
Stormwater developed discharge durations shall match pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow.

The proposed pond is a single-celled pond utilizing 6 feet of live storage per Figure 3.9 as shown in the 2005 Department of Ecology Stormwater Management Manual for Western Washington (SMMWW). This is a detention pond only, since water quality treatment will be accomplished in via a rain garden and Filterra unit. A minimum 6" of sediment storage will be provided. A control structure will be used to control the runoff and an emergency overflow spillway will be used for extreme storm events or in case of failure within the control structure.

Runoff from upstream off-site basin will be routed around the project site and will discharge as close to the stream as possible.

Figure 9 Grading and Storm Drainage Plan and Construction Details

PRELIMINARY GRADING PLAN



1 PROVIDE 2" CURB OPENING FOR DRAINAGE

2 SIDEWALK TO BE FLUSH WITH ASPHALT

No.	Date	By	Ckd.	Appr.	Revision

Title: PRELIMINARY GRADING PLAN

POULSBO, WA

For: POULSBO HEATED STORAGE
C/O URBAN DEVELOPMENT AND CONSTRUCTION LLC
918 SOUTH HORTON STREET, SUITE 1000
SEATTLE, WA 98134

Scale: Horizontal 1"=20' Vertical NA

Designed KEH
Drawn RDC
Checked KEH
Approved JDH
Date 5/16/16

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Job Number 16929

Sheet C4 of 6

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4.5 Water Quality System

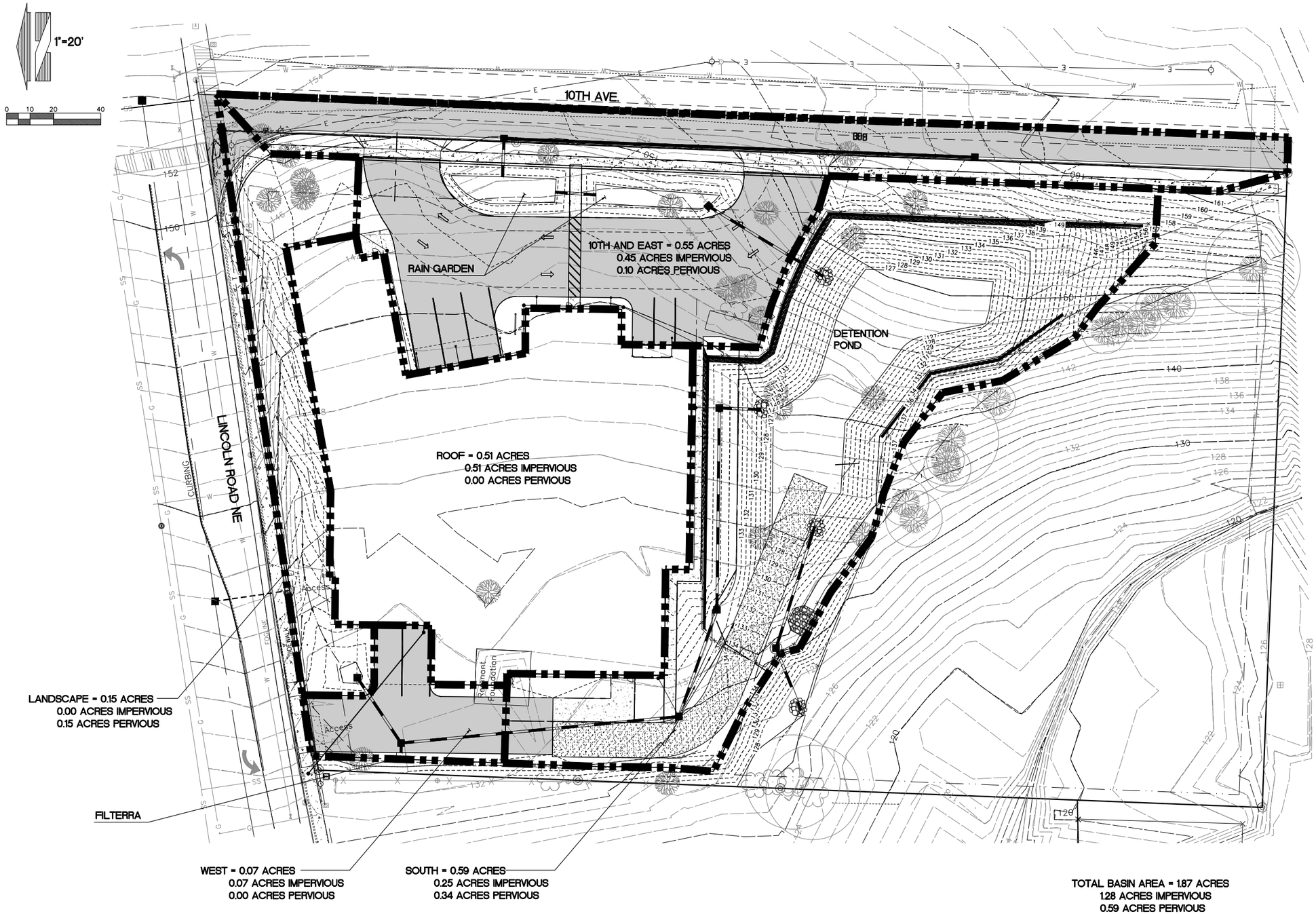
Water quality treatment for this project site will be achieved through the use of a rain garden for the 10th and East Basin, and a Filterra unit for the West basin. The rain garden is sized in accordance with the 2005 Department of Ecology Stormwater Management Manual for Western Washington and the Filterra unit is sized per DOE GULD guidelines.

Basin	Area (sf)	% Impervious	Water Quality Facility	Size Required
10th and East	23,958 sf =0.55 ac	82	Rain Garden 1	500 sf
West	3049 sf =0.07 ac	100	Filterra	4' x 4'

The rain garden will be designed to utilize amended soil for water quality and then underdrains will be installed to collect the treated runoff and route it to the detention pond. Due to the low infiltration rates of the onsite soils, infiltration has not been accounted for in the storm facility design.

Figure 10 Water Quality Basin Map

PRELIMINARY BASIN MAP



No.	Date	By	Ckd.	Appr.	Revision

Title: PRELIMINARY BASIN MAP POULSBO, WA

For: POULSBO SELF STORAGE

Designed KEH
Drawn RDC
Checked KEH
Approved JGH
Date 5/16/16

Scale:
Horizontal 1"=20'
Vertical NA

BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH
KENT, WA 98032
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(425)251-8782 FAX
CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES

Job Number 16929

Sheet 1 of 1

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4.6 Conveyance System Analysis and Design

The conveyance system for this project consists of the use of underground pipes and catch basins. Conveyance sizing will be performed as required by the 2005 Department of Ecology Stormwater Management Manual for Western Washington.

Conveyance system analysis and design will be completed during the engineering review process.

Tab 5.0

5.0 CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

The SWPPP will be prepared and included during the engineering review process.

Tab 6.0

6.0 SPECIAL REPORTS AND STUDIES

Additional special reports and studies are included in the appendices.

Tab 7.0

7.0 OTHER PERMITS

Additional permits to complete this project will include the building permit, and a right-of-way use permit.

Tab 8.0

8.0 OPERATIONS AND MAINTENANCE MANUAL

The operations and maintenance of the site will adhere to the City of Poulsbo 2014 Stormwater Maintenance Manual. The site specific operations and maintenance manual shall be completed later as part of the engineering design review process.

Tab 9.0

9.0 BOND QUANTITY WORKSHEET

The bond quantity worksheet will be completed during the engineering review process.

Appendix A
Hydrology Calculations

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	16929-pond
Site Name:	
Site Address:	
City:	
Report Date:	7/26/2016
Gage:	Quilcene
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.80
Version Date:	2016/02/25
Version:	4.2.12

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
C, Forest, Mod	1.87
Pervious Total	1.87
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.87

Element Flows To:

Surface	Interflow	Groundwater

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Mitigated Land Use

Roof

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.51
Impervious Total	0.51
Basin Total	0.51

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

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10th and East

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.1
Pervious Total	0.1
Impervious Land Use	acre
ROADS FLAT	0.2
PARKING FLAT	0.25
Impervious Total	0.45
Basin Total	0.55

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

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South Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Steep	0.22
C, Lawn, Flat	0.12
Pervious Total	0.34
Impervious Land Use	acre
POND	0.25
Impervious Total	0.25
Basin Total	0.59

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

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Landscape

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Steep	0.15
Pervious Total	0.15
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.15

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

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West

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
PARKING FLAT	0.07
Impervious Total	0.07
Basin Total	0.07

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

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Routing Elements
Predeveloped Routing

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Mitigated Routing

Trapezoidal Pond 1

Bottom Length:	124.00 ft.
Bottom Width:	37.00 ft.
Depth:	7 ft.
Volume at riser head:	0.9384 acre-feet.
Side slope 1:	2 To 1
Side slope 2:	2 To 1
Side slope 3:	2 To 1
Side slope 4:	2 To 1
Discharge Structure	
Riser Height:	6 ft.
Riser Diameter:	12 in.
Notch Type:	Rectangular
Notch Width:	0.040 ft.
Notch Height:	1.550 ft.
Orifice 1 Diameter:	1.22 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

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Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.105	0.000	0.000	0.000
0.0778	0.106	0.008	0.011	0.000
0.1556	0.107	0.016	0.015	0.000
0.2333	0.108	0.025	0.019	0.000
0.3111	0.110	0.033	0.022	0.000
0.3889	0.111	0.042	0.025	0.000
0.4667	0.112	0.050	0.027	0.000
0.5444	0.113	0.059	0.029	0.000
0.6222	0.114	0.068	0.031	0.000
0.7000	0.115	0.077	0.033	0.000
0.7778	0.117	0.086	0.035	0.000
0.8556	0.118	0.095	0.037	0.000
0.9333	0.119	0.104	0.039	0.000
1.0111	0.120	0.114	0.040	0.000
1.0889	0.121	0.123	0.042	0.000
1.1667	0.123	0.133	0.043	0.000
1.2444	0.124	0.142	0.045	0.000
1.3222	0.125	0.152	0.046	0.000
1.4000	0.126	0.162	0.047	0.000
1.4778	0.128	0.172	0.049	0.000
1.5556	0.129	0.182	0.050	0.000
1.6333	0.130	0.192	0.051	0.000
1.7111	0.131	0.202	0.052	0.000
1.7889	0.132	0.212	0.054	0.000
1.8667	0.134	0.223	0.055	0.000
1.9444	0.135	0.233	0.056	0.000
2.0222	0.136	0.244	0.057	0.000
2.1000	0.138	0.254	0.058	0.000
2.1778	0.139	0.265	0.059	0.000
2.2556	0.140	0.276	0.060	0.000
2.3333	0.141	0.287	0.061	0.000
2.4111	0.143	0.298	0.062	0.000

2.4889	0.144	0.309	0.063	0.000
2.5667	0.145	0.321	0.064	0.000
2.6444	0.147	0.332	0.065	0.000
2.7222	0.148	0.344	0.066	0.000
2.8000	0.149	0.355	0.067	0.000
2.8778	0.150	0.367	0.068	0.000
2.9556	0.152	0.379	0.069	0.000
3.0333	0.153	0.390	0.070	0.000
3.1111	0.154	0.402	0.071	0.000
3.1889	0.156	0.415	0.072	0.000
3.2667	0.157	0.427	0.073	0.000
3.3444	0.158	0.439	0.073	0.000
3.4222	0.160	0.451	0.074	0.000
3.5000	0.161	0.464	0.075	0.000
3.5778	0.162	0.477	0.076	0.000
3.6556	0.164	0.489	0.077	0.000
3.7333	0.165	0.502	0.078	0.000
3.8111	0.167	0.515	0.078	0.000
3.8889	0.168	0.528	0.079	0.000
3.9667	0.169	0.541	0.080	0.000
4.0444	0.171	0.555	0.081	0.000
4.1222	0.172	0.568	0.082	0.000
4.2000	0.173	0.581	0.082	0.000
4.2778	0.175	0.595	0.083	0.000
4.3556	0.176	0.609	0.084	0.000
4.4333	0.178	0.622	0.085	0.000
4.5111	0.179	0.636	0.087	0.000
4.5889	0.180	0.650	0.093	0.000
4.6667	0.182	0.664	0.100	0.000
4.7444	0.183	0.679	0.108	0.000
4.8222	0.185	0.693	0.116	0.000
4.9000	0.186	0.708	0.126	0.000
4.9778	0.188	0.722	0.135	0.000
5.0556	0.189	0.737	0.146	0.000
5.1333	0.190	0.752	0.156	0.000
5.2111	0.192	0.766	0.167	0.000
5.2889	0.193	0.781	0.178	0.000
5.3667	0.195	0.797	0.189	0.000
5.4444	0.196	0.812	0.200	0.000
5.5222	0.198	0.827	0.213	0.000
5.6000	0.199	0.843	0.227	0.000
5.6778	0.201	0.858	0.241	0.000
5.7556	0.202	0.874	0.255	0.000
5.8333	0.204	0.890	0.270	0.000
5.9111	0.205	0.906	0.346	0.000
5.9889	0.207	0.922	0.367	0.000
6.0667	0.208	0.938	0.553	0.000
6.1444	0.210	0.954	0.944	0.000
6.2222	0.211	0.971	1.418	0.000
6.3000	0.213	0.987	1.882	0.000
6.3778	0.214	1.004	2.252	0.000
6.4556	0.216	1.020	2.488	0.000
6.5333	0.217	1.037	2.674	0.000
6.6111	0.219	1.054	2.837	0.000
6.6889	0.220	1.071	2.990	0.000
6.7667	0.222	1.089	3.134	0.000
6.8444	0.223	1.106	3.271	0.000
6.9222	0.225	1.123	3.402	0.000

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7.0000	0.226	1.141	3.528	0.000
7.0778	0.228	1.159	3.648	0.000

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Bioretention 1

Bottom Length:	50.00 ft.
Bottom Width:	10.00 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:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	6
Orifice Diameter (in.):	6
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	102.347
Total Outflow (ac-ft.):	110.75
Percent Through Underdrain:	92.41
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	12 in.
Element Flows To:	
Outlet 1	Outlet 2
Trapezoidal Pond 1	

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Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
151.20	0.0257	0.0000	0.0000	0.0000
151.23	0.0256	0.0002	0.0000	0.0000
151.27	0.0252	0.0004	0.0000	0.0000
151.30	0.0249	0.0005	0.0000	0.0000
151.33	0.0245	0.0007	0.0001	0.0000
151.36	0.0242	0.0009	0.0002	0.0000
151.40	0.0238	0.0011	0.0002	0.0000
151.43	0.0235	0.0013	0.0003	0.0000
151.46	0.0231	0.0015	0.0005	0.0000
151.50	0.0228	0.0017	0.0006	0.0000
151.53	0.0225	0.0019	0.0008	0.0000
151.56	0.0221	0.0022	0.0010	0.0000
151.60	0.0218	0.0024	0.0013	0.0000
151.63	0.0214	0.0026	0.0016	0.0000
151.66	0.0211	0.0028	0.0019	0.0000
151.69	0.0208	0.0031	0.0022	0.0000
151.73	0.0205	0.0033	0.0026	0.0000
151.76	0.0201	0.0036	0.0030	0.0000
151.79	0.0198	0.0038	0.0035	0.0000
151.83	0.0195	0.0041	0.0040	0.0000
151.86	0.0192	0.0043	0.0045	0.0000
151.89	0.0189	0.0046	0.0051	0.0000
151.93	0.0185	0.0048	0.0057	0.0000
151.96	0.0182	0.0051	0.0064	0.0000
151.99	0.0179	0.0054	0.0071	0.0000
152.02	0.0176	0.0057	0.0078	0.0000
152.06	0.0173	0.0060	0.0086	0.0000
152.09	0.0170	0.0063	0.0095	0.0000
152.12	0.0167	0.0066	0.0104	0.0000
152.16	0.0164	0.0069	0.0113	0.0000
152.19	0.0161	0.0072	0.0123	0.0000

152.22	0.0158	0.0075	0.0134	0.0000
152.25	0.0155	0.0078	0.0145	0.0000
152.29	0.0152	0.0081	0.0156	0.0000
152.32	0.0149	0.0084	0.0168	0.0000
152.35	0.0146	0.0088	0.0181	0.0000
152.39	0.0143	0.0091	0.0194	0.0000
152.42	0.0140	0.0094	0.0208	0.0000
152.45	0.0137	0.0098	0.0222	0.0000
152.49	0.0134	0.0101	0.0237	0.0000
152.52	0.0131	0.0105	0.0252	0.0000
152.55	0.0129	0.0109	0.0268	0.0000
152.58	0.0126	0.0112	0.0285	0.0000
152.62	0.0123	0.0116	0.0302	0.0000
152.65	0.0120	0.0120	0.0320	0.0000
152.68	0.0118	0.0124	0.0338	0.0000
152.70	0.0115	0.0126	0.0347	0.0000

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
1.5000	0.0257	0.0126	0.0000	0.1419	0.0000
1.5330	0.0261	0.0134	0.0000	0.1419	0.0000
1.5659	0.0264	0.0143	0.0000	0.1450	0.0000
1.5989	0.0268	0.0151	0.0000	0.1480	0.0000
1.6319	0.0272	0.0160	0.0000	0.1511	0.0000
1.6648	0.0275	0.0169	0.0000	0.1542	0.0000
1.6978	0.0279	0.0179	0.0000	0.1572	0.0000
1.7308	0.0283	0.0188	0.0000	0.1603	0.0000
1.7637	0.0286	0.0197	0.0000	0.1633	0.0000
1.7967	0.0290	0.0207	0.0000	0.1664	0.0000
1.8297	0.0294	0.0216	0.0000	0.1694	0.0000
1.8626	0.0297	0.0226	0.0000	0.1725	0.0000
1.8956	0.0301	0.0236	0.0000	0.1755	0.0000
1.9286	0.0305	0.0246	0.0000	0.1786	0.0000
1.9615	0.0309	0.0256	0.0000	0.1816	0.0000
1.9945	0.0312	0.0266	0.0000	0.1847	0.0000
2.0275	0.0316	0.0277	0.0000	0.1877	0.0000
2.0604	0.0320	0.0287	0.0000	0.1908	0.0000
2.0934	0.0324	0.0298	0.0000	0.1938	0.0000
2.1264	0.0328	0.0308	0.0000	0.1969	0.0000
2.1593	0.0332	0.0319	0.0000	0.1999	0.0000
2.1923	0.0336	0.0330	0.0000	0.2030	0.0000
2.2253	0.0340	0.0341	0.0000	0.2060	0.0000
2.2582	0.0344	0.0353	0.0000	0.2091	0.0000
2.2912	0.0348	0.0364	0.0000	0.2121	0.0000
2.3242	0.0352	0.0376	0.0000	0.2152	0.0000
2.3571	0.0356	0.0387	0.0000	0.2183	0.0000
2.3901	0.0360	0.0399	0.0000	0.2213	0.0000
2.4231	0.0364	0.0411	0.0000	0.2244	0.0000
2.4560	0.0368	0.0423	0.0000	0.2274	0.0000
2.4890	0.0372	0.0435	0.0000	0.2305	0.0000
2.5220	0.0376	0.0448	0.0346	0.2335	0.0000
2.5549	0.0380	0.0460	0.1365	0.2366	0.0000
2.5879	0.0384	0.0473	0.2754	0.2396	0.0000
2.6209	0.0388	0.0485	0.4414	0.2427	0.0000
2.6538	0.0392	0.0498	0.6273	0.2457	0.0000
2.6868	0.0396	0.0511	0.8261	0.2488	0.0000
2.7198	0.0401	0.0524	1.0308	0.2518	0.0000
2.7527	0.0405	0.0538	1.2343	0.2549	0.0000

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2.7857	0.0409	0.0551	1.4294	0.2579	0.0000
2.8187	0.0413	0.0565	1.6096	0.2610	0.0000
2.8516	0.0418	0.0578	1.7695	0.2640	0.0000
2.8846	0.0422	0.0592	1.9054	0.2671	0.0000
2.9176	0.0426	0.0606	2.0158	0.2701	0.0000
2.9505	0.0431	0.0620	2.1028	0.2732	0.0000
2.9835	0.0435	0.0635	2.1721	0.2763	0.0000
3.0000	0.0437	0.0642	2.2635	0.2778	0.0000

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Surface retention 1

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 1

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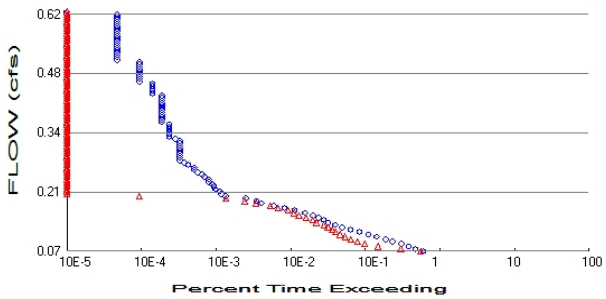
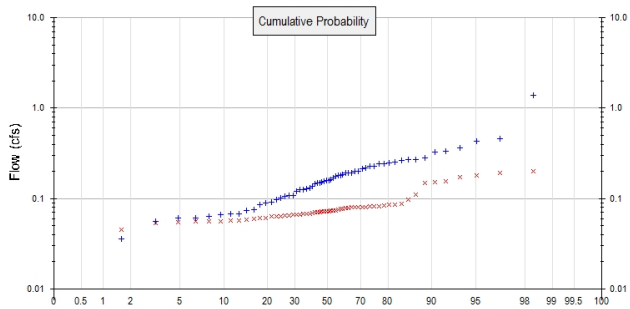
Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.87
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.59
Total Impervious Area: 1.28

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.147148
5 year	0.258523
10 year	0.351444
25 year	0.492289
50 year	0.615281
100 year	0.754645

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.073933
5 year	0.100441
10 year	0.12069
25 year	0.149543
50 year	0.173549
100 year	0.199834

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.280	0.077
1950	0.090	0.064
1951	0.202	0.080
1952	0.089	0.065
1953	0.119	0.078
1954	0.325	0.084
1955	0.253	0.065
1956	1.396	0.080
1957	0.218	0.097
1958	0.331	0.066

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1959	0.267	0.199
1960	0.149	0.074
1961	0.434	0.066
1962	0.098	0.071
1963	0.136	0.085
1964	0.109	0.057
1965	0.068	0.060
1966	0.367	0.063
1967	0.199	0.171
1968	0.213	0.081
1969	0.156	0.073
1970	0.168	0.081
1971	0.269	0.070
1972	0.241	0.067
1973	0.127	0.072
1974	0.181	0.181
1975	0.193	0.058
1976	0.227	0.068
1977	0.107	0.071
1978	0.190	0.069
1979	0.146	0.076
1980	0.107	0.068
1981	0.085	0.064
1982	0.067	0.061
1983	0.158	0.110
1984	0.061	0.055
1985	0.029	0.045
1986	0.151	0.081
1987	0.127	0.073
1988	0.102	0.072
1989	0.063	0.056
1990	0.061	0.073
1991	0.130	0.082
1992	0.163	0.194
1993	0.075	0.055
1994	0.191	0.156
1995	0.176	0.081
1996	0.225	0.147
1997	0.148	0.080
1998	0.183	0.085
1999	0.270	0.152
2000	0.074	0.060
2001	0.036	0.055
2002	0.456	0.073
2003	0.241	0.088
2004	0.066	0.054
2005	0.125	0.057
2006	0.246	0.079
2007	0.159	0.066
2008	0.182	0.077
2009	0.056	0.038

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Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.3963	0.1995
2	0.4563	0.1937
3	0.4338	0.1809

4	0.3669	0.1714
5	0.3309	0.1557
6	0.3254	0.1520
7	0.2798	0.1474
8	0.2701	0.1098
9	0.2689	0.0969
10	0.2667	0.0877
11	0.2532	0.0849
12	0.2461	0.0849
13	0.2412	0.0835
14	0.2411	0.0824
15	0.2268	0.0814
16	0.2254	0.0811
17	0.2176	0.0808
18	0.2129	0.0806
19	0.2017	0.0802
20	0.1987	0.0797
21	0.1934	0.0796
22	0.1908	0.0789
23	0.1900	0.0782
24	0.1829	0.0772
25	0.1818	0.0766
26	0.1807	0.0755
27	0.1760	0.0739
28	0.1679	0.0734
29	0.1629	0.0730
30	0.1592	0.0726
31	0.1582	0.0726
32	0.1561	0.0723
33	0.1507	0.0721
34	0.1485	0.0706
35	0.1484	0.0706
36	0.1456	0.0699
37	0.1363	0.0693
38	0.1304	0.0680
39	0.1267	0.0678
40	0.1265	0.0673
41	0.1255	0.0663
42	0.1193	0.0657
43	0.1087	0.0656
44	0.1073	0.0648
45	0.1065	0.0646
46	0.1016	0.0641
47	0.0981	0.0640
48	0.0902	0.0633
49	0.0889	0.0606
50	0.0847	0.0605
51	0.0752	0.0601
52	0.0743	0.0585
53	0.0676	0.0574
54	0.0670	0.0569
55	0.0663	0.0564
56	0.0628	0.0554
57	0.0607	0.0553
58	0.0606	0.0548
59	0.0556	0.0540
60	0.0361	0.0447
61	0.0293	0.0383

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Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0736	12758	11751	92	Pass
0.0790	9991	6361	63	Pass
0.0845	8149	3155	38	Pass
0.0900	6566	2088	31	Pass
0.0955	4960	1682	33	Pass
0.1009	3961	1372	34	Pass
0.1064	3033	1150	37	Pass
0.1119	2355	989	41	Pass
0.1173	1770	849	47	Pass
0.1228	1346	764	56	Pass
0.1283	1035	680	65	Pass
0.1338	839	594	70	Pass
0.1392	674	475	70	Pass
0.1447	586	420	71	Pass
0.1502	503	342	67	Pass
0.1557	425	274	64	Pass
0.1611	334	236	70	Pass
0.1666	239	198	82	Pass
0.1721	176	144	81	Pass
0.1775	128	113	88	Pass
0.1830	87	73	83	Pass
0.1885	74	52	70	Pass
0.1940	53	29	54	Pass
0.1994	29	2	6	Pass
0.2049	25	0	0	Pass
0.2104	24	0	0	Pass
0.2158	21	0	0	Pass
0.2213	20	0	0	Pass
0.2268	19	0	0	Pass
0.2323	17	0	0	Pass
0.2377	17	0	0	Pass
0.2432	15	0	0	Pass
0.2487	14	0	0	Pass
0.2541	12	0	0	Pass
0.2596	11	0	0	Pass
0.2651	11	0	0	Pass
0.2706	9	0	0	Pass
0.2760	8	0	0	Pass
0.2815	7	0	0	Pass
0.2870	7	0	0	Pass
0.2924	7	0	0	Pass
0.2979	7	0	0	Pass
0.3034	7	0	0	Pass
0.3089	7	0	0	Pass
0.3143	7	0	0	Pass
0.3198	7	0	0	Pass
0.3253	7	0	0	Pass
0.3307	6	0	0	Pass
0.3362	5	0	0	Pass
0.3417	5	0	0	Pass
0.3472	5	0	0	Pass
0.3526	5	0	0	Pass
0.3581	5	0	0	Pass

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0.3636	5	0	0	Pass
0.3691	4	0	0	Pass
0.3745	4	0	0	Pass
0.3800	4	0	0	Pass
0.3855	4	0	0	Pass
0.3909	4	0	0	Pass
0.3964	4	0	0	Pass
0.4019	4	0	0	Pass
0.4074	4	0	0	Pass
0.4128	4	0	0	Pass
0.4183	4	0	0	Pass
0.4238	4	0	0	Pass
0.4292	4	0	0	Pass
0.4347	3	0	0	Pass
0.4402	3	0	0	Pass
0.4457	3	0	0	Pass
0.4511	3	0	0	Pass
0.4566	3	0	0	Pass
0.4621	2	0	0	Pass
0.4675	2	0	0	Pass
0.4730	2	0	0	Pass
0.4785	2	0	0	Pass
0.4840	2	0	0	Pass
0.4894	2	0	0	Pass
0.4949	2	0	0	Pass
0.5004	2	0	0	Pass
0.5058	2	0	0	Pass
0.5113	1	0	0	Pass
0.5168	1	0	0	Pass
0.5223	1	0	0	Pass
0.5277	1	0	0	Pass
0.5332	1	0	0	Pass
0.5387	1	0	0	Pass
0.5441	1	0	0	Pass
0.5496	1	0	0	Pass
0.5551	1	0	0	Pass
0.5606	1	0	0	Pass
0.5660	1	0	0	Pass
0.5715	1	0	0	Pass
0.5770	1	0	0	Pass
0.5825	1	0	0	Pass
0.5879	1	0	0	Pass
0.5934	1	0	0	Pass
0.5989	1	0	0	Pass
0.6043	1	0	0	Pass
0.6098	1	0	0	Pass
0.6153	1	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
Trapezoidal Pond 1 POC	☐	320.39			☐	0.00			
retention 1	☐	100.78			☐	0.00			
Total Volume Infiltrated		421.17	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

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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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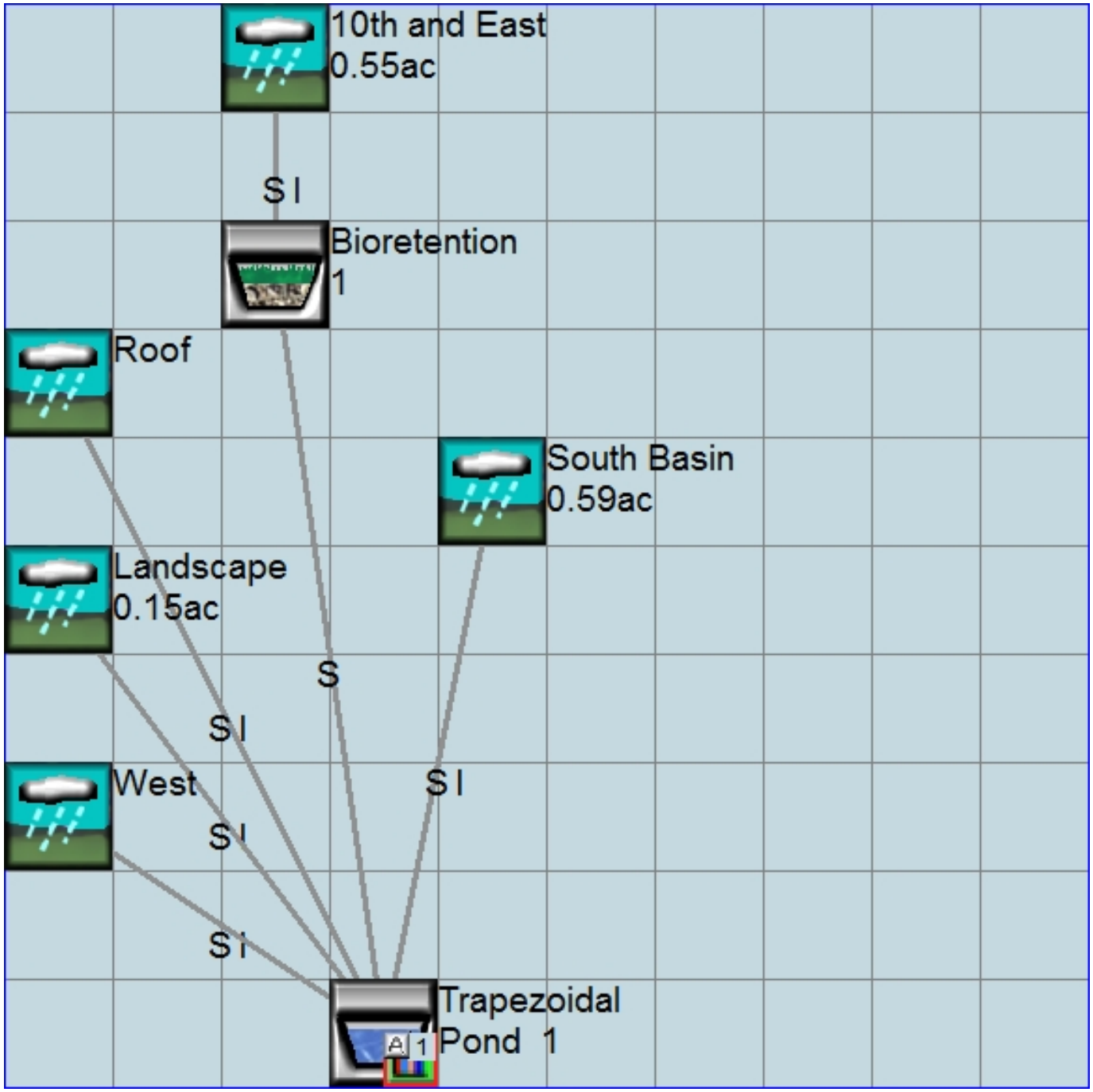
Appendix

Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       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   16929-pond.wdm
MESSU      25   Pre16929-pond.MES
           27   Pre16929-pond.L61
           28   Pre16929-pond.L62
           30   POC16929-pond1.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
```

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```
  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
```

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```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  11                        1.87     COPY   501     12
PERLND  11                        1.87     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

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

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```
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
```

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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   16929-pond.wdm
MESSU      25   Mit16929-pond.MES
           27   Mit16929-pond.L61
           28   Mit16929-pond.L62
           30   POC16929-pond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       4
      PERLND      16
      IMPLND       1
      IMPLND      11
      PERLND      18
      IMPLND      14
      GENER        2
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    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           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
   18     C, Lawn, Steep          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***
```

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```
  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -   # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
   18         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -   # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   18         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 ***
   16         0    0    0    0    0    0    0    0    0    0    0
   18         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
   16              0       4.5      0.03       400      0.05       0.5     0.996
   18              0       4.5      0.03       400      0.15       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -   # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
   18              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -   #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
   18            0.1      0.15      0.25         6       0.3      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -   # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16              0         0         0         0       2.5         1         0
   18              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

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

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```
  14         0    0    1    0    0    0
 END ACTIVITY

 PRINT-INFO
   <ILS > ******** Print-flags ******** PIVL  PYR
   # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   4         0    0    4    0    0    0    1    9
   1         0    0    4    0    0    0    1    9
  11         0    0    4    0    0    0    1    9
  14         0    0    4    0    0    0    1    9
 END PRINT-INFO

 IWAT-PARM1
   <PLS >  IWATER variable monthly parameter value flags  ***
   # -  # CSNO RTOP  VRS  VNN RTLI     ***
   4         0    0    0    0    0
   1         0    0    0    0    0
  11         0    0    0    0    0
  14         0    0    0    0    0
 END IWAT-PARM1

 IWAT-PARM2
   <PLS >      IWATER input info: Part 2         ***
   # -  # ***  LSUR     SLSUR      NSUR     RETSC
   4            400      0.01       0.1       0.1
   1            400      0.01       0.1       0.1
  11            400      0.01       0.1       0.1
  14            400      0.01       0.1       0.1
 END IWAT-PARM2

 IWAT-PARM3
   <PLS >      IWATER input info: Part 3         ***
   # -  # ***PETMAX    PETMIN
   4              0         0
   1              0         0
  11              0         0
  14              0         0
 END IWAT-PARM3

 IWAT-STATE1
   <PLS > *** Initial conditions at start of simulation
   # -  # ***  RETS      SURS
   4              0         0
   1              0         0
  11              0         0
  14              0         0
 END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Roof***
IMPLND   4                        0.51     RCHRES   3      5
10th and East***
PERLND  16                         0.1     RCHRES   1      2
PERLND  16                         0.1     RCHRES   1      3
IMPLND   1                         0.2     RCHRES   1      5
IMPLND  11                        0.25     RCHRES   1      5
South Basin***
PERLND  18                        0.22     RCHRES   3      2
PERLND  18                        0.22     RCHRES   3      3
PERLND  16                        0.12     RCHRES   3      2
PERLND  16                        0.12     RCHRES   3      3
IMPLND  14                        0.25     RCHRES   3      5
Landscape***
PERLND  18                        0.15     RCHRES   3      2
PERLND  18                        0.15     RCHRES   3      3
West***
```

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```
IMPLND  11                        0.07     RCHRES   3      5

******Routing******
IMPLND   4                        0.51     COPY     1     15
RCHRES   2                           1     RCHRES   3      6
RCHRES   2                                 COPY     1     16
RCHRES   1                           1     RCHRES   3      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
PERLND  18                        0.22     COPY     1     12
PERLND  16                        0.12     COPY     1     12
IMPLND  14                        0.25     COPY     1     15
PERLND  18                        0.22     COPY     1     13
PERLND  16                        0.12     COPY     1     13
PERLND  18                        0.15     COPY     1     12
PERLND  18                        0.15     COPY     1     13
IMPLND  11                        0.07     COPY     1     15
RCHRES   3                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
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-008    3    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
    3     Trapezoidal Pond-005    1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         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
    3         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  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
```

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```
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0     151.2       0.5       0.0
    2              2      0.01       0.0     151.2       0.5       0.0
    3              3      0.02       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                        ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** 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            =  511.
*** 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      3
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.105326  0.000000  0.000000
  0.077778  0.106478  0.008237  0.011264
  0.155556  0.107635  0.016563  0.015930
  0.233333  0.108796  0.024980  0.019510
  0.311111  0.109961  0.033487  0.022529
  0.388889  0.111131  0.042085  0.025188
  0.466667  0.112305  0.050775  0.027592
  0.544444  0.113484  0.059555  0.029803
  0.622222  0.114667  0.068428  0.031860
  0.700000  0.115855  0.077393  0.033793
  0.777778  0.117047  0.086450  0.035621
  0.855556  0.118244  0.095600  0.037360
  0.933333  0.119445  0.104843  0.039021
  1.011111  0.120650  0.114180  0.040614
  1.088889  0.121860  0.123611  0.042147
  1.166667  0.123074  0.133137  0.043627
  1.244444  0.124293  0.142756  0.045057
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1.322222	0.125516	0.152471	0.046444
1.400000	0.126744	0.162281	0.047791
1.477778	0.127976	0.172187	0.049100
1.555556	0.129212	0.182189	0.050376
1.633333	0.130453	0.192287	0.051620
1.711111	0.131699	0.202482	0.052834
1.788889	0.132949	0.212774	0.054022
1.866667	0.134203	0.223163	0.055184
1.944444	0.135462	0.233650	0.056322
2.022222	0.136725	0.244235	0.057437
2.100000	0.137993	0.254918	0.058531
2.177778	0.139265	0.265701	0.059605
2.255556	0.140541	0.276582	0.060660
2.333333	0.141822	0.287563	0.061697
2.411111	0.143108	0.298643	0.062717
2.488889	0.144398	0.309824	0.063721
2.566667	0.145692	0.321105	0.064709
2.644444	0.146991	0.332488	0.065682
2.722222	0.148294	0.343971	0.066641
2.800000	0.149601	0.355556	0.067586
2.877778	0.150914	0.367242	0.068518
2.955556	0.152230	0.379031	0.069438
3.033333	0.153551	0.390923	0.070346
3.111111	0.154876	0.402917	0.071242
3.188889	0.156206	0.415015	0.072127
3.266667	0.157541	0.427216	0.073001
3.344444	0.158879	0.439521	0.073865
3.422222	0.160223	0.451931	0.074719
3.500000	0.161570	0.464445	0.075564
3.577778	0.162922	0.477064	0.076399
3.655556	0.164279	0.489789	0.077224
3.733333	0.165640	0.502619	0.078042
3.811111	0.167005	0.515555	0.078850
3.888889	0.168375	0.528598	0.079651
3.966667	0.169749	0.541747	0.080444
4.044444	0.171128	0.555003	0.081228
4.122222	0.172511	0.568367	0.082006
4.200000	0.173899	0.581838	0.082776
4.277778	0.175291	0.595418	0.083539
4.355556	0.176688	0.609106	0.084295
4.433333	0.178089	0.622903	0.085044
4.511111	0.179494	0.636809	0.087774
4.588889	0.180904	0.650824	0.093226
4.666667	0.182318	0.664950	0.100105
4.744444	0.183737	0.679185	0.108006
4.822222	0.185160	0.693531	0.116692
4.900000	0.186588	0.707988	0.125998
4.977778	0.188020	0.722556	0.135796
5.055556	0.189456	0.737236	0.145982
5.133333	0.190897	0.752027	0.156470
5.211111	0.192343	0.766931	0.167185
5.288889	0.193793	0.781947	0.178061
5.366667	0.195247	0.797077	0.189039
5.444444	0.196706	0.812319	0.200064
5.522222	0.198169	0.827676	0.213225
5.600000	0.199636	0.843146	0.226995
5.677778	0.201108	0.858730	0.241211
5.755556	0.202585	0.874429	0.255859
5.833333	0.204066	0.890244	0.270926
5.911111	0.205551	0.906173	0.346668
5.988889	0.207041	0.922218	0.367413
6.066667	0.208535	0.938380	0.553201
6.144444	0.210034	0.954658	0.944245
6.222222	0.211537	0.971052	1.418264
6.300000	0.213045	0.987563	1.882534
6.377778	0.214557	1.004192	2.252756
6.455556	0.216074	1.020939	2.488333
6.533333	0.217595	1.037804	2.674887
6.611111	0.219120	1.054787	2.837514
6.688889	0.220650	1.071890	2.990116

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  6.766667  0.222184  1.089111  3.134350
  6.844444  0.223723  1.106452  3.271462
  6.922222  0.225266  1.123912  3.402416
  7.000000  0.226814  1.141493  3.527976
  END FTABLE  3
  FTABLE      2
   47    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.025735  0.000000  0.000000
  0.032967  0.025558  0.000175  0.000000
  0.065934  0.025205  0.000354  0.000021
  0.098901  0.024855  0.000538  0.000048
  0.131868  0.024506  0.000725  0.000092
  0.164835  0.024159  0.000917  0.000154
  0.197802  0.023814  0.001113  0.000237
  0.230769  0.023470  0.001314  0.000343
  0.263736  0.023129  0.001518  0.000473
  0.296703  0.022789  0.001727  0.000630
  0.329670  0.022451  0.001940  0.000815
  0.362637  0.022115  0.002158  0.001029
  0.395604  0.021780  0.002380  0.001273
  0.428571  0.021448  0.002607  0.001550
  0.461538  0.021117  0.002838  0.001861
  0.494505  0.020788  0.003073  0.002207
  0.527473  0.020460  0.003313  0.002588
  0.560440  0.020135  0.003558  0.003007
  0.593407  0.019811  0.003807  0.003464
  0.626374  0.019489  0.004060  0.003960
  0.659341  0.019169  0.004319  0.004497
  0.692308  0.018851  0.004582  0.005076
  0.725275  0.018535  0.004849  0.005698
  0.758242  0.018220  0.005121  0.006363
  0.791209  0.017907  0.005399  0.007072
  0.824176  0.017596  0.005680  0.007827
  0.857143  0.017287  0.005967  0.008629
  0.890110  0.016979  0.006258  0.009478
  0.923077  0.016674  0.006555  0.010376
  0.956044  0.016370  0.006856  0.011322
  0.989011  0.016068  0.007162  0.012319
  1.021978  0.015767  0.007473  0.013367
  1.054945  0.015469  0.007789  0.014466
  1.087912  0.015172  0.008109  0.015618
  1.120879  0.014877  0.008435  0.016823
  1.153846  0.014584  0.008766  0.018083
  1.186813  0.014293  0.009102  0.019397
  1.219780  0.014003  0.009443  0.020767
  1.252747  0.013716  0.009789  0.022194
  1.285714  0.013430  0.010140  0.023677
  1.318681  0.013145  0.010497  0.025218
  1.351648  0.012863  0.010858  0.026818
  1.384615  0.012583  0.011225  0.028476
  1.417582  0.012304  0.011597  0.030194
  1.450549  0.012027  0.011975  0.031970
  1.483516  0.011752  0.012357  0.033803
  1.500000  0.011478  0.026356  0.034722
  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  0.011478  0.000000  0.000000  0.000000  0.000000
  0.032967  0.026090  0.000854  0.000000  0.141942  0.000000
  0.065934  0.026447  0.001720  0.000000  0.144994  0.000000
  0.098901  0.026805  0.002598  0.000000  0.148047  0.000000
  0.131868  0.027166  0.003488  0.000000  0.151099  0.000000
  0.164835  0.027528  0.004389  0.000000  0.154152  0.000000
  0.197802  0.027892  0.005303  0.000000  0.157204  0.000000
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  0.230769  0.028258  0.006228  0.000000  0.160257  0.000000
  0.263736  0.028626  0.007166  0.000000  0.163309  0.000000
  0.296703  0.028995  0.008116  0.000000  0.166362  0.000000
  0.329670  0.029366  0.009078  0.000000  0.169414  0.000000
  0.362637  0.029739  0.010052  0.000000  0.172467  0.000000
  0.395604  0.030114  0.011039  0.000000  0.175519  0.000000
  0.428571  0.030491  0.012038  0.000000  0.178572  0.000000
  0.461538  0.030869  0.013049  0.000000  0.181624  0.000000
  0.494505  0.031250  0.014073  0.000000  0.184677  0.000000
  0.527473  0.031632  0.015109  0.000000  0.187729  0.000000
  0.560440  0.032015  0.016159  0.000000  0.190782  0.000000
  0.593407  0.032401  0.017220  0.000000  0.193834  0.000000
  0.626374  0.032789  0.018295  0.000000  0.196887  0.000000
  0.659341  0.033178  0.019382  0.000000  0.199939  0.000000
  0.692308  0.033569  0.020482  0.000000  0.202992  0.000000
  0.725275  0.033962  0.021596  0.000000  0.206044  0.000000
  0.758242  0.034356  0.022722  0.000000  0.209097  0.000000
  0.791209  0.034753  0.023861  0.000000  0.212149  0.000000
  0.824176  0.035151  0.025013  0.000000  0.215202  0.000000
  0.857143  0.035551  0.026179  0.000000  0.218254  0.000000
  0.890110  0.035953  0.027357  0.000000  0.221307  0.000000
  0.923077  0.036356  0.028549  0.000000  0.224359  0.000000
  0.956044  0.036762  0.029754  0.000000  0.227412  0.000000
  0.989011  0.037169  0.030973  0.000000  0.230464  0.000000
  1.021978  0.037578  0.032205  0.034569  0.233517  0.000000
  1.054945  0.037988  0.033451  0.136453  0.236569  0.000000
  1.087912  0.038401  0.034710  0.275387  0.239622  0.000000
  1.120879  0.038815  0.035983  0.441409  0.242674  0.000000
  1.153846  0.039232  0.037269  0.627270  0.245727  0.000000
  1.186813  0.039650  0.038569  0.826090  0.248779  0.000000
  1.219780  0.040069  0.039883  1.030827  0.251832  0.000000
  1.252747  0.040491  0.041211  1.234286  0.254884  0.000000
  1.285714  0.040914  0.042553  1.429395  0.257937  0.000000
  1.318681  0.041339  0.043909  1.609623  0.260989  0.000000
  1.351648  0.041766  0.045279  1.769522  0.264042  0.000000
  1.384615  0.042195  0.046663  1.905359  0.267094  0.000000
  1.417582  0.042626  0.048061  2.015818  0.270147  0.000000
  1.450549  0.043058  0.049473  2.102770  0.273199  0.000000
  1.483516  0.043492  0.050900  2.172110  0.276252  0.000000
  1.500000  0.043710  0.051619  2.263538  0.277778  0.000000
  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   3 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
```

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```
  END MASS-LINK    2

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

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

  MASS-LINK        6
RCHRES     ROFLOW                          RCHRES         INFLOW
  END MASS-LINK    6

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                  RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                  RCHRES         INFLOW IVOL
  END MASS-LINK    8

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

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

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

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

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


END MASS-LINK

END RUN
```

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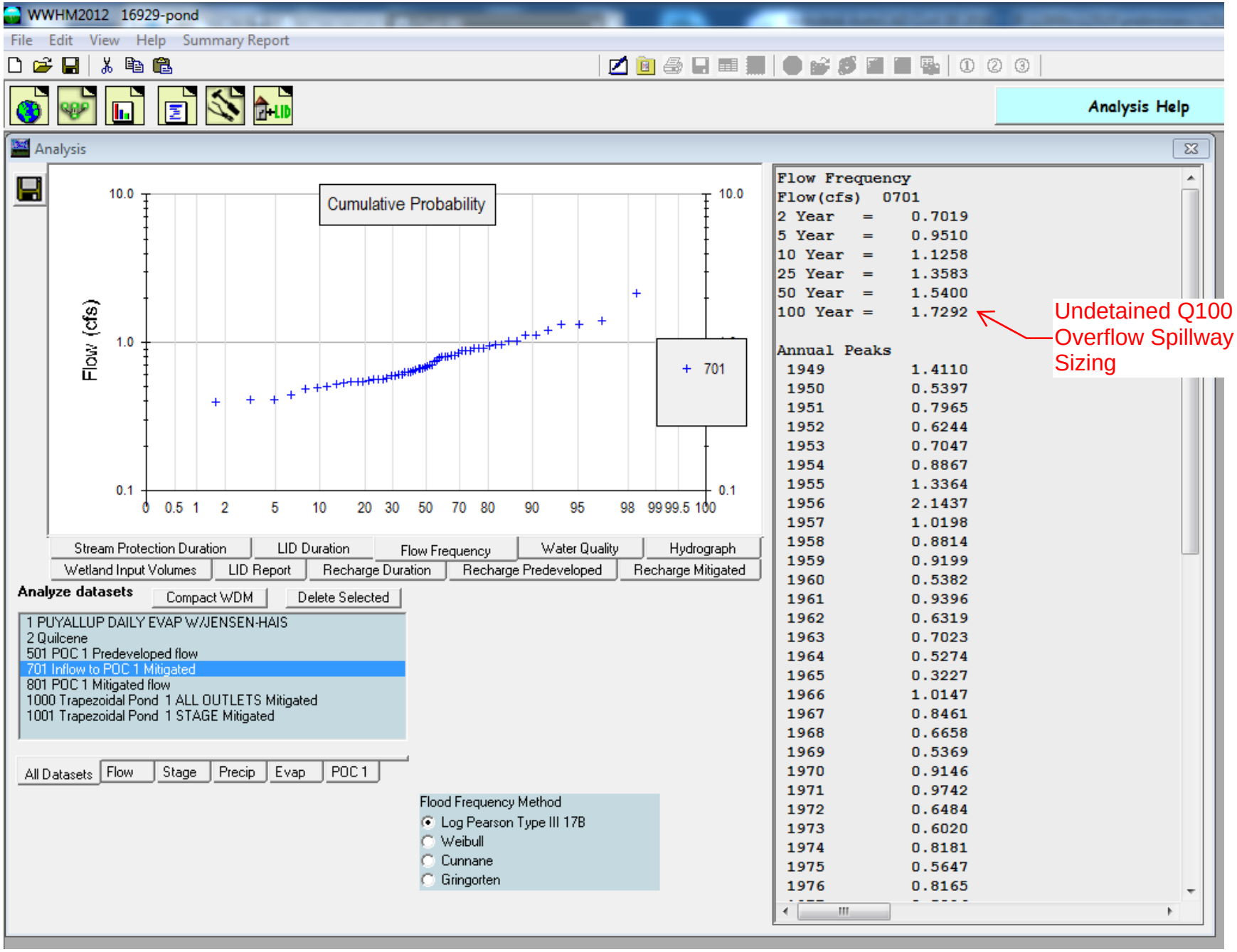
Detention Sizing

South Pond

Elevation	Area	Volume	Sum Volume	Volume	
	(SF)	(CF)	(CF)	(ac-ft)	Depth
127	4292		0	0	0
127.5	4673	2241.25	2241.25	0.051452	0.5
128	5064	2434.25	4675.5	0.107335	1
129	5890	5477	10152.5	0.233069	2
130	6772	6331	16483.5	0.378409	3
131	7700	7236	23719.5	0.544525	4
132	8696	8198	31917.5	0.732725	5
132.5	9232	4482	36399.5	0.835618	5.5
133	9793	4756.25	41155.75	0.944806	6
134	11102	10447.5	51603.25	1.184648	7

0.94 ac ft required


WWHM2012 16929-pond
File Edit View Help Summary Report
Analysis Help
Analysis
Cumulative Probability
Flow (cfs)
10.0
1.0
0.1
0 0.5 1 2 5 10 20 30 50 70 80 90 95 98 99 99.5 100
+ 701
Stream Protection Duration
LID Duration
Flow Frequency
Water Quality
Hydrograph
Wetland Input Volumes
LID Report
Recharge Duration
Recharge Predeveloped
Recharge Mitigated
Analyze datasets
Compact WDM
Delete Selected
1 PUYALLUP DAILY EVAP W/JENSEN-HAIS
2 Quilcene
501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Trapezoidal Pond 1 ALL OUTLETS Mitigated
1001 Trapezoidal Pond 1 STAGE Mitigated
All Datasets
Flow
Stage
Precip
Evap
POC 1
Flood Frequency Method
Log Pearson Type III 17B
Weibull
Cunnane
Gringorten
Flow Frequency
Flow(cfs) 0701
2 Year = 0.7019
5 Year = 0.9510
10 Year = 1.1258
25 Year = 1.3583
50 Year = 1.5400
100 Year = 1.7292
Annual Peaks
1949 1.4110
1950 0.5397
1951 0.7965
1952 0.6244
1953 0.7047
1954 0.8867
1955 1.3364
1956 2.1437
1957 1.0198
1958 0.8814
1959 0.9199
1960 0.5382
1961 0.9396
1962 0.6319
1963 0.7023
1964 0.5274
1965 0.3227
1966 1.0147
1967 0.8461
1968 0.6658
1969 0.5369
1970 0.9146
1971 0.9742
1972 0.6484
1973 0.6020
1974 0.8181
1975 0.5647
1976 0.8165
Undetained Q100 for Overflow Spillway Sizing

EMERGENCY OVERFLOW SPILLWAY CALCULATIONS

Basin = 1.87 acres

<u>Emergency Overflow Spillway Sizing</u>

$$L = \frac{Q_{100}}{3.21\ H^{3/2}} - 2.4\ H$$

$Q_{100\ (Un\text{-}detained)}$ = 2.77 cfs = (1.73 cfs x 1.6)

H = 0.30 ft

L = 4.5 ft

Therefore, use 6-foot minimum spillway.

Input:

$$\frac{2.77}{3.21 \times 0.3^{3/2}} - 2.4 \times 0.3$$

Result:

4.53161...

Appendix B
Water Quality Calculations

RAINGARDEN SIZING

Bioretention 1

Bottom Length:	50.00 ft.
Bottom Width:	10.00 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:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	6
Orifice Diameter (in.):	6
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	102.347
Total Outflow (ac-ft.):	110.75
Percent Through Underdrain:	92.41
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	12 in.
Element Flows To:	
Outlet 1	Outlet 2
Trapezoidal Pond 1	

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Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
151.20	0.0257	0.0000	0.0000	0.0000
151.23	0.0256	0.0002	0.0000	0.0000
151.27	0.0252	0.0004	0.0000	0.0000
151.30	0.0249	0.0005	0.0000	0.0000
151.33	0.0245	0.0007	0.0001	0.0000
151.36	0.0242	0.0009	0.0002	0.0000
151.40	0.0238	0.0011	0.0002	0.0000
151.43	0.0235	0.0013	0.0003	0.0000
151.46	0.0231	0.0015	0.0005	0.0000
151.50	0.0228	0.0017	0.0006	0.0000
151.53	0.0225	0.0019	0.0008	0.0000
151.56	0.0221	0.0022	0.0010	0.0000
151.60	0.0218	0.0024	0.0013	0.0000
151.63	0.0214	0.0026	0.0016	0.0000
151.66	0.0211	0.0028	0.0019	0.0000
151.69	0.0208	0.0031	0.0022	0.0000
151.73	0.0205	0.0033	0.0026	0.0000
151.76	0.0201	0.0036	0.0030	0.0000
151.79	0.0198	0.0038	0.0035	0.0000
151.83	0.0195	0.0041	0.0040	0.0000
151.86	0.0192	0.0043	0.0045	0.0000
151.89	0.0189	0.0046	0.0051	0.0000
151.93	0.0185	0.0048	0.0057	0.0000
151.96	0.0182	0.0051	0.0064	0.0000
151.99	0.0179	0.0054	0.0071	0.0000
152.02	0.0176	0.0057	0.0078	0.0000
152.06	0.0173	0.0060	0.0086	0.0000
152.09	0.0170	0.0063	0.0095	0.0000
152.12	0.0167	0.0066	0.0104	0.0000
152.16	0.0164	0.0069	0.0113	0.0000
152.19	0.0161	0.0072	0.0123	0.0000

WWHM2012

PROJECT REPORT

Filterra Sizing

General Model Information

Project Name:	16929 - Filterra Sizing
Site Name:	16929
Site Address:	
City:	
Report Date:	7/22/2016
Gage:	Quilcene
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.80
Version Date:	2016/02/25
Version:	4.2.12

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

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Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.07
Impervious Total	0.07
Basin Total	0.07

Element Flows To:

Surface	Interflow	Groundwater
Filterra 1	Filterra 1	

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Routing Elements
Predeveloped Routing

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Mitigated Routing

Filterra 1

Bottom Length:	4.00 ft.
Bottom Width:	4.00 ft.
Depth:	0.75 ft.
Side slope 1:	0 To 1
Side slope 2:	0 To 1
Side slope 3:	0 To 1
Side slope 4:	0 To 1
Filtration On	
Hydraulic conductivity:	24.82
Depth of filter medium:	1.8
Total Volume Infiltrated (ac-ft.):	13.107
Total Volume Through Riser (ac-ft.):	0.566
Total Volume Through Facility (ac-ft.):	13.673
Percent Infiltrated:	95.86
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	0.7 ft.
Riser Diameter:	100 in.
Element Flows To:	
Outlet 1	Outlet 2

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Sand Filter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000	0.000	0.000	0.000
0.0083	0.000	0.000	0.000	0.009
0.0167	0.000	0.000	0.000	0.009
0.0250	0.000	0.000	0.000	0.009
0.0333	0.000	0.000	0.000	0.009
0.0417	0.000	0.000	0.000	0.009
0.0500	0.000	0.000	0.000	0.009
0.0583	0.000	0.000	0.000	0.009
0.0667	0.000	0.000	0.000	0.009
0.0750	0.000	0.000	0.000	0.009
0.0833	0.000	0.000	0.000	0.009
0.0917	0.000	0.000	0.000	0.009
0.1000	0.000	0.000	0.000	0.009
0.1083	0.000	0.000	0.000	0.009
0.1167	0.000	0.000	0.000	0.009
0.1250	0.000	0.000	0.000	0.009
0.1333	0.000	0.000	0.000	0.009
0.1417	0.000	0.000	0.000	0.009
0.1500	0.000	0.000	0.000	0.010
0.1583	0.000	0.000	0.000	0.010
0.1667	0.000	0.000	0.000	0.010
0.1750	0.000	0.000	0.000	0.010
0.1833	0.000	0.000	0.000	0.010
0.1917	0.000	0.000	0.000	0.010
0.2000	0.000	0.000	0.000	0.010
0.2083	0.000	0.000	0.000	0.010
0.2167	0.000	0.000	0.000	0.010
0.2250	0.000	0.000	0.000	0.010

0.2333	0.000	0.000	0.000	0.010
0.2417	0.000	0.000	0.000	0.010
0.2500	0.000	0.000	0.000	0.010
0.2583	0.000	0.000	0.000	0.010
0.2667	0.000	0.000	0.000	0.010
0.2750	0.000	0.000	0.000	0.010
0.2833	0.000	0.000	0.000	0.010
0.2917	0.000	0.000	0.000	0.010
0.3000	0.000	0.000	0.000	0.010
0.3083	0.000	0.000	0.000	0.010
0.3167	0.000	0.000	0.000	0.010
0.3250	0.000	0.000	0.000	0.010
0.3333	0.000	0.000	0.000	0.010
0.3417	0.000	0.000	0.000	0.010
0.3500	0.000	0.000	0.000	0.011
0.3583	0.000	0.000	0.000	0.011
0.3667	0.000	0.000	0.000	0.011
0.3750	0.000	0.000	0.000	0.011
0.3833	0.000	0.000	0.000	0.011
0.3917	0.000	0.000	0.000	0.011
0.4000	0.000	0.000	0.000	0.011
0.4083	0.000	0.000	0.000	0.011
0.4167	0.000	0.000	0.000	0.011
0.4250	0.000	0.000	0.000	0.011
0.4333	0.000	0.000	0.000	0.011
0.4417	0.000	0.000	0.000	0.011
0.4500	0.000	0.000	0.000	0.011
0.4583	0.000	0.000	0.000	0.011
0.4667	0.000	0.000	0.000	0.011
0.4750	0.000	0.000	0.000	0.011
0.4833	0.000	0.000	0.000	0.011
0.4917	0.000	0.000	0.000	0.011
0.5000	0.000	0.000	0.000	0.011
0.5083	0.000	0.000	0.000	0.011
0.5167	0.000	0.000	0.000	0.011
0.5250	0.000	0.000	0.000	0.011
0.5333	0.000	0.000	0.000	0.011
0.5417	0.000	0.000	0.000	0.012
0.5500	0.000	0.000	0.000	0.012
0.5583	0.000	0.000	0.000	0.012
0.5667	0.000	0.000	0.000	0.012
0.5750	0.000	0.000	0.000	0.012
0.5833	0.000	0.000	0.000	0.012
0.5917	0.000	0.000	0.000	0.012
0.6000	0.000	0.000	0.000	0.012
0.6083	0.000	0.000	0.000	0.012
0.6167	0.000	0.000	0.000	0.012
0.6250	0.000	0.000	0.000	0.012
0.6333	0.000	0.000	0.000	0.012
0.6417	0.000	0.000	0.000	0.012
0.6500	0.000	0.000	0.000	0.012
0.6583	0.000	0.000	0.000	0.012
0.6667	0.000	0.000	0.000	0.012
0.6750	0.000	0.000	0.000	0.012
0.6833	0.000	0.000	0.000	0.012
0.6917	0.000	0.000	0.000	0.012
0.7000	0.000	0.000	0.000	0.012
0.7083	0.000	0.000	0.067	0.012

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0.7167	0.000	0.000	0.190	0.012
0.7250	0.000	0.000	0.349	0.012
0.7333	0.000	0.000	0.538	0.012
0.7417	0.000	0.000	0.752	0.013
0.7500	0.000	0.000	0.989	0.013
0.7583	0.000	0.000	1.246	0.013

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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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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

FOR FILTERRA SIZING ONLY
PREDEVELOPED NOT REQUIRED

Mitigated Schematic

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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   16929 - Filterra Sizing.wdm
MESSU      25   Mit16929 - Filterra Sizing.MES
           27   Mit16929 - Filterra Sizing.L61
           28   Mit16929 - Filterra Sizing.L62
           30   POC16929 - Filterra Sizing1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      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        Filterra 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           ***
    1      ROADS/FLAT            1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         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     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1           400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1
```

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```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   1                        0.07     RCHRES   1      5

******Routing******
IMPLND   1                        0.07     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     Filterra 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
  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
91 5

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.000367	0.000000	0.000000	0.000000		
0.008333	0.000367	0.000003	0.000000	0.009235		
0.016667	0.000367	0.000006	0.000000	0.009278		
0.025000	0.000367	0.000009	0.000000	0.009320		
0.033333	0.000367	0.000012	0.000000	0.009363		
0.041667	0.000367	0.000015	0.000000	0.009405		
0.050000	0.000367	0.000018	0.000000	0.009448		
0.058333	0.000367	0.000021	0.000000	0.009491		
0.066667	0.000367	0.000024	0.000000	0.009533		
0.075000	0.000367	0.000028	0.000000	0.009576		
0.083333	0.000367	0.000031	0.000000	0.009618		
0.091667	0.000367	0.000034	0.000000	0.009661		
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0.166667	0.000367	0.000061	0.000000	0.010044		
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END FTABLES

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<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 ***
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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
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<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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Mitigated HSPF Message File

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Appendix C
Conveyance Calculations

APPENDIX C
CONVEYANCE CALCULATIONS WILL BE COMPLETED DURING THE ENGINEERING REVIEW PROCESS

Appendix D
Preliminary Geotechnical Report by GeoEngineers dated February 28, 2014

PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
Proposed Self Storage Facility
927 Northeast Lincoln Road
Poulsbo, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed self storage facility to be located in Poulsbo.

We have been provided with an undated topographic survey of the site by Pazooki & Associates Map. We have also been provided with preliminary site plans of the proposed development. Based on these plans, we understand that the development will consist of a three-story self storage building with a paved parking area on the south side of the building. The irregularly shaped building will have dimensions of up to about 180 feet in the north-south direction and 190 feet in the east-west direction. The building limits are constrained on the southeast because of a 125-foot buiding setback from an existing stream located at the southwestern corner of the site. The lowest level of the building will be close to the existing ground surface along the western edge of the building, but a cut of up to about 20 feet will be required at the eastern side of the building. We understand that a stormwater infiltration system is being considered for the project and may be located at the southeastern and northeastern sides of the site.

If the scope of the project changes from what we have described above, we should be provided with revised plans in order to determine if modifications to the recommendations and conclusions of this report are warranted.

SITE CONDITIONS

SURFACE

The Vicinity Map, Plate 1, illustrates the general location of the trapezoidal-shaped site. The site is bordered to the north by Northeast Lincoln Road, to the east by 10th Avenue Northeast, to the south by undeveloped wooded land, and to the west by a commercial property. The site has maximum dimensions of about 270 feet in east-west direction and about 450 feet in north-south direction.

The ground surface within the northern portion of the site where development is planned slopes gently to moderately down toward the west. The southern portion of the site has a steeper inclination, being more moderate. Across the northern portion of the site there is a change in elevation of about 25 feet across a distance of 280 feet. A stream crosses the southwest corner of the site and flows toward the west/northwest. Because the slope on the southern portion of the site continues down to the stream, its elevation change is in the range of 40 vertical feet across a distance of 200 feet.

An apparent basement excavation that is a few feet deep remains at the location of a former house near the northwest corner of the site. A collapsed shed is located about 50 feet south of the basement excavation. An apparent fill embankment up to about 5 feet high has been constructed adjacent to the eastern portion of the site and supports Lincoln Road.

The northern portion of the site is vegetated with brush, blackberry vines, and scattered mature evergreen and deciduous trees. The southern portion of the site is wooded with mature evergreen trees.

A commercial building is located as close as about 15 feet west of the western property line. Between this building and the western edge of the site, the ground surface slopes down to the adjacent building about 6 feet vertically. This slope appears to be the result of a cut made when the adjacent property was developed in our opinion.

SUBSURFACE

The subsurface conditions were explored by excavating six test pits at the approximate locations shown on the Site Exploration Plan, Plate 2. Our exploration program was based on the proposed construction, anticipated subsurface conditions and those encountered during exploration, and the scope of work outlined in our proposal.

Test pits were excavated on February 17, 2014 with an excavator with rubber-tracks. A geotechnical engineer from our staff observed the excavation process, logged the test pits, and obtained representative samples of the soil encountered. "Grab" samples of selected subsurface soil were collected from the backhoe bucket. The Test Pit Logs are attached to this report as Plates 3 through 5.

Soil Conditions

Test Pits 1, 2, 4, and 6, located in the northern portion of the proposed building, encountered about one foot of topsoil and fill over loose silty sand that extended to depths of about 2 to 3.5 feet. The silty sand was underlain by relatively coarse sand with varying amounts of gravel; it was initially medium-dense, but became dense with depth. This sand and gravel generally extended to the base of the test pits at depths of 8 to 8.5 feet. In Test Pit 6, excavated in the lower, northwestern portion of the site, some lenses of finer sand and silt were revealed in the coarse sand.

Test Pits 3 and 5 were located in the southern portion of the proposed building. Below the topsoil, these explorations found loose to medium-dense silty sand that extended to a depth of approximatey 2.5 feet. The silty sand was underlain by mostly medium-dense sand (some with silt) to a depth of approximately 6 to 7 feet. Dense silty sand was revealed below these depths to the maximum explored depth of 9 feet.

Groundwater Conditions

No groundwater seepage was observed in the test pits, which were left open for only a short time period. Therefore, the lack of seepage levels on the logs may not accurately represent the absence of a static groundwater level. It should be noted that groundwater levels vary seasonally with rainfall and other factors. We anticipate that groundwater could be found between the near-surface sandy soil and the underlying low-permeability soil.

The stratification lines on the logs represent the approximate boundaries between soil types at the exploration locations. The actual transition between soil types may be gradual, and subsurface conditions can vary between exploration locations. The logs provide specific subsurface information only at the locations tested. The relative densities and moisture descriptions indicated on the test pit logs are interpretive descriptions based on the conditions observed during excavation.

Compaction of test pit backfill was not in the scope of our services. Loose soil will therefore be found in the area of the test pits. If this presents a problem, the backfill will need to be removed and replaced with structural fill during construction.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

THIS SECTION CONTAINS A SUMMARY OF OUR STUDY AND FINDINGS FOR THE PURPOSES OF A GENERAL OVERVIEW ONLY. MORE SPECIFIC RECOMMENDATIONS AND CONCLUSIONS ARE CONTAINED IN THE REMAINDER OF THIS REPORT. ANY PARTY RELYING ON THIS REPORT SHOULD READ THE ENTIRE DOCUMENT.

The test pits conducted for this study encountered medium-dense native soils at relatively shallow depths, with more dense sand/silty sand soils at depths of approximately 5 to 7 feet. These medium-dense soils are adequate to support the proposed structure that is founded on conventional footings. It appears that a significant portion of the structure will be excavated into the dense soils.

The significant consideration for the development from a geotechnical engineering perspective is the proposed excavations at the eastern side of the building. Because our study was prelimnary and information of site soils was needed quickly, we used exploration equipment that could only dig to depths of about 9 feet. Excavations of up to 20 feet are proposed on the eastern side of the building. Our three explorations in that part of the site generally found sandy soils that should be temporarily excavated to an inclination no steeper than 1:1 (Horizontal:Vertical). However, more dense and compact silty sand was revealed in the most southeastern test pit at about 7 feet. The silty sand soil could possibly be excavated more steeply. We recommend that additional, deeper explorations be conducted on the eastern side of the building to evaluate subsurface conditions to the approximate elevation of the planned excavation. The deeper explorations would be able to determine if the more dense, silty sand soil is present more consistently and if groundwater is present above the base of the proposed excavation. If temporary excavations cannot be safely kept within the property, then shoring may be necessary.

We understand that infiltration is being proposed for the project, with the likely locations at the southeastern corner or the northwestern corner of the site. Most other areas are covered with the building or within the stream buffer. Some relatively clean sand soils were revealed at relatively shallow depths in these area that have high permeability and are suitable for infiltration of stormwater. However, we believe that infiltration is not suitable from a geotechnical engineering standpoint at the southeastern area because the infiltrated water could flow to the building (the basement level of the building is quite deep in that area), and also not at the northwestern area because there is a declining slope and building just off the western edge of the property.

Based on our explorations, we expect that most of the volume of soil from the proposed building excavation area will consist of sand and gravel. An appropriate amount of this material should be stockpiled onsite for use as retaining wall backfill. Because substantial fills are not proposed for the project, most of the excavated soil will need to be exported. The sand and gravel soil is only slightly moisture sensitive and is therefore desireable. It may be possible to export the soil at low cost, or even to sell the soil, especially the sand/gravel soil with little silt.

The erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered. We anticipate that a silt fence will be needed around the downslope sides of any cleared areas. Existing pavements, ground cover, and landscaping should be left in place wherever possible to minimize the amount of exposed soil. Rocked staging areas and construction access roads should be provided to reduce the amount of soil or mud carried off the property by trucks and equipment. Wherever possible, the access roads should follow the alignment of planned pavements. Trucks should not be allowed to drive off of the rock-covered areas. Cut slopes and soil stockpiles should be covered with plastic during wet weather. Following clearing or rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface. On most construction projects it is necessary to periodically maintain or modify temporary erosion control measures to address specific site and weather conditions.

The drainage and/or waterproofing recommendations presented in this report are intended only to prevent active seepage from flowing through concrete walls or slabs. Even in the absence of active seepage into and beneath structures, water vapor can migrate through walls, slabs, and floors from the surrounding soil, and can even be transmitted from slabs and foundation walls due to the concrete curing process. Water vapor also results from occupant uses, such as cooking and bathing. Excessive water vapor trapped within structures can result in a variety of undesirable conditions, including, but not limited to, moisture problems with flooring systems, excessively moist air within occupied areas, and the growth of molds, fungi, and other biological organisms that may be harmful to the health of the occupants. The designer or architect must consider the potential vapor sources and likely occupant uses, and provide sufficient ventilation, either passive or mechanical, to prevent a build up of excessive water vapor within the planned structure.

Geotech Consultants, Inc. should be allowed to review the final development plans to verify that the recommendations presented in this report are adequately addressed in the design. Such a plan review would be additional work beyond the current scope of work for this study, and it may include revisions to our recommendations to accommodate site, development, and geotechnical constraints that become more evident during the review process.

We recommend including this report, in its entirety, in the project contract documents. This report should also be provided to any future property owners so they will be aware of our findings and recommendations.

SEISMIC CONSIDERATIONS

In accordance with the International Building Code (IBC), the site soil profile within 100 feet of the ground surface is best represented by Site Class Type D (Stiff Site Class). As noted in the USGS website, the mapped spectral acceleration value for a 0.2 second (S_s) and 1.0 second period (S_1) equals 1.24g and 0.44g, respectively.

The site soils are have a very low potential for seismic liquefaction because of their dense nature and/or the absence of near-surface groundwater.

CONVENTIONAL FOUNDATIONS

The proposed structure can be supported on conventional continuous and spread footings bearing on undisturbed, medium-dense or denser, native sand soils. Some compaction of the sand at the subgrade level with vibratory equipment, especially on the western side of the building, may be needed. We recommend that continuous and individual spread footings have minimum widths of 16 and 24 inches, respectively. Exterior footings should also be bottomed at least 18 inches below the lowest adjacent finish ground surface for protection against frost and erosion. Local building codes should be reviewed to determine if different footing widths or embedment depths are required. Footing subgrades must be cleaned of loose or disturbed soil prior to pouring concrete. Depending upon site and equipment constraints, this may require removing the disturbed soil by hand.

An allowable bearing pressure of 3,000 pounds per square foot (psf) is appropriate for footings supported on competent, medium-dense or denser native soil. A one-third increase in this design bearing pressure may be used when considering short-term wind or seismic loads. For the above design criteria, it is anticipated that the total post-construction settlement of footings founded on competent native soil will be up to about one-inch, with differential settlements on the order of 3/4-inch in a distance of 50 feet along a continuous footing with a uniform load.

Lateral loads due to wind or seismic forces may be resisted by friction between the foundation and the bearing soil, or by passive earth pressure acting on the vertical, embedded portions of the foundation. For the latter condition, the foundation must be either poured directly against relatively level, undisturbed soil or be surrounded by level, well-compacted fill. We recommend using the following ultimate values for the foundation's resistance to lateral loading:

PARAMETER	ULTIMATE VALUE
Coefficient of Friction	0.45
Passive Earth Pressure	300 pcf

Where: (i) pcf is pounds per cubic foot, and (ii) passive earth pressure is computed using the equivalent fluid density.

If the ground in front of a foundation is loose or sloping, the passive earth pressure given above will not be appropriate. We recommend maintaining a safety factor of at least 1.5 for the foundation's resistance to lateral loading, when using the above ultimate values.

FOUNDATION AND RETAINING WALLS

Retaining walls backfilled on only one side should be designed to resist the lateral earth pressures imposed by the soil they retain. The following recommended parameters are for walls that restrain level backfill:

PARAMETER	VALUE
Active Earth Pressure *	35 pcf
Passive Earth Pressure	300 pcf
~~Coefficient of Friction~~	~~0.45~~
Soil Unit Weight	130 pcf

Where: (i) pcf is pounds per cubic foot, and (ii) active and passive earth pressures are computed using the equivalent fluid pressures.
*** For a restrained wall that cannot deflect at least 0.002 times its height, a uniform lateral pressure equal to 10 psf times the height of the wall should be added to the above active equivalent fluid pressure.**

The design values given above do not include the effects of any hydrostatic pressures behind the walls and assume that no surcharges, such as those caused by slopes, vehicles, or adjacent foundations will be exerted on the walls. If these conditions exist, those pressures should be added to the above lateral soil pressures. Where sloping backfill is desired behind the walls, we will need to be given the wall dimensions and the slope of the backfill in order to provide the appropriate design earth pressures. The surcharge due to traffic loads behind a wall can typically be accounted for by adding a uniform pressure equal to 2 feet multiplied by the above active fluid density. Heavy construction equipment should not be operated behind retaining and foundation walls within a distance equal to the height of a wall, unless the walls are designed for the additional lateral pressures resulting from the equipment.

The values given above are to be used to design only permanent foundation and retaining walls that are to be backfilled, such as conventional walls constructed of reinforced concrete or masonry. It is not appropriate to use the above earth pressures and soil unit weight to back-calculate soil strength parameters for design of other types of retaining walls, such as soldier pile, reinforced earth, modular or soil nail walls. We can assist with design of these types of walls, if desired. The passive pressure given is appropriate only for a shear key poured directly against undisturbed native soil, or for the depth of level, well-compacted fill placed in front of a retaining or foundation wall. The values for friction and passive resistance are ultimate values and do not include a safety factor. We recommend a safety factor of at least 1.5 for overturning and sliding, when using the above values to design the walls. Restrained wall soil parameters should be utilized for a distance of 1.5 times the wall height from corners or bends in the walls. This is intended to reduce the amount of cracking that can occur where a wall is restrained by a corner.

Wall Pressures Due to Seismic Forces

The surcharge wall loads that could be imposed by the design earthquake can be modeled by adding a uniform lateral pressure to the above-recommended active pressure. The recommended surcharge pressure is 8**H** pounds per square foot (psf), where **H** is the

design retention height of the wall. Using this increased pressure, the safety factor against sliding and overturning can be reduced to 1.2 for the seismic analysis.

Retaining Wall Backfill and Waterproofing

Backfill placed behind retaining or foundation walls should be coarse, free-draining structural fill containing no organics. This backfill should contain no more than 5 percent silt or clay particles and have no gravel greater than 4 inches in diameter. The percentage of particles passing the No. 4 sieve should be between 25 and 70 percent. If the native sand is used as backfill, a drainage composite similar to Miradrain 6000 should be placed against the backfilled retaining walls. The later section entitled ***Drainage Considerations*** should also be reviewed for recommendations related to subsurface drainage behind foundation and retaining walls.

The purpose of these backfill requirements is to ensure that the design criteria for a retaining wall are not exceeded because of a build-up of hydrostatic pressure behind the wall. Also, subsurface drainage systems are not intended to handle large volumes of water from surface runoff. The top 12 to 18 inches of the backfill should consist of a compacted, relatively impermeable soil or topsoil, or the surface should be paved. The ground surface must also slope away from backfilled walls to reduce the potential for surface water to percolate into the backfill. Water percolating through pervious surfaces (pavers, gravel, permeable pavement, ect.) must also be prevented from flowing toward walls or into the backfill zone. The compacted subgrade below pervious surfaces and any associated drainage layer should therefore be sloped away. Alternatively, a membrane and subsurface collection system could be provided below a pervious surface.

It is critical that the wall backfill be placed in lifts and be properly compacted, in order for the above-recommended design earth pressures to be appropriate. The wall design criteria assume that the backfill will be well-compacted in lifts no thicker than 12 inches. The compaction of backfill near the walls should be accomplished with hand-operated equipment to prevent the walls from being overloaded by the higher soil forces that occur during compaction. The section entitled ***General Earthwork and Structural Fill*** contains additional recommendations regarding the placement and compaction of structural fill behind retaining and foundation walls.

The above recommendations are not intended to waterproof below-grade walls, or to prevent the formation of mold, mildew or fungi in interior spaces. Over time, the performance of subsurface drainage systems can degrade, subsurface groundwater flow patterns can change, and utilities can break or develop leaks. Therefore, waterproofing should be provided where future seepage through the walls is not acceptable. This typically includes limiting cold-joints and wall penetrations, and using bentonite panels or membranes on the outside of the walls. There are a variety of different waterproofing materials and systems, which should be installed by an experienced contractor familiar with the anticipated construction and subsurface conditions. Applying a thin coat of asphalt emulsion to the outside face of a wall is not considered waterproofing, and will only help to reduce moisture generated from water vapor or capillary action from seeping through the concrete. As with any project, adequate ventilation of basement and crawl space areas is important to prevent a build up of water vapor that is commonly transmitted through concrete walls from the surrounding soil, even when seepage is not present. This is appropriate even when waterproofing is applied to the outside of foundation and retaining walls. We recommend that you contact an experienced envelope consultant if detailed

recommendations or specifications related to waterproofing design, or minimizing the potential for infestations of mold and mildew are desired.

The ***General***, ***Slabs-On-Grade***, and ***Drainage Considerations*** sections should be reviewed for additional recommendations related to the control of groundwater and excess water vapor for the anticipated construction.

SLABS-ON-GRADE

The building floors can be constructed as slabs-on-grade atop competent native soil, or on structural fill. The subgrade soil must be in a firm, non-yielding condition at the time of slab construction or underslab fill placement. Any soft areas encountered should be excavated and replaced with select, imported structural fill.

Even where the exposed soils appear dry, water vapor will tend to naturally migrate upward through the soil to the new constructed space above it. This can affect moisture-sensitive flooring, cause imperfections or damage to the slab, or simply allow excessive water vapor into the space above the slab. All interior slabs-on-grade should be underlain by a capillary break drainage layer consisting of a minimum 4-inch thickness of clean gravel or crushed rock that has a fines content (percent passing the No. 200 sieve) of less than 3 percent and a sand content (percent passing the No. 4 sieve) of no more than 10 percent. Pea gravel or crushed rock are typically used for this layer.

As noted by the American Concrete Institute (ACI) in the *Guides for Concrete Floor and Slab Structures*, proper moisture protection is desirable immediately below any on-grade slab that will be covered by tile, wood, carpet, impermeable floor coverings, or any moisture-sensitive equipment or products. ACI also notes that vapor *retarders* such as 6-mil plastic sheeting have been used in the past, but are now recommending a minimum 10-mil thickness for better durability and long term performance. A vapor retarder is defined as a material with a permeance of less than 0.3 perms, as determined by ASTM E 96. It is possible that concrete admixtures may meet this specification, although the manufacturers of the admixtures should be consulted. Where vapor retarders are used under slabs, their edges should overlap by at least 6 inches and be sealed with adhesive tape. The sheeting should extend to the foundation walls for maximum vapor protection. If no potential for vapor passage through the slab is desired, a vapor *barrier* should be used. A vapor barrier, as defined by ACI, is a product with a water transmission rate of 0.01 perms when tested in accordance with ASTM E 96. Reinforced membranes having sealed overlaps can meet this requirement.

In the recent past, ACI (Section 4.1.5) recommended that a minimum of 4 inches of well-graded compactable granular material, such as a 5/8-inch-minus crushed rock pavement base, be placed over the vapor retarder or barrier for their protection, and as a "blotter" to aid in the curing of the concrete slab. Sand was not recommended by ACI for this purpose. However, the use of material over the vapor retarder is controversial as noted in current ACI literature because of the potential that the protection/blotter material can become wet between the time of its placement and the installation of the slab. If the material is wet prior to slab placement, which is always possible in the Puget Sound area, it could cause vapor transmission to occur up through the slab in the future, essentially destroying the purpose of the vapor barrier/retarder. Therefore, if there is a potential that the protection/blotter material will become wet before the slab is installed, ACI now recommends that no protection/blotter material be used. However, ACI then recommends that, because there is a potential for slab curl due to the loss of the blotter material, joint spacing in the

slab be reduced, a low shrinkage concrete mixture be used, and "other measures" (steel reinforcing, etc.) be used. ASTM E-1643-98 "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs" generally agrees with the recent ACI literature.

We recommend that the contractor, project materials engineer, and owner discuss these issues and review recent ACI literature and ASTM E-1643 for installation guidelines and guidance on use of the protection/blotter material.

The ***General***, ***Permanent Foundation and Retaining Walls***, and ***Drainage Considerations*** sections should be reviewed for additional recommendations related to control of groundwater and excess water vapor for the anticipated construction.

EXCAVATIONS AND SLOPES

Excavation slopes should not exceed the limits specified in local, state, and national government safety regulations. Temporary cuts to a depth of about 4 feet may be attempted vertically in unsaturated soil, if there are no indications of slope instability. However, vertical cuts should not be made near property boundaries, or existing utilities and structures. Based upon Washington Administrative Code (WAC) 296, Part N, the loose to dense sand soil at the subject site would generally be classified as Type B. Therefore, temporary cut slopes greater than 4 feet in height should not be excavated at an inclination steeper than 1:1 (Horizontal:Vertical), extending continuously between the top and bottom of a cut. Dense silty sand soil may be excavated steeper depending on results of future explorations on the eastern side of the site.

The above-recommended temporary slope inclination is based on the conditions exposed in our explorations, and on what has been successful at other sites with similar soil conditions. It is possible that variations in soil and groundwater conditions will require modifications to the inclination at which temporary slopes can stand. Temporary cuts are those that will remain unsupported for a relatively short duration to allow for the construction of foundations, retaining walls, or utilities. Temporary cut slopes should be protected with plastic sheeting during wet weather. It is also important that surface runoff be directed away from the top of temporary slope cuts. Cut slopes should also be backfilled or retained as soon as possible to reduce the potential for instability. Please note that sand or loose soil can cave suddenly and without warning. Excavation, foundation, and utility contractors should be made especially aware of this potential danger. These recommendations may need to be modified if the area near the potential cuts has been disturbed in the past by utility installation, or if settlement-sensitive utilities are located nearby.

All permanent cuts into native soil should be inclined no steeper than 2:1 (H:V). Compacted fill slopes should not be constructed with an inclination steeper than 2:1 (H:V). To reduce the potential for shallow sloughing, fill must be compacted to the face of these slopes. This can be accomplished by overbuilding the compacted fill and then trimming it back to its final inclination. Adequate compaction of the slope face is important for long-term stability and is necessary to prevent excessive settlement of patios, slabs, foundations, or other improvements that may be placed near the edge of the slope.

Water should not be allowed to flow uncontrolled over the top of any temporary or permanent slope. All permanently exposed slopes should be seeded with an appropriate species of vegetation to reduce erosion and improve the stability of the surficial layer of soil.

DRAINAGE CONSIDERATIONS

Footing drains should be used where (1) crawl spaces or basements will be below a structure, (2) a slab is below the outside grade, or (3) the outside grade does not slope downward from a building. Drains should also be placed at the base of all earth-retaining walls. These drains should be surrounded by at least 6 inches of 1-inch-minus, washed rock that is encircled with non-woven, geotextile filter fabric (Mirafi 140N, Supac 4NP, or similar material). At its highest point, a perforated pipe invert should be at least 6 inches below the bottom of a slab floor or the level of a crawl space. The discharge pipe for subsurface drains should be sloped for flow to the outlet point. Roof and surface water drains must not discharge into the foundation drain system. A typical drain detail is attached to this report as Plate 6. For the best long-term performance, perforated PVC pipe is recommended for all subsurface drains.

If the structure includes an elevator, it may be necessary to provide special drainage or waterproofing measures for the elevator pit. If no seepage into the elevator pit is acceptable, it will be necessary to provide a footing drain and free-draining wall backfill, and the walls should be waterproofed. If the footing drain will be too low to connect to the storm drainage system, then it will likely be necessary to install a pumped sump to discharge the collected water. Alternatively, the elevator pit could be designed to be entirely waterproof; this would include designing the pit structure to resist hydrostatic uplift pressures.

As a minimum, a vapor retarder, as defined in the ***Slabs-On-Grade*** section, should be provided in any crawl space area to limit the transmission of water vapor from the underlying soils. Crawl space grades are sometimes left near the elevation of the bottom of the footings. As a result, an outlet drain is recommended for all crawl spaces to prevent an accumulation of any water that may bypass the footing drains. Providing even a few inches of free draining gravel underneath the vapor retarder limits the potential for seepage to build up on top of the vapor retarder.

No groundwater was observed during our field work. If seepage is encountered in an excavation, it should be drained from the site by directing it through drainage ditches, perforated pipe, or French drains, or by pumping it from sumps interconnected by shallow connector trenches at the bottom of the excavation.

The excavation and site should be graded so that surface water is directed off the site and away from the tops of slopes. Water should not be allowed to stand in any area where foundations, slabs, or pavements are to be constructed. Final site grading in areas adjacent to a building should slope away at least 2 percent, except where the area is paved. Surface drains should be provided where necessary to prevent ponding of water behind foundation or retaining walls. A discussion of grading and drainage related to pervious surfaces near walls and structures is contained in the ***Foundation and Retaining Walls*** section. Additionally, a drainage swale should be provided upslope of the building to intercept surface run-off and direct it into the storm drains. Water from roof, storm water, and foundation drains should not be discharged onto slopes; it should be tightlined to a suitable outfall located away from any slopes.

GENERAL EARTHWORK AND STRUCTURAL FILL

All building and pavement areas should be stripped of surface vegetation, topsoil, organic soil, and other deleterious material. It is important that existing foundations be removed before site development. The stripped or removed materials should not be mixed with any materials to be used as structural fill, but they could be used in non-structural areas, such as landscape beds.

Structural fill is defined as any fill, including utility backfill, placed under, or close to, a building, behind permanent retaining or foundation walls, or in other areas where the underlying soil needs to support loads. All structural fill should be placed in horizontal lifts with a moisture content at, or near, the optimum moisture content. The optimum moisture content is that moisture content that results in the greatest compacted dry density. The moisture content of fill is very important and must be closely controlled during the filling and compaction process.

Fills placed on sloping ground should be keyed into the firm native soils. This is typically accomplished by placing and compacting the structural fill on level benches that are cut into the competent soils. The allowable thickness of the fill lift will depend on the material type selected, the compaction equipment used, and the number of passes made to compact the lift. The loose lift thickness should not exceed 12 inches. We recommend testing the fill as it is placed. If the fill is not sufficiently compacted, it can be recompacted before another lift is placed. This eliminates the need to remove the fill to achieve the required compaction. The following table presents recommended relative compactions for structural fill:

LOCATION OF FILL PLACEMENT	MINIMUM RELATIVE COMPACTION
Beneath footings, slabs or walkways	95%
Filled slopes and behind retaining walls	90%
Beneath pavements	95% for upper 12 inches of subgrade; 90% below that level

Where: Minimum Relative Compaction is the ratio, expressed in percentages, of the compacted dry density to the maximum dry density, as determined in accordance with ASTM Test Designation D 1557-91 (Modified Proctor).

Use of On-Site Soil

The on-site sand soil that contains little silt could likely be used as structural fill throughout much of the year provided it is not excessively wet or dry and vibratory equipment is used for compaction. The more silty soil on the site is moisture sensitive. If grading activities take place during wet weather, or when the on-site soil of the site is wet, site preparation costs may be higher because of delays due to rain and the potential need for less moisture-sensitive soil, which could be sourced from the upper portion of the site. Grading operations in the lower portion of the site will be difficult during wet weather, or when the moisture content of this soil exceeds the optimum moisture content.

Moisture-sensitive soil may also be susceptible to excessive softening and "pumping" from construction equipment, or even foot traffic, when the moisture content is greater than the optimum moisture content. It may be beneficial to protect subgrades with a layer of sand or crushed rock to limit disturbance from traffic.

LIMITATIONS

The conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our exploration and assume that the soil and groundwater conditions encountered in the test pits are representative of subsurface conditions on the site. If the subsurface conditions encountered during construction are significantly different from those observed in our explorations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. Unanticipated conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking samples in test pits. Subsurface conditions can also vary between exploration locations. Such unexpected conditions frequently require making additional expenditures to attain a properly constructed project. It is recommended that the owner consider providing a contingency fund to accommodate such potential extra costs and risks. This is a standard recommendation for all projects.

This report has been prepared for the exclusive use of Ohana Development, LLC and its representatives for specific application to this project and site. Our conclusions and recommendations are professional opinions derived in accordance with our understanding of current local standards of practice, and within the scope of our services. No warranty is expressed or implied. The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. Our services also do not include assessing or minimizing the potential for biological hazards, such as mold, bacteria, mildew and fungi in either the existing or proposed site development.

ADDITIONAL SERVICES

In addition to reviewing the final plans, Geotech Consultants, Inc. should be retained to provide geotechnical consultation, testing, and observation services during construction. This is to confirm that subsurface conditions are consistent with those indicated by our exploration, to evaluate whether earthwork and foundation construction activities comply with the general intent of the recommendations presented in this report, and to provide suggestions for design changes in the event subsurface conditions differ from those anticipated prior to the start of construction. However, our work would not include the supervision or direction of the actual work of the contractor and its employees or agents. Also, job and site safety, and dimensional measurements, will be the responsibility of the contractor.

During the construction phase, we will provide geotechnical observation and testing services when requested by you or your representatives. Please be aware that we can only document site work we actually observe. It is still the responsibility of your contractor or on-site construction team to verify that our recommendations are being followed, whether we are present at the site or not.

The following plates are attached to complete this report:

Plate 1	Vicinity Map
Plate 2	Site Exploration Plan
Plates 3 - 5	Test Pit Logs
Plate 6	Typical Footing Drain Detail

We appreciate the opportunity to be of service on this project. Please contact us if you have any questions, or if we can be of further assistance.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.

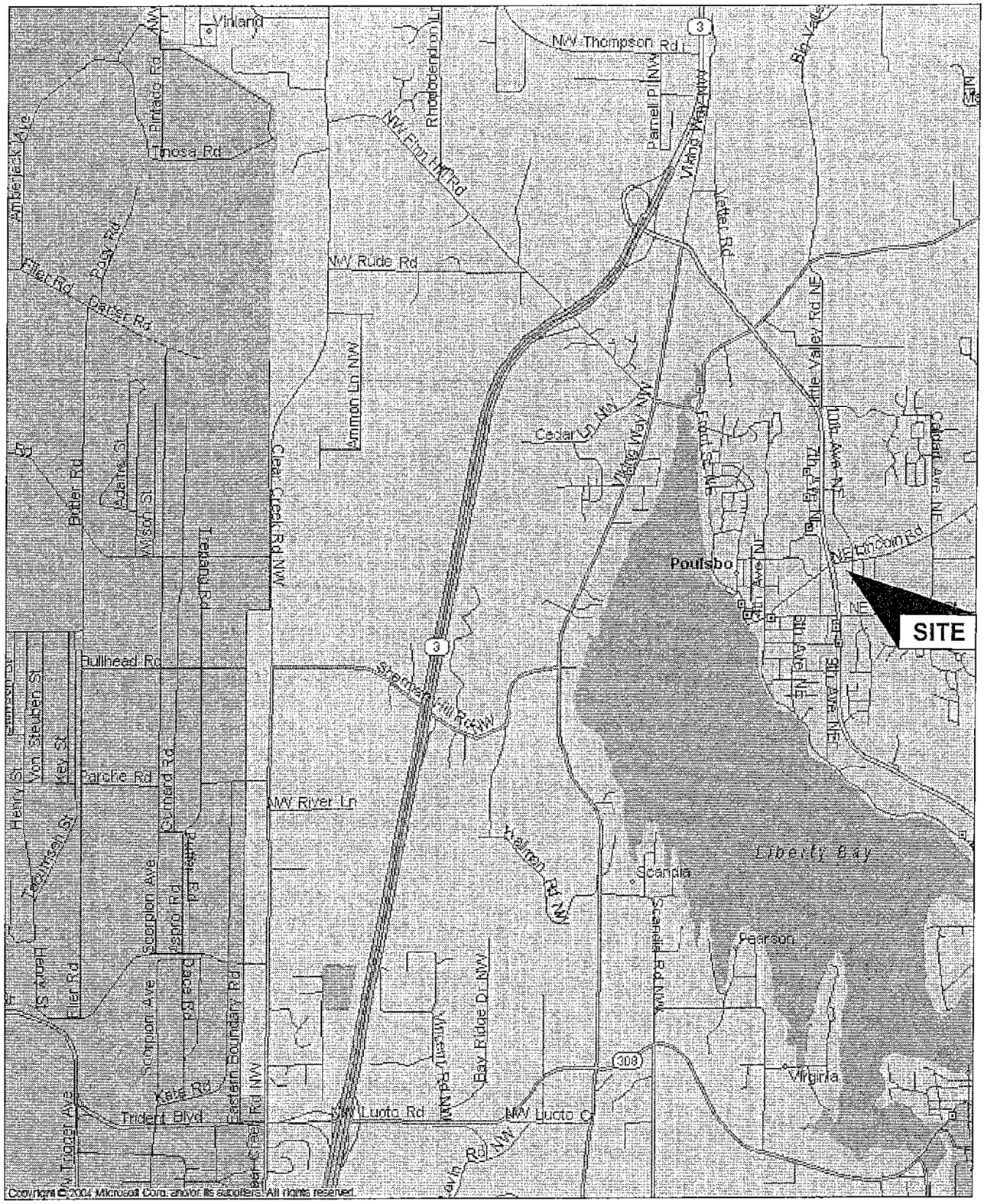
Thor Christensen, P.E.
Senior Engineer

D. ROBERT WARD
STATE OF WASHINGTON
2010
REGISTERED
PROFESSIONAL ENGINEER

2/28/14

D. Robert Ward, P.E.
Principal

TRC/DRW:at



(Source: Microsoft Streets and Trips, 2004)

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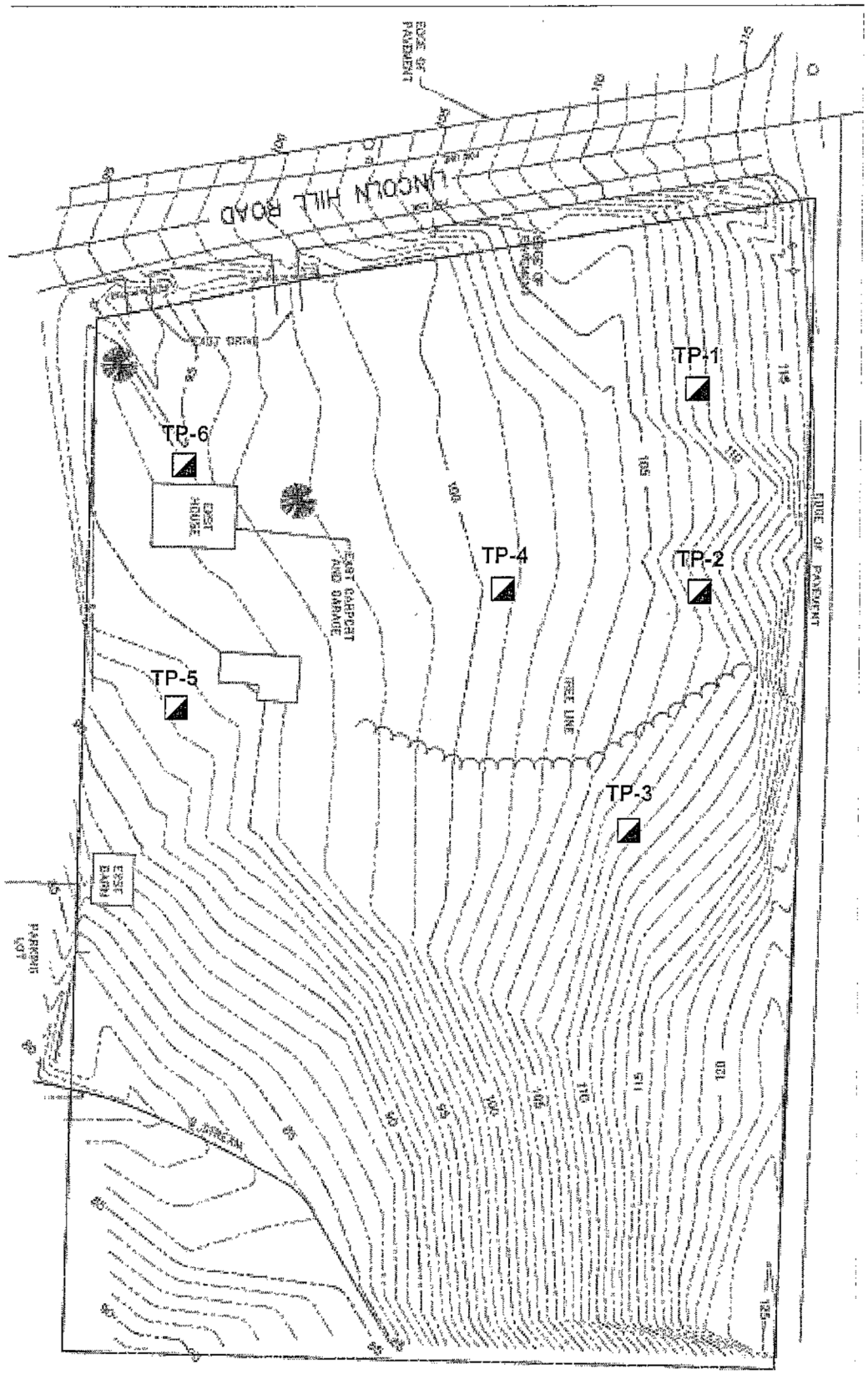
VICINITY MAP

927 Northeast Lincoln Road
Poulsbo, Washington

Job No:	Date:		Plate:
14055	Feb. 2014		1



Legend:

Test pit location

GEOTECH
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SITE EXPLORATION PLAN

927 Northeast Lincoln Road
Poulsbo, Washington

Job No:	Date:		Plate:
14055	Feb. 2014	No Scale	2

TEST PIT 1

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
				TOPSOIL
			SM	Brown silty SAND with gravel, fine to coarse-grained, moist, loose to medium-dense
			SW	Gray SAND with gravel, fine to coarse-grained, moist, medium-dense
5				-reduced coarse sand and gravel
				-becomes dense, increased coarse sand and gravel
10				

* **Test Pit terminated at 8.5 feet on February 17, 2014.**
* **No groundwater seepage was observed during excavation.**
* **No caving observed during excavation.**

TEST PIT 2

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
				TOPSOIL
			SM	Brown silty SAND, fine to coarse-grained, moist, loose to medium-dense
			SW	Gray SAND with gravel, fine to coarse-grained, moist, medium-dense
5				-reduced coarse sand and gravel
				-becomes dense, increased coarse sand and gravel
10				

* **Test Pit terminated at 8.0 feet on February 17, 2014.**
* **No groundwater seepage was observed during excavation.**
* **No caving observed during excavation.**

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TEST PIT LOG

927 Northeast Lincoln Road
Poulsbo, Washington

Job	Date:	Logged by:	Plate:
14055	Feb. 2014	TRC	3

TEST PIT 3

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
				TOPSOIL
			SM	Brown silty SAND, fine to coarse-grained, moist, loose
5			SP	Gray SAND with gravel, fine to medium-grained, moist, loose to medium-dense
			SM	Tan silty SAND, fine-grained, moist, dense
10				

* **Test Pit terminated at 9.0 feet on February 17, 2014.**
* **No groundwater seepage was observed during excavation.**
* **No caving observed during excavation.**

TEST PIT 4

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
				TOPSOIL
			SM	Brown silty SAND, fine to coarse-grained, moist, loose to medium-dense
5			SW	Gray SAND with gravel, fine to coarse-grained, moist, medium-dense -becomes dense
10				

* **Test Pit terminated at 8.0 feet on February 17, 2014.**
* **No groundwater seepage was observed during excavation.**
* **No caving observed during excavation.**

GEOTECH
CONSULTANTS, INC.

TEST PIT LOG

927 Northeast Lincoln Road
Poulsbo, Washington

Job	Date:	Logged by:	Plate:
14055	Feb. 2014	TRC	4

TEST PIT 5

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
				TOPSOIL
			SM	Brown silty SAND, fine to coarse-grained, moist, loose to medium-dense
5			SP SM	Gray-brown SAND with silt, fine to coarse-grained, moist, medium-dense -reduced silt content
			SM	Gray silty SAND, fine-grained, moist, dense
10				

* **Test Pit terminated at 9.0 feet on February 17, 2014.**
* **No groundwater seepage was observed during excavation.**
* **No caving observed during excavation.**

TEST PIT 6

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
				Gray SAND with gravel, fine to coarse-grained, moist, loose **FILL** over **TOPSOIL**
			SM	Brown silty SAND with gravel, fine to coarse-grained, moist, loose to medium-dense
5			SW	Gray SAND, fine to coarse-grained, moist, medium-dense -with gravel -becomes dense, with layers of silty sand
10				

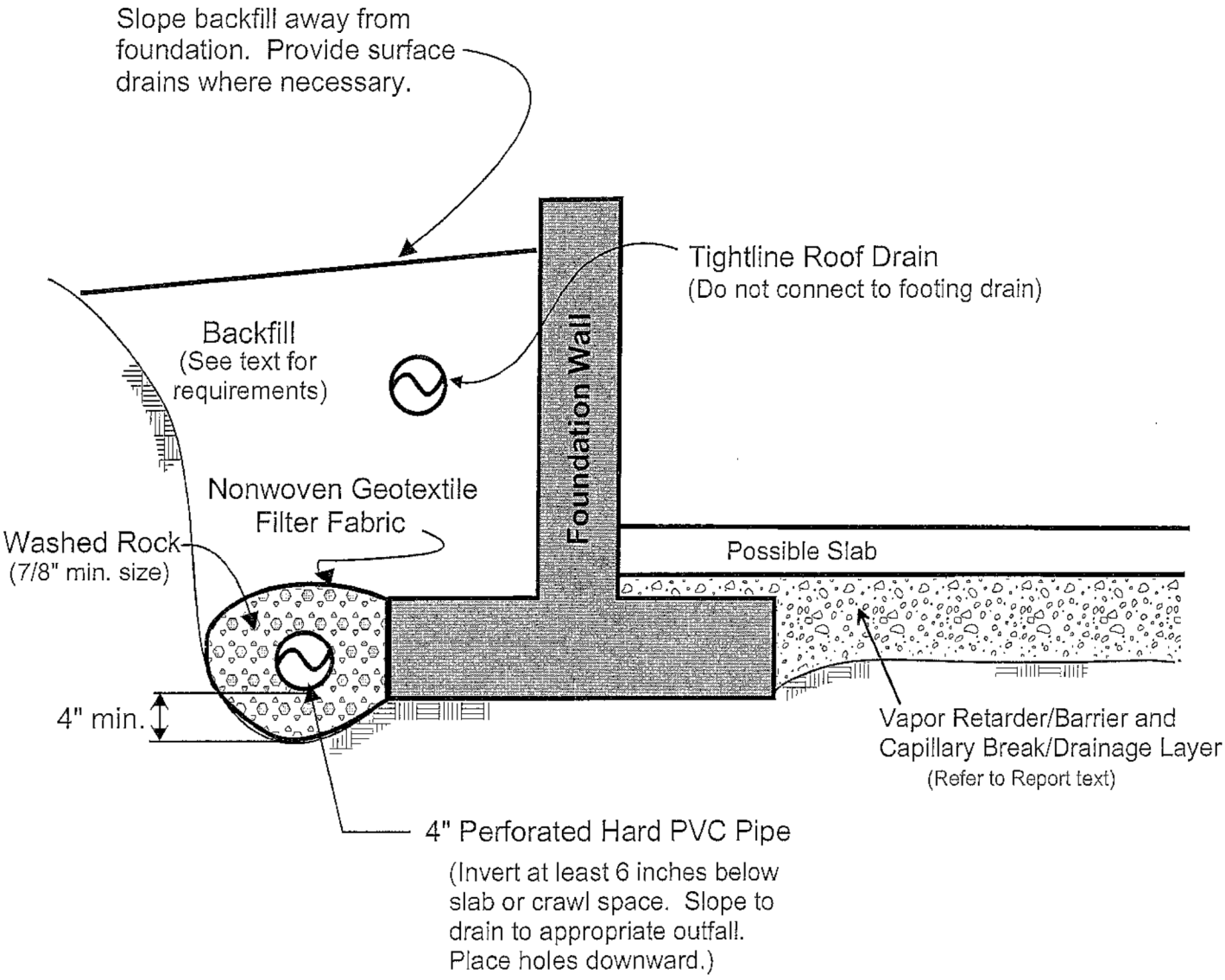
* **Test Pit terminated at 8.5 feet on February 17, 2014.**
* **No groundwater seepage was observed during excavation.**
* **No caving observed during excavation.**

GEOTECH
CONSULTANTS, INC.

TEST PIT LOG

927 Northeast Lincoln Road
Poulsbo, Washington

Job	Date:	Logged by:	Plate:
14055	Feb. 2014	TRC	5



NOTES:

(1) In crawl spaces, provide an outlet drain to prevent buildup of water that bypasses the perimeter footing drains.

(2) Refer to report text for additional drainage, waterproofing, and slab considerations.

GEOTECH
CONSULTANTS, INC.

FOOTING DRAIN DETAIL
927 Northeast Lincoln Road
Poulsbo, Washington

Job No:	Date:		Plate:
14055	Feb. 2014		6

Appendix E
Construction Stormwater Pollution Prevention Plan (SWPPP)

APPENDIX E
CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

SWPPP WILL BE PREPARED AND INCLUDED DURING THE ENGINEERING REVIEW PROCESS

Appendix F
Operations and Maintenance Manual

APPENDIX F
OPERATIONS AND MAINTENANCE MANUAL

THE MANUAL WILL BE COMPLETED AS PART OF THE ENGINEERING REVIEW PROCESS

Due Annually by September 15th

2016
PRIVATE DRAINAGE FACILITY
INSPECTION & MAINTENANCE REPORT

Property Owner Name:_____

Property or Business Name:_____

Property Address:_____

Tax Parcel #:_____

Inspected By: _____ Inspection Date:_____

INSTRUCTIONS

1. Refer to the *Stormwater Facility Maintenance Manual* ("manual") to determine **(a)** which facility type and components you have on your property, **(b)** the conditions to check for, and **(c)** the conditions that should exist (the maintenance standard).
2. **Inspect each component for defects** (refer to the maintenance checklists in the manual).
3. Enter the **total number of each type of component** within each facility type.
4. Enter the **number of components that have defects**. Enter "0" if there are no defects.
5. Enter the applicable **defect codes** from the manual.
6. **Perform maintenance** on all defective facility components to bring them up to the appropriate standard.
7. **Check off that maintenance has been completed** and **enter the date completed**.
8. Additional information or comments may be added on the last page or a separate sheet of paper.
9. Both the service provider and the owner/agent must sign the Certification on the last page and then return this checklist to the City of Poulsbo Public Works Department.

Do not send in the checklist until **both** the inspection **and** any required maintenance has been completed.

The due date for **both** inspection and maintenance is **September 15th each year**.

Thank you !

FACILITY TYPE	ID*	COMPONENT	TOTAL OF EACH TYPE OF COMPONENT	NUMBER OF COMPONENTS WITH DEFECTS	DEFECT CODE(S)	MAINTENANCE COMPLETED	
						✓	DATE
CONVEYANCE							
1. CONVEYANCE ***Brief Definition*:** Culverts, pipes, ditches, and catch basins that pick up and convey runoff from buildings and parking areas.	3.1	Type I Catch Basin					
	3.1	Type I Catch Basin with Spill Control Tee or Elbow					
	3.1	Type II Catch Basin					
	3.1	Type II Catch Basin with Spill Control Tee or Elbow					
	3.3	Pipe / Culvert					
	3.8	Debris Barrier					
	3.9	Energy Dissipater					
	3.23	Ditch					
		Other					
FLOW CONTROL							
2. POND ***Brief Definition*:** Open-air basins made by excavation below existing ground or the construction of above-ground embankments. Temporarily stores stormwater runoff. May be enclosed by a fence. Discharges to a stormwater conveyance system that carries the stormwater to a creek or bay. **Dry Pond:** Designed to drain within 24 hours. Has single cell water storage area. Has a bioswale or other treatment facility associated with it. **Wet Pond:** Designed to retain a permanent pool of water (may dry out during extended dry weather). Has 2 or more cells for water storage. May have a bioswale or other treatment facility associated with it. **Infiltration:** Fills with stormwater but relies on the soil to absorb the stormwater into the ground. Has control structure and overflow spillway like other pond types.	3.6	Dry Pond (water storage area)					
	3.7	Wet Pond (water storage area)					
	3.11	Infiltration Pond (water storage area)					
	3.1	Type II Catch Basin (*NOT CONVEYANCE)*					
	3.2	Control Structure / Flow Restrictor (in Type II CB)					
	3.3	Pipe					
	3.8	Debris Barrier					
	3.9	Energy Dissipater					
	3.10	Fencing/Gate/Landscaping					
	3.24	Access Road					
		Other:					
		Other:					

* Section number in the *City of Poulsbo Private Stormwater Facility Inspection and Maintenance Manual*

FACILITY TYPE	ID*	COMPONENT	TOTAL NUMBER OF COMPONENTS	NUMBER OF COMPONENTS WITH DEFECTS	DEFECT CODE(S)	MAINTENANCE COMPLETED	
						✓	DATE
FLOW CONTROL							
3. INFILTRATION CHAMBER / TANK ***Brief Definition*:** Underground perforated pipe, tank, vault, trench, or drywell system that allows runoff to percolate back into surrounding soil. Some may include Type I Catch Basins, Type II Catch Basins or elements to facilitate inspection and cleaning. Some are enclosed or buried without access and are only evaluated by looking for flooding or erosion problems in the surrounding area.		Manufacturer Name:					
	3.27	Chamber					
	3.27	Isolator Row					
	3.27	Overflow Manifold					
	3.1	Type II Catch Basin (*NOT CONVEYANCE)*					
	3.2	Control Structure/Flow Restrictor (in Type II CB)					
		Trench or Drywell:					
		Other:					
4. TANK / VAULT (DRY) ***Brief Definition*:** Underground structure used to store runoff. May be large-diameter pipe or a concrete vault. A tank may consist of a series of pipes connected by Type II catch basins. It may have intermediate access ports along the pipe length. Vaults will have a minimum of 2 access ports. Dry tanks and vaults are intended to drain completely.	3.4	Tank (water storage area)	Legs/ tubes:				
	3.4	Vault (water storage area)					
	3.1	Type II Catch Basin- End or connector for tank legs (*NOT CONVEYANCE)*					
	3.2	Type II Catch Basin with Control Structure/Flow Restrictor					
	3.3	Pipe					
	3.4	Access Port or Riser:					
		Other:					
5. VAULT (WET) ***Brief Definition:*** Underground runoff storage area. Concrete precast or poured in place. Usually has access at the corners and is normally a large scale storage facility.	3.14	Vault (water storage area)					
	3.1	Type II Catch Basin *NOT CONVEYANCE*					
	3.2	Type II Catch Basin with Control Structure/Flow Restrictor					
	3.3	Pipe					
	3.4	Access Port or Riser:					
		Other:					

* Section number in the *City of Poulsbo Private Stormwater Facility Inspection and Maintenance Manual*

FACILITY TYPE	ID*	COMPONENT	TOTAL NUMBER OF COMPONENTS	NUMBER OF COMPONENTS WITH DEFECTS	DEFECT CODE(S)	MAINTENANCE COMPLETED	
						✓	DATE
WATER QUALITY TREATMENT							
6. BIOSWALE ***Brief Definition:*** Broad open channel that is lined with grass or water- tolerant (wet swale) vegetation, which acts as a filter to remove pollutants from runoff.	3.5	Typical Biofiltration Swale					
	3.22	Wet Biofiltration Swale					
	3.8	Debris Barrier					
	3.9	Energy Dissipater					
		Other:					
7. SPECIALTY TREATMENT ***Brief Definition*:** Structures or manufactured units intended to capture oils and/or sediments or filter stormwater. Most are contained within their own individual vault.	3.15	Stormfilter™ (media filter)					
	3.16	Baffle Oil / Water Separator					
	3.17	Coalescing Plate Oil / Water Separator					
	3.18	Vortechs™					
	3.25	Filterra™					
		Other:					
LOW IMPACT DEVELOPMENT							
8. PERVIOUS PAVEMENT ***Brief Definition:*** Hard surfacing of asphalt or concrete that is porous and allows water to pass through it into a gravel layer and the underlying soil.	7.0	Pervious pavement					
		Other: (ex. paving stones)					
		Other:					
9. BIO-RETENTION ***Brief Definition:*** CELL: Shallow depressions with a designed soil mix and variety of plant material. May or may not have an under-drain. Not designed to convey runoff. SWALE: Same design features as cells; but also convey runoff when ponding depth is exceeded**.** RAIN GARDEN: Same as cell but no designed soil mix.	7.0	Bioretention Cell					
	7.0	Bioretention Swale					
	7.0	Rain Garden					
	3.8	Debris Barrier					
	3.9	Energy Dissipater					
		Other:					

* Section number in the *City of Poulsbo Private Stormwater Facility Inspection and Maintenance Manual*

Certification

I, the undersigned, do hereby certify under penalty of perjury, that the inspection has been performed, the materials have been furnished, the services rendered, and/or the labor performed as deemed necessary for the inspection and maintenance to meet City of Poulsbo standards for the facilities indicated above.

Owner / Managing Agent	**Service Provider**

***Please check status*:** ☐ **Owner** ☐ **Agent**

Signature	Signature
Printed Name	Printed Name
Company Name	Company Name
Mailing Address	Mailing Address
City State Zip	City State Zip
Phone Number	Phone Number
E-mail Address	E-mail Address
Date	Date

COMMENTS: *(use reverse side or attach additional pages if necessary)* _____

Complete and submit all pages of this checklist via mail, email, hand-delivery or fax to:

City of Poulsbo Public Works Department
ATTN: Stormwater Program Manager
200 NE Moe St.
Poulsbo, WA 98370

Fax: 360-697-8269
publicworks@cityofpoulsbo.com
Phone: 360-779-4078