Exhibit C: Washington County Assessor's Map

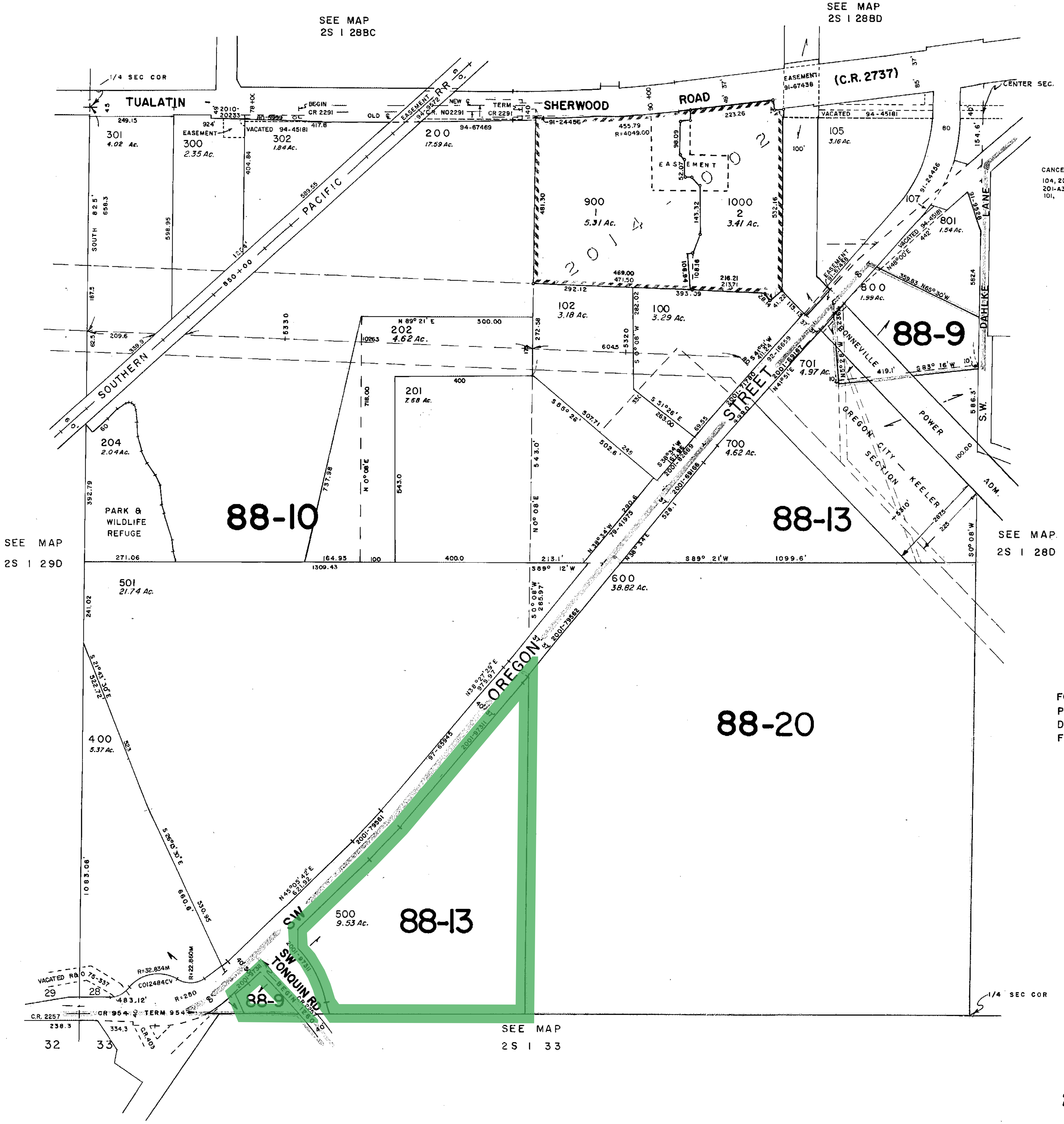
Exhibit A

2S 1 28C

SW1/4 SECTION 28 T2S R1W W.M.

WASHINGTON COUNTY OREGON

SCALE 1"=200'



CANCELLED TAX LOTS
104, 203, 103, 106, 401, 201-A2, 201-A3, 300-A1, 200-A1, 201-A1, 101.

FOR ASSESSMENT PURPOSES ONLY
DO NOT RELY ON
FOR ANY OTHER USE

SHERWOOD
2S 1 28C

Exhibit D: Preliminary Stormwater Report

Exhibit A

Oregon Street Business Park
Sherwood, Oregon

Stormwater Report

Date: May 12, 2022

Client:
Oregon Street Business Park, LLC
PO Box 1489
Sherwood, Oregon 97140

Engineering Contact:
John Christiansen, PE
503-563-6151 | johnc@aks-eng.com

Prepared By: Braden Lambert

Engineering Firm:
AKS Engineering & Forestry, LLC
12965 SW Herman Road
Suite 100
Tualatin, OR 97062

AKS Job Number: 7971

REGISTERED PROFESSIONAL ENGINEER
76382PE
OREGON
JUNE 29, 2009
JOHN P. CHRISTIANSEN
RENEWAL DATE: 12/31/21

Preliminary

www.aks-eng.com

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Exhibit A

Stormwater Report
OREGON STREET BUSINESS PARK
SHERWOOD, OREGON

1.0 Purpose of Report

The purpose of this report is to analyze the effects the proposed development will have on the existing stormwater conveyance system; document the criteria, methodology, and informational sources used to design the proposed stormwater system; and present the results of the preliminary hydraulic analysis.

2.0 Project Location/Description

The proposed industrial development will be located at the intersection of SW Oregon St and SW Tonquin Rd, encompassing approximately 9.53 acres (Tax Lot 500, Washington County Assessor's Map 2S 1W 28C). Improvements include the construction of industrial buildings, paved site access, public and private underground utilities and a stormwater facility. The development will result in the addition and/or modification of approximately 7.64 acres of impervious area to the existing site.

3.0 Regulatory Design Criteria

3.1. Stormwater Quantity

3.1.1. Clean Water Services Standards

Per Clean Water Services' (CWS) *Design and Construction Standards* (R&O 19-22), *Section 4.02: Water Quantity Control Requirements*, on-site detention is required when any of the following conditions exist:

a. *There is an identified downstream deficiency and the District or City determines that detention rather than conveyance system enlargement is the more effective solution.*
b. *There is an identified regional detention site within the boundary of the development.*
c. *Water quantity facilities are required by District-adopted watershed management plans or adopted subbasin master plans.*

Stormwater quantity will be met by creating a stormwater facility in the southwest corner of the site.

Further description of stormwater quantity management for the project is provided in Section 6.4 of this report.

3.1.2. NMFS SLOPES V Standards

Because the project requires a Clean Water Act (CWA) Section 404 permit from the US Army Corps of Engineers (USACE), the stormwater quantity management system was designed to meet the National Marine Fisheries Service (NMFS) requirements of the revised Standard Local Operating Procedures for Endangered Species (SLOPES V, NMFS No: NWR-2013-10411). SLOPES V criteria require the implementation of a Stormwater Management Plan that includes water quantity retention or detention facilities for all stormwater systems that do not discharge directly into a major body of water (e.g. lakes, rivers, etc.). SLOPES V criteria require retention or detention facilities that limit discharge to match pre-developed discharge rates using a continuous simulation for flows between 50 percent of the 2-year design storm and the 10-year design storm.

3.2. Hydromodification

Per CWS R&O 19-22, *Section 4.03: Hydromodification Approach Requirements*, the implementation or funding of techniques to reduce impacts to the downstream receiving water body is required when a new development, or other activities, creates or modifies 1,000 square feet or more of impervious surfaces or increases the amount or rate of surface water leaving the site. The following techniques may be used to mitigate impacts to the downstream receiving water body:

a. *Construction of permanent LIDA designed in accordance with this Chapter; or*
b. *Construction of a permanent stormwater detention facility designed in accordance with this Chapter; or*
c. *Construction or funding of a hydromodification approach that is consistent with a District-approved sub-basin strategy; or*
d. *Payment of a Hydromodification Fee-In-Lieu.*

Per Section 4.03.2, unless specifically waived in writing by the District, a Hydromodification Assessment is required of all activities described in Section 4.03.1, unless the activity meets any of the following criteria:

a. *The project results in the addition and/or modification of less than 12,000 square feet of impervious surface.*
b. *The project is located within a District-approved sub-basin strategy with an identified regional stormwater management approach for hydromodification.*

The project will result in the addition and/or modification of approximately 7.64 acres of impervious surface. Therefore, hydromodification will be addressed by the implementation of a stormwater facility in the southwest corner of the site. The proposed stormwater facility is designed to provide peak-flow matching detention, using the criteria established within CWS Section 4.08.6. A Hydromodification Assessment and further description of the hydromodification management approach is provided in Section 6.3 of this report.

3.3. Stormwater Quality

3.3.1. Clean Water Services Standards

Per CWS R&O 19-22, *Section 4.04: Water Quality Treatment Requirements*, the implementation or funding of permanent water quality approaches are required when new development or other activities create or modify 1,000 square feet or greater of impervious surfaces, or increase the amount of stormwater runoff or pollution leaving the site.

This project will result in the addition and/or of modification of approximately 7.64 acres of impervious area; thus, increasing the amount of stormwater runoff leaving the site. Stormwater quality management for this project will be met by creating a stormwater facility in the southwest corner of the site. The proposed stormwater facility has been designed per CWS Standards. Further description of stormwater quality management for the project is provided in Section 6.2 of this report.

3.3.2. NMFS SLOPES V and DEQ Section 401 Water Quality Certification Program Standards

Per SLOPES V and Oregon Department of Environmental Quality (DEQ) CWA Section 401 Water Quality Certification Program standards, water quality treatment for post-construction stormwater runoff from all contributing impervious area is required. The stormwater quality treatment facilities will be designed to accept and fully treat the volume of stormwater equal to either 50 percent of the cumulative rainfall from the 2-year, 24-hour storm event or at least 80 percent of the average annual rainfall, as modeled with a continuous rainfall/runoff model.

3.3.3. Post-Construction Stormwater Management Plan for Section 401 Water Quality Certification

To address post construction stormwater pollution, the DEQ CWA Section 401 Water Quality Certification Program requires a post-construction Stormwater Management Plan to meet the most current standards and regulations. This report has been prepared to supplement the DEQ's 401 Post-Construction Stormwater Management Plan Submission Form.

4.0 Design Methodology

The Santa Barbara Urban Hydrograph (SBUH) Method was used to analyze stormwater runoff from the site. This method utilizes the Natural Resource Conservation Service (NRCS) Type 1A 24-hour design storm. HydroCAD 10.00 computer software aided in the analysis. Representative runoff Curve Numbers (CN) were obtained from the NRCS *Urban Hydrology for Small Watersheds* (Technical Release 55), and are included in Appendix C.

5.0 Design Parameters

5.1. Design Storms

Per CWS requirements, the stormwater analysis used the 24-hour storm for the evaluation and design of the existing and proposed stormwater facilities. The following 24-hour rainfall intensity was used as the design storm for the recurrence interval:

Table 5-1: Rainfall Intensities

Recurrence Interval (Years)	Total Precipitation Depth (Inches)
2	2.50
5	3.10
10	3.45
25	3.90

5.2. Pre-Developed Site Conditions

5.2.1. Site Topography

Existing on-site grades generally vary from ±1% to ±45%, with the site draining towards the southwest (existing SW Tonquin Rd). The site has a high point of ±203 feet in the northeast property corner and a low point of ±132 feet in the southwest property corner. There is an off-site contributing basin to the east of the site that also drains towards the southwest corner of the site. This contributing basin is 45.39 acres. The high point of this basin is ±234 along its eastern edge.

5.2.2. Land Use

The existing zoning is Employment Industrial. The existing site consists of an industrial property with gravel driveway and parking lot, buildings, and field areas. The contributing basin to the east consists of field areas with scattered trees.

5.3. Soil Type

The soil beneath the project site and associated drainage basins is classified as Briedwell Stony Silt Loam, Cove Silty Clay Loam, Laurelwood Silt Loam and Xerochrept-Rock outcrop complex according to the USDA

Natural Resources Conservation Service (NRCS) Soil Survey for Washington County. The following table outlines the Hydrologic Soil Group rating for these soil type:

Table 5-2: Hydrologic Soil Groupings

NRCS Map Unit Identification	NRCS Soil Classification	Hydrologic Soil Group Rating
5B	Briedwell Stony Silt Loam	B
13	Cove Silty Clay Loam	D
28B	Laurelwood Silt Loam	B

Further information on this soil type is included in the NRCS Soil Resource Report located in Appendix B of this report.

5.4. Post-Developed Site Conditions

5.4.1. Site Topography

The on-site slopes will be modified with cuts and fills to accommodate the construction of building pads, pavement parking areas and drive aisles and a stormwater facility. Retaining walls will be created along the southern, western, and eastern edges of the paved section of the site. Overall site topography will continue to drain to the southwest with grades between 2% and 33%. A new public road will be constructed along the east edge of the site.

5.4.2. Land Use

The zoning will remain Employment Industrial. The post-developed site land use will consist of industrial buildings with associated underground utilities and paved site access.

5.4.3. Post-Developed Site Parameters

See HydroCAD Analysis in the attached appendices.

5.4.4. Description of Off-Site Contributing Basins

The contributing off-site basin to the east is approximately 45.39 acres. The site was recently logged, and redevelopment is anticipated in the near future. A public stormwater main will be extended to this property as part of this anticipated development.

6.0 Stormwater Analyses

6.1. Proposed Stormwater Conduit Sizing and Inlet Spacing

The proposed public stormwater main will be constructed to the south of the subject site and discharge to the Rock Creek stream corridor to the west of the subject site. It will be sized to provide adequate capacity to serve adjacent downstream and upstream development areas. The proposed stormwater conveyance system will connect to the proposed stormwater facility, and then connect to the proposed public stormwater main. The proposed onsite stormwater drainage conduits and inlets will be spaced in accordance with CWS requirements to properly convey stormwater runoff. Storm drainage piping will be designed using Manning’s equation and sized to convey peak flows generated by the 25-year design storm event.

6.2. Proposed Stormwater Quality Control Facility

Stormwater quality treatment for newly created on-site impervious surfaces will be addressed by the construction of a stormwater quality facility designed to per Clean Water Services Design and Construction Standards for Sanitary Sewer and Surface Water Management (R&0 19-05). This facility will be sized to treat runoff from the impervious area created by the proposed project according to CWS and Slopes V water quality requirements. Detailed calculations are included in Appendix D.

A portion of the project site cannot be directed to the stormwater facility due to site grading and layout. Stormwater runoff from new sidewalks and adjacent landscape areas will be directed to the existing stormwater catch basins on SW Tonquin Road and SW Oregon Street, discharging into the Rock Creek stream corridor.

6.2.1. Hydromodification Assessment

- Risk Level (CWS R&O 4.03.3.a) – Low
- Development Class (CWS R&O 4.03.3.b) – Expansion Area
- Project Size Category (CWS R&O 4.03.3.c) – Large
- Project Category (R&0 4.03.5, Table 4-2) – Category 3

6.2.2. Hydromodification Approach

The proposed project will result in the addition and/or modification of approximately 7.64 acres of impervious area. Based on the parameters in Section 6.2.1 this project is classified as a Category 3 Hydromodification Approach. This will be addressed with the construction of a stormwater quality facility. It will be sized for detention per CWS Section 4.08.6 so site runoff does not exceed 50% of the pre-development 2, 5 and 10 year storm event flows. Detailed calculations are included in Appendix D.

6.3. Proposed Stormwater Quantity Control Facility

Stormwater quality treatment for newly created on-site impervious surfaces will be addressed by the construction of a stormwater quality facility in the southwest corner of the site. The following table summarizes the pre and post developed flows from the stormwater facility. Post developed flows are limited to less than the allowable pre-development park flows, as outlined within CWS stormwater quantity and hydromodification management requirements. The facility was sized and designed to provide water quality treatment according to CWS and Slopes V water quantity requirements. Detailed calculations are included in Appendix D.

Table 6-1: Pre and Post Developed On Site Flows

Recurrence Interval (Years)	Peak Pre-Development Flows (cfs)	Peak Post-Development Flows (cfs)*	Peak Flow Increase or (Decrease) – (cfs)
2	0.24 (50% of 2-yr=0.12)	0.10	(0.02)
5	0.57	0.11	(0.46)
10	0.92	0.31	(0.61)
25	1.43	0.46	(0.97)

*Peak post-developed flow for 2-year storm event is less than equal to 50% of 2-year peak pre-developed flow.

6.4. Downstream Analysis

A downstream analysis was not performed because the onsite stormwater facility will be designed to limit site post-developed discharge to the pre-developed flows by providing detention. The proposed project will provide stormwater detention via an extended dry basin designed per Clean Water Services’ standards. The outfall from the stormwater facility will discharge directly to the vegetated corridor adjacent to Rock Creek.

7.0 SLOPES V Stormwater Management Design

This stormwater summary report demonstrates that the planned stormwater conveyance and management system for this project meets SLOPES V. The following paragraphs are intended to address specific concerns for the NMFS review of the project.

7.1. Pollutants of Concern

The pollutants of concern for Rock Creek are arsenic, iron, lead year-round and dissolved oxygen from Jan 1 to May 15.

7.2. Low Impact Development

To provide water quality, the bottom of the stormwater facility will consist of 18 inches of growing medium and will be planted with grasses, shrubs and trees. Stormwater runoff from the impervious area will flow through the stormwater facility and allow pollutants to settle and filter out. Hydraulic, physical, biological, and chemical processes such as absorption, filtration, infiltration, nitrification, decomposition, sedimentation, and thermal control will take place when stormwater runoff flows through the facility. See Appendix F for Clean Water Services planting requirements and facility cross-section.

The stormwater facility is also designed to detain and reduce the flow rate and velocity of stormwater flows. This will reduce the quantity of stormwater runoff, and reduce the total sediment load before entering the downstream system.

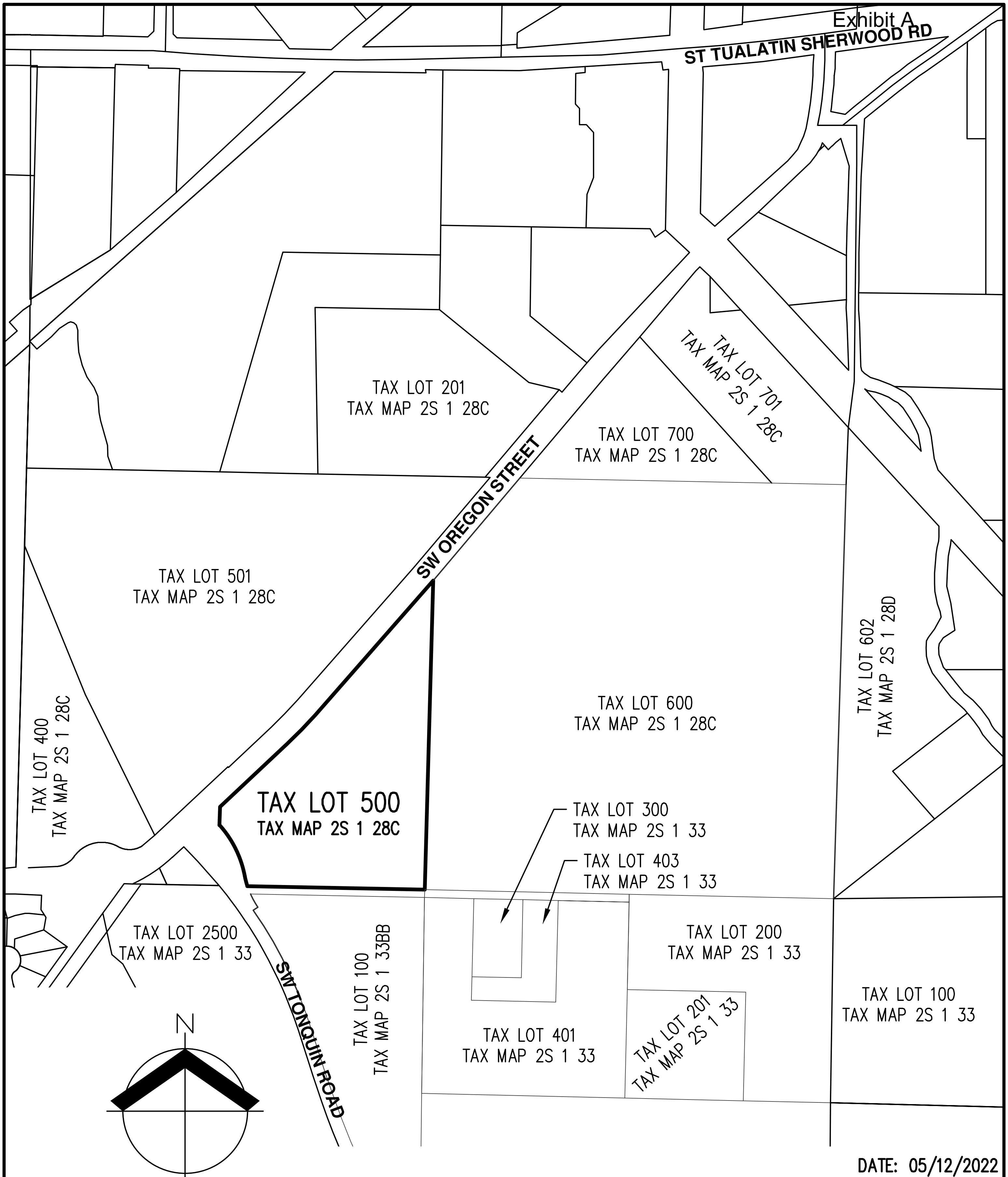
7.3. Operations and Maintenance

The owner is required to conduct annual inspections with recommended monthly inspections. Any discovered deficiencies must be corrected within 30 days of the inspection. The district maintains the right to conduct inspections with either 10 days written notice or as required by an emergency. Any deficiencies found during district inspections must be corrected within 30 days of the inspection. Any deficiencies not corrected within 30 days of inspection may be corrected by the district at the expense of the owner.

See Appendix G for a typical Clean Water Services Operations and Maintenance plan.

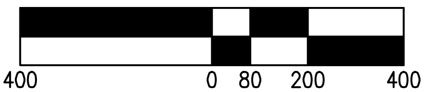
Exhibit A:
Vicinity Map

Exhibit A



DATE: 05/12/2022

SCALE: 1"= 400 FEET



ORIGINAL PAGE SIZE: 8.5" x 11"

VICINITY MAP

EXHIBIT A

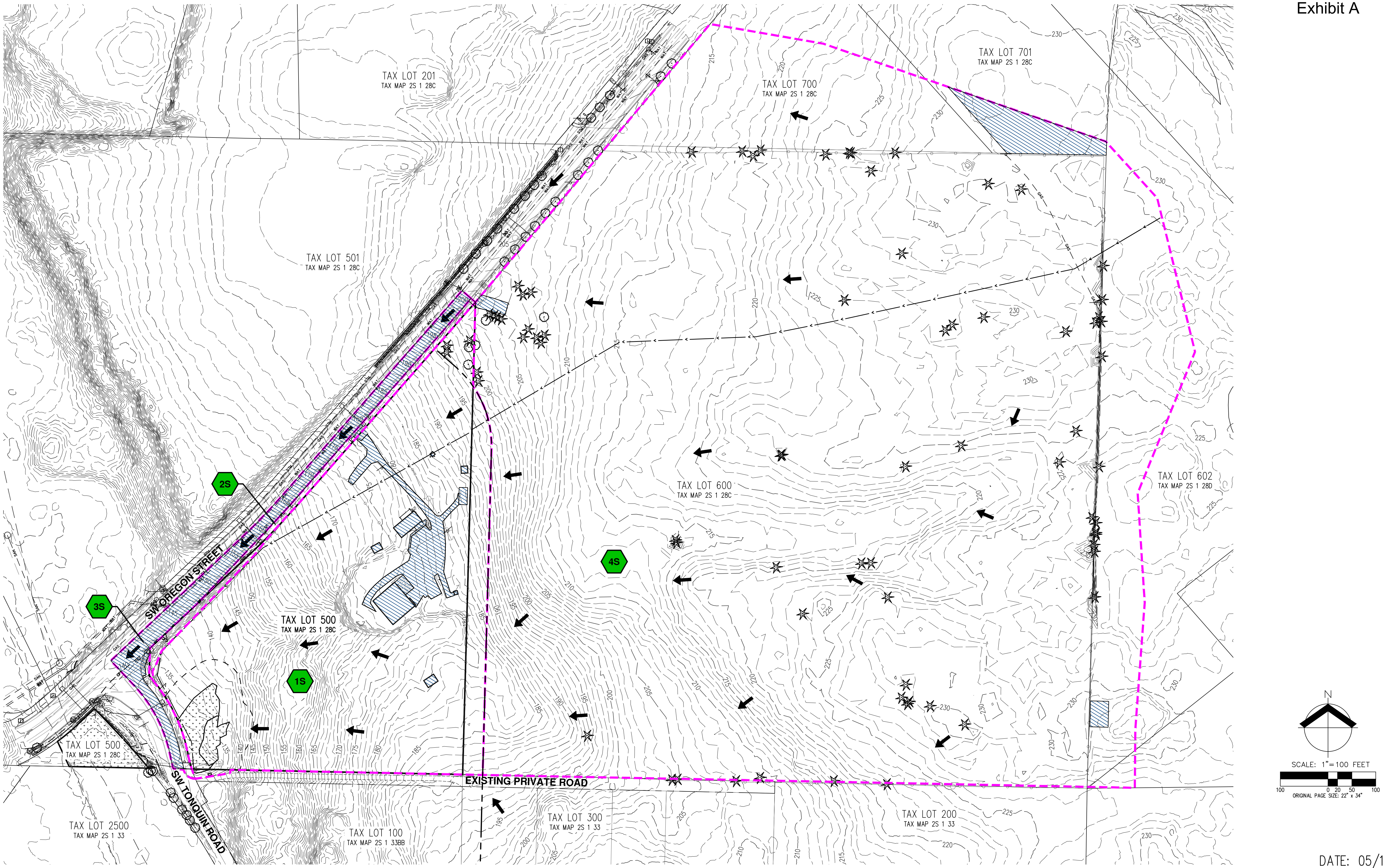
AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD, STE 100
TUALATIN, OR 97062
503.563.6151 WWW.AKS-ENG.COM

DRWN: BDL
CHKD: JDS
AKS JOB: 7971

DWG: 7971 VICINITY MAP | EXH A

Exhibit B:
Pre-Developed
Stormwater Catchment Map

Exhibit A



DATE: 05/12/2022

▨ IMPERVIOUS SURFACE

1S: ±9.57 AC
2S: ±0.32 AC
3S: ±0.94 AC
4S: ±45.39 AC
TOTAL AREA: ±56.22 AC

TOTAL ON SITE PRE-DEVELOPMENT IMPERVIOUS = ±0.63 AC
TOTAL OFF SITE PRE-DEVELOPMENT IMPERVIOUS = ±1.38 AC
TOTAL PRE-DEVELOPMENT IMPERVIOUS = ±2.01 AC

OVERALL PRE-DEVELOPED STORMWATER CATCHMENT MAP

OREGON STREET BUSINESS PARK

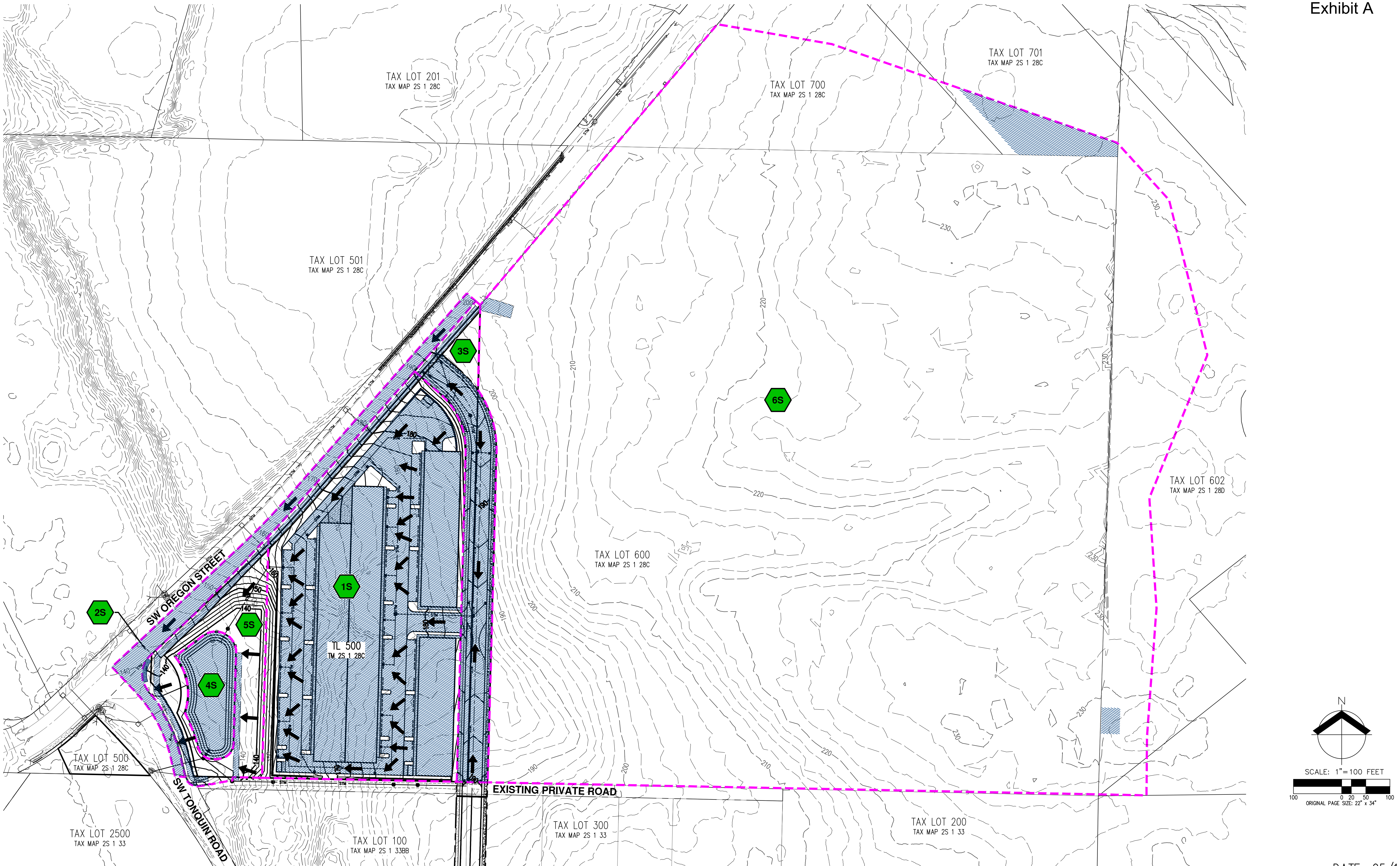
AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD, STE 100
TUALATIN, OR 97062
503.563.6151 WWW.AKS-ENG.COM

EXHIBIT
B
DRWN: BDL
CHKD: JDS
AKS JOB:
7971

DWG: 7971 PRE-DEV | EXH B

Exhibit C:
Post-Developed
Stormwater Catchment Map

Exhibit A



DATE: 05/12/2022

▨ IMPERVIOUS SURFACE

1S: ±6.57 AC
2S: ±0.83 AC
3S: ±1.55 AC
4S: ±0.55 AC
5S: ±1.34 AC
6S: 45.39 AC
TOTAL AREA: ±56.22 AC

TOTAL ON SITE POST-DEVELOPMENT IMPERVIOUS = ±7.64 AC
TOTAL OFF SITE POST-DEVELOPMENT IMPERVIOUS = ±1.38 AC
TOTAL POST-DEVELOPMENT IMPERVIOUS = ±9.02 AC

OVERALL POST-DEVELOPED STORMWATER CATCHMENT MAP

OREGON STREET BUSINESS PARK

AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD, STE 100
TUALATIN, OR 97062
503.563.6151 WWW.AKS-ENG.COM

EXHIBIT
C
DRWN: BDL
CHKD: JDS
AKS JOB:
7971

DWG: 7971 POST-DEV | EXH C

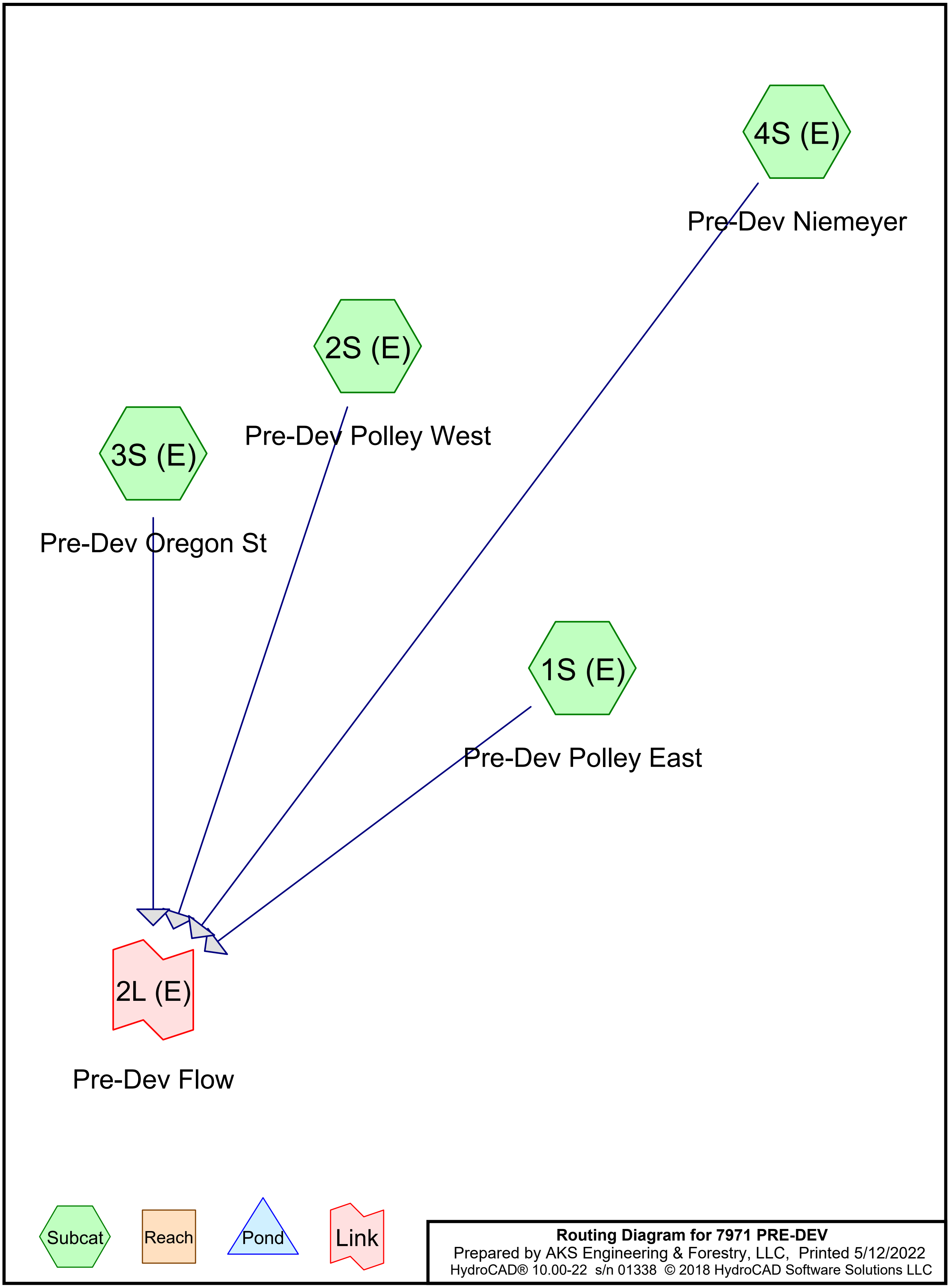
Exhibit A

Appendix A:
Peak Flow Calculations – HydroCAD Analysis

Exhibit A

Pre-Developed Node Diagram and Area Summary Table

Exhibit A



Routing Diagram for 7971 PRE-DEV
Prepared by AKS Engineering & Forestry, LLC, Printed 5/12/2022
HydroCAD® 10.00-22 s/n 01338 © 2018 HydroCAD Software Solutions LLC

Exhibit A

Pre-Developed 2-yr Storm Event Peak Flow Calculations

Exhibit A

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S (E): Pre-Dev Polley East Runoff Area=9.540 ac 2.10% Impervious Runoff Depth>0.36"
Flow Length=1,075' Tc=15.2 min CN=66/98 Runoff=0.23 cfs 0.288 af

Subcatchment2S (E): Pre-Dev Polley West Runoff Area=0.320 ac 0.00% Impervious Runoff Depth>0.30"
Tc=5.0 min CN=65/0 Runoff=0.01 cfs 0.008 af

Subcatchment3S (E): Pre-Dev Oregon St Runoff Area=0.940 ac 90.43% Impervious Runoff Depth>2.13"
Tc=5.0 min CN=79/98 Runoff=0.50 cfs 0.167 af

Subcatchment4S (E): Pre-Dev Niemeyer Runoff Area=45.390 ac 1.06% Impervious Runoff Depth>0.99"
Flow Length=1,550' Tc=39.4 min CN=82/98 Runoff=5.73 cfs 3.736 af

Link 2L (E): Pre-Dev Flow Inflow=6.17 cfs 4.198 af
Primary=6.17 cfs 4.198 af

Total Runoff Area = 56.190 ac Runoff Volume = 4.198 af Average Runoff Depth = 0.90"
97.28% Pervious = 54.660 ac 2.72% Impervious = 1.530 ac

Exhibit A

Summary for Subcatchment 1S (E): Pre-Dev Polley East

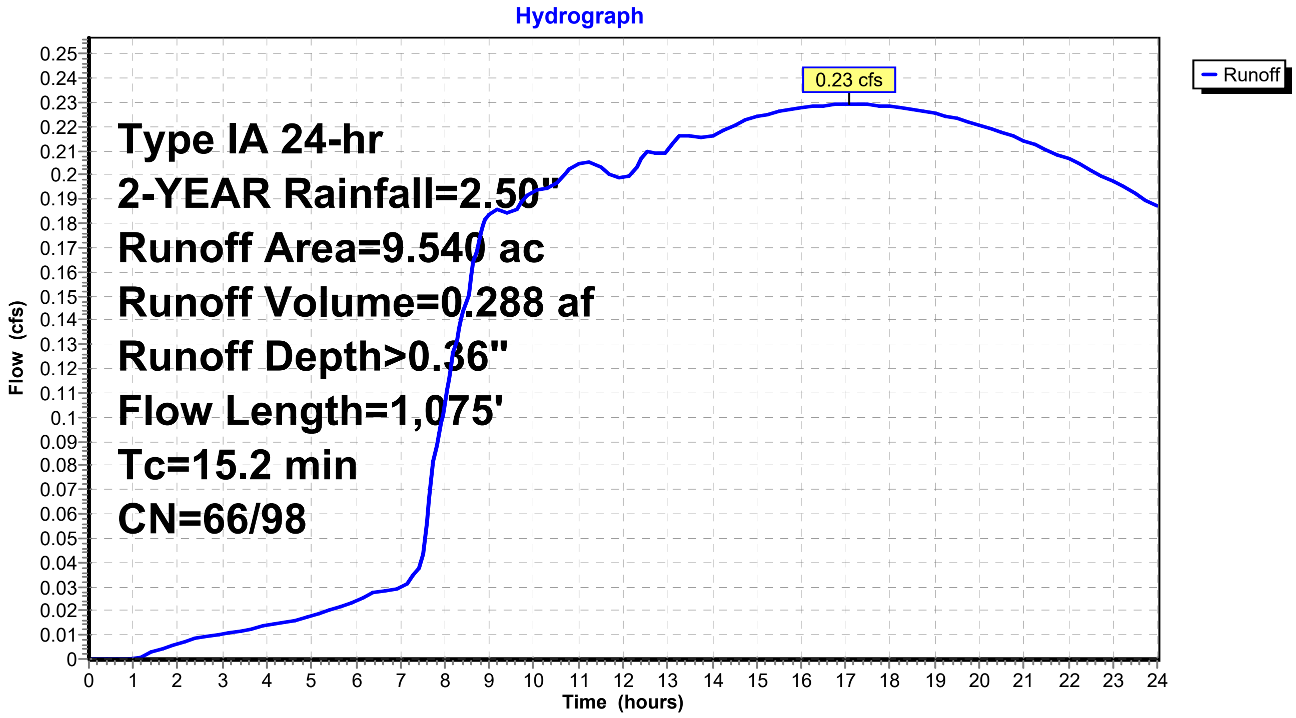
Runoff = 0.23 cfs @ 17.07 hrs, Volume= 0.288 af, Depth> 0.36"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

Area (ac)	CN	Description
8.920	65	Woods/grass comb., Fair, HSG B
0.200	98	Paved parking, HSG B
0.420	96	Gravel surface, HSG B
9.540	67	Weighted Average
9.340	66	97.90% Pervious Area
0.200	98	2.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.1000	0.29		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
5.6	750	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.8	225	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
15.2	1,075	Total			

Subcatchment 1S (E): Pre-Dev Polley East



Summary for Subcatchment 2S (E): Pre-Dev Polley West

Runoff = 0.01 cfs @ 17.60 hrs, Volume= 0.008 af, Depth> 0.30"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

	Area (ac)	CN	Description
*	0.320	65	Woods/grass comb., Fair, HSG B
	0.320	65	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S (E): Pre-Dev Polley West

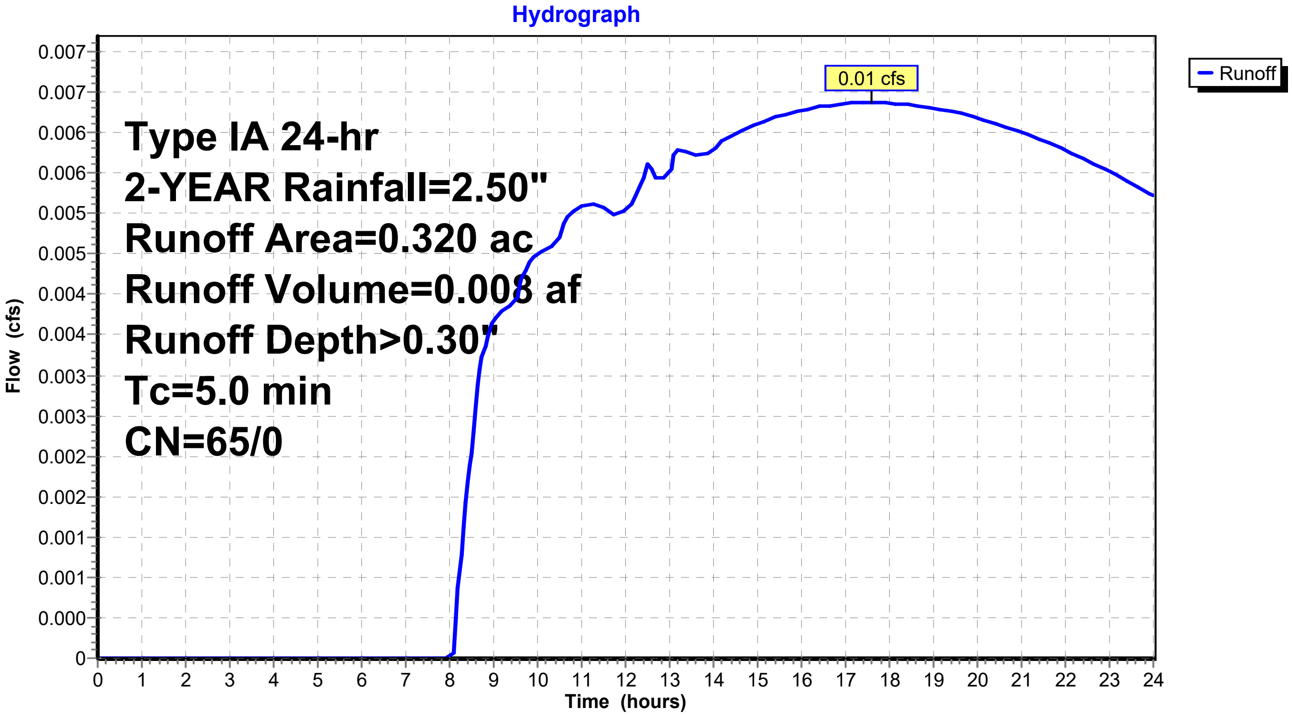


Exhibit A

Summary for Subcatchment 3S (E): Pre-Dev Oregon St

Runoff = 0.50 cfs @ 7.91 hrs, Volume= 0.167 af, Depth> 2.13"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

	Area (ac)	CN	Description
*	0.850	98	Paved Street, HSG B
	0.090	79	<50% Grass cover, Poor, HSG B
	0.940	96	Weighted Average
	0.090	79	9.57% Pervious Area
	0.850	98	90.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S (E): Pre-Dev Oregon St

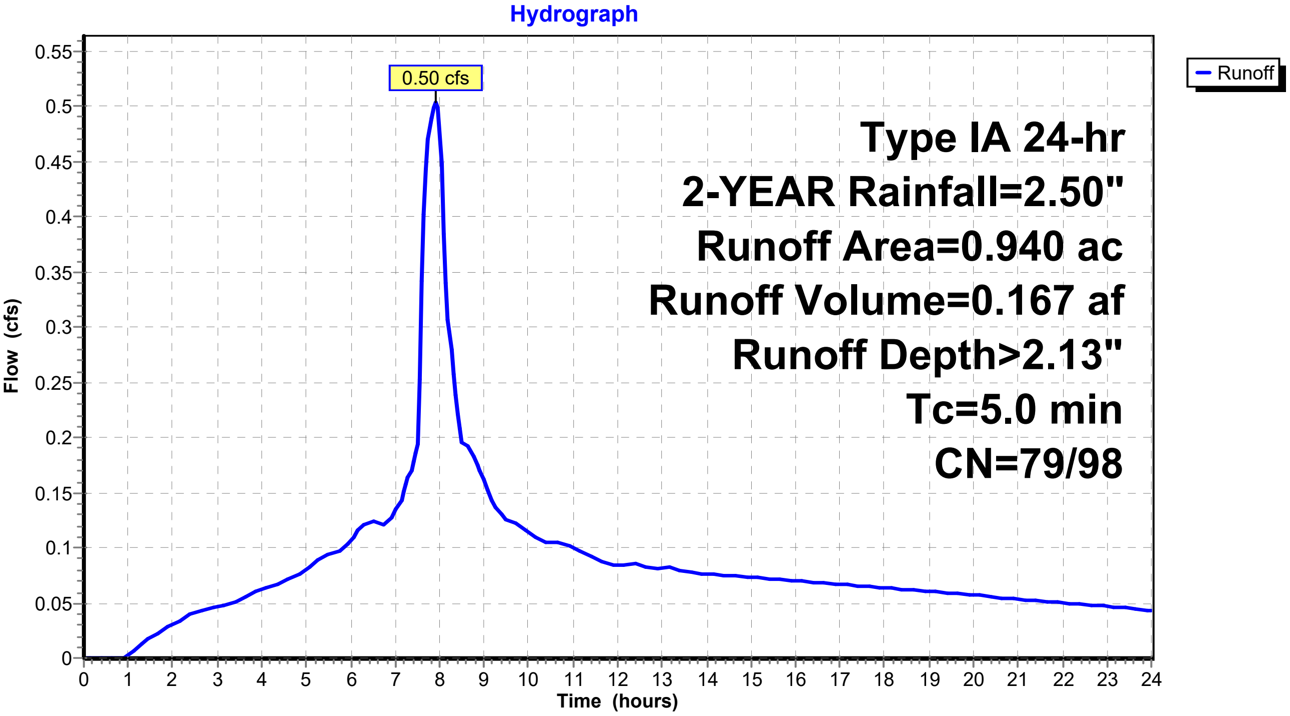


Exhibit A

Summary for Subcatchment 4S (E): Pre-Dev Niemeyer

Runoff = 5.73 cfs @ 8.21 hrs, Volume= 3.736 af, Depth> 0.99"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

Area (ac)	CN	Description
32.480	79	<50% Grass cover, Poor, HSG B
0.480	98	Paved parking, HSG D
12.430	89	<50% Grass cover, Poor, HSG D
45.390	82	Weighted Average
44.910	82	98.94% Pervious Area
0.480	98	1.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
21.4	1,100	0.0150	0.86		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.4	350	0.0600	1.71		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
39.4	1,550	Total			

Subcatchment 4S (E): Pre-Dev Niemeyer

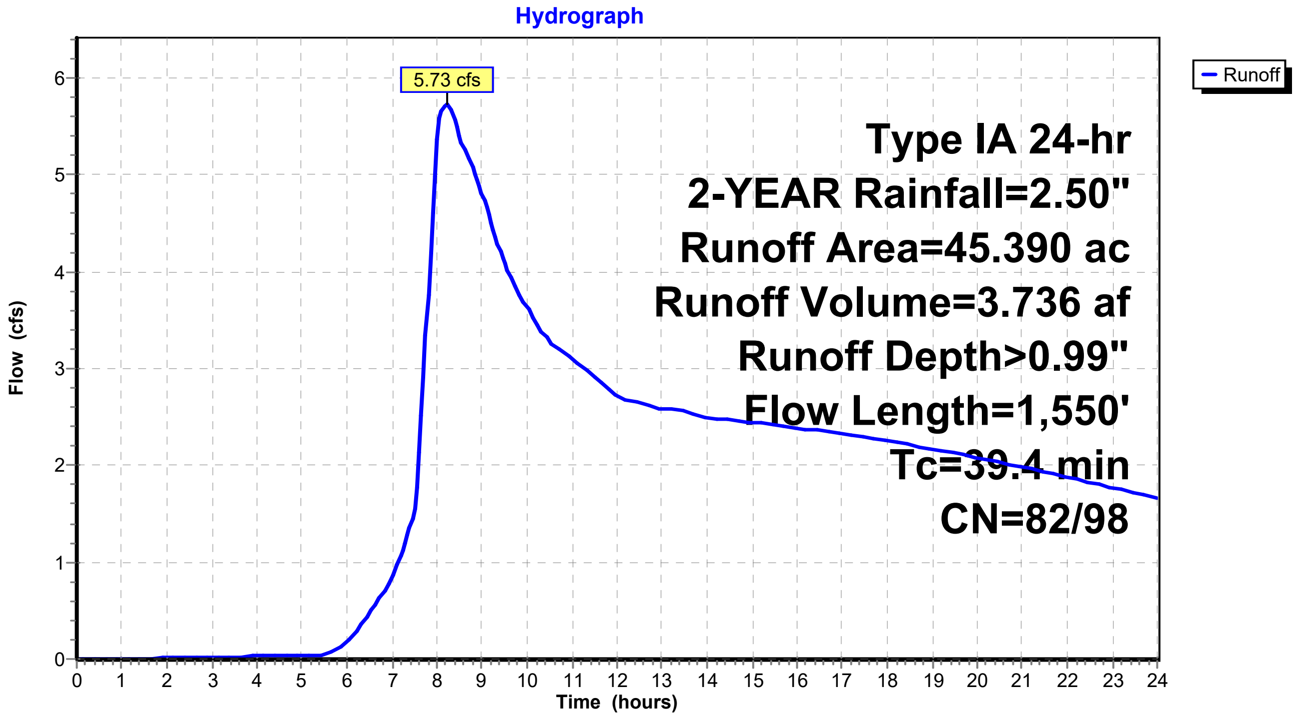


Exhibit A

Summary for Link 2L (E): Pre-Dev Flow

Inflow Area = 56.190 ac, 2.72% Impervious, Inflow Depth > 0.90" for 2-YEAR event
Inflow = 6.17 cfs @ 8.15 hrs, Volume= 4.198 af
Primary = 6.17 cfs @ 8.15 hrs, Volume= 4.198 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L (E): Pre-Dev Flow

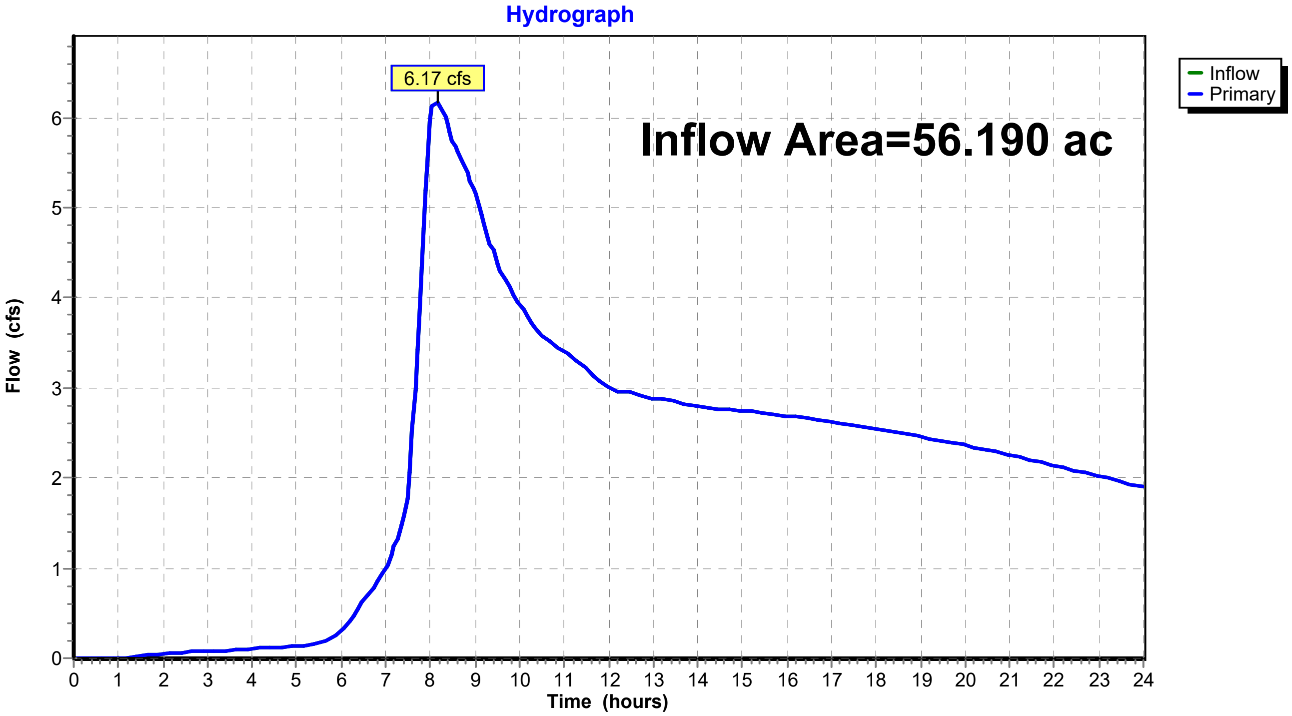


Exhibit A

Pre-Developed 5-yr Storm Event Peak Flow Calculations

Exhibit A

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S (E): Pre-Dev Polley East Runoff Area=9.540 ac 2.10% Impervious Runoff Depth>0.63"
Flow Length=1,075' Tc=15.2 min CN=66/98 Runoff=0.51 cfs 0.504 af

Subcatchment2S (E): Pre-Dev Polley West Runoff Area=0.320 ac 0.00% Impervious Runoff Depth>0.55"
Tc=5.0 min CN=65/0 Runoff=0.01 cfs 0.015 af

Subcatchment3S (E): Pre-Dev Oregon St Runoff Area=0.940 ac 90.43% Impervious Runoff Depth>2.71"
Tc=5.0 min CN=79/98 Runoff=0.64 cfs 0.212 af

Subcatchment4S (E): Pre-Dev Niemeyer Runoff Area=45.390 ac 1.06% Impervious Runoff Depth>1.44"
Flow Length=1,550' Tc=39.4 min CN=82/98 Runoff=9.20 cfs 5.451 af

Link 2L (E): Pre-Dev Flow Inflow=10.16 cfs 6.181 af
Primary=10.16 cfs 6.181 af

Total Runoff Area = 56.190 ac Runoff Volume = 6.181 af Average Runoff Depth = 1.32"
97.28% Pervious = 54.660 ac 2.72% Impervious = 1.530 ac

Exhibit A

Summary for Subcatchment 1S (E): Pre-Dev Polley East

Runoff = 0.51 cfs @ 8.21 hrs, Volume= 0.504 af, Depth> 0.63"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

Area (ac)	CN	Description
8.920	65	Woods/grass comb., Fair, HSG B
0.200	98	Paved parking, HSG B
0.420	96	Gravel surface, HSG B
9.540	67	Weighted Average
9.340	66	97.90% Pervious Area
0.200	98	2.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.1000	0.29		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
5.6	750	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.8	225	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
15.2	1,075	Total			

Subcatchment 1S (E): Pre-Dev Polley East

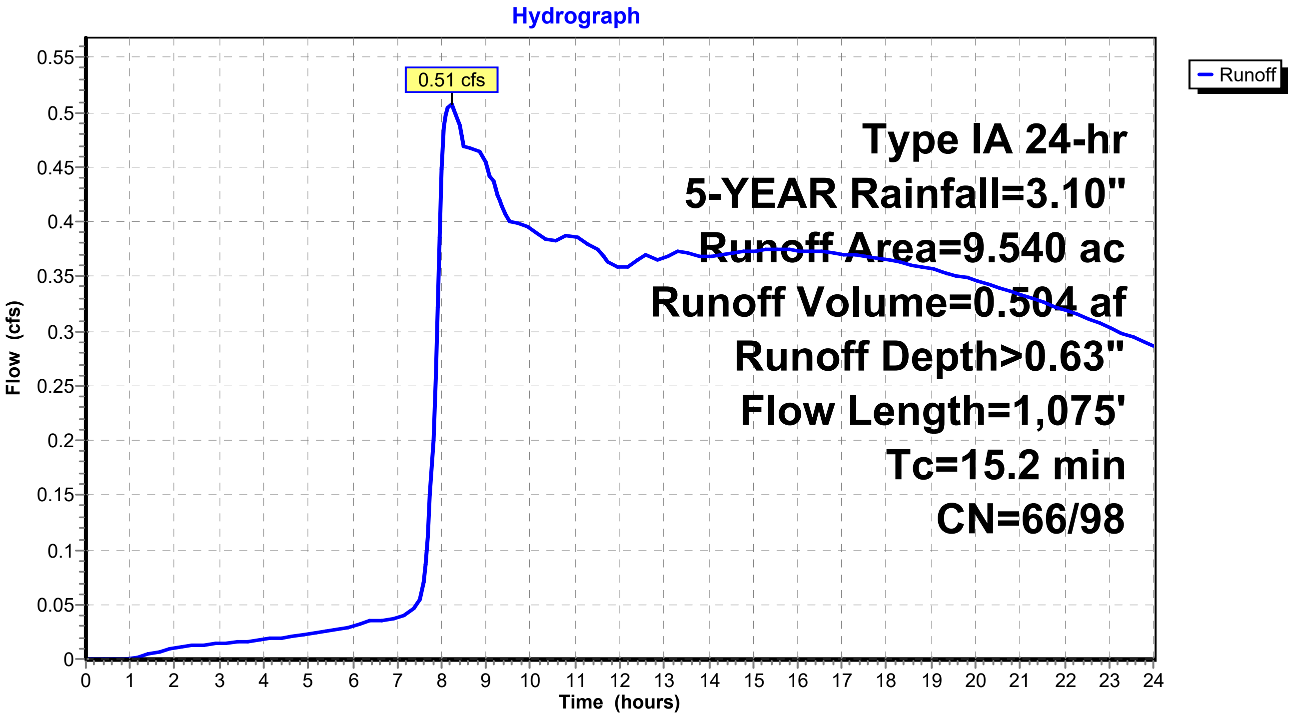


Exhibit A

Summary for Subcatchment 2S (E): Pre-Dev Polley West

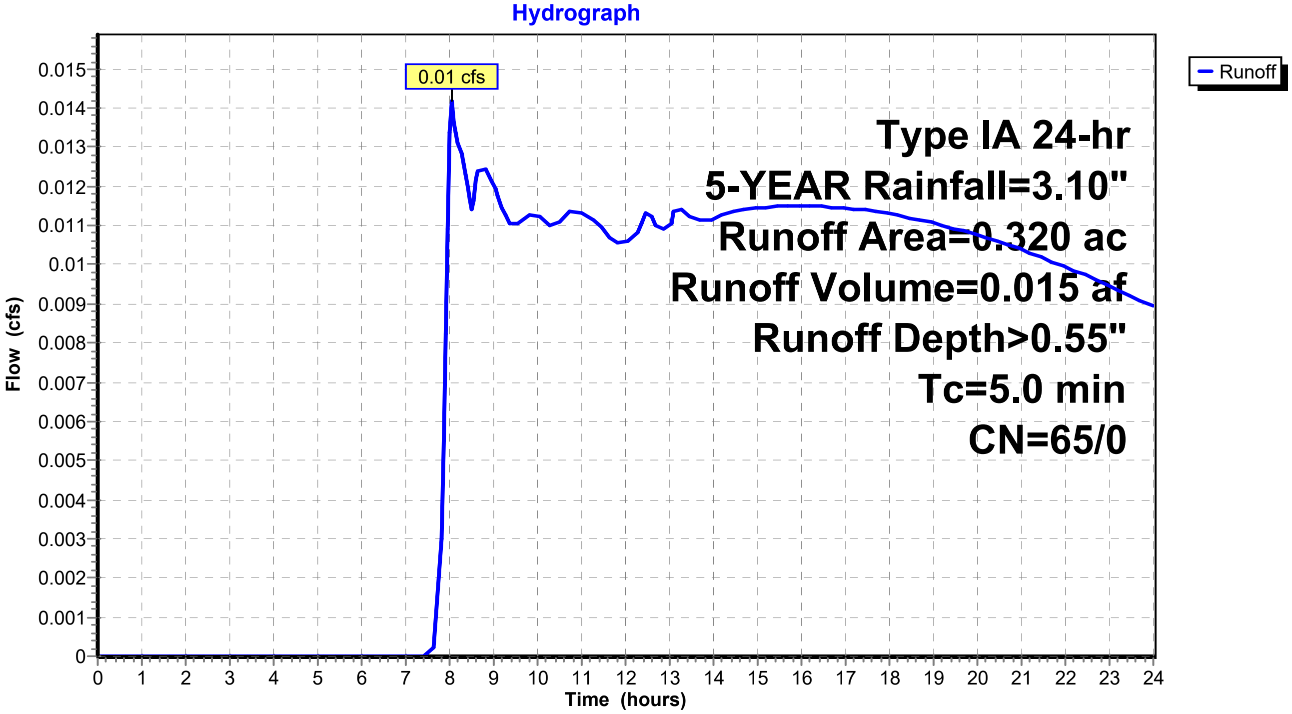
Runoff = 0.01 cfs @ 8.06 hrs, Volume= 0.015 af, Depth> 0.55"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

	Area (ac)	CN	Description
*	0.320	65	Woods/grass comb., Fair, HSG B
	0.320	65	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S (E): Pre-Dev Polley West



Summary for Subcatchment 3S (E): Pre-Dev Oregon St

Runoff = 0.64 cfs @ 7.90 hrs, Volume= 0.212 af, Depth> 2.71"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

	Area (ac)	CN	Description
*	0.850	98	Paved Street, HSG B
	0.090	79	<50% Grass cover, Poor, HSG B
	0.940	96	Weighted Average
	0.090	79	9.57% Pervious Area
	0.850	98	90.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S (E): Pre-Dev Oregon St

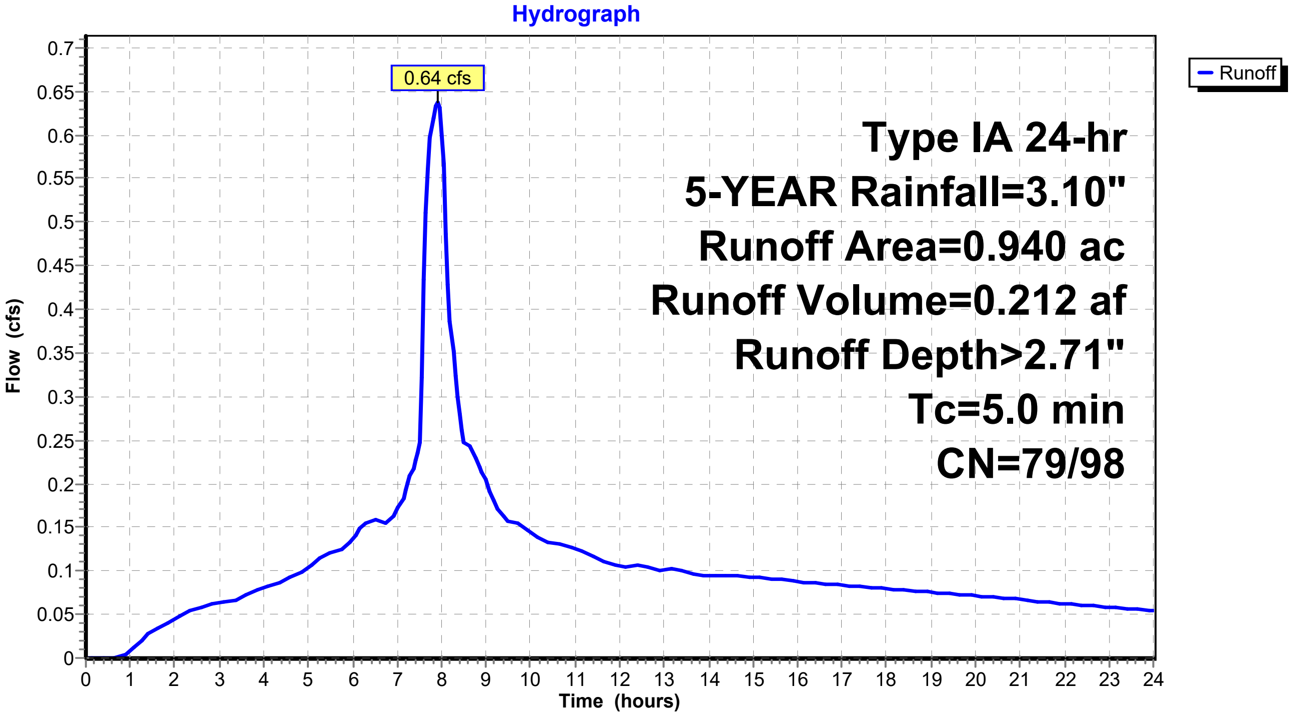


Exhibit A

Summary for Subcatchment 4S (E): Pre-Dev Niemeyer

Runoff = 9.20 cfs @ 8.16 hrs, Volume= 5.451 af, Depth> 1.44"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

Area (ac)	CN	Description
32.480	79	<50% Grass cover, Poor, HSG B
0.480	98	Paved parking, HSG D
12.430	89	<50% Grass cover, Poor, HSG D
45.390	82	Weighted Average
44.910	82	98.94% Pervious Area
0.480	98	1.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
21.4	1,100	0.0150	0.86		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.4	350	0.0600	1.71		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
39.4	1,550	Total			

Subcatchment 4S (E): Pre-Dev Niemeyer

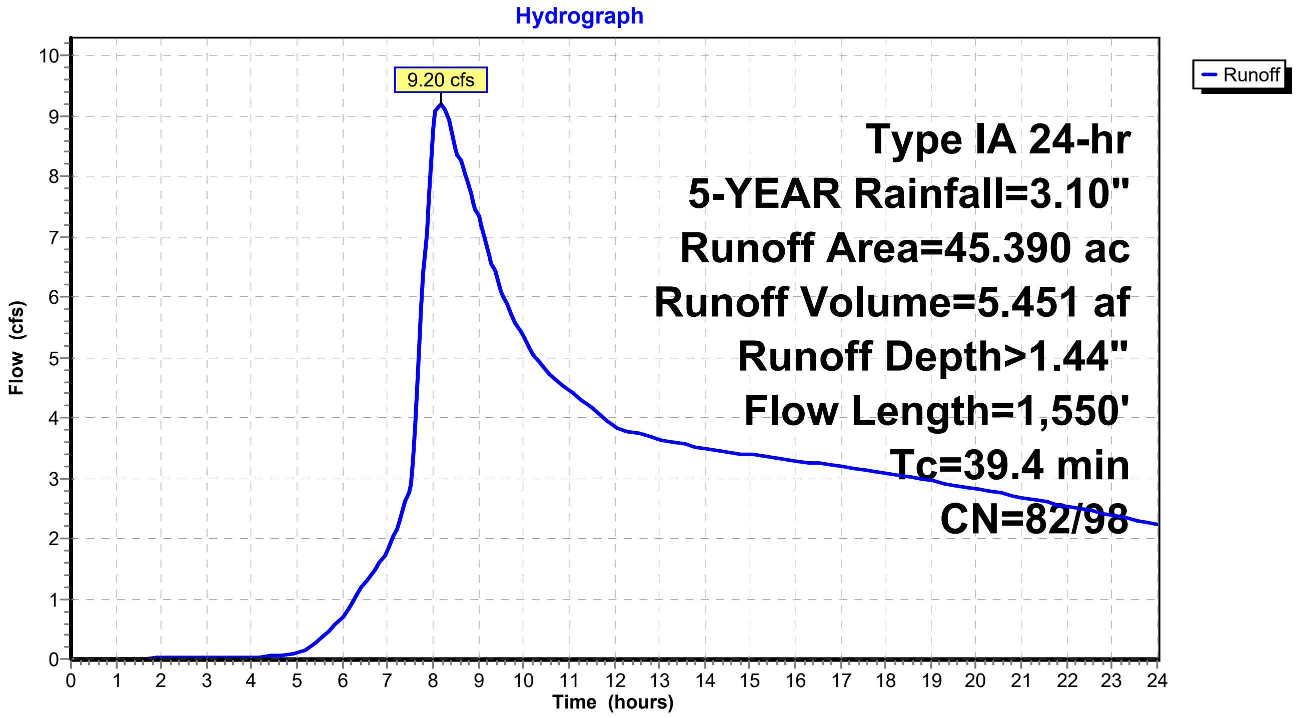


Exhibit A

Summary for Link 2L (E): Pre-Dev Flow

Inflow Area =	56.190 ac,	2.72% Impervious,	Inflow Depth >	1.32"	for 5-YEAR event	
Inflow =	10.16 cfs @	8.10 hrs,	Volume=	6.181 af		
Primary =	10.16 cfs @	8.10 hrs,	Volume=	6.181 af,	Atten= 0%,	Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L (E): Pre-Dev Flow

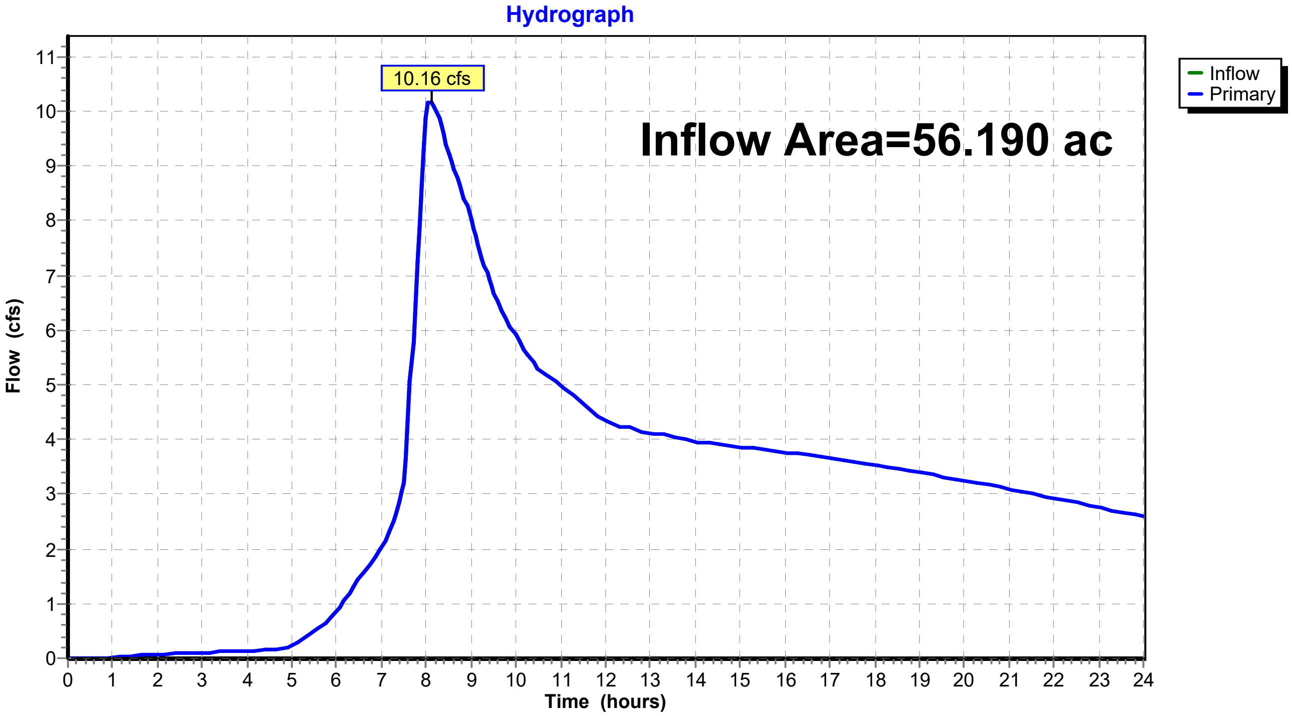


Exhibit A

Pre-Developed 10-yr Storm Event Peak Flow Calculations

Exhibit A

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S (E): Pre-Dev Polley East Runoff Area=9.540 ac 2.10% Impervious Runoff Depth>0.82"
Flow Length=1,075' Tc=15.2 min CN=66/98 Runoff=0.83 cfs 0.648 af

Subcatchment2S (E): Pre-Dev Polley West Runoff Area=0.320 ac 0.00% Impervious Runoff Depth>0.72"
Tc=5.0 min CN=65/0 Runoff=0.03 cfs 0.019 af

Subcatchment3S (E): Pre-Dev Oregon St Runoff Area=0.940 ac 90.43% Impervious Runoff Depth>3.05"
Tc=5.0 min CN=79/98 Runoff=0.72 cfs 0.239 af

Subcatchment4S (E): Pre-Dev Niemeyer Runoff Area=45.390 ac 1.06% Impervious Runoff Depth>1.72"
Flow Length=1,550' Tc=39.4 min CN=82/98 Runoff=11.38 cfs 6.507 af

Link 2L (E): Pre-Dev Flow Inflow=12.81 cfs 7.413 af
Primary=12.81 cfs 7.413 af

Total Runoff Area = 56.190 ac Runoff Volume = 7.413 af Average Runoff Depth = 1.58"
97.28% Pervious = 54.660 ac 2.72% Impervious = 1.530 ac

Exhibit A

Summary for Subcatchment 1S (E): Pre-Dev Polley East

Runoff = 0.83 cfs @ 8.08 hrs, Volume= 0.648 af, Depth> 0.82"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

Area (ac)	CN	Description
8.920	65	Woods/grass comb., Fair, HSG B
0.200	98	Paved parking, HSG B
0.420	96	Gravel surface, HSG B
9.540	67	Weighted Average
9.340	66	97.90% Pervious Area
0.200	98	2.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.1000	0.29		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
5.6	750	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.8	225	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
15.2	1,075	Total			

Subcatchment 1S (E): Pre-Dev Polley East

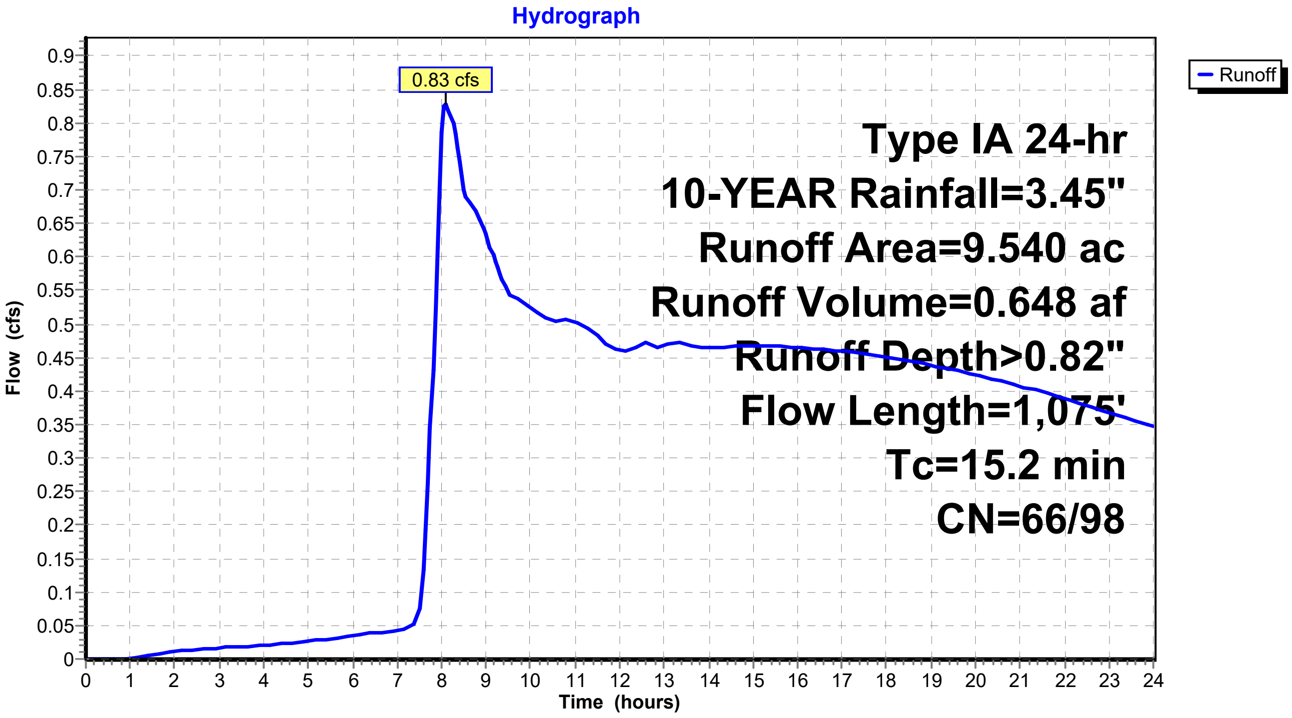


Exhibit A

Summary for Subcatchment 2S (E): Pre-Dev Polley West

Runoff = 0.03 cfs @ 8.02 hrs, Volume= 0.019 af, Depth> 0.72"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

	Area (ac)	CN	Description
*	0.320	65	Woods/grass comb., Fair, HSG B
	0.320	65	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S (E): Pre-Dev Polley West

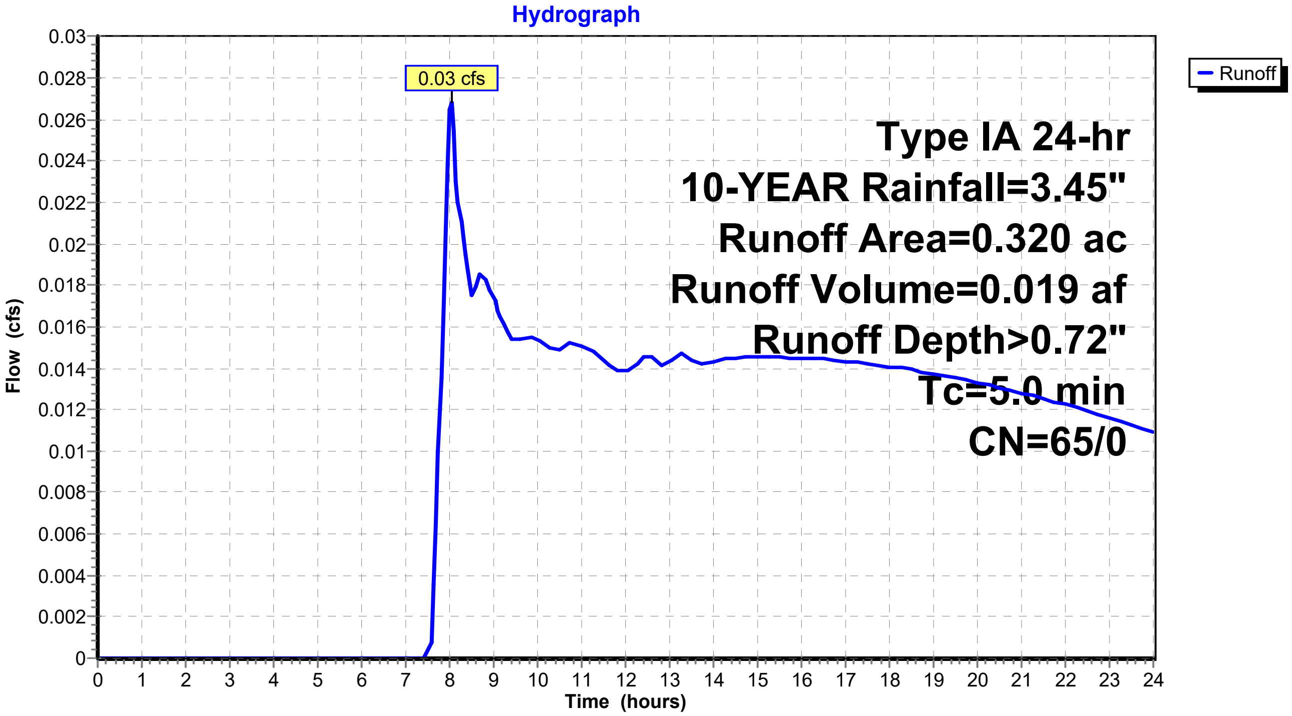


Exhibit A

Summary for Subcatchment 3S (E): Pre-Dev Oregon St

Runoff = 0.72 cfs @ 7.90 hrs, Volume= 0.239 af, Depth> 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

	Area (ac)	CN	Description
*	0.850	98	Paved Street, HSG B
	0.090	79	<50% Grass cover, Poor, HSG B
	0.940	96	Weighted Average
	0.090	79	9.57% Pervious Area
	0.850	98	90.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S (E): Pre-Dev Oregon St

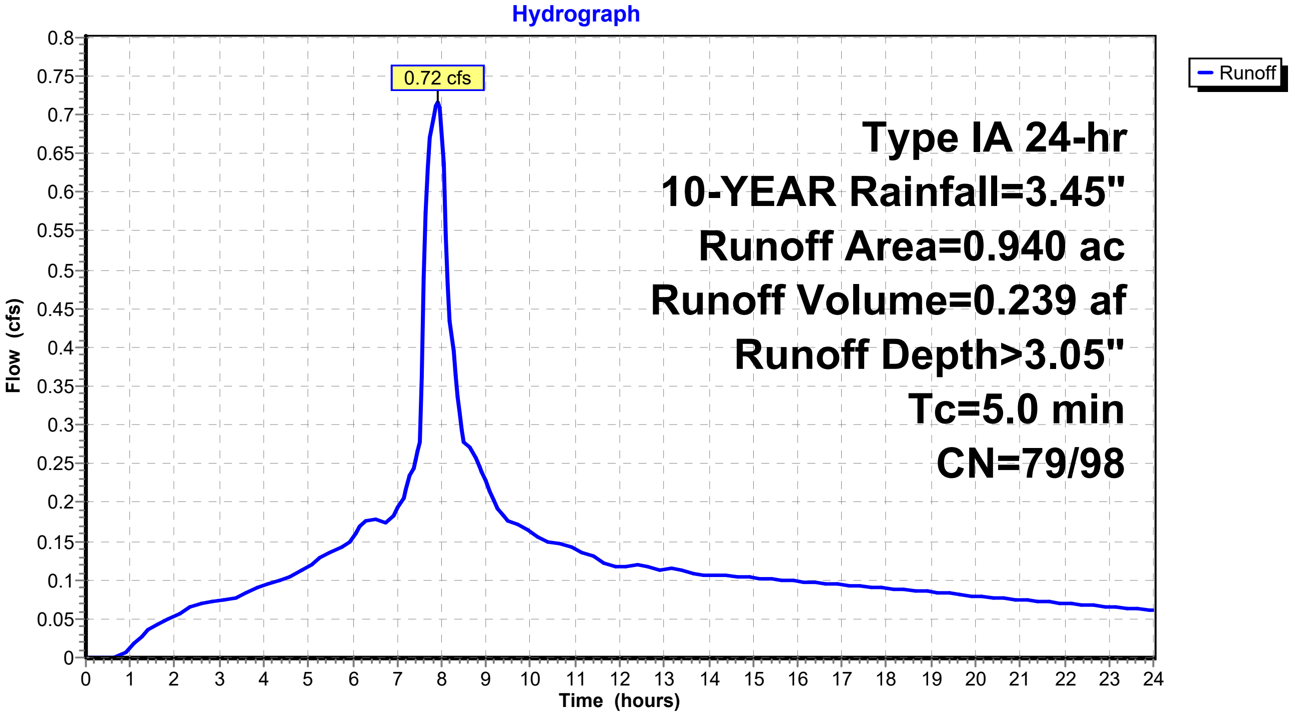


Exhibit A

Summary for Subcatchment 4S (E): Pre-Dev Niemeyer

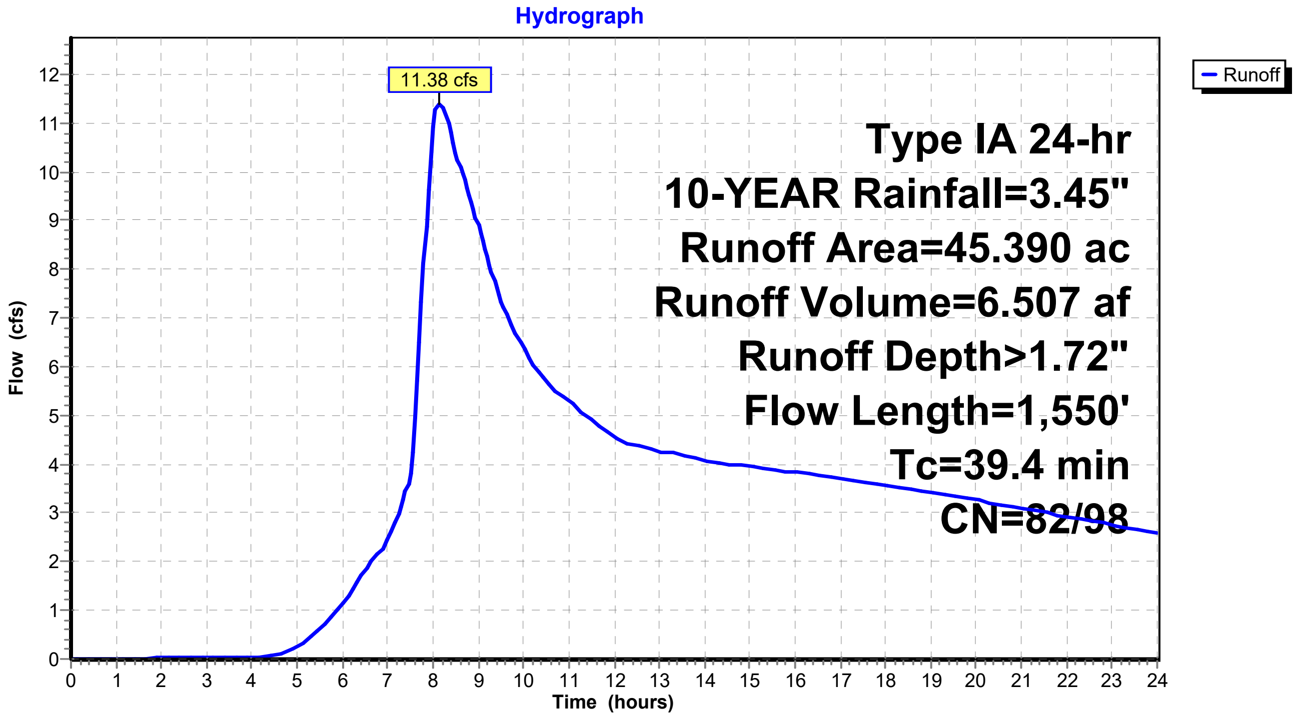
Runoff = 11.38 cfs @ 8.14 hrs, Volume= 6.507 af, Depth> 1.72"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

Area (ac)	CN	Description
32.480	79	<50% Grass cover, Poor, HSG B
0.480	98	Paved parking, HSG D
12.430	89	<50% Grass cover, Poor, HSG D
45.390	82	Weighted Average
44.910	82	98.94% Pervious Area
0.480	98	1.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
21.4	1,100	0.0150	0.86		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.4	350	0.0600	1.71		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
39.4	1,550	Total			

Subcatchment 4S (E): Pre-Dev Niemeyer



Summary for Link 2L (E): Pre-Dev Flow

Inflow Area = 56.190 ac, 2.72% Impervious, Inflow Depth > 1.58" for 10-YEAR event
Inflow = 12.81 cfs @ 8.07 hrs, Volume= 7.413 af
Primary = 12.81 cfs @ 8.07 hrs, Volume= 7.413 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

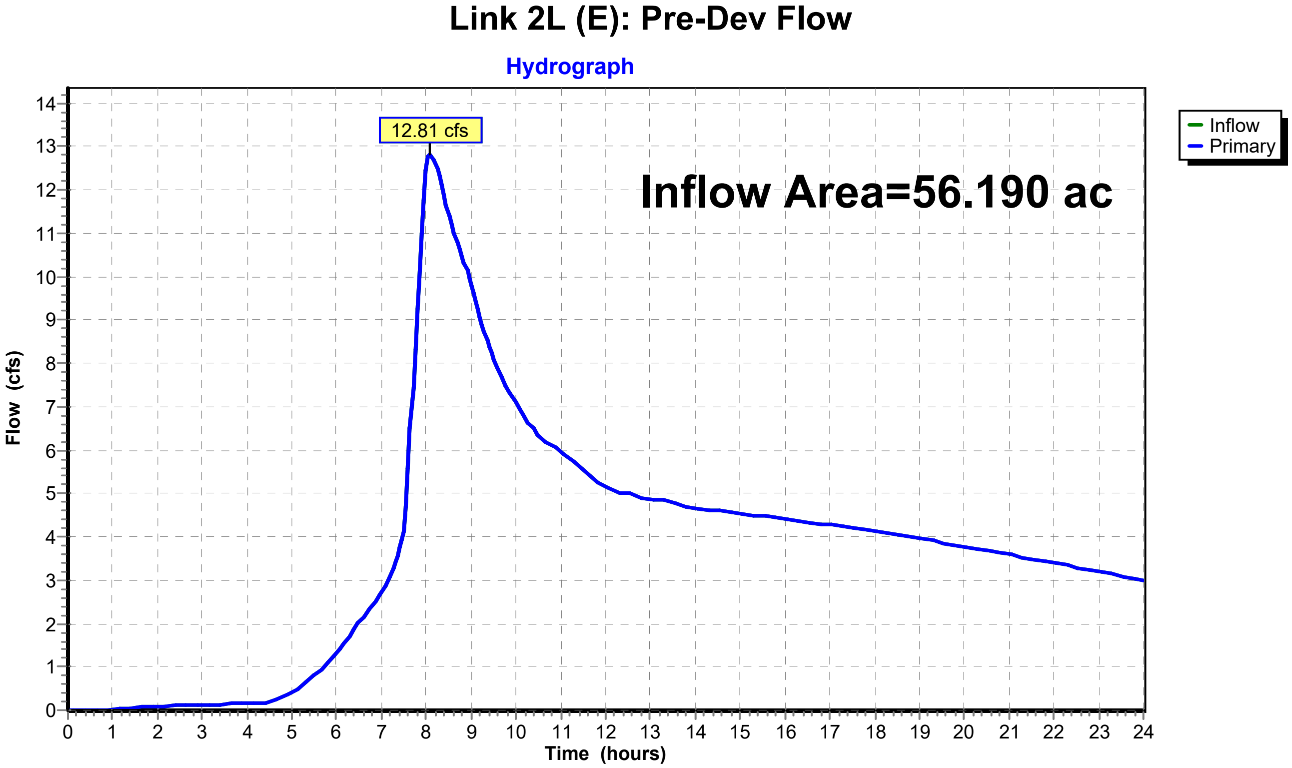


Exhibit A

```
                Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
                  Runoff by SBUH method, Split Pervious/Imperv.
       Reach routing by Dyn-Stor-Ind method  -  Pond routing by Dyn-Stor-Ind method

Subcatchment1S (E): Pre-Dev Polley East    Runoff Area=9.540 ac   2.10% Impervious   Runoff Depth>1.07"
                              Flow Length=1,075'   Tc=15.2 min   CN=66/98   Runoff=1.34 cfs  0.851 af

Subcatchment2S (E): Pre-Dev Polley West    Runoff Area=0.320 ac   0.00% Impervious   Runoff Depth>0.97"
                                                  Tc=5.0 min   CN=65/0   Runoff=0.05 cfs  0.026 af

Subcatchment3S (E): Pre-Dev Oregon St     Runoff Area=0.940 ac   90.43% Impervious   Runoff Depth>3.49"
                                                 Tc=5.0 min   CN=79/98   Runoff=0.82 cfs  0.273 af

Subcatchment4S (E): Pre-Dev Niemeyer      Runoff Area=45.390 ac   1.06% Impervious   Runoff Depth>2.09"
                             Flow Length=1,550'   Tc=39.4 min   CN=82/98   Runoff=14.32 cfs  7.910 af

Link 2L (E): Pre-Dev Flow                                                Inflow=16.37 cfs  9.060 af
                                                                        Primary=16.37 cfs  9.060 af

        Total Runoff Area = 56.190 ac   Runoff Volume = 9.060 af   Average Runoff Depth = 1.93"
                                 97.28% Pervious = 54.660 ac     2.72% Impervious = 1.530 ac
```

Exhibit A

Summary for Subcatchment 1S (E): Pre-Dev Polley East

Runoff = 1.34 cfs @ 8.06 hrs, Volume= 0.851 af, Depth> 1.07"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

Area (ac)	CN	Description
8.920	65	Woods/grass comb., Fair, HSG B
0.200	98	Paved parking, HSG B
0.420	96	Gravel surface, HSG B
9.540	67	Weighted Average
9.340	66	97.90% Pervious Area
0.200	98	2.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.1000	0.29		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
5.6	750	0.1000	2.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.8	225	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
15.2	1,075	Total			

Subcatchment 1S (E): Pre-Dev Polley East

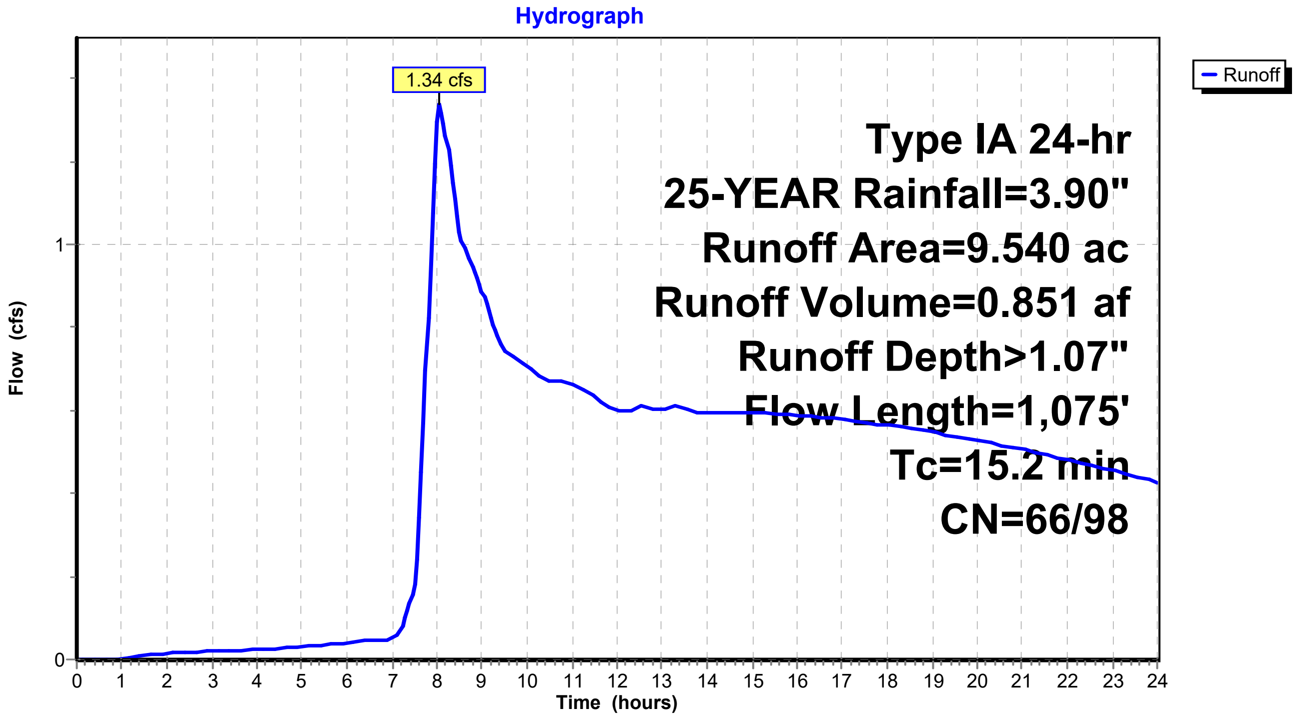


Exhibit A

Summary for Subcatchment 2S (E): Pre-Dev Polley West

Runoff = 0.05 cfs @ 8.01 hrs, Volume= 0.026 af, Depth> 0.97"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

	Area (ac)	CN	Description
*	0.320	65	Woods/grass comb., Fair, HSG B
	0.320	65	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S (E): Pre-Dev Polley West

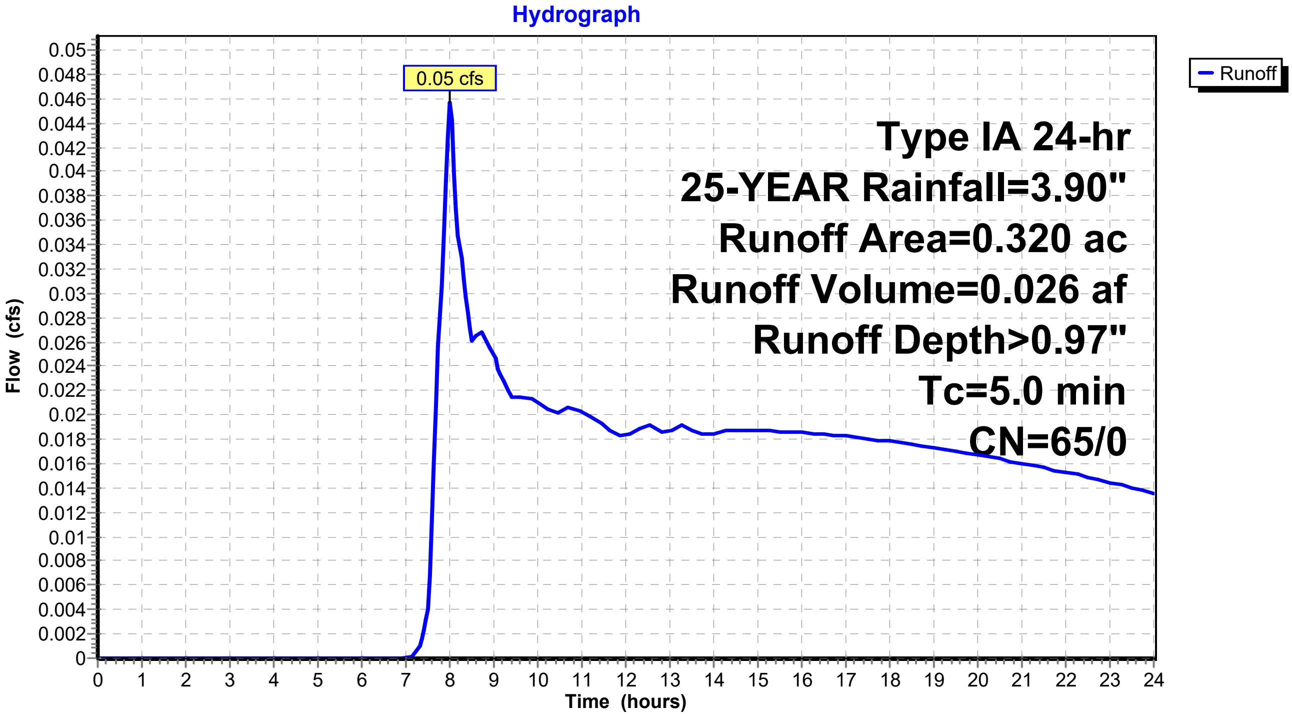


Exhibit A

Summary for Subcatchment 3S (E): Pre-Dev Oregon St

Runoff = 0.82 cfs @ 7.90 hrs, Volume= 0.273 af, Depth> 3.49"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

	Area (ac)	CN	Description
*	0.850	98	Paved Street, HSG B
	0.090	79	<50% Grass cover, Poor, HSG B
	0.940	96	Weighted Average
	0.090	79	9.57% Pervious Area
	0.850	98	90.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S (E): Pre-Dev Oregon St

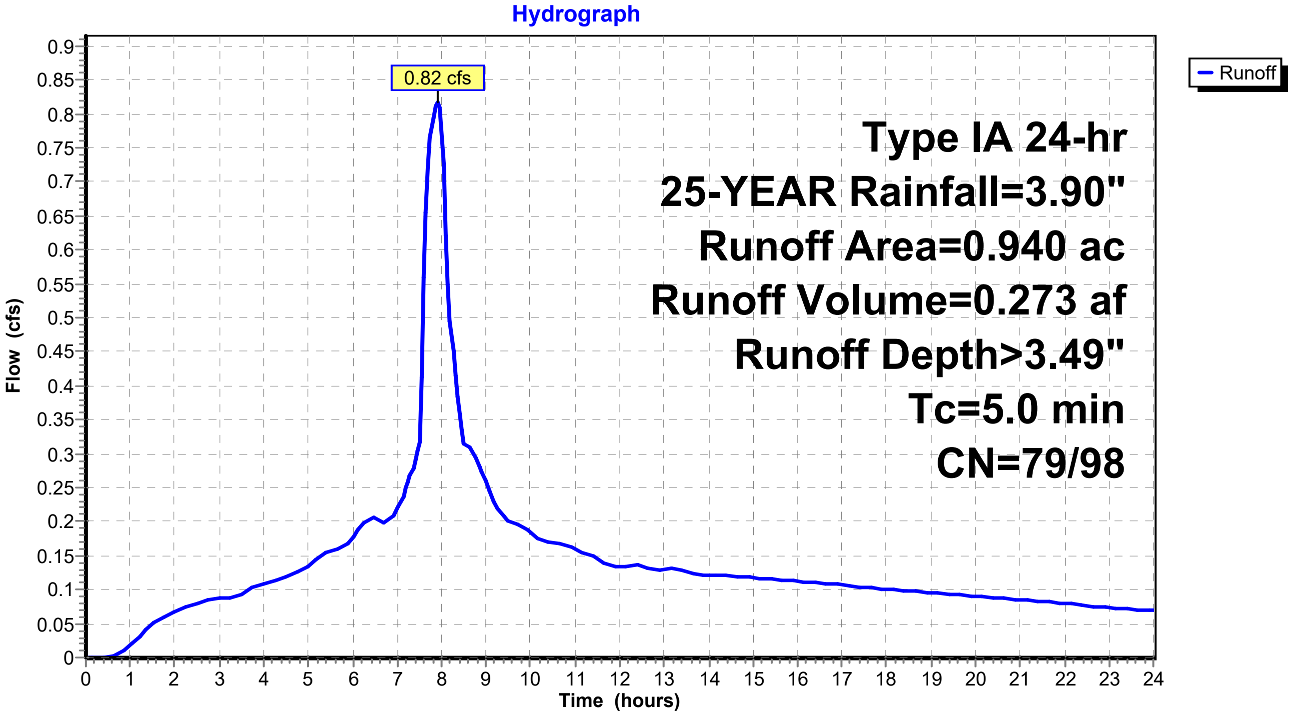


Exhibit A

Summary for Subcatchment 4S (E): Pre-Dev Niemeyer

Runoff = 14.32 cfs @ 8.13 hrs, Volume= 7.910 af, Depth> 2.09"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

Area (ac)	CN	Description
32.480	79	<50% Grass cover, Poor, HSG B
0.480	98	Paved parking, HSG D
12.430	89	<50% Grass cover, Poor, HSG D
45.390	82	Weighted Average
44.910	82	98.94% Pervious Area
0.480	98	1.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
21.4	1,100	0.0150	0.86		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.4	350	0.0600	1.71		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
39.4	1,550	Total			

Subcatchment 4S (E): Pre-Dev Niemeyer

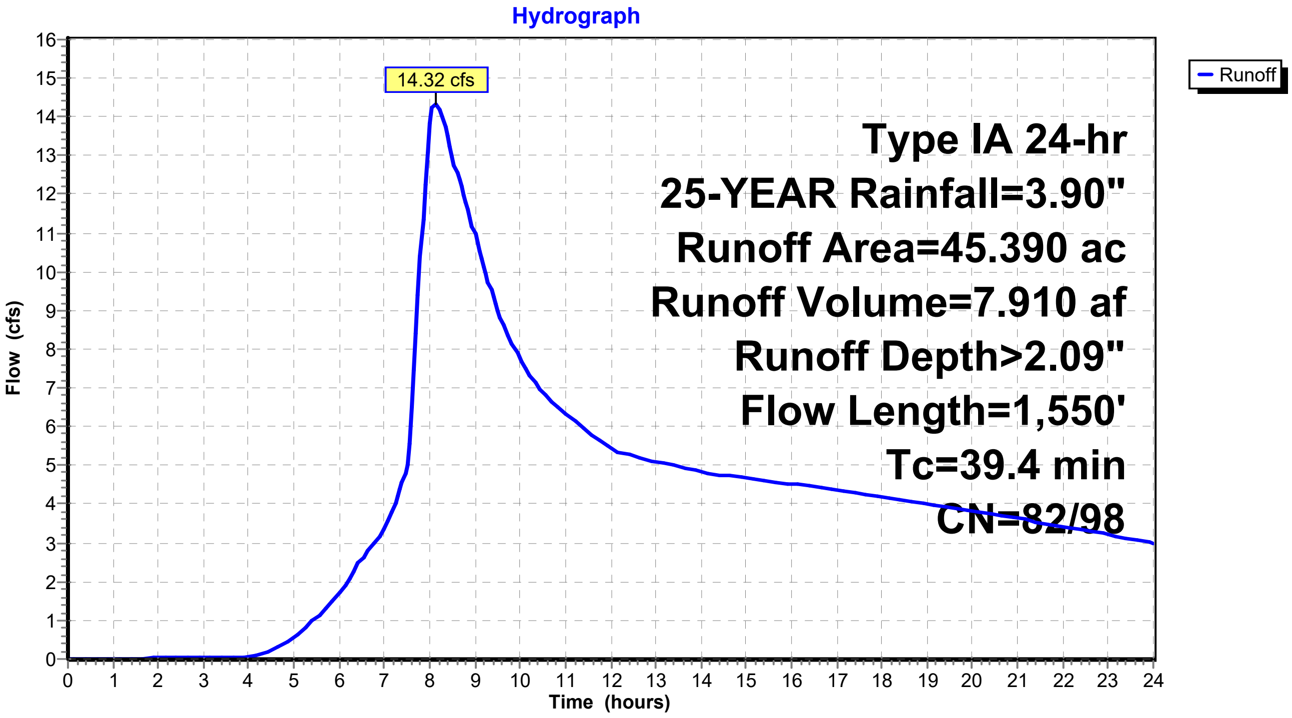


Exhibit A

Summary for Link 2L (E): Pre-Dev Flow

Inflow Area = 56.190 ac, 2.72% Impervious, Inflow Depth > 1.93" for 25-YEAR event
Inflow = 16.37 cfs @ 8.07 hrs, Volume= 9.060 af
Primary = 16.37 cfs @ 8.07 hrs, Volume= 9.060 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L (E): Pre-Dev Flow

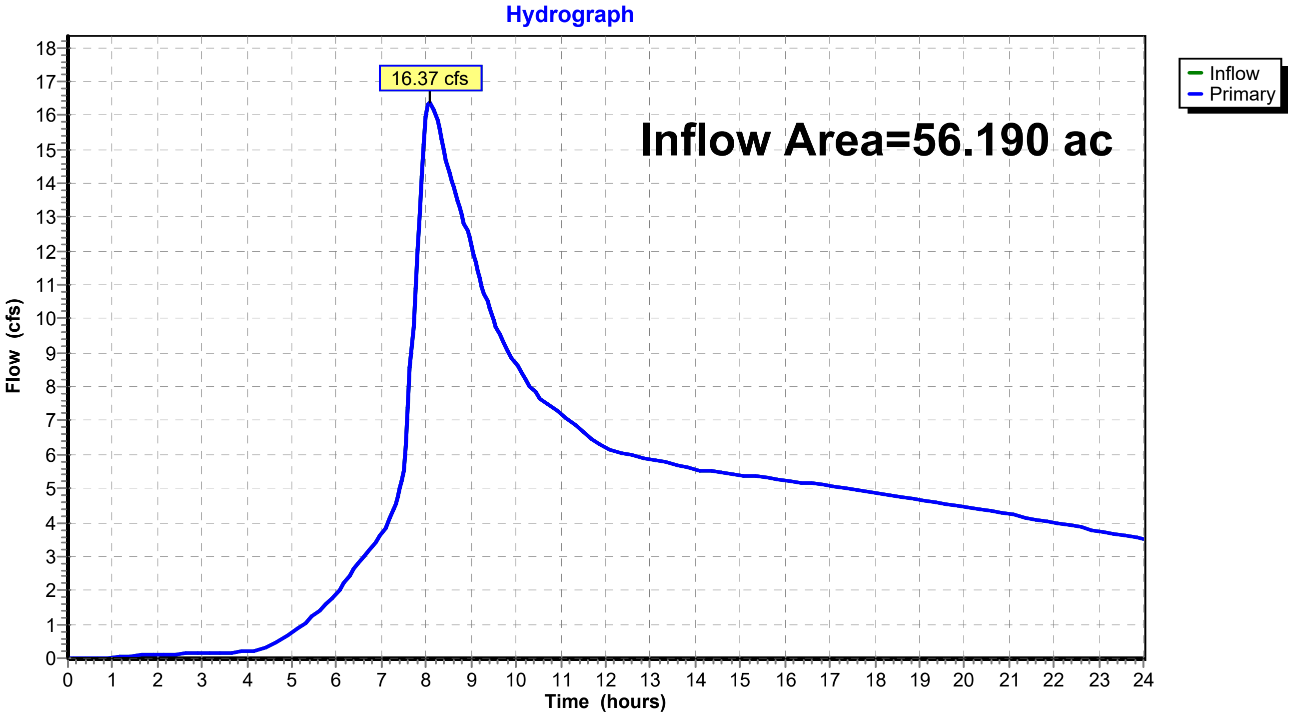
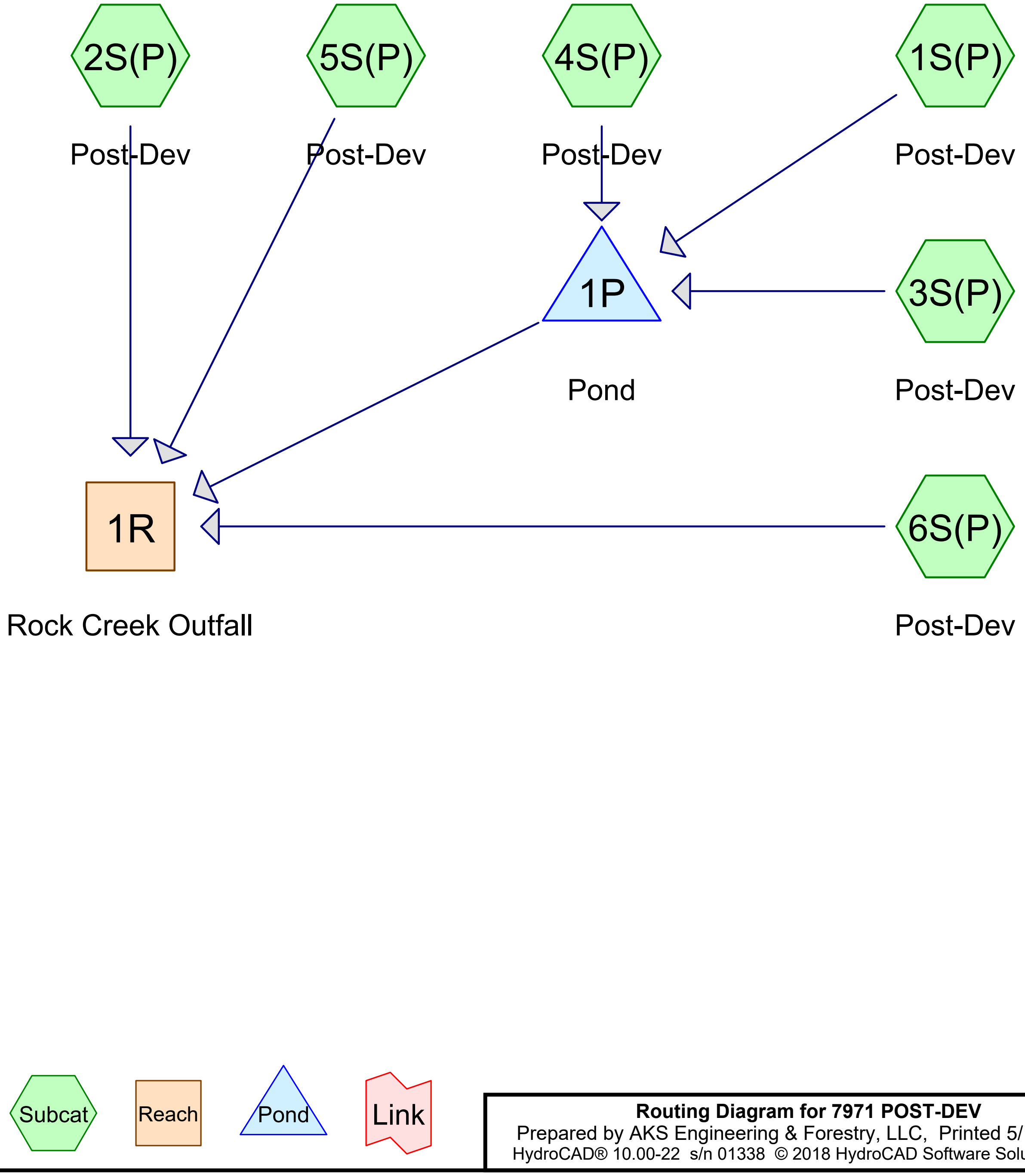


Exhibit A

Post-Developed Node Diagram and Area Summary Table

Exhibit A



Routing Diagram for 7971 POST-DEV
Prepared by AKS Engineering & Forestry, LLC, Printed 5/12/2022
HydroCAD® 10.00-22 s/n 01338 © 2018 HydroCAD Software Solutions LLC

Exhibit A

Post-Developed 2-yr Storm Event Peak Flow Calculations

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S(P): Post-Dev Runoff Area=6.570 ac 83.56% Impervious Runoff Depth>2.03"
Tc=5.0 min CN=79/98 Runoff=3.33 cfs 1.112 af

Subcatchment2S(P): Post-Dev Runoff Area=0.830 ac 100.00% Impervious Runoff Depth>2.27"
Tc=5.0 min CN=0/98 Runoff=0.48 cfs 0.157 af

Subcatchment3S(P): Post-Dev Runoff Area=1.550 ac 85.81% Impervious Runoff Depth>2.06"
Tc=5.0 min CN=79/98 Runoff=0.80 cfs 0.267 af

Subcatchment4S(P): Post-Dev Runoff Area=0.550 ac 100.00% Impervious Runoff Depth>2.27"
Tc=5.0 min CN=0/98 Runoff=0.32 cfs 0.104 af

Subcatchment5S(P): Post-Dev Runoff Area=1.340 ac 20.15% Impervious Runoff Depth>1.12"
Tc=5.0 min CN=79/98 Runoff=0.33 cfs 0.125 af

Subcatchment6S(P): Post-Dev Runoff Area=45.390 ac 1.06% Impervious Runoff Depth>0.99"
Flow Length=1,550' Tc=39.4 min CN=82/98 Runoff=5.73 cfs 3.736 af

Reach 1R: Rock Creek Outfall Inflow=6.39 cfs 4.166 af
Outflow=6.39 cfs 4.166 af

Pond 1P: Pond Peak Elev=135.59' Storage=58,108 cf Inflow=4.44 cfs 1.483 af
Outflow=0.10 cfs 0.148 af

Total Runoff Area = 56.230 ac Runoff Volume = 5.501 af Average Runoff Depth = 1.17"
84.08% Pervious = 47.280 ac 15.92% Impervious = 8.950 ac

Exhibit A

Summary for Subcatchment 1S(P): Post-Dev

Runoff = 3.33 cfs @ 7.91 hrs, Volume= 1.112 af, Depth> 2.03"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

	Area (ac)	CN	Description
*	5.490	98	Paved parking, roofs, HSG B
	1.080	79	<50% Grass cover, Poor, HSG B
	6.570	95	Weighted Average
	1.080	79	16.44% Pervious Area
	5.490	98	83.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S(P): Post-Dev

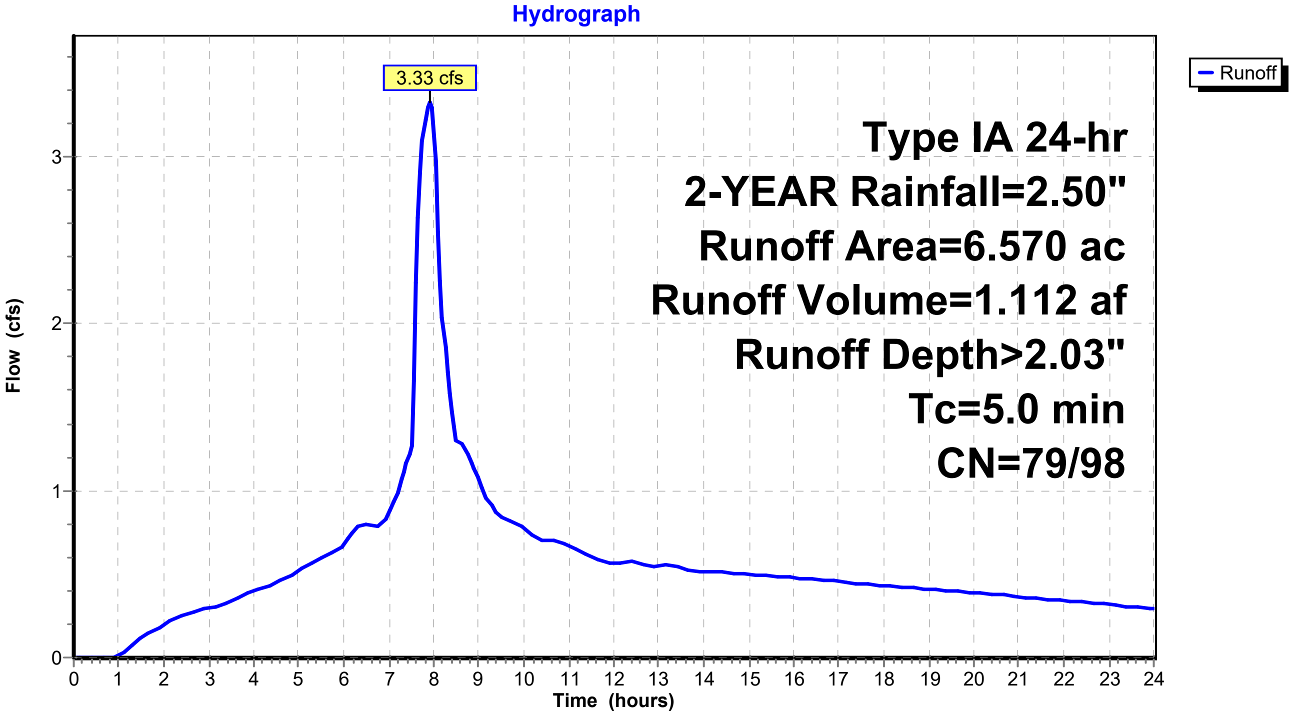


Exhibit A

Summary for Subcatchment 2S(P): Post-Dev

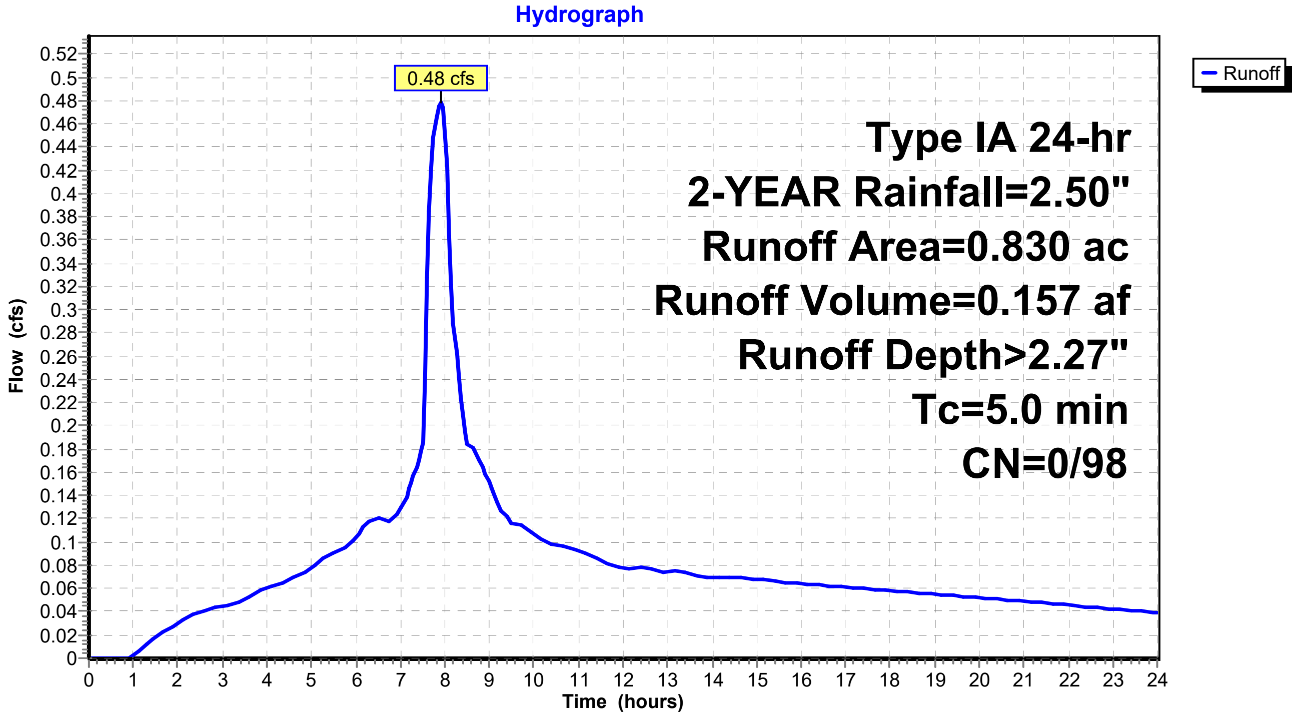
Runoff = 0.48 cfs @ 7.90 hrs, Volume= 0.157 af, Depth> 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

Area (ac)	CN	Description
0.830	98	Paved roads w/curbs & sewers, HSG D
0.830	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S(P): Post-Dev



Summary for Subcatchment 3S(P): Post-Dev

Runoff = 0.80 cfs @ 7.91 hrs, Volume= 0.267 af, Depth> 2.06"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

	Area (ac)	CN	Description
*	1.330	98	Paved parking, roofs, HSG B
	0.220	79	<50% Grass cover, Poor, HSG B
	1.550	95	Weighted Average
	0.220	79	14.19% Pervious Area
	1.330	98	85.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S(P): Post-Dev

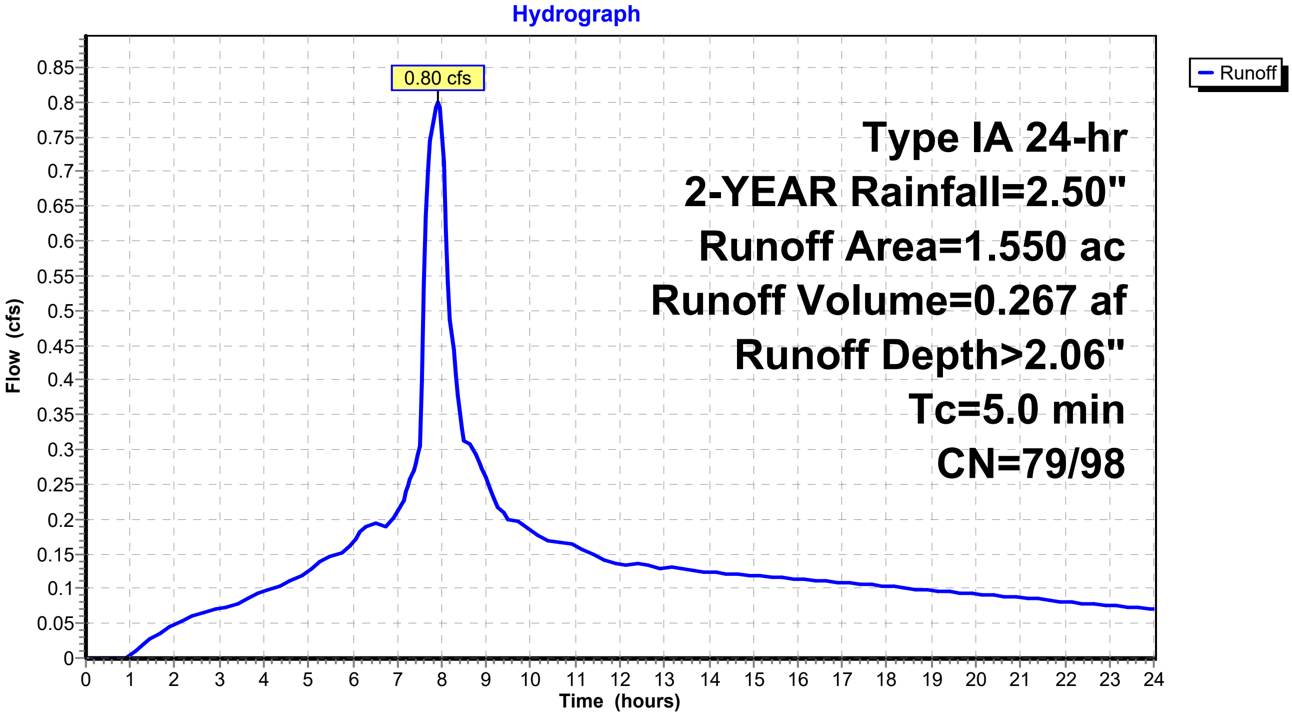


Exhibit A

Summary for Subcatchment 4S(P): Post-Dev

Runoff = 0.32 cfs @ 7.90 hrs, Volume= 0.104 af, Depth> 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

Area (ac)	CN	Description
0.550	98	Water Surface, HSG B
0.550	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S(P): Post-Dev

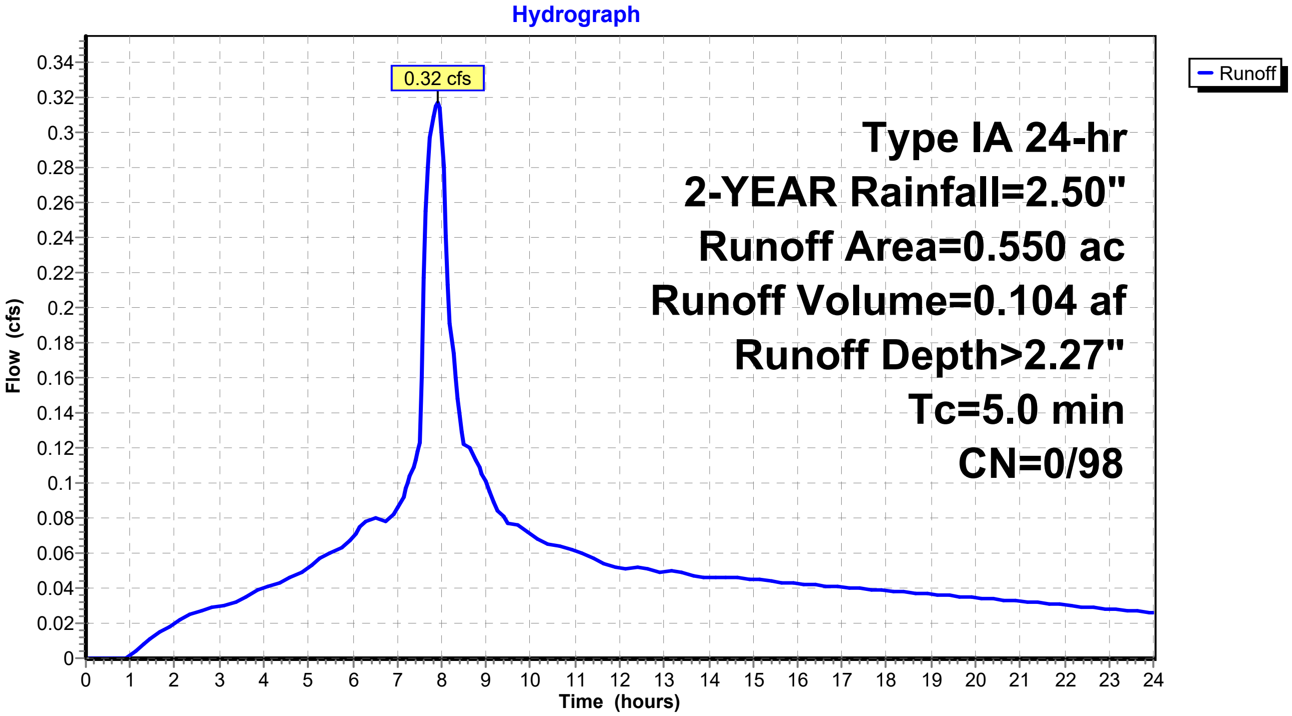


Exhibit A

Summary for Subcatchment 5S(P): Post-Dev

Runoff = 0.33 cfs @ 7.98 hrs, Volume= 0.125 af, Depth> 1.12"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

Area (ac)	CN	Description
0.270	98	Paved parking, HSG B
1.070	79	<50% Grass cover, Poor, HSG B
1.340	83	Weighted Average
1.070	79	79.85% Pervious Area
0.270	98	20.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S(P): Post-Dev

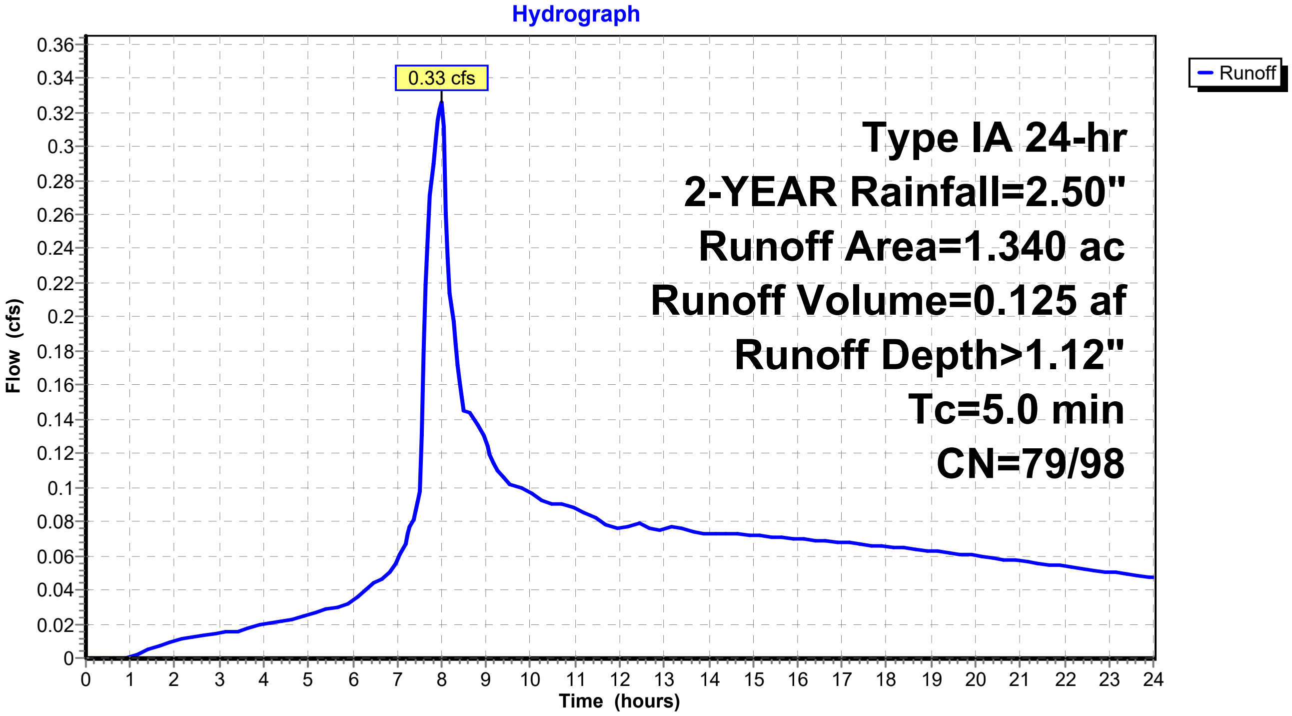


Exhibit A

Summary for Subcatchment 6S(P): Post-Dev

Runoff = 5.73 cfs @ 8.21 hrs, Volume= 3.736 af, Depth> 0.99"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-YEAR Rainfall=2.50"

Area (ac)	CN	Description
32.480	79	<50% Grass cover, Poor, HSG B
0.480	98	Paved parking, HSG D
12.430	89	<50% Grass cover, Poor, HSG D
45.390	82	Weighted Average
44.910	82	98.94% Pervious Area
0.480	98	1.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
21.4	1,100	0.0150	0.86		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.4	350	0.0600	1.71		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
39.4	1,550	Total			

Subcatchment 6S(P): Post-Dev

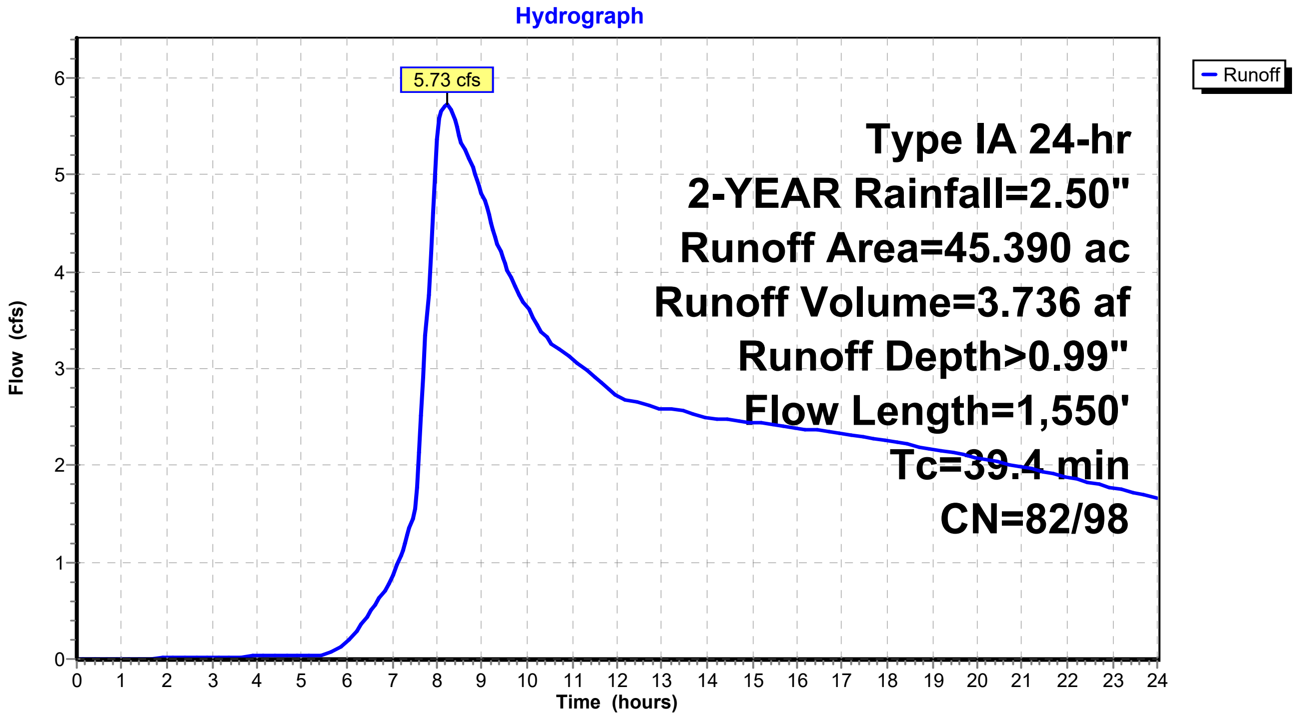


Exhibit A

Summary for Reach 1R: Rock Creek Outfall

Inflow Area = 56.230 ac, 15.92% Impervious, Inflow Depth > 0.89" for 2-YEAR event
Inflow = 6.39 cfs @ 8.07 hrs, Volume= 4.166 af
Outflow = 6.39 cfs @ 8.07 hrs, Volume= 4.166 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2

Reach 1R: Rock Creek Outfall

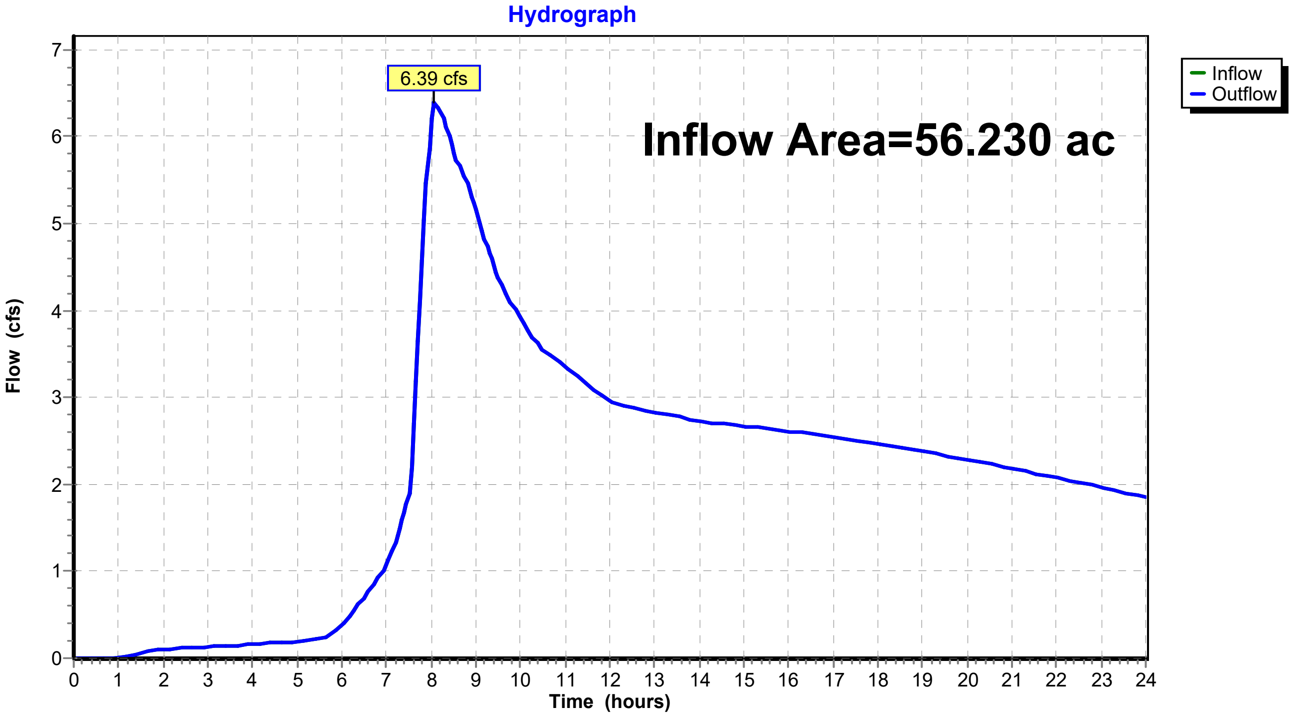


Exhibit A

Summary for Pond 1P: Pond

Inflow Area = 8.670 ac, 85.01% Impervious, Inflow Depth > 2.05" for 2-YEAR event
Inflow = 4.44 cfs @ 7.91 hrs, Volume= 1.483 af
Outflow = 0.10 cfs @ 24.00 hrs, Volume= 0.148 af, Atten= 98%, Lag= 965.4 min
Primary = 0.10 cfs @ 24.00 hrs, Volume= 0.148 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 135.59' @ 24.00 hrs Surf.Area= 19,033 sf Storage= 58,108 cf

Plug-Flow detention time= 621.0 min calculated for 0.148 af (10% of inflow)
Center-of-Mass det. time= 161.2 min (845.0 - 683.8)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	111,009 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	13,337	0	0
133.00	14,863	14,100	14,100
134.00	16,432	15,648	29,748
135.00	18,051	17,242	46,989
136.00	19,718	18,885	65,874
137.00	23,200	21,459	87,333
138.00	24,152	23,676	111,009

Device	Routing	Invert	Outlet Devices
#1	Primary	131.00'	**18.0" Vert. 18" Pond Outlet** C= 0.620
#2	Device 1	136.70'	**4.2" Horiz. 5-year Orifice** C= 0.620 Limited to weir flow at low heads
#3	Device 1	137.25'	**6.0" Horiz. 10/25-year Orifice** C= 0.620 Limited to weir flow at low heads
#4	Device 1	131.00'	**1.3" Horiz. WQ Orifice** C= 0.620 Limited to weir flow at low heads
#5	Device 4	132.00'	**27.0" x 24.0" Horiz. WQ Inlet (Bottom)** C= 0.600 Limited to weir flow at low heads
#6	Device 1	137.99'	**27.0" x 24.0" Horiz. Overflow Inlet (Top)** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.10 cfs @ 24.00 hrs HW=135.59' TW=0.00' (Dynamic Tailwater)
- **1=18" Pond Outlet** (Passes 0.10 cfs of 17.23 cfs potential flow)
  - **2=5-year Orifice** (Controls 0.00 cfs)
  - **3=10/25-year Orifice** (Controls 0.00 cfs)
  - **4=WQ Orifice** (Orifice Controls 0.10 cfs @ 10.66 fps)
    - **5=WQ Inlet (Bottom)** (Passes 0.10 cfs of 41.05 cfs potential flow)
  - **6=Overflow Inlet (Top)** (Controls 0.00 cfs)

Exhibit A

Pond 1P: Pond

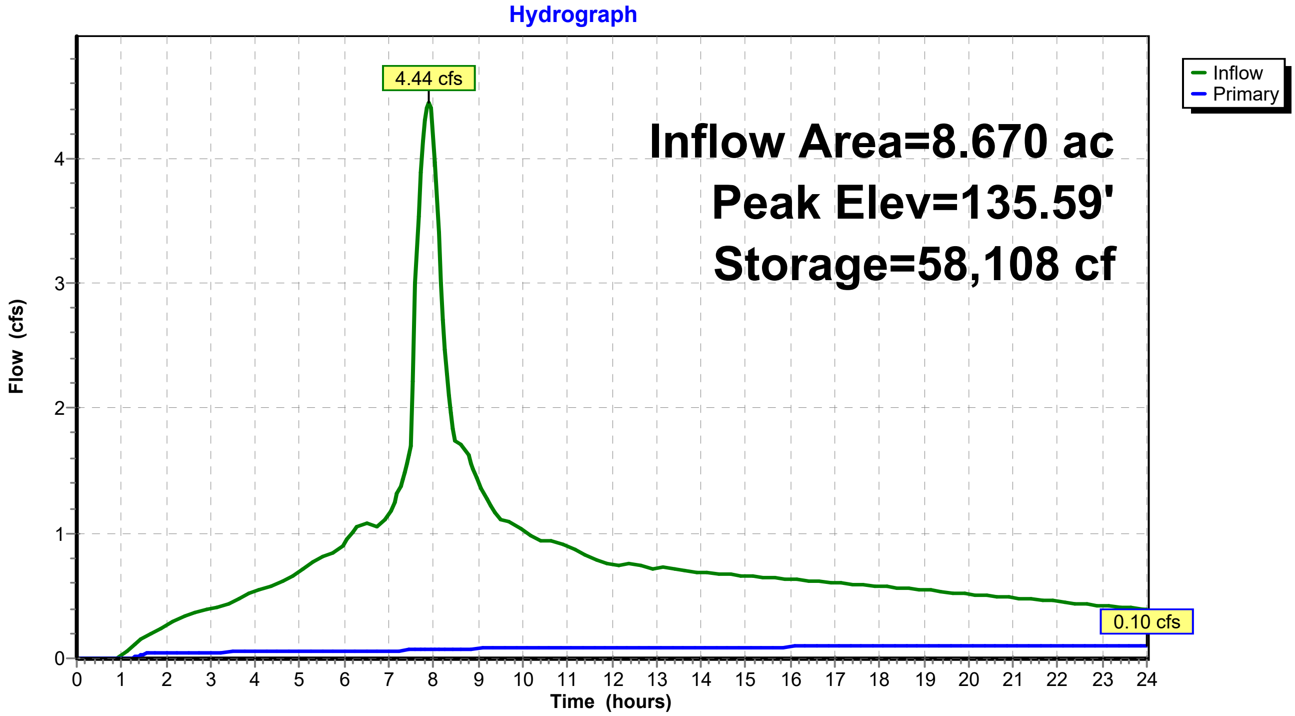


Exhibit A

Post-Developed 5-yr Storm Event Peak Flow Calculations

Exhibit A

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S(P): Post-Dev Runoff Area=6.570 ac 83.56% Impervious Runoff Depth>2.60"
Tc=5.0 min CN=79/98 Runoff=4.25 cfs 1.423 af

Subcatchment2S(P): Post-Dev Runoff Area=0.830 ac 100.00% Impervious Runoff Depth>2.86"
Tc=5.0 min CN=0/98 Runoff=0.60 cfs 0.198 af

Subcatchment3S(P): Post-Dev Runoff Area=1.550 ac 85.81% Impervious Runoff Depth>2.64"
Tc=5.0 min CN=79/98 Runoff=1.02 cfs 0.340 af

Subcatchment4S(P): Post-Dev Runoff Area=0.550 ac 100.00% Impervious Runoff Depth>2.86"
Tc=5.0 min CN=0/98 Runoff=0.40 cfs 0.131 af

Subcatchment5S(P): Post-Dev Runoff Area=1.340 ac 20.15% Impervious Runoff Depth>1.58"
Tc=5.0 min CN=79/98 Runoff=0.48 cfs 0.177 af

Subcatchment6S(P): Post-Dev Runoff Area=45.390 ac 1.06% Impervious Runoff Depth>1.44"
Flow Length=1,550' Tc=39.4 min CN=82/98 Runoff=9.20 cfs 5.451 af

Reach 1R: Rock Creek Outfall Inflow=10.15 cfs 5.986 af
Outflow=10.15 cfs 5.986 af

Pond 1P: Pond Peak Elev=136.45' Storage=75,490 cf Inflow=5.66 cfs 1.895 af
Outflow=0.11 cfs 0.161 af

Total Runoff Area = 56.230 ac Runoff Volume = 7.720 af Average Runoff Depth = 1.65"
84.08% Pervious = 47.280 ac 15.92% Impervious = 8.950 ac

Exhibit A

Summary for Subcatchment 1S(P): Post-Dev

Runoff = 4.25 cfs @ 7.91 hrs, Volume= 1.423 af, Depth> 2.60"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

	Area (ac)	CN	Description
*	5.490	98	Paved parking, roofs, HSG B
	1.080	79	<50% Grass cover, Poor, HSG B
	6.570	95	Weighted Average
	1.080	79	16.44% Pervious Area
	5.490	98	83.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S(P): Post-Dev

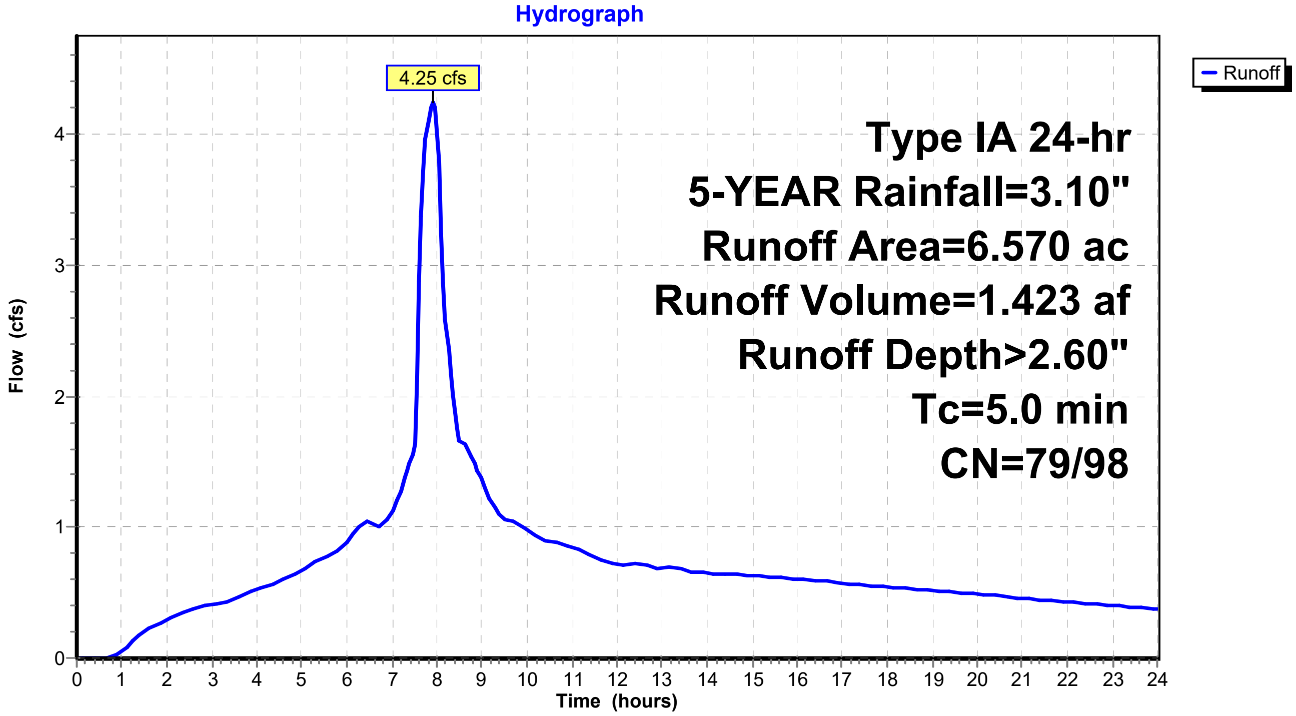


Exhibit A

Summary for Subcatchment 2S(P): Post-Dev

Runoff = 0.60 cfs @ 7.90 hrs, Volume= 0.198 af, Depth> 2.86"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

Area (ac)	CN	Description
0.830	98	Paved roads w/curbs & sewers, HSG D
0.830	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S(P): Post-Dev

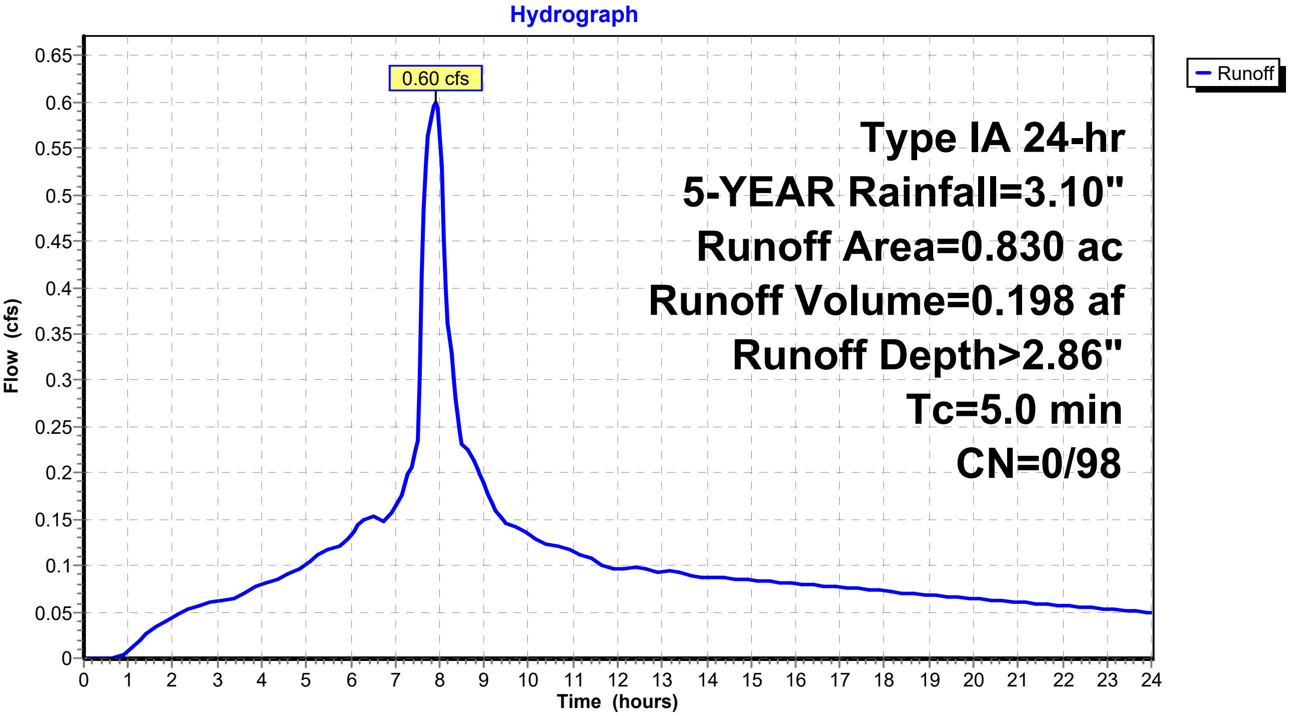


Exhibit A

Summary for Subcatchment 3S(P): Post-Dev

Runoff = 1.02 cfs @ 7.91 hrs, Volume= 0.340 af, Depth> 2.64"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

	Area (ac)	CN	Description
*	1.330	98	Paved parking, roofs, HSG B
	0.220	79	<50% Grass cover, Poor, HSG B
	1.550	95	Weighted Average
	0.220	79	14.19% Pervious Area
	1.330	98	85.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S(P): Post-Dev

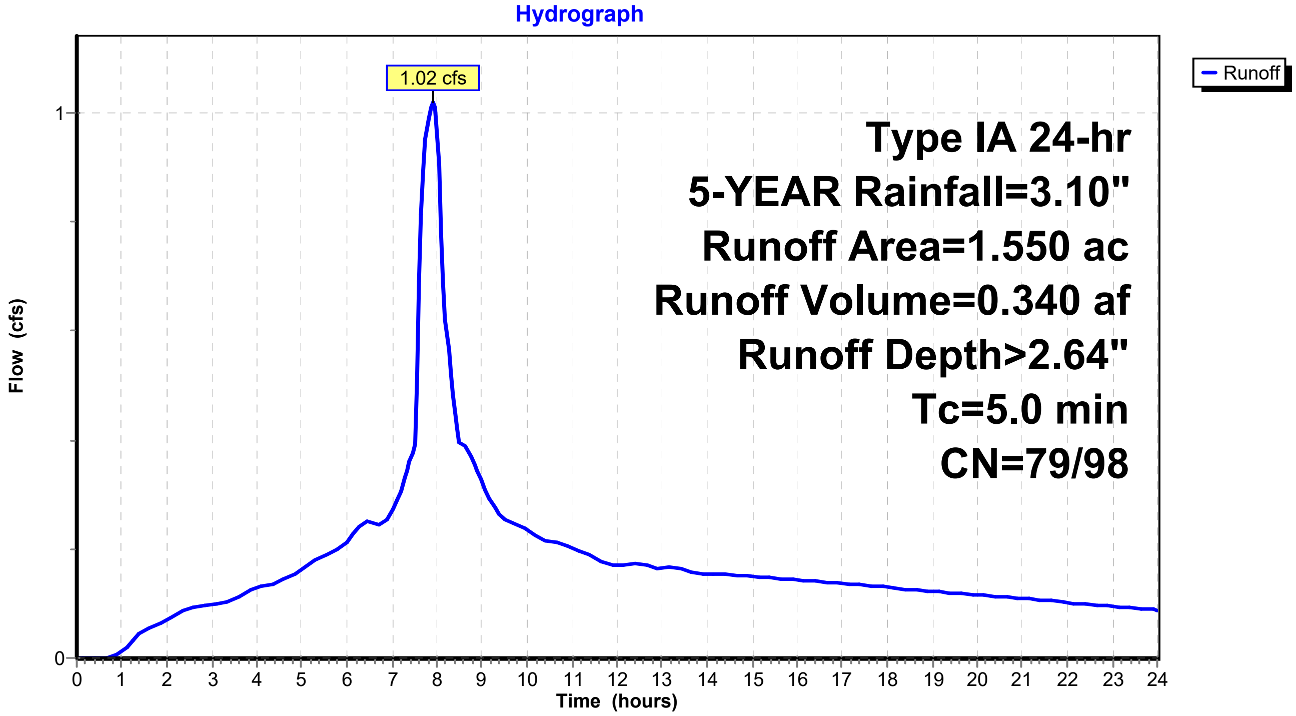


Exhibit A

Summary for Subcatchment 4S(P): Post-Dev

Runoff = 0.40 cfs @ 7.90 hrs, Volume= 0.131 af, Depth> 2.86"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

Area (ac)	CN	Description
0.550	98	Water Surface, HSG B
0.550	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S(P): Post-Dev

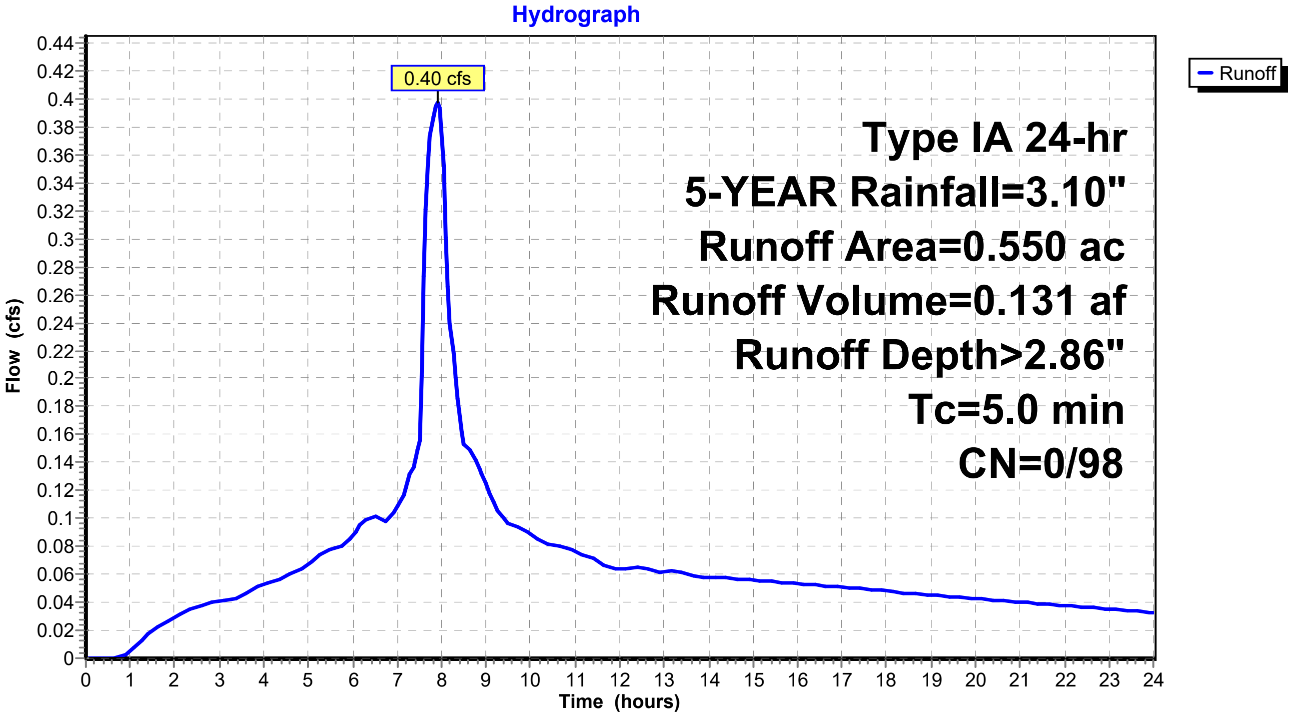


Exhibit A

Summary for Subcatchment 5S(P): Post-Dev

Runoff = 0.48 cfs @ 7.98 hrs, Volume= 0.177 af, Depth> 1.58"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

Area (ac)	CN	Description
0.270	98	Paved parking, HSG B
1.070	79	<50% Grass cover, Poor, HSG B
1.340	83	Weighted Average
1.070	79	79.85% Pervious Area
0.270	98	20.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S(P): Post-Dev

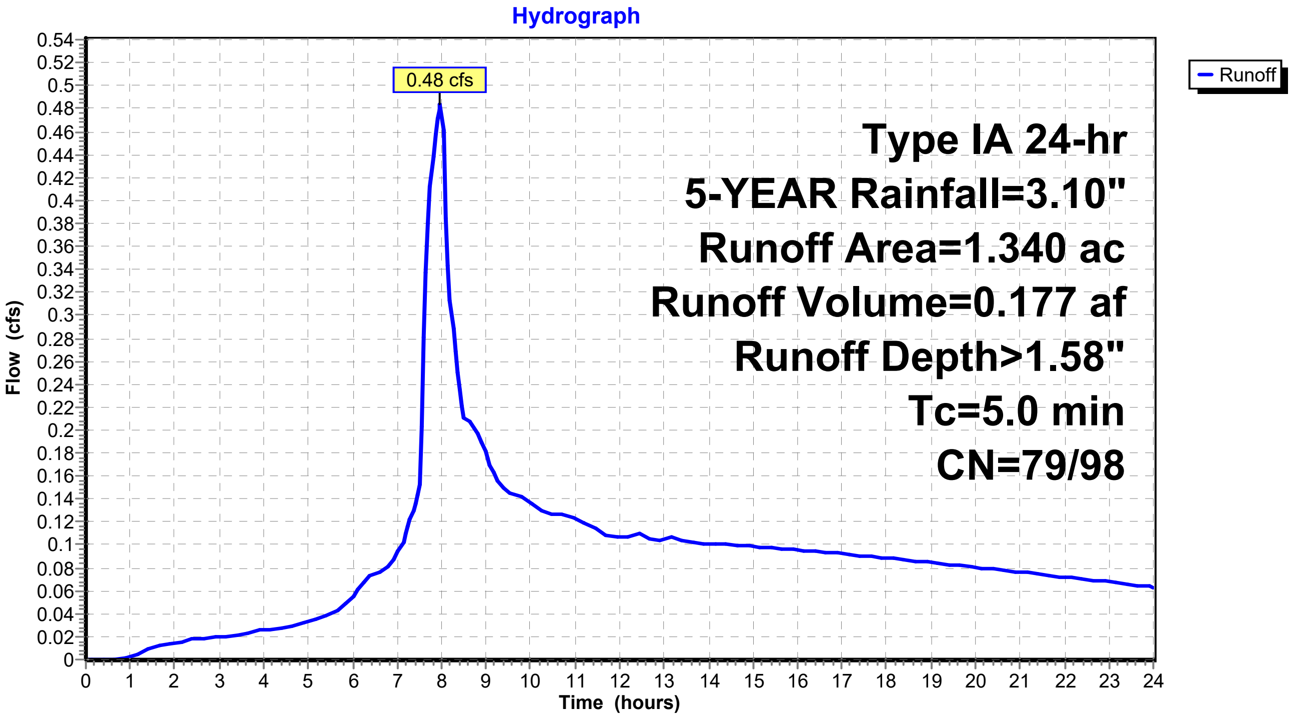


Exhibit A

Summary for Subcatchment 6S(P): Post-Dev

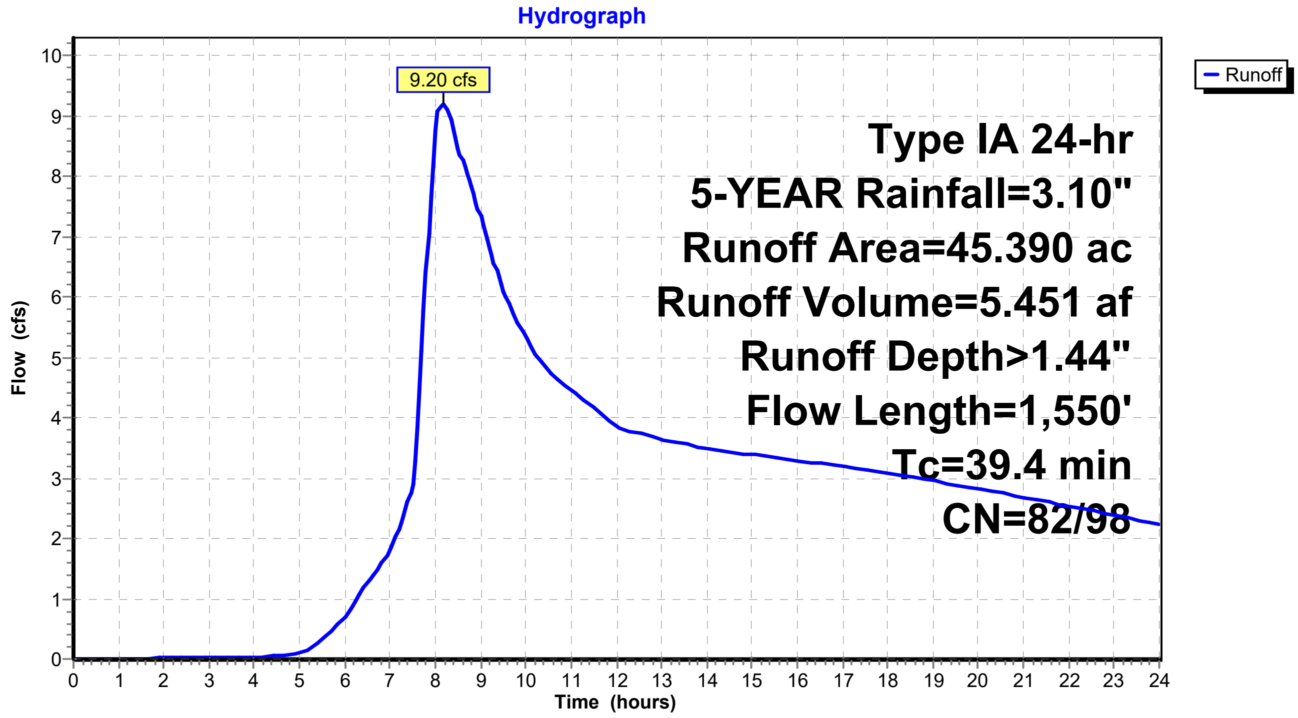
Runoff = 9.20 cfs @ 8.16 hrs, Volume= 5.451 af, Depth> 1.44"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5-YEAR Rainfall=3.10"

Area (ac)	CN	Description
32.480	79	<50% Grass cover, Poor, HSG B
0.480	98	Paved parking, HSG D
12.430	89	<50% Grass cover, Poor, HSG D
45.390	82	Weighted Average
44.910	82	98.94% Pervious Area
0.480	98	1.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
21.4	1,100	0.0150	0.86		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.4	350	0.0600	1.71		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
39.4	1,550	Total			

Subcatchment 6S(P): Post-Dev



Summary for Reach 1R: Rock Creek Outfall

```
Inflow Area =       56.230 ac, 15.92% Impervious, Inflow Depth >  1.28"   for 5-YEAR event
Inflow      =      10.15 cfs @    8.07 hrs, Volume=          5.986 af
Outflow     =      10.15 cfs @    8.07 hrs, Volume=          5.986 af, Atten= 0%, Lag= 0.0 min
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2

Reach 1R: Rock Creek Outfall

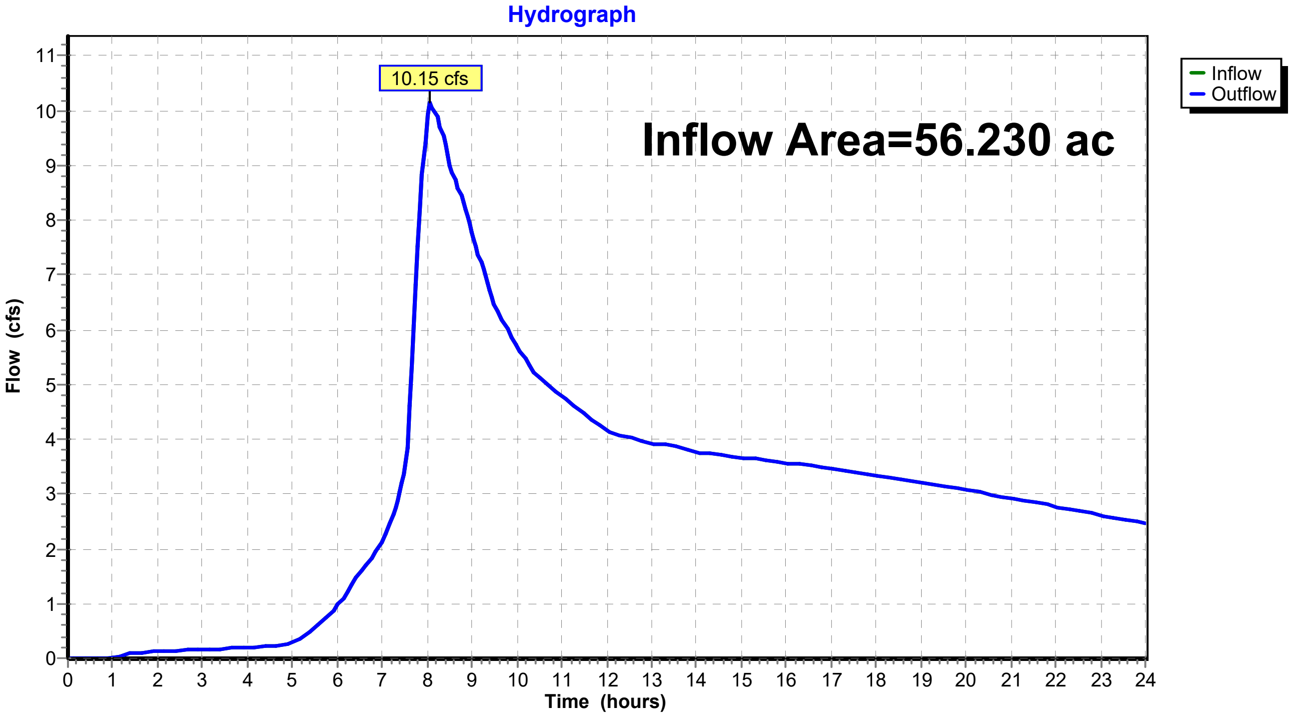


Exhibit A

Summary for Pond 1P: Pond

```
Inflow Area =        8.670 ac,  85.01% Impervious,  Inflow Depth >   2.62"    for  5-YEAR event
Inflow      =       5.66 cfs @    7.91 hrs,  Volume=           1.895 af
Outflow     =       0.11 cfs @   24.00 hrs,  Volume=           0.161 af,  Atten= 98%,  Lag= 965.6 min
Primary     =       0.11 cfs @   24.00 hrs,  Volume=           0.161 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 136.45' @ 24.00 hrs Surf.Area= 21,278 sf Storage= 75,490 cf

Plug-Flow detention time= 649.9 min calculated for 0.161 af (8% of inflow)
Center-of-Mass det. time= 168.3 min (846.2 - 677.8)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	111,009 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	13,337	0	0
133.00	14,863	14,100	14,100
134.00	16,432	15,648	29,748
135.00	18,051	17,242	46,989
136.00	19,718	18,885	65,874
137.00	23,200	21,459	87,333
138.00	24,152	23,676	111,009

Device	Routing	Invert	Outlet Devices
#1	Primary	131.00'	**18.0" Vert. 18" Pond Outlet** C= 0.620
#2	Device 1	136.70'	**4.2" Horiz. 5-year Orifice** C= 0.620 Limited to weir flow at low heads
#3	Device 1	137.25'	**6.0" Horiz. 10/25-year Orifice** C= 0.620 Limited to weir flow at low heads
#4	Device 1	131.00'	**1.3" Horiz. WQ Orifice** C= 0.620 Limited to weir flow at low heads
#5	Device 4	132.00'	**27.0" x 24.0" Horiz. WQ Inlet (Bottom)** C= 0.600 Limited to weir flow at low heads
#6	Device 1	137.99'	**27.0" x 24.0" Horiz. Overflow Inlet (Top)** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.11 cfs @ 24.00 hrs HW=136.45' TW=0.00' (Dynamic Tailwater)

```
↑—1=18" Pond Outlet (Passes 0.11 cfs of 19.06 cfs potential flow)
  ↑—2=5-year Orifice ( Controls 0.00 cfs)
  ├—3=10/25-year Orifice ( Controls 0.00 cfs)
  ├—4=WQ Orifice (Orifice Controls 0.11 cfs @ 11.61 fps)
  │ ↑—5=WQ Inlet (Bottom) (Passes 0.11 cfs of 45.70 cfs potential flow)
  └—6=Overflow Inlet (Top) ( Controls 0.00 cfs)
```

Exhibit A

Pond 1P: Pond

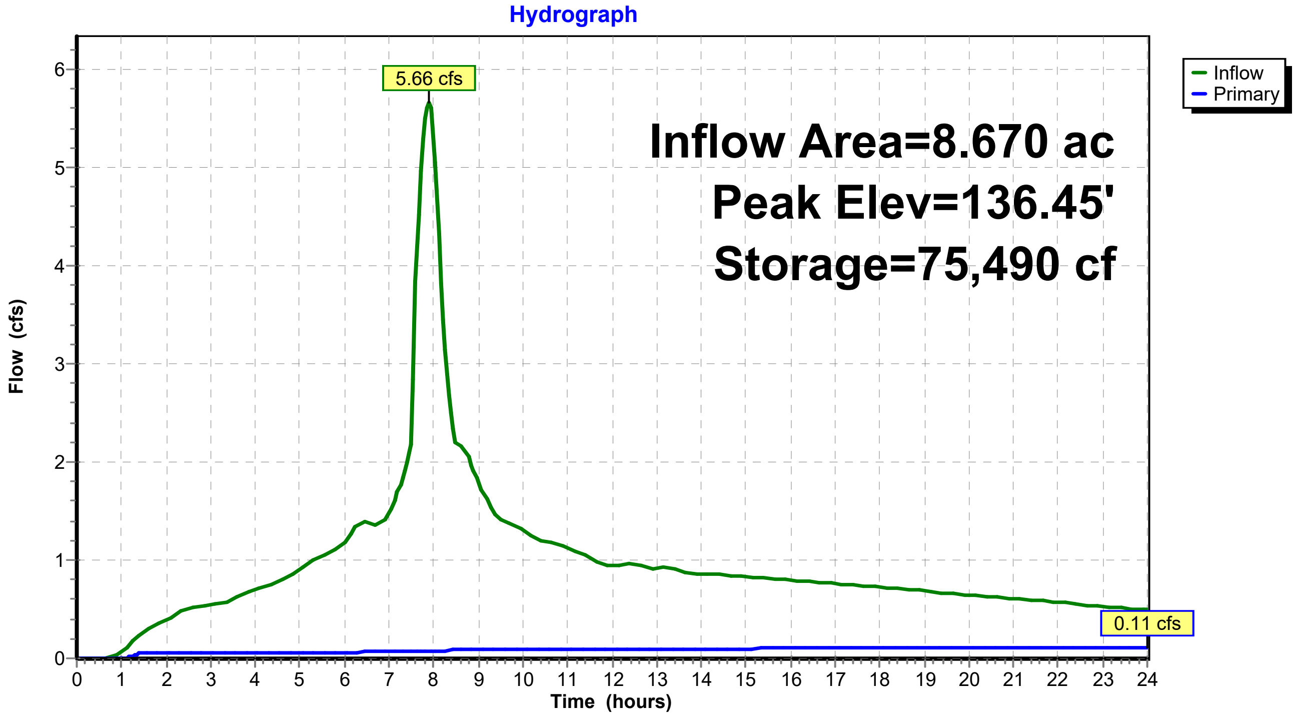


Exhibit A

Post-Developed 10-yr Storm Event Peak Flow Calculations

Exhibit A

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S(P): Post-Dev Runoff Area=6.570 ac 83.56% Impervious Runoff Depth>2.93"
Tc=5.0 min CN=79/98 Runoff=4.79 cfs 1.606 af

Subcatchment2S(P): Post-Dev Runoff Area=0.830 ac 100.00% Impervious Runoff Depth>3.21"
Tc=5.0 min CN=0/98 Runoff=0.67 cfs 0.222 af

Subcatchment3S(P): Post-Dev Runoff Area=1.550 ac 85.81% Impervious Runoff Depth>2.97"
Tc=5.0 min CN=79/98 Runoff=1.15 cfs 0.384 af

Subcatchment4S(P): Post-Dev Runoff Area=0.550 ac 100.00% Impervious Runoff Depth>3.21"
Tc=5.0 min CN=0/98 Runoff=0.44 cfs 0.147 af

Subcatchment5S(P): Post-Dev Runoff Area=1.340 ac 20.15% Impervious Runoff Depth>1.86"
Tc=5.0 min CN=79/98 Runoff=0.58 cfs 0.208 af

Subcatchment6S(P): Post-Dev Runoff Area=45.390 ac 1.06% Impervious Runoff Depth>1.72"
Flow Length=1,550' Tc=39.4 min CN=82/98 Runoff=11.38 cfs 6.507 af

Reach 1R: Rock Creek Outfall Inflow=12.50 cfs 7.131 af
Outflow=12.50 cfs 7.131 af

Pond 1P: Pond Peak Elev=136.87' Storage=84,634 cf Inflow=6.38 cfs 2.137 af
Outflow=0.31 cfs 0.194 af

Total Runoff Area = 56.230 ac Runoff Volume = 9.074 af Average Runoff Depth = 1.94"
84.08% Pervious = 47.280 ac 15.92% Impervious = 8.950 ac

Exhibit A

Summary for Subcatchment 1S(P): Post-Dev

Runoff = 4.79 cfs @ 7.91 hrs, Volume= 1.606 af, Depth> 2.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

	Area (ac)	CN	Description
*	5.490	98	Paved parking, roofs, HSG B
	1.080	79	<50% Grass cover, Poor, HSG B
	6.570	95	Weighted Average
	1.080	79	16.44% Pervious Area
	5.490	98	83.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S(P): Post-Dev

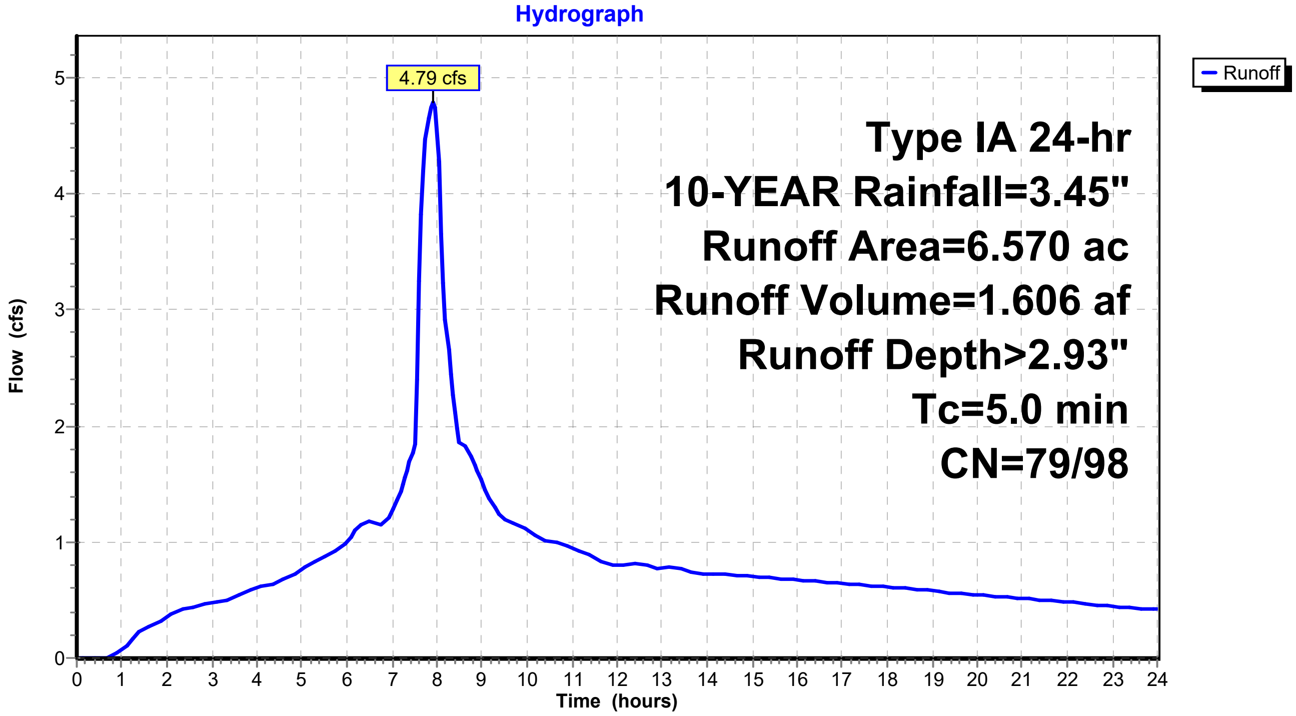


Exhibit A

Summary for Subcatchment 2S(P): Post-Dev

Runoff = 0.67 cfs @ 7.90 hrs, Volume= 0.222 af, Depth> 3.21"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

Area (ac)	CN	Description
0.830	98	Paved roads w/curbs & sewers, HSG D
0.830	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S(P): Post-Dev

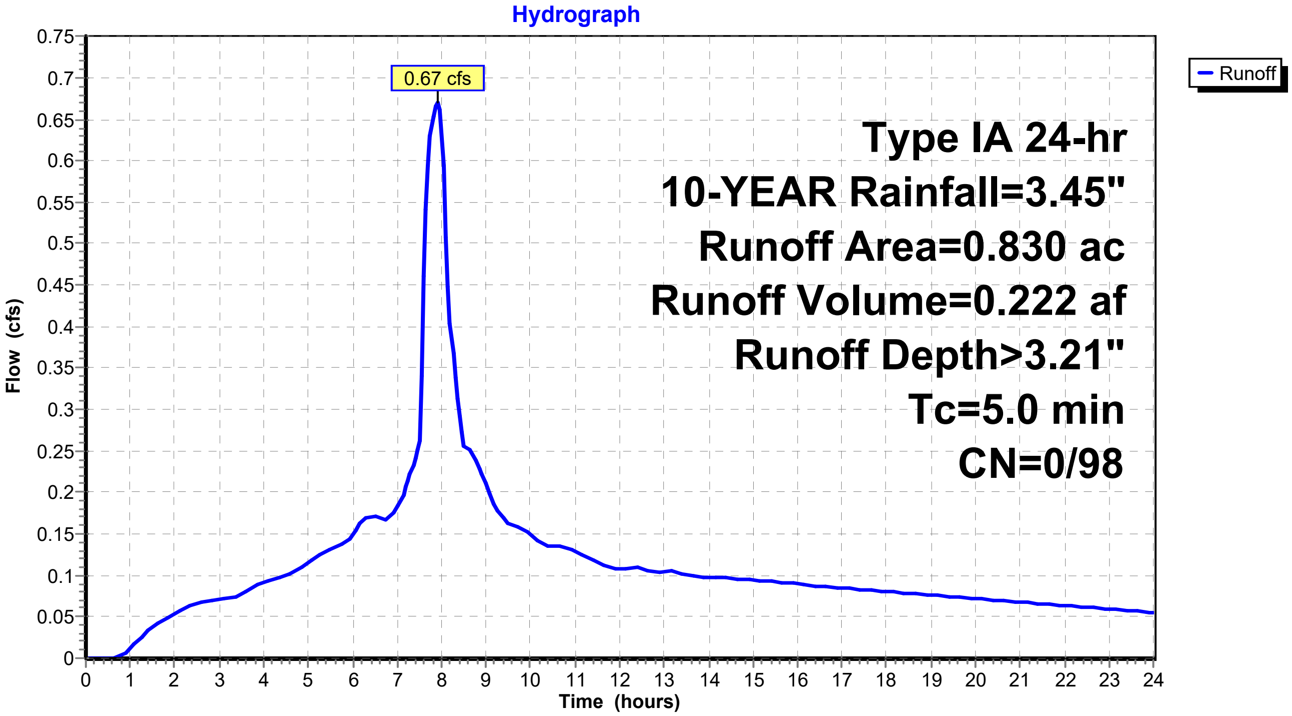


Exhibit A

Summary for Subcatchment 3S(P): Post-Dev

Runoff = 1.15 cfs @ 7.91 hrs, Volume= 0.384 af, Depth> 2.97"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

	Area (ac)	CN	Description
*	1.330	98	Paved parking, roofs, HSG B
	0.220	79	<50% Grass cover, Poor, HSG B
	1.550	95	Weighted Average
	0.220	79	14.19% Pervious Area
	1.330	98	85.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S(P): Post-Dev

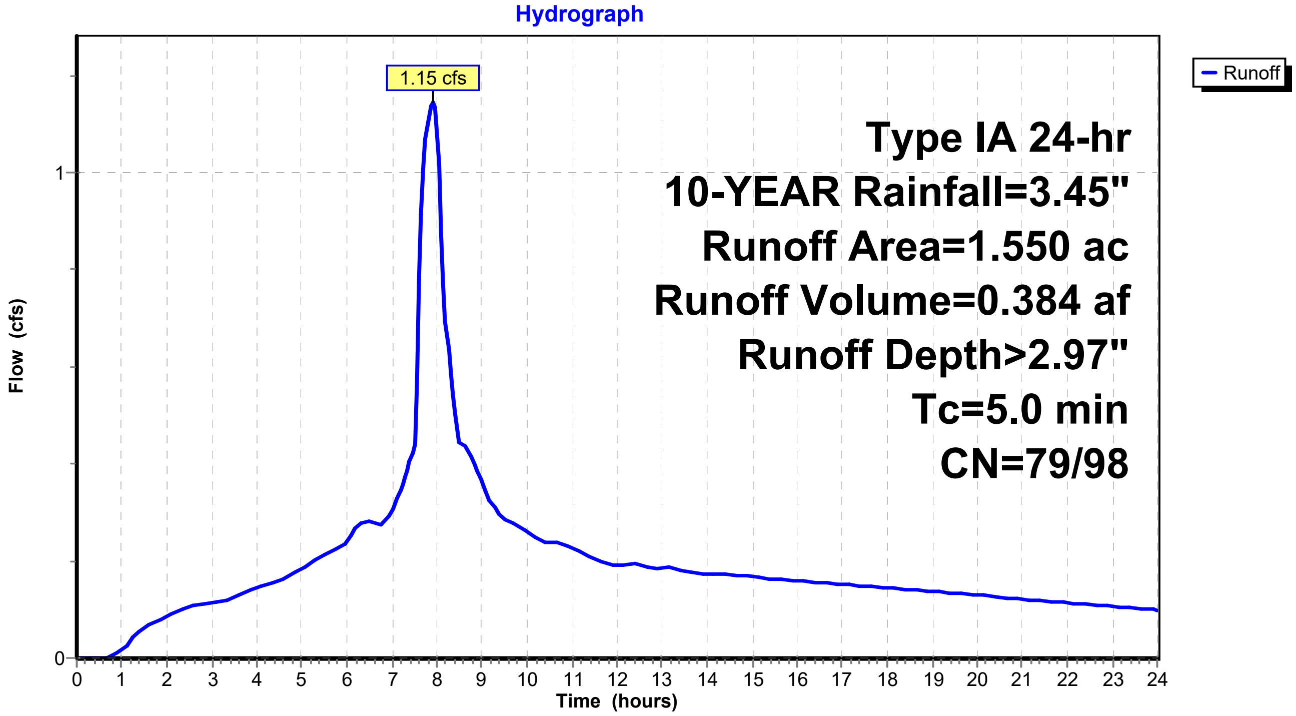


Exhibit A

Summary for Subcatchment 4S(P): Post-Dev

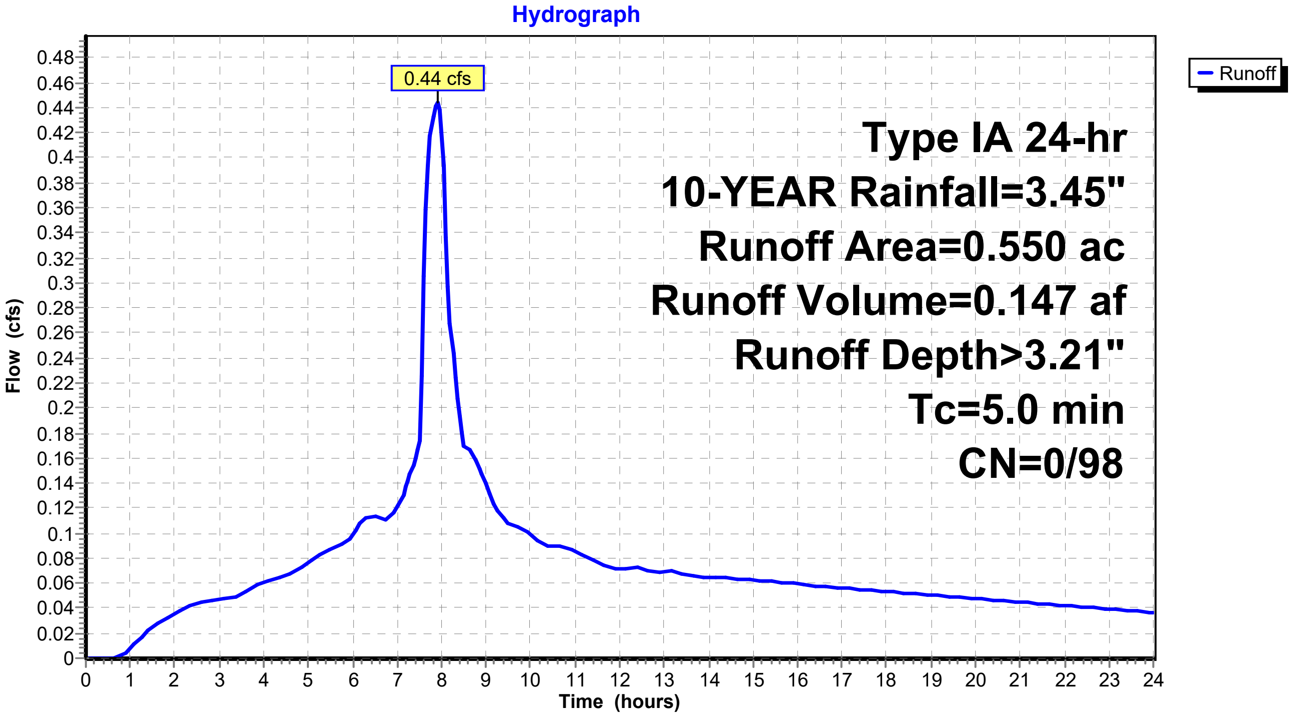
Runoff = 0.44 cfs @ 7.90 hrs, Volume= 0.147 af, Depth> 3.21"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

Area (ac)	CN	Description
0.550	98	Water Surface, HSG B
0.550	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S(P): Post-Dev



Summary for Subcatchment 5S(P): Post-Dev

Runoff = 0.58 cfs @ 7.97 hrs, Volume= 0.208 af, Depth> 1.86"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

Area (ac)	CN	Description
0.270	98	Paved parking, HSG B
1.070	79	<50% Grass cover, Poor, HSG B
1.340	83	Weighted Average
1.070	79	79.85% Pervious Area
0.270	98	20.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S(P): Post-Dev

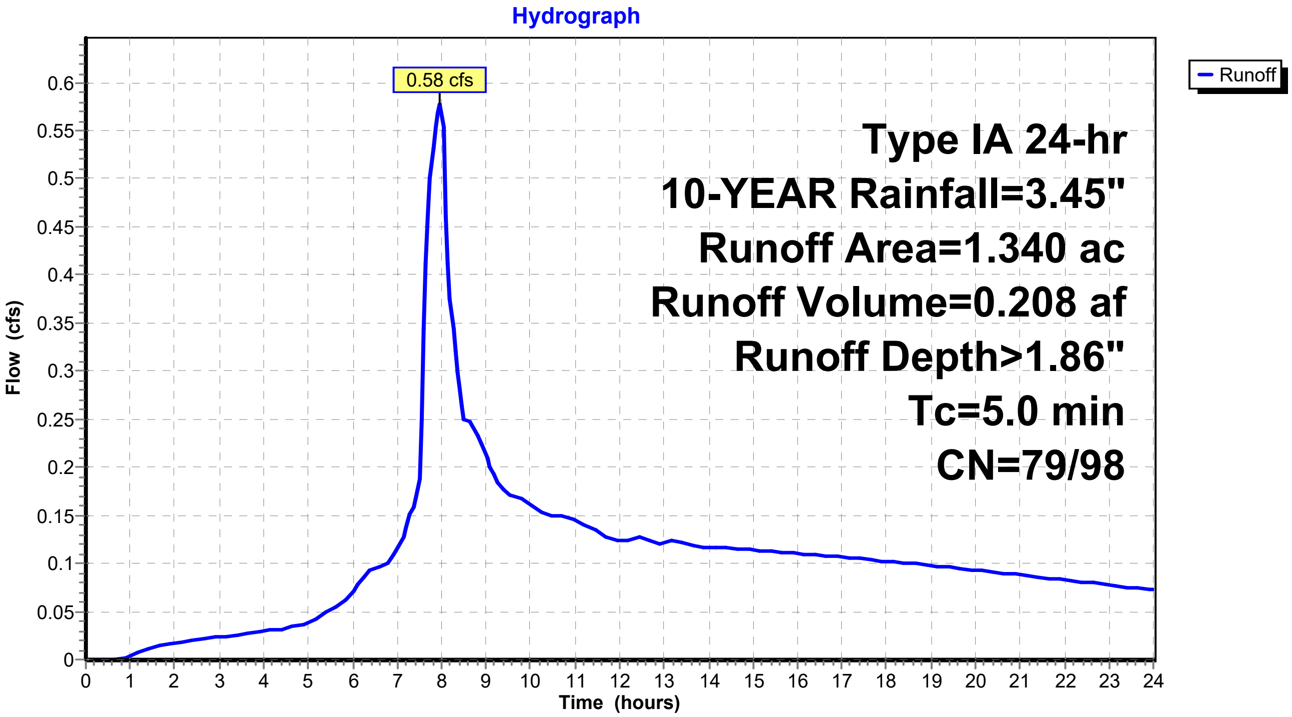


Exhibit A

Summary for Subcatchment 6S(P): Post-Dev

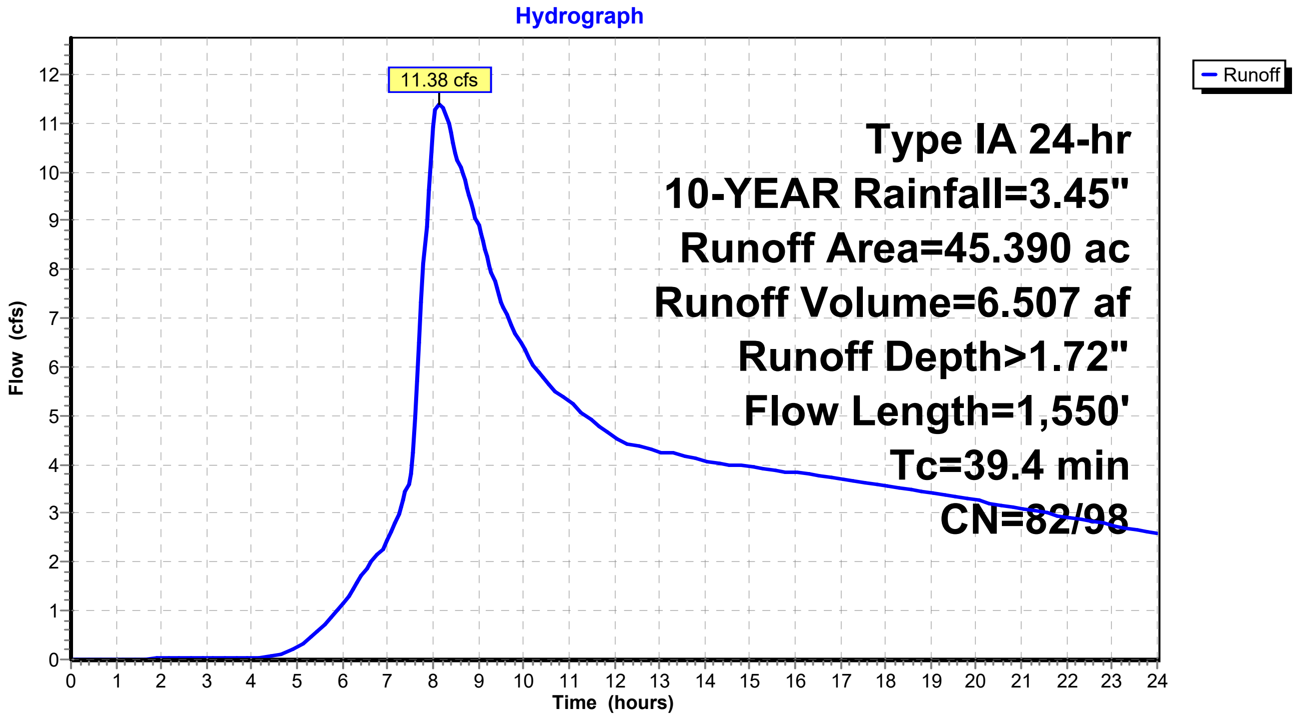
Runoff = 11.38 cfs @ 8.14 hrs, Volume= 6.507 af, Depth> 1.72"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YEAR Rainfall=3.45"

Area (ac)	CN	Description
32.480	79	<50% Grass cover, Poor, HSG B
0.480	98	Paved parking, HSG D
12.430	89	<50% Grass cover, Poor, HSG D
45.390	82	Weighted Average
44.910	82	98.94% Pervious Area
0.480	98	1.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
21.4	1,100	0.0150	0.86		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.4	350	0.0600	1.71		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
39.4	1,550	Total			

Subcatchment 6S(P): Post-Dev



Summary for Reach 1R: Rock Creek Outfall

Inflow Area = 56.230 ac, 15.92% Impervious, Inflow Depth > 1.52" for 10-YEAR event
Inflow = 12.50 cfs @ 8.06 hrs, Volume= 7.131 af
Outflow = 12.50 cfs @ 8.06 hrs, Volume= 7.131 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2

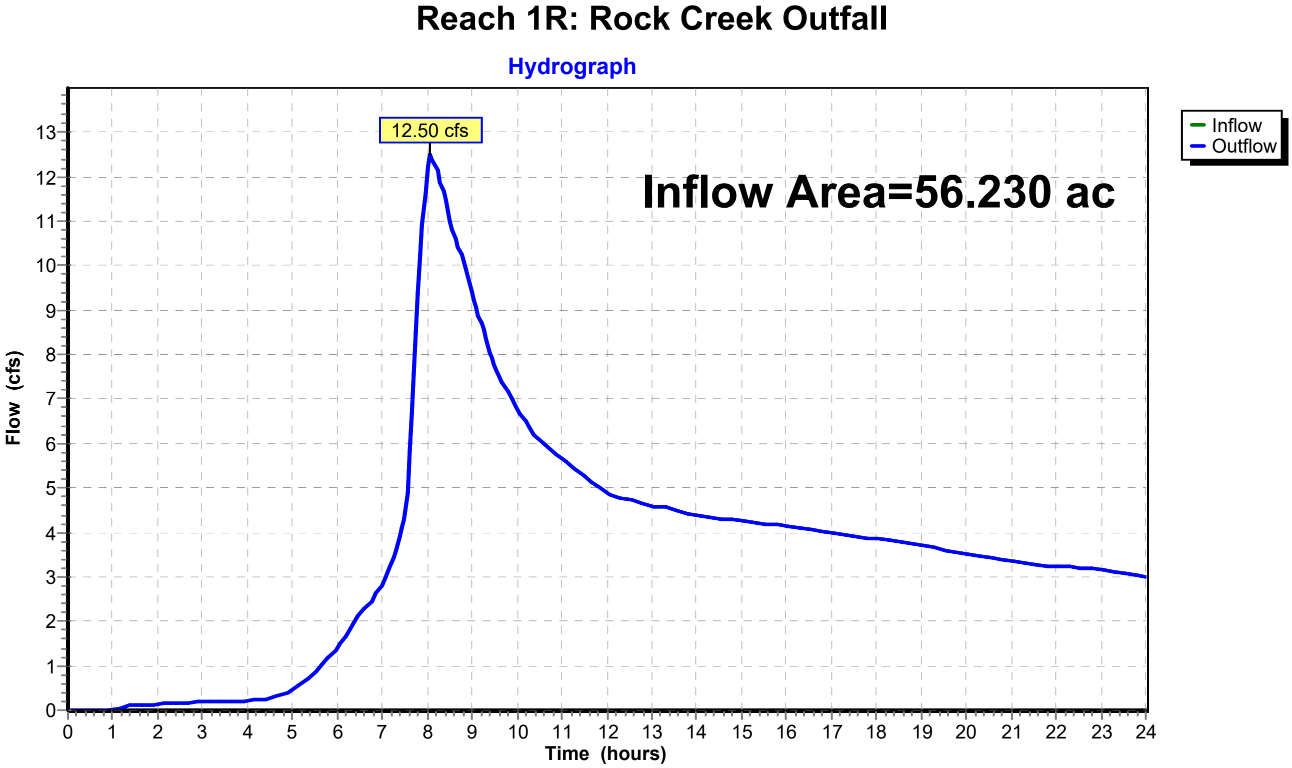


Exhibit A

Summary for Pond 1P: Pond

Inflow Area = 8.670 ac, 85.01% Impervious, Inflow Depth > 2.96" for 10-YEAR event
Inflow = 6.38 cfs @ 7.91 hrs, Volume= 2.137 af
Outflow = 0.31 cfs @ 24.00 hrs, Volume= 0.194 af, Atten= 95%, Lag= 965.6 min
Primary = 0.31 cfs @ 24.00 hrs, Volume= 0.194 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 136.87' @ 24.00 hrs Surf.Area= 22,762 sf Storage= 84,634 cf

Plug-Flow detention time= 721.6 min calculated for 0.193 af (9% of inflow)
Center-of-Mass det. time= 244.4 min (919.5 - 675.1)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	111,009 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	13,337	0	0
133.00	14,863	14,100	14,100
134.00	16,432	15,648	29,748
135.00	18,051	17,242	46,989
136.00	19,718	18,885	65,874
137.00	23,200	21,459	87,333
138.00	24,152	23,676	111,009

Device	Routing	Invert	Outlet Devices
#1	Primary	131.00'	**18.0" Vert. 18" Pond Outlet** C= 0.620
#2	Device 1	136.70'	**4.2" Horiz. 5-year Orifice** C= 0.620 Limited to weir flow at low heads
#3	Device 1	137.25'	**6.0" Horiz. 10/25-year Orifice** C= 0.620 Limited to weir flow at low heads
#4	Device 1	131.00'	**1.3" Horiz. WQ Orifice** C= 0.620 Limited to weir flow at low heads
#5	Device 4	132.00'	**27.0" x 24.0" Horiz. WQ Inlet (Bottom)** C= 0.600 Limited to weir flow at low heads
#6	Device 1	137.99'	**27.0" x 24.0" Horiz. Overflow Inlet (Top)** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.31 cfs @ 24.00 hrs HW=136.87' TW=0.00' (Dynamic Tailwater)
- **1=18" Pond Outlet** (Passes 0.31 cfs of 19.90 cfs potential flow)
  - **2=5-year Orifice** (Orifice Controls 0.20 cfs @ 2.08 fps)
  - **3=10/25-year Orifice** (Controls 0.00 cfs)
  - **4=WQ Orifice** (Orifice Controls 0.11 cfs @ 12.06 fps)
    - **5=WQ Inlet (Bottom)** (Passes 0.11 cfs of 47.84 cfs potential flow)
  - **6=Overflow Inlet (Top)** (Controls 0.00 cfs)

Exhibit A

Pond 1P: Pond

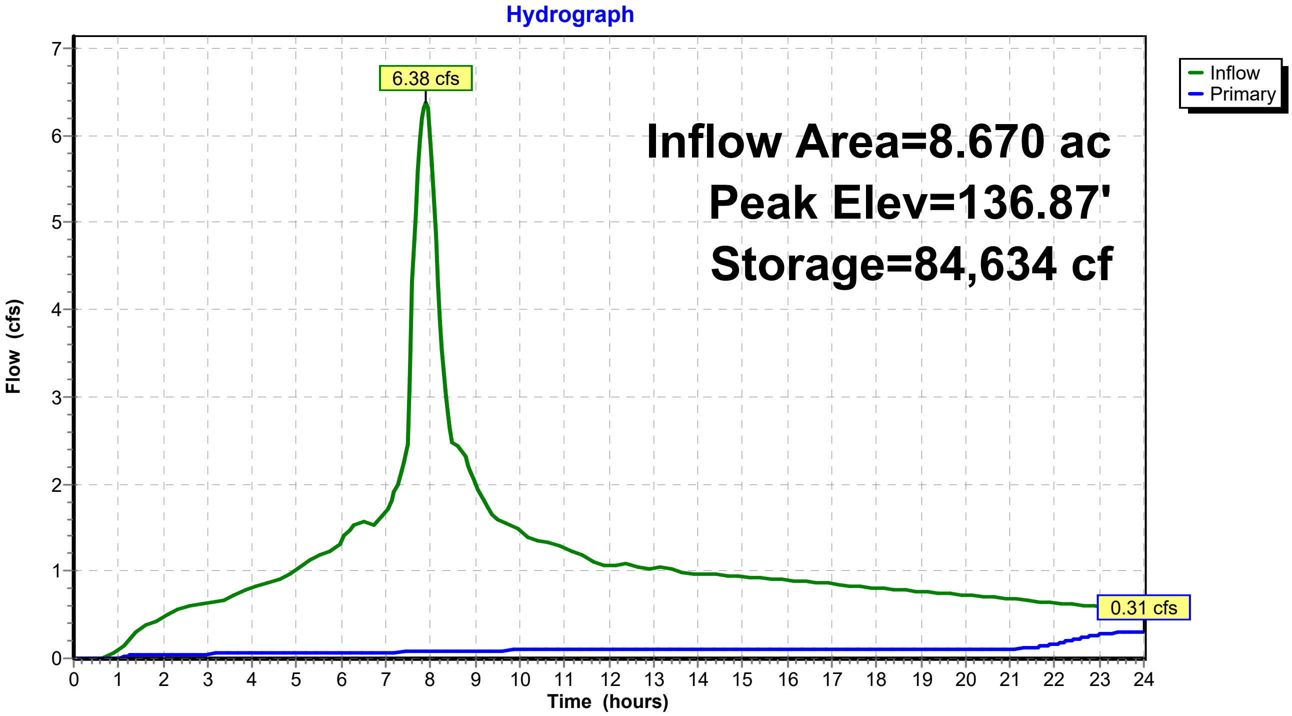


Exhibit A

Post-Developed 25-yr Storm Event Peak Flow Calculations

Exhibit A

```
                    Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
                        Runoff by SBUH method, Split Pervious/Imperv.
            Reach routing by Dyn-Stor-Ind method  -  Pond routing by Dyn-Stor-Ind method

Subcatchment1S(P): Post-Dev     Runoff Area=6.570 ac   83.56% Impervious   Runoff Depth>3.37"
                                       Tc=5.0 min   CN=79/98   Runoff=5.49 cfs  1.843 af

Subcatchment2S(P): Post-Dev    Runoff Area=0.830 ac   100.00% Impervious   Runoff Depth>3.66"
                                        Tc=5.0 min   CN=0/98   Runoff=0.76 cfs  0.253 af

Subcatchment3S(P): Post-Dev     Runoff Area=1.550 ac   85.81% Impervious   Runoff Depth>3.41"
                                       Tc=5.0 min   CN=79/98   Runoff=1.31 cfs  0.440 af

Subcatchment4S(P): Post-Dev    Runoff Area=0.550 ac   100.00% Impervious   Runoff Depth>3.66"
                                        Tc=5.0 min   CN=0/98   Runoff=0.50 cfs  0.168 af

Subcatchment5S(P): Post-Dev     Runoff Area=1.340 ac   20.15% Impervious   Runoff Depth>2.24"
                                       Tc=5.0 min   CN=79/98   Runoff=0.71 cfs  0.250 af

Subcatchment6S(P): Post-Dev     Runoff Area=45.390 ac   1.06% Impervious   Runoff Depth>2.09"
                      Flow Length=1,550'   Tc=39.4 min   CN=82/98   Runoff=14.32 cfs  7.910 af

Reach 1R: Rock Creek Outfall                                     Inflow=15.65 cfs  8.742 af
                                                                Outflow=15.65 cfs  8.742 af

Pond 1P: Pond                  Peak Elev=137.21'  Storage=92,372 cf   Inflow=7.30 cfs  2.451 af
                                                                 Outflow=0.46 cfs  0.330 af

        Total Runoff Area = 56.230 ac   Runoff Volume = 10.863 af   Average Runoff Depth = 2.32"
                                 84.08% Pervious = 47.280 ac     15.92% Impervious = 8.950 ac
```

Exhibit A

Summary for Subcatchment 1S(P): Post-Dev

Runoff = 5.49 cfs @ 7.91 hrs, Volume= 1.843 af, Depth> 3.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

	Area (ac)	CN	Description
*	5.490	98	Paved parking, roofs, HSG B
	1.080	79	<50% Grass cover, Poor, HSG B
	6.570	95	Weighted Average
	1.080	79	16.44% Pervious Area
	5.490	98	83.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S(P): Post-Dev

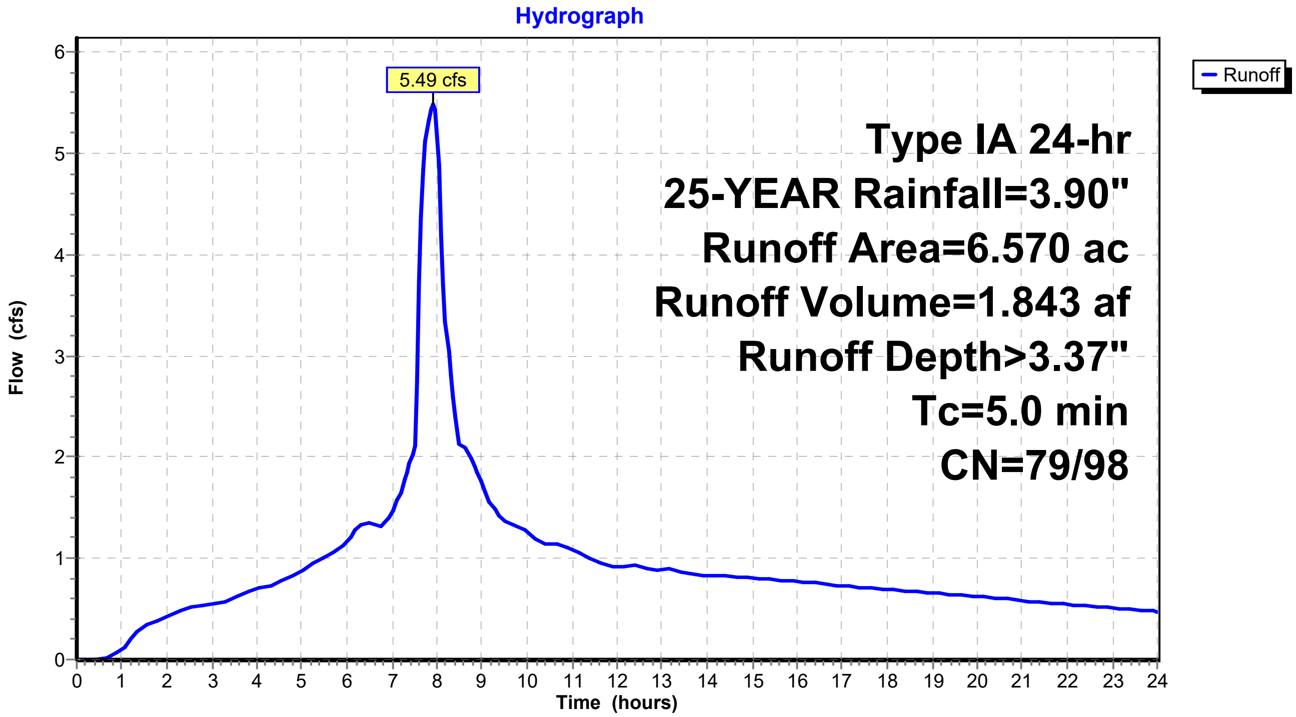


Exhibit A

Summary for Subcatchment 2S(P): Post-Dev

Runoff = 0.76 cfs @ 7.90 hrs, Volume= 0.253 af, Depth> 3.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

Area (ac)	CN	Description
0.830	98	Paved roads w/curbs & sewers, HSG D
0.830	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S(P): Post-Dev

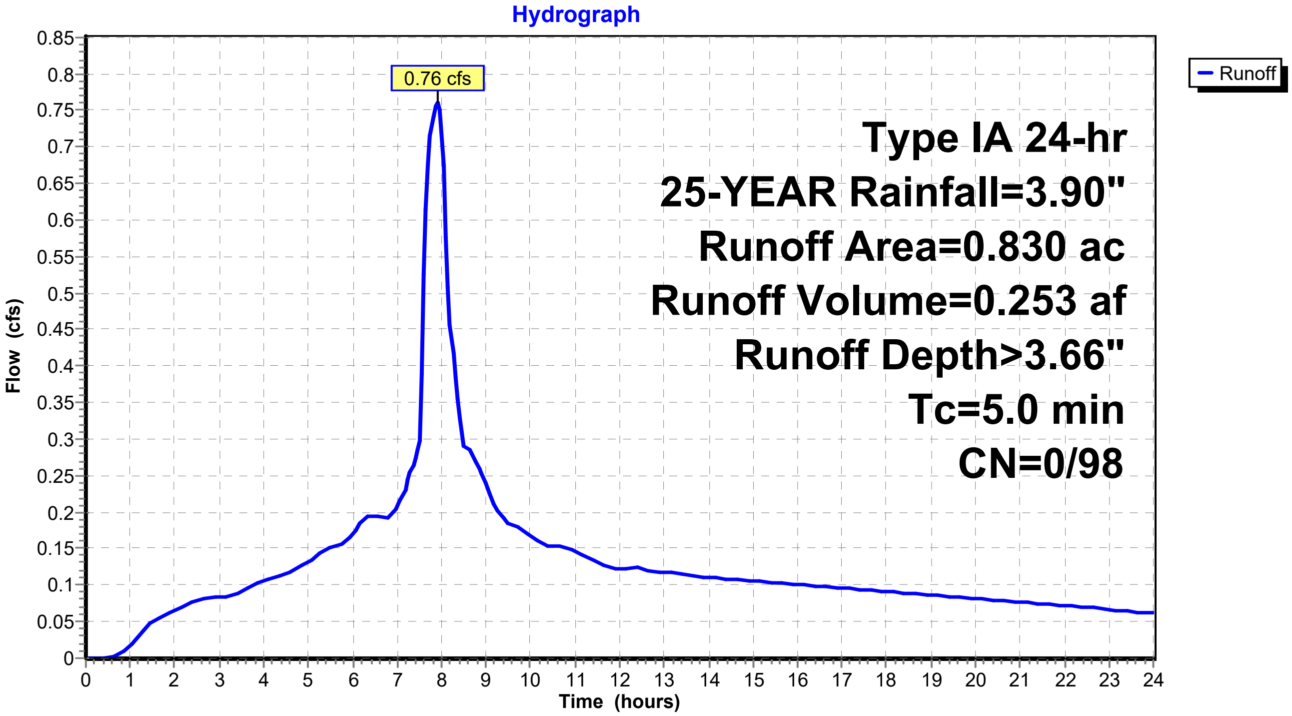


Exhibit A

Summary for Subcatchment 3S(P): Post-Dev

Runoff = 1.31 cfs @ 7.90 hrs, Volume= 0.440 af, Depth> 3.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

	Area (ac)	CN	Description
*	1.330	98	Paved parking, roofs, HSG B
	0.220	79	<50% Grass cover, Poor, HSG B
	1.550	95	Weighted Average
	0.220	79	14.19% Pervious Area
	1.330	98	85.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S(P): Post-Dev

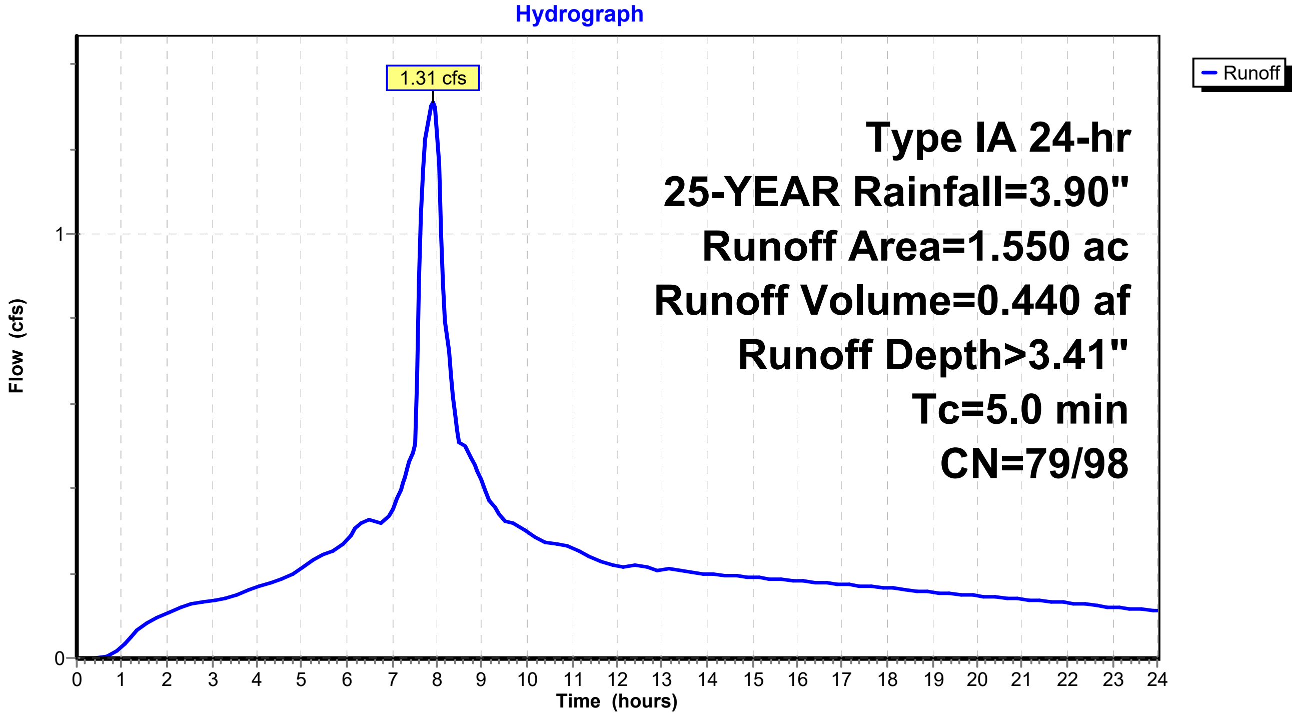


Exhibit A

Summary for Subcatchment 4S(P): Post-Dev

Runoff = 0.50 cfs @ 7.90 hrs, Volume= 0.168 af, Depth> 3.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

Area (ac)	CN	Description
0.550	98	Water Surface, HSG B
0.550	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S(P): Post-Dev

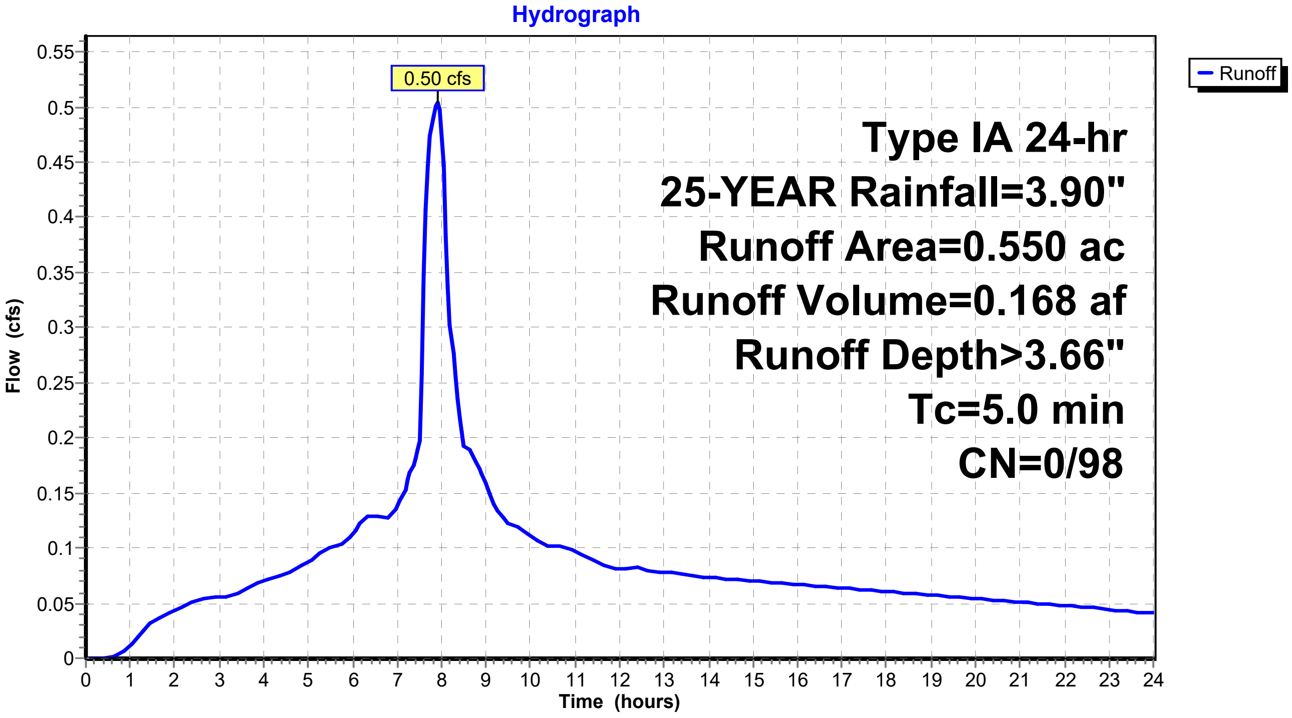


Exhibit A

Summary for Subcatchment 5S(P): Post-Dev

Runoff = 0.71 cfs @ 7.97 hrs, Volume= 0.250 af, Depth> 2.24"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

Area (ac)	CN	Description
0.270	98	Paved parking, HSG B
1.070	79	<50% Grass cover, Poor, HSG B
1.340	83	Weighted Average
1.070	79	79.85% Pervious Area
0.270	98	20.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S(P): Post-Dev

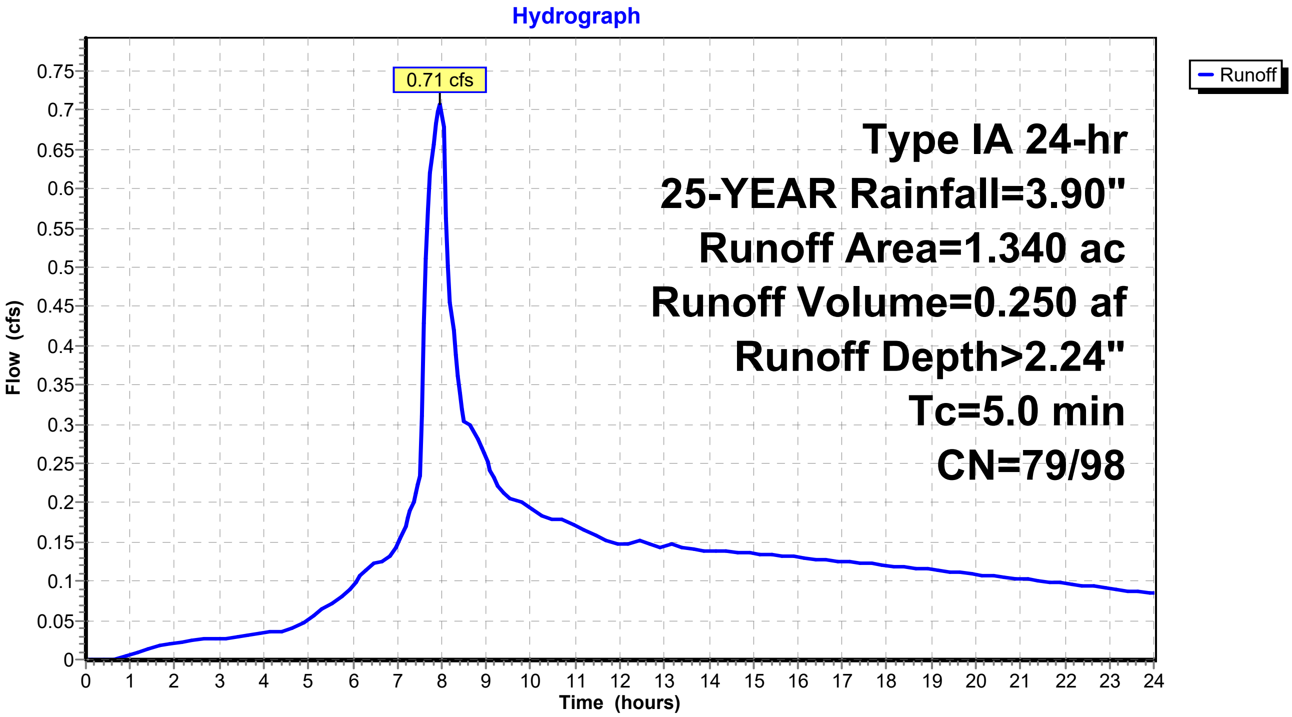


Exhibit A

Summary for Subcatchment 6S(P): Post-Dev

Runoff = 14.32 cfs @ 8.13 hrs, Volume= 7.910 af, Depth> 2.09"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

Area (ac)	CN	Description
32.480	79	<50% Grass cover, Poor, HSG B
0.480	98	Paved parking, HSG D
12.430	89	<50% Grass cover, Poor, HSG D
45.390	82	Weighted Average
44.910	82	98.94% Pervious Area
0.480	98	1.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.6	100	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
21.4	1,100	0.0150	0.86		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.4	350	0.0600	1.71		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
39.4	1,550	Total			

Subcatchment 6S(P): Post-Dev

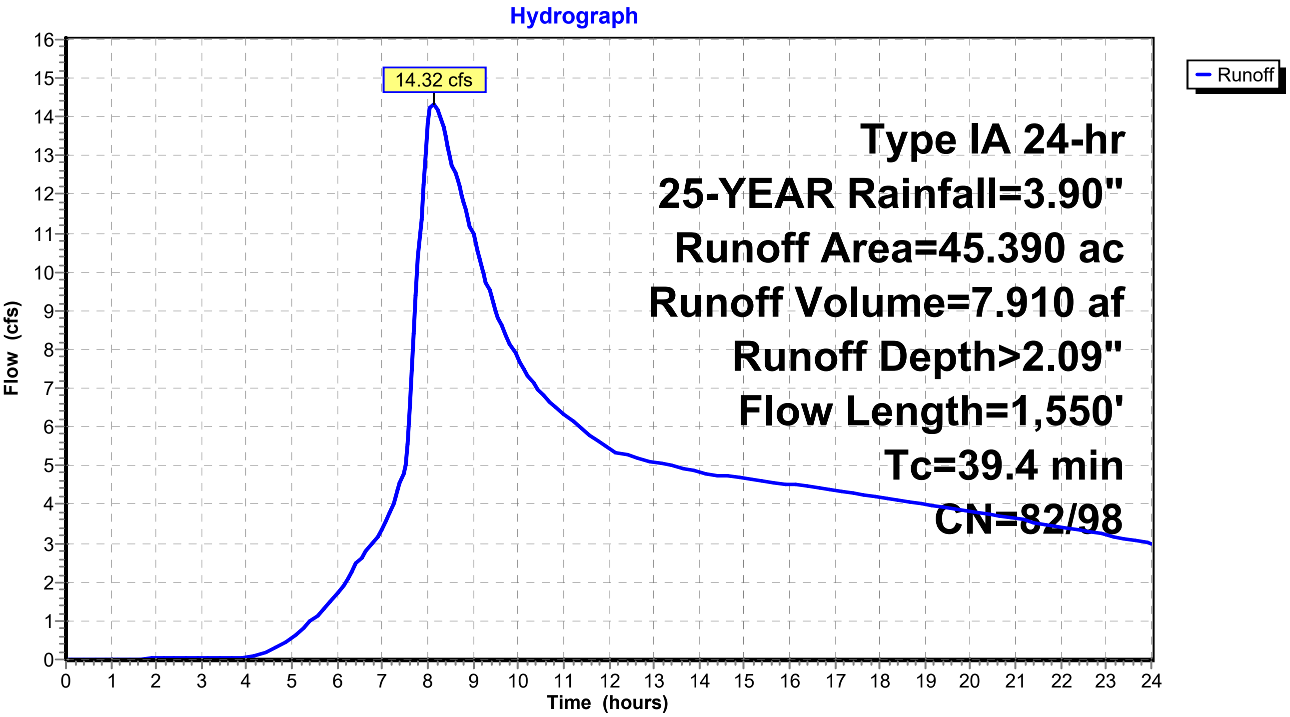


Exhibit A

Summary for Reach 1R: Rock Creek Outfall

```
Inflow Area =       56.230 ac,  15.92% Impervious,  Inflow Depth >   1.87"    for  25-YEAR event
Inflow       =      15.65 cfs @     8.06 hrs,  Volume=            8.742 af
Outflow      =      15.65 cfs @     8.06 hrs,  Volume=            8.742 af,  Atten= 0%,  Lag= 0.0 min
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2

Reach 1R: Rock Creek Outfall

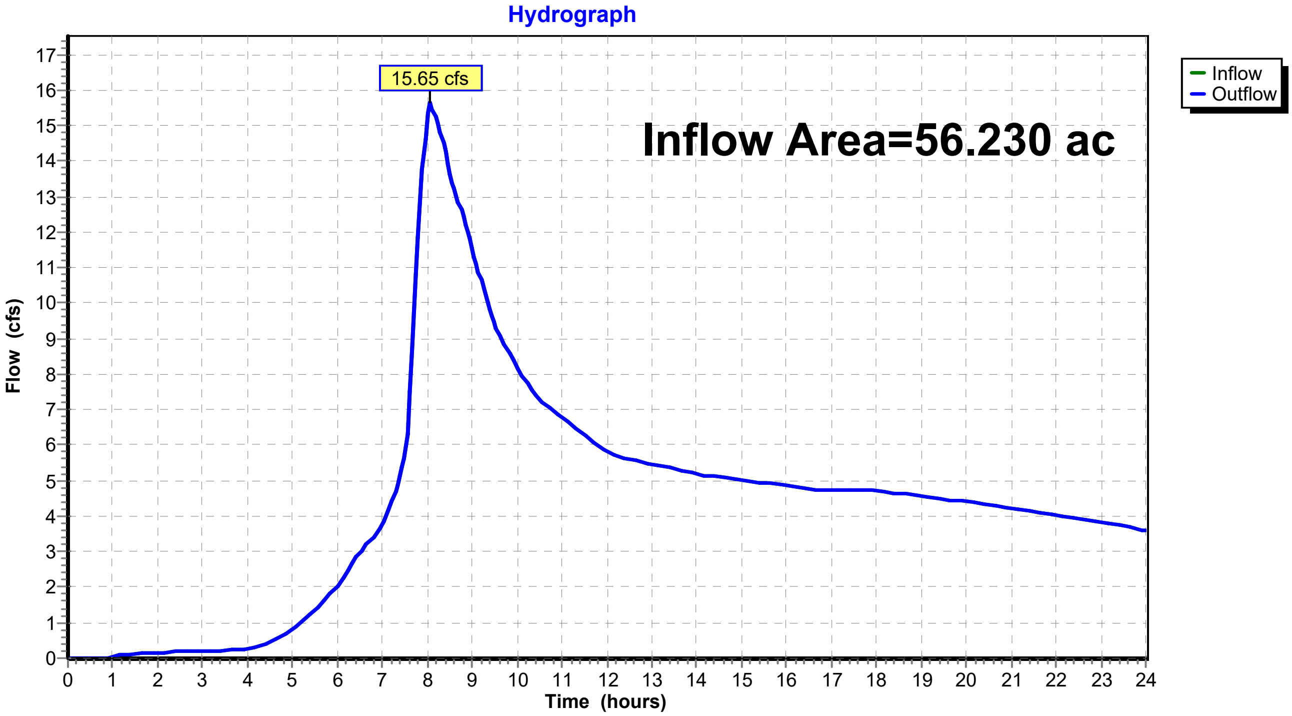


Exhibit A

Summary for Pond 1P: Pond

```
Inflow Area =       8.670 ac,  85.01% Impervious,  Inflow Depth >   3.39"    for  25-YEAR event
Inflow      =      7.30 cfs @    7.90 hrs,  Volume=          2.451 af
Outflow     =      0.46 cfs @   24.00 hrs,  Volume=          0.330 af,  Atten= 94%,  Lag= 965.7 min
Primary     =      0.46 cfs @   24.00 hrs,  Volume=          0.330 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 137.21' @ 24.00 hrs   Surf.Area= 23,403 sf   Storage= 92,372 cf

Plug-Flow detention time= 807.3 min calculated for 0.329 af (13% of inflow)
Center-of-Mass det. time= 368.0 min ( 1,040.2 - 672.1 )

Volume      Invert    Avail.Storage   Storage Description
   #1      132.00'       111,009 cf   Custom Stage Data (Prismatic)Listed below

 Elevation        Surf.Area        Inc.Store       Cum.Store
    (feet)          (sq-ft)     (cubic-feet)    (cubic-feet)
    132.00           13,337                0               0
    133.00           14,863           14,100          14,100
    134.00           16,432           15,648          29,748
    135.00           18,051           17,242          46,989
    136.00           19,718           18,885          65,874
    137.00           23,200           21,459          87,333
    138.00           24,152           23,676         111,009

Device   Routing          Invert   Outlet Devices
   #1    Primary         131.00'   18.0" Vert. 18" Pond Outlet  C= 0.620
   #2    Device 1        136.70'   4.2" Horiz. 5-year Orifice  C= 0.620
                                   Limited to weir flow at low heads
   #3    Device 1        137.25'   6.0" Horiz. 10/25-year Orifice  C= 0.620
                                   Limited to weir flow at low heads
   #4    Device 1        131.00'   1.3" Horiz. WQ Orifice   C= 0.620   Limited to weir flow at low heads
   #5    Device 4        132.00'   27.0" x 24.0" Horiz. WQ Inlet (Bottom)  C= 0.600
                                   Limited to weir flow at low heads
   #6    Device 1        137.99'   27.0" x 24.0" Horiz. Overflow Inlet (Top)  C= 0.600
                                   Limited to weir flow at low heads

Primary OutFlow Max=0.46 cfs @ 24.00 hrs  HW=137.21'  TW=0.00'   (Dynamic Tailwater)
└─1=18" Pond Outlet (Passes 0.46 cfs of 20.55 cfs potential flow)
   ├─2=5-year Orifice (Orifice Controls 0.34 cfs @ 3.56 fps)
   ├─3=10/25-year Orifice ( Controls 0.00 cfs)
   ├─4=WQ Orifice  (Orifice Controls 0.11 cfs @ 12.40 fps)
   │  └─5=WQ Inlet (Bottom) (Passes 0.11 cfs of 49.47 cfs potential flow)
   └─6=Overflow Inlet (Top) ( Controls 0.00 cfs)
```

Exhibit A

Pond 1P: Pond

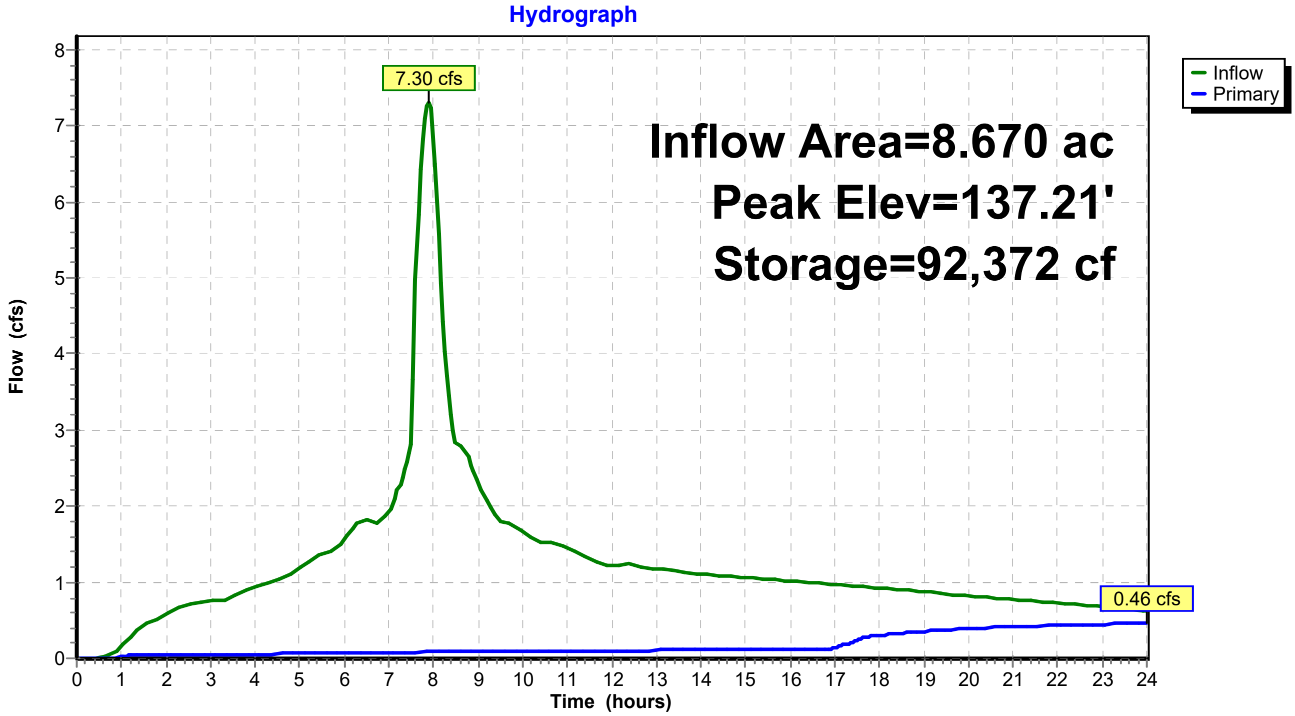


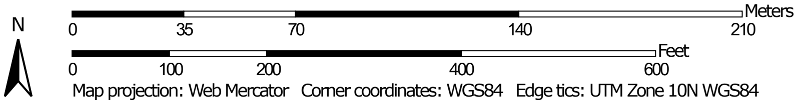
Exhibit A

Appendix B:
USDA – NRCS Soil Resource Report

Exhibit A

Soil Map—Washington County, Oregon

Map Scale: 1:2,370 if printed on A portrait (8.5" x 11") sheet.



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

Exhibit A

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 18, Jun 11, 2020

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

Date(s) aerial images were photographed: Aug 1, 2019—Sep 12, 2019

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.

Exhibit A

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
5B	Briedwell stony silt loam, 0 to 7 percent slopes	9.4	84.9%
13	Cove silty clay loam	0.9	8.3%
28B	Laurelwood silt loam, 3 to 7 percent slopes	0.8	6.8%
Totals for Area of Interest		**11.0**	**100.0%**

Exhibit A

Appendix C:
TR 55 Runoff Curve Numbers

Exhibit A

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

---

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Exhibit A

Appendix D:
Water Quality Calculations

Exhibit A

STORMWATER QUALITY CALCULATIONS

AKS ENGINEERING & FORESTRY, LLC | 12965 SW Herman Rd, Suite 100 | Tualatin, OR 97062
p: 503.563.6151 | f: 503.563.6152 | www.aks-eng.com

PROJECT
Polley Industrial Site

AKS JOB NO.
7971

DATE
5/12/2022

PREPARED FOR:
Oregon Street Business Park, LLC

ADDRESS
PO Box 1489

CITY/STATE/ZIP
Sherwood, OR 97140

PROJECT MANAGER:
JPC

PREPARED BY:
BDL

REVIEWED BY:
JPC

IMPERVIOUS AREA TABLE (Drains to Rock Creek)		
SUBCATCHMENT		**NET CHANGE (sq ft)**
Existing 1S(E) (ac)	**PROPOSED 1S(P) (ac)**	
0.63	7.640	7.01
***TOTAL**	7.640	

Note:
*Runoff generated on impervious area to be treated by new pond.

Exhibit A

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SUBCATCHMENT 1S(P)

IMPERVIOUS AREA USED IN DESIGN

Per CWS 4.05.5 - R&O 07-20

332,798 square feet

WATER QUALITY VOLUME (WQV)

Per CWS 4.05.6b - R&O 07-20

$$WQV = \frac{\text{0.36 in. X Area (sq ft.)}}{\text{12 in. per ft.}} =$$

9984 cubic feet

WATER QUALITY FLOW (WQF)

Per CWS 4.05.6b - R&O 07-20

$$WQF = \frac{\text{WQV (sf)}}{\text{14,400 seconds}} =$$

0.69 cubic feet per second

WATER QUALITY MANHOLE SUMP VOLUME CALCULATIONS

Per CWS 4.06.1b - R&O 07-20

CWS Criteria: Sump Volume = 20 cubic feet per 1.0 cfs of flow

Calculated 25-year Flow through WQ Manhole = **7** cubic feet per second

Calculated Manhole Sump Volume = **140** cubic feet

Calculated Manhole Sump Depth (60" dia. MH) = **7.1** feet **therefore sump = 5.0 ft.**

3 ft. minimum < Sump Depth < 5 ft. maximum

Exhibit A

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EXTENDED DRY BASIN WATER QUALITY FLOW DESIGN AND CALCULATIONS

Hydraulic Design Criteria (Per CWS 4.06.3 - R&O 07-20)

Design Flow: Water Quality Flow

Water Quality Drawdown Time: 48 hours

Maximum Water Design Depth: 4.0 feet

Minimum Freeboard: 1.0 foot (for facilities not protected from high flows)

48-HOUR WATER QUALITY DRAW DOWN RATE (Q):

Water Quality Volume Pond Depth = **0.50** feet

$$Q = \frac{\text{WQV (sf)}}{\text{172,800 seconds}} =$$ **0.058** cubic feet per second

ORIFICE SIZING

Diameter of Orifice

$$D = 24 \times \left[\frac{Q/(C[2gH]^{0.5})}{\pi}\right]^{0.5} =$$ **1.60** inches

ORIFICE SIZING ASSUMPTIONS:

Q	C	g	H*
(cfs)		(ft/s^2)	(ft)
0.058	0.62	32.2	0.7

Note:
* H is 2/3 of the temporary detention height to centerline of orifice

POND ELEVATIONS:

Top of Pond =	138.50	feet
Top of WQV Storage =	133.00	feet
Top of Dead Storage =	132.50	feet
Centerline of Orifice Elevation =	132.00	feet

25-YEAR STORM EVENT:

Peak Flow Elevation =	137.21	feet
Freeboard depth =	**1.29**	foot
Ponding depth =	4.71	feet
Total Pond Depth =	**6.00**	feet

Exhibit A

STORMWATER QUALITY CALCULATIONS

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EXTENDED DRY BASIN VOLUME

Contour Elevation (Feet)	Contour Area (SF)	Average Area (SF)	Contour Interval (Feet)	Incremental Volume (CF)	Cumulative Volume (CF)	
132.00	13,337			0	0	
		13,717	0.5			
132.5	14,096			6,859	6,859	
		14,480	0.5			
133.00	14,863			7,240	14,099	Top of WQV
		15,648	1.0			
134.0	16,432			15,648	29,747	
		17,242	1.0			
135.0	18,051			17,242	46,989	
		18,885	1.0			
136.0	19,718			18,885	65,874	
		20,576	1.0			
137.0	21,434			20,576	86,450	
		22,317	1.0			
138.0	23,200			22,317	108,767	
		23,676	0.5			
138.5	24,152			11,838	120,605	

Exhibit A

Appendix E:
Geotechnical Report

Exhibit A

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

June 22, 2020
Project No. 20-5500

Bruce Polley
21720 SW Oregon Street
Sherwood, Oregon 97140
Via email: bruce@airteknw.com

SUBJECT: GEOTECHNICAL ENGINEERING REPORT
PROPOSED COMMERCIAL DEVELOPMENT
21720 SW OREGON STREET
SHERWOOD, OREGON

This report presents the results of a geotechnical engineering study conducted by GeoPacific Engineering, Inc. (GeoPacific) for the above-referenced project. The purpose of our investigation was to evaluate subsurface conditions at the site and to provide geotechnical recommendations for site development. This geotechnical study was performed in accordance with GeoPacific Proposal No. P-7334, dated May 4, 2020 and your subsequent authorization of our proposal and *General Conditions for Geotechnical Services*.

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The subject site is located to the southeast of the intersection of SW Oregon Street and SW Tonquin Road in the City of Sherwood, Washington County, Oregon (Figures 1 & 2). The site is approximately 8.5 acres in size. Topography on the site generally slopes down to the east at average grades of 15 percent or less. The property is currently occupied by a single family residence and a separate shop building. Both structures are located in the north-central portion of the site and are accessed by a driveway on SW Oregon Street. Vegetation consists of grass pasture and dense to sparse trees.

We understand that plans for site development consist of the construction of four new industrial buildings, parking areas, driving lanes, stormwater management facility, and associated underground utilities. The structures will likely be supported by a spread footing foundation incorporating a slab-on-grade. Plans for site development have not yet been finalized, but we anticipate cuts and fills of 10 feet or less.

REGIONAL AND LOCAL GEOLOGIC SETTING

Regionally, the subject site lies within the Willamette Valley/Puget Sound lowland, a broad structural depression situated between the Coast Range on the west and the Cascade Range on the east. A series of discontinuous faults subdivide the Willamette Valley into a mosaic of faultbounded, structural blocks (Yeats et al., 1996). Uplifted structural blocks form bedrock highlands, while down-warped structural blocks form sedimentary basins.

The site is underlain by the Quaternary age (last 1.6 million years) Willamette Formation, a catastrophic flood deposit associated with repeated glacial outburst flooding of the Willamette Valley (Schlicker and Deacon, 1967; Yeats et al., 1996). The last of these outburst floods occurred about 10,000 years ago. In this vicinity, these flood deposits consist of coarse grained deposits typically consisting of pebbles and boulders in a silty matrix and fine grained deposits consisting of silt (Schlicker and Deacon, 1967; Beeson et al., 1989).

The catastrophic flood deposits are underlain by the Columbia River Basalt Formation (Schlicker and Deacon, 1967; Gannett and Caldwell, 1998). In the central and southern portions of the site, the Columbia River Basalt Formation is near the ground surface. The Miocene aged (about 14.5 to 16.5 million years ago) Columbia River Basalts are a thick sequence of lava flows which form the crystalline basement of the Tualatin Valley. The basalts are composed of dense, finely crystalline rock that is commonly fractured along blocky and columnar vertical joints. Individual basalt flow units typically range from 25 to 125 feet thick and interflow zones are typically vesicular, scoriaceous, brecciated, and sometimes include sedimentary rocks.

REGIONAL SEISMIC SETTING

At least three potential source zones capable of generating damaging earthquakes are thought to exist in the region. These include the Portland Hills Fault Zone, the Gales Creek-Newberg-Mt. Angel Structural Zone, and the Cascadia Subduction Zone, as discussed below.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that include the central Portland Hills Fault, the western Oatfield Fault, and the eastern East Bank Fault. These faults occur in a northwest-trending zone that varies in width between 3.5 and 5.0 miles. The combined three faults vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years) sediment (Madin, 1990). The Portland Hills Fault occurs along the Willamette River at the base of the Portland Hills, and is approximately 11 miles northeast of the site. The East Bank Fault occurs along the eastern margin of the Willamette River, and is approximately 14 miles northeast of the site. The Oatfield Fault occurs along the western side of the Portland Hills, and is approximately 9 miles northeast of the site. The accuracy of the fault mapping is stated to be within 500 meters (Wong, et al., 2000). No historical seismicity is correlated with the mapped portion of the Portland Hills Fault Zone, but in 1991 a M3.5 earthquake occurred on a NW-trending shear plane located 1.3 miles east of the fault (Yelin, 1992). Although there is no definitive evidence of recent activity, the Portland Hills Fault Zone is assumed to be potentially active (Geomatrix Consultants, 1995).

Gales Creek-Newberg-Mt. Angel Structural Zone

The Gales Creek-Newberg-Mt. Angel Structural Zone is a 50-mile-long zone of discontinuous, NW-trending faults that lies approximately 8.4 miles southwest of the subject site. These faults are recognized in the subsurface by vertical separation of the Columbia River Basalt and offset seismic reflectors in the overlying basin sediment (Yeats et al., 1996; Werner et al., 1992). A geologic reconnaissance and photogeologic analysis study conducted for the Scoggins Dam site in the Tualatin Basin revealed no evidence of deformed geomorphic surfaces along the structural zone (Unruh et al., 1994). No seismicity has been recorded on the Gales Creek Fault or Newberg Fault;

however, these faults are considered to be potentially active because they may connect with the seismically active Mount Angel Fault and the rupture plane of the 1993 M5.6 Scotts Mills earthquake (Werner et al. 1992; Geomatrix Consultants, 1995).

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year (Goldfinger et al., 1996). A growing body of geologic evidence suggests that prehistoric subduction zone earthquakes have occurred (Atwater, 1992; Carver, 1992; Peterson et al., 1993; Geomatrix Consultants, 1995). This evidence includes: (1) buried tidal marshes recording episodic, sudden subsidence along the coast of northern California, Oregon, and Washington, (2) burial of subsided tidal marshes by tsunami wave deposits, (3) paleoliquefaction features, and (4) geodetic uplift patterns on the Oregon coast. Radiocarbon dates on buried tidal marshes indicate a recurrence interval for major subduction zone earthquakes of 250 to 650 years with the last event occurring 300 years ago (Atwater, 1992; Carver, 1992; Peterson et al., 1993; Geomatrix Consultants, 1995). The inferred seismogenic portion of the plate interface lies approximately 50 miles west of the Portland Basin at depths of between 20 and 40 kilometers below the surface.

FIELD EXPLORATION

Our site-specific exploration for this report was conducted on May 14, 2020. Nine exploratory test pits were excavated with a medium sized backhoe to depths ranging between 1 and 13 feet at the approximate locations presented on Figure 2. On May 26, 2020, seven hand auger borings were performed with hand equipment to depths of 1 to 5 feet, as presented on Figure 2. It should be noted that exploration locations were located in the field by pacing or taping distances from apparent property corners and other site features shown on the plans provided. As such, the locations of the explorations should be considered approximate.

A GeoPacific Engineering Geologist continuously monitored the field exploration program and logged the explorations. Soils observed were classified in general accordance with the Unified Soil Classification System (USCS). Rock hardness was classified in accordance with Table 1, modified from the ODOT Rock Hardness Classification Chart. During exploration, our geologist also noted geotechnical conditions such as soil consistency, moisture and groundwater conditions. Logs of the test pits and hand auger borings are attached to this report. The following report sections are based on the exploration program and summarize subsurface conditions encountered at the site.

Table 1. Rock Hardness Classification Chart

ODOT Rock Hardness Rating	Field Criteria	Unconfined Compressive Strength	Typical Equipment Needed For Excavation
Extremely Soft (R0)	Indented by thumbnail	<100 psi	Small excavator
Very Soft (R1)	Scratched by thumbnail, crumbled by rock hammer	100-1,000 psi	Small excavator
Soft (R2)	Not scratched by thumbnail, indented by rock hammer	1,000-4,000 psi	Medium excavator (slow digging with small excavator)
Medium Hard (R3)	Scratched or fractured by rock hammer	4,000-8,000 psi	Medium to large excavator (slow to very slow digging), typically requires chipping with hydraulic hammer or mass excavation)
Hard (R4)	Scratched or fractured w/ difficulty	8,000-16,000 psi	Slow chipping with hydraulic hammer and/or blasting
Very Hard (R5)	Not scratched or fractured after many blows, hammer rebounds	>16,000 psi	Blasting

Undocumented Fill: Undocumented fill was encountered at the ground surface in test pit TP-9. The fill generally consisted of abundant inorganic debris (concrete, bricks, fabric) in a silty GRAVEL (GM) matrix that extended to a depth of 6.5 feet. The fill was loose to medium dense and significant caving of the sidewalls was observed. Topography indicates additional fill is present in the vicinity of the shop building, as presented on Figure 2. It is likely that other areas of undocumented fill may exist in the vicinity of the existing structures.

Topsoil Horizon: The ground surface in test pits TP-1 through TP-8 and hand auger borings HA-1 through HA-7 was directly underlain by a topsoil horizon generally consisting of brown, moderately to highly organic silt (ML-OL). Generally, the topsoil horizon was loose, contained fine roots throughout, and extended to a depth of approximately 7 to 12 inches below the ground surface.

Catastrophic Flood Deposits (Willamette Formation):

Fine Grained: Underlying the topsoil horizon in test pits TP-1, TP-2, TP-4 through TP-8 and hand auger borings HA-1 through HA-3, HA-5, and HA-7 and the undocumented fill in test pit TP-9 was fine grained catastrophic flood deposits. These soils generally consisted of light brown clayey silt (ML) that typically had a stiff to very stiff consistency. Test pits TP-1 and TP-2 encountered additional fine grained flood deposits beneath the coarse grained deposits. Fine grained catastrophic flood deposits extended to depths of approximately 1.5 to 9 feet in test pits TP-4 through TP-8 and beyond the maximum depth of exploration in test pits TP-1, TP-2, and TP-9.

Coarse Grained: In test pits TP-1, TP-2, TP-4 through TP-6, and TP-8 and hand auger borings HA-1 through HA-3, HA-5, and HA-7, the fine grained flood deposits were underlain by coarse

Exhibit A

grained flood deposits. In explorations, these soils typically consisted of silty GRAVEL, COBBLES, and BOULDERS (GM) that had a dense to very dense relative density. In test pits TP-1, TP-2, TP-4, TP-5, and TP-7, the coarse grained flood deposits extended to depths of 8.5 to 11 feet. Practical refusal was achieved in hand auger borings HA-1 through HA-3, HA-5, and HA-7 and with a medium sized backhoe equipped with rock teeth was achieved on very dense flood deposits in test pit TP-6 and TP-8 at a depth of 10 feet. In our test pits we observed boulders up to 30 inches in diameter. It is possible that larger boulders are present on the site in areas outside our explorations.

Peat Deposit: A deposit of PEAT (PT) was encountered beneath the fine grained flood deposits in test pit TP-7. The highly organic peat was approximately 1 foot in thickness in test pit TP-7 and extended from a depth of 9 to 10 feet. Laboratory testing indicates the peat soils have an organic content of 14.3 percent. The results of laboratory testing are attached at the end of this report.

Columbia River Basalt Formation: Basalt bedrock belonging to the Columbia River Basalt Formation was encountered beneath the topsoil horizon in test pit TP-3 and hand auger borings HA-4 and HA-6 and the coarse grained flood deposits in test pits TP-4, TP-5, and TP-7. In our explorations, the gray rock contained trace silty clay to clayey silt matrix and was weathered to very soft (R1) to hard (R4) according to the ODOT Rock Hardness Chart (Table 1). Basalt belonging to the Columbia River Basalt Formation extended beyond the maximum depth of exploration in test pits TP-5 (11 feet) and TP-7 (13 feet). Practical refusal on hard (R4) basalt was achieved at 1 foot in test pit TP-3 and hand augers HA-4 and HA-6 and at 8.5 feet in test pit TP-4.

Soil Moisture and Groundwater

On May 14 and 26, 2020, soils encountered in our explorations were damp to wet. Perched groundwater seepage was encountered in test pits TP-4, TP-6, TP-7 and hand auger borings HA-1, HA-2, and HA-7 at depths of 1.5 to 9 feet. Discharge was visually estimated at less than ¼ gallon per minute to ½ gallon per minute. Static groundwater was not encountered in explorations to a maximum depth of 13 feet. Experience has shown that temporary perched storm-related groundwater conditions often occur within the surface soils over fine-grained native deposits such as those beneath the site, particularly during the wet season. It is anticipated that groundwater conditions will vary depending on the season, local subsurface conditions, changes in site utilization, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

Our investigation indicates that the proposed development is geotechnically feasible, provided that the recommendations of this report are incorporated into the design and construction phases of the project. In our opinion, the primary geotechnical issues for the proposed development include:

1) The presence of undocumented fill in the central portion of the site. Up to 6.5 feet of fill was encountered in test pit TP-9 and topography indicates other fill is present in the vicinity of the existing shop building. Existing fill should be removed and replaced with engineered fill as described in the following *Site Preparation* and *Engineered Fill* sections.

2) The potential to encounter very dense flood boulders and hard, basalt bedrock. Practical refusal on hard (R4) basalt bedrock was achieved with a medium sized backhoe equipped with rock teeth at a depth of 1 foot in test pit TP-3 and 8.5 feet in test pit TP-4. Practical refusal on very dense flood deposit boulders was achieved at a depth of 10 feet in test pits

Exhibit A

TP-6 and TP-8. The hard basalt bedrock and very dense flood boulders could hamper deep excavations (such as for utility trenching). Contractors should be prepared to manage difficult excavation conditions and budget accordingly. The presence of cobbles and boulders may also complicate reuse of the native soils as engineered fill material. Reuse of the native coarse grained flood deposit soils may require sorting operations under the supervision of GeoPacific.

3) The potential to encounter peat soils. Highly organic peat was encounter at depths of 9 to 10 feet in test pit TP-7. Hand auger explorations conducted in the vicinity of test pit TP-7 did not encountered peat soils indicating that the peat layer does not extend significantly north, south, or east from test pit TP-7. However, we recommend that the extent of the peat soils be evaluated further in the field by potholing during construction in an effort to verify that peat is not present within the influence zone of the building. If peat soils are encountered within the influence zones of proposed structures during construction, removal and backfill with engineered fill material may be necessary.

Site Preparation

Areas of proposed buildings, streets, and areas to receive fill should be cleared of vegetation and any organic and inorganic debris. Existing fill should be completely removed. Undocumented fill was encountered in test pit TP-9 and extended to a depth of approximately 6.5 feet. Topography indicated additional fill may be present in the vicinity of test pit TP-9, as presented on Figure 2. It is likely that other areas of fill are present in the vicinity of the existing structures and driveway. Existing buried structures such as septic tanks, should be demolished and any cavities structurally backfilled. Inorganic debris should be removed from the site.

Organic-rich topsoil should then be stripped from native soil areas of the site. Depth of stripping of existing topsoil is estimated to be approximately 6 to 9 inches across the majority of the site. The final depth of soil removal will be determined on the basis of a site inspection after the stripping/excavation has been performed. Stripped topsoil should preferably be removed from the site due to the high density of the proposed development. Any remaining topsoil should be stockpiled only in designated areas and stripping operations should be observed and documented by the geotechnical engineer or his representative.

Once topsoil stripping and removal of organic and inorganic debris is approved in a particular area, the area must be ripped or tilled to a depth of 12 inches, moisture conditioned, root-picked, and compacted in-place prior to the placement of engineered fill or crushed aggregate base for pavement. Exposed subgrade soils should be evaluated by the geotechnical engineer. For large areas, this evaluation is normally performed by proof-rolling the exposed subgrade with a fully loaded scraper or dump truck. For smaller areas where access is restricted, the subgrade should be evaluated by probing the soil with a steel probe. Soft/loose soils identified during subgrade preparation should be compacted to a firm and unyielding condition, over-excavated and replaced with engineered fill (as described below) or stabilized with rock prior to placement of engineered fill. The depth of overexcavation, if required, should be evaluated by the geotechnical engineer at the time of construction.

Engineered Fill

All grading for the proposed construction should be performed as engineered grading in accordance with the applicable building code at time of construction with the exceptions and additions noted herein. Proper test frequency and earthwork documentation usually requires daily observation and testing during stripping, rough grading, and placement of engineered fill. Imported fill material must be approved by the geotechnical engineer prior to being imported to the site. Oversize material greater than 6 inches in size should not be used within 3 feet of foundation footings, and material greater than 12 inches in diameter should not be used in engineered fill.

Engineered fill should be compacted in horizontal lifts not exceeding 8 inches using standard compaction equipment. We recommend that engineered fill be compacted to at least 95% of the maximum dry density determined by ASTM D698 (Standard Proctor) or equivalent. Field density testing should conform to ASTM D2922 and D3017, or D1556. All engineered fill should be observed and tested by the project geotechnical engineer or his representative. Typically, one density test is performed for at least every 2 vertical feet of fill placed or every 500 yd^3, whichever requires more testing. Because testing is performed on an on-call basis, we recommend that the earthwork contractor be held contractually responsible for test scheduling and frequency.
Site earthwork will be impacted by soil moisture and shallow groundwater conditions. Earthwork in wet weather would likely require extensive use of cement or lime treatment, or other special measures, at considerable additional cost compared to earthwork performed under dry-weather conditions.

Excavating Conditions and Utility Trenches

We anticipate that on-site soils can be excavated using conventional heavy equipment such as trackhoes to a depth of at least 13 feet; however practical refusal on hard (R4) basalt bedrock was achieved with a medium sized backhoe at a depth of 1 foot in test pit TP-3 and 8.5 feet in test pit TP-4. Practical refusal on very dense flood deposit boulders was achieved at a depth of 10 feet in test pits TP-6 and TP-8. Difficult excavating conditions especially for utility trenching should be expected. The selected contractor for site development should be prepared for encountering very dense boulders and hard rock conditions.

All temporary cuts in excess of 4 feet in height should be sloped in accordance with U.S. Occupational Safety and Health Administration (OSHA) regulations (29 CFR Part 1926), or be shored. The existing near surface native soil is classified as Type B Soils and temporary excavation side slope inclinations as steep as 1H:1V may be assumed for planning purposes. This cut slope inclination is applicable to excavations above the water table only. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. Actual slope inclinations at the time of construction should be determined based on safety requirements and actual soil and groundwater conditions.

Saturated soils and groundwater may be encountered in utility trenches, particularly during the wet season. We anticipate that dewatering systems consisting of ditches, sumps and pumps would be adequate for control of perched groundwater. Regardless of the dewatering system used, it should be installed and operated such that in-place soils are prevented from being removed along with the groundwater.

Vibrations created by traffic and construction equipment may cause some caving and raveling of excavation walls. In such an event, lateral support for the excavation walls should be provided by the contractor to prevent loss of ground support and possible distress to existing or previously constructed structural improvements.

PVC pipe should be installed in accordance with the procedures specified in ASTM D2321. We recommend that trench backfill be compacted to at least 95% of the maximum dry density obtained by Standard Proctor ASTM D698 or equivalent. Initial backfill lift thickness for a ¾”-0 crushed aggregate base may need to be as great as 4 feet to reduce the risk of flattening underlying flexible pipe. Subsequent lift thickness should not exceed 1 foot. If imported granular fill material is used, then the lifts for large vibrating plate-compaction equipment (e.g. hoe compactor attachments) may be up to 2 feet, provided that proper compaction is being achieved and each lift is tested. Use of large vibrating compaction equipment should be carefully monitored near existing structures and improvements due to the potential for vibration-induced damage.

Adequate density testing should be performed during construction to verify that the recommended relative compaction is achieved. Typically, one density test is taken for every 4 vertical feet of backfill on each 200-lineal-foot section of trench.

Erosion Control Considerations

During our field exploration program, we did not observe soil types that would be considered highly susceptible to erosion. In our opinion, the primary concern regarding erosion potential will occur during construction, in areas that have been stripped of vegetation. Erosion at the site during construction can be minimized by implementing the project erosion control plan, which should include judicious use of straw wattles and silt fences. If used, these erosion control devices should be in place and remain in place throughout site preparation and construction.

Erosion and sedimentation of exposed soils can also be minimized by quickly re-vegetating exposed areas of soil, and by staging construction such that large areas of the project site are not denuded and exposed at the same time. Areas of exposed soil requiring immediate and/or temporary protection against exposure should be covered with either mulch or erosion control netting/blankets. Areas of exposed soil requiring permanent stabilization should be seeded with an approved grass seed mixture, or hydroseeded with an approved seed-mulch-fertilizer mixture.

Wet Weather Earthwork

Soils underlying the site are likely to be moisture sensitive and may be difficult to handle or traverse with construction equipment during periods of wet weather. Earthwork is typically most economical when performed under dry weather conditions. Earthwork performed during the wet-weather season will probably require expensive measures such as cement treatment or imported granular material to compact fill to the recommended engineering specifications. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions when soil moisture content is difficult to control, the following recommendations should be incorporated into the contract specifications.

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean engineered fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance. Under some circumstances, it may be necessary to excavate soils with a backhoe to minimize subgrade disturbance caused by equipment traffic;
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water;
- Material used as engineered fill should consist of clean, granular soil containing less than 5 percent fines. The fines should be non-plastic. Alternatively, cement treatment of on-site soils may be performed to facilitate wet weather placement;
- The ground surface within the construction area should be sealed by a smooth drum vibratory roller, or equivalent, and under no circumstances should be left uncompacted and exposed to

Exhibit A

moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials;

- Excavation and placement of fill should be observed by the geotechnical engineer to verify that all unsuitable materials are removed and suitable compaction and site drainage is achieved; and
- Geotextile silt fences, straw wattles, and fiber rolls should be strategically located to control erosion.

If cement or lime treatment is used to facilitate wet weather construction, GeoPacific should be contacted to provide additional recommendations and field monitoring.

Structural Foundations

Based on our understanding of the proposed project and the results of our exploration program, and assuming our recommendations for site preparation are followed, native deposits or engineered fill are anticipated to be encountered at or near the foundation level of the proposed structure. These soils are generally stiff to dense and should provide adequate support of the structural loads; however, approximately 6.5 feet of undocumented fill was encountered at the ground surface in test pit TP-9 which was located near a large shop building. Topography indicates more fill is present in the vicinity of the shop building, as presented on Figure 2. These fill areas should be removed beneath structural areas and replaced with engineered fill. Peat soils were encountered at depths of 9 to 10 feet in test pit TP-7. Supplemental hand auger borings conducted in the vicinity of test pit TP-7 did not encounter peat soil. However, we recommend that the extent of the peat soils be evaluated further in the field during construction in an effort to verify that peat is not present within the influence of the building. GeoPacific should be contacted for further recommendations if additional areas of peat are encountered.

The allowable soil bearing capacity for spread or continuous foundations bearing on competent, unimproved, native soil and/or engineered fill is 2,000 psf with a coefficient of subgrade reaction of 150 kcf (87 pci). Higher allowable bearing pressures may be possible if the subgrade is overexcavated and compacted base rock is placed underneath the footings. If higher allowable bearing capacities are desired, GeoPacific may be consulted to provide additional recommendations.

The recommended maximum allowable bearing pressure may be increased by 1/3 for short-term transient conditions such as wind and seismic loading. The maximum anticipated total and differential footing movements under static loading conditions are 1 inch and ¾ inch over a span of 20 feet, respectively. We anticipate that the majority of the estimated settlement will occur during construction, as loads are applied. Excavations near structural footings should not extend within a 1H:1V plane projected downward from the bottom edge of footings.

Wind, earthquakes, and unbalanced earth loads will subject the proposed structure to lateral forces. Lateral forces on a structure will be resisted by a combination of sliding resistance of its base or footing on the underlying soil and passive earth pressure against the buried portions of the structure. For use in design, a coefficient of friction of 0.42 may be assumed along the interface between the base of the footing and subgrade soils. Passive earth pressure for buried portions of structures may be calculated using an equivalent fluid weight of 320 pounds per cubic foot (pcf), assuming footings are cast against native soils or engineered fill. The recommended coefficient of friction and passive earth pressure values do not include a safety factor. The upper 12 inches of soil should be neglected in passive pressure computations unless it is protected by pavement or slabs on grade.

Footing excavations should be trimmed neat and the bottom of the excavation should be carefully prepared. Loose, wet or otherwise softened soil should be removed from the footing excavation prior to placing reinforcing steel bars. The above foundation recommendations are for dry weather conditions. Due to the high moisture sensitivity of on-site soils, construction during wet weather may require additional overexcavation of footings and backfill with compacted, crushed aggregate. GeoPacific should observe foundation excavations prior to placing formwork and reinforcing steel, to verify that adequate bearing soils have been reached.

We recommend a minimum thickness of 12 inches of 1½”-0 crushed aggregate beneath the slab. The total thickness of crushed aggregate will be dependent on the subgrade conditions at the time of construction and should be verified visually by proof-rolling. Under-slab aggregate should be compacted to at least 90 percent of its maximum dry density as determined by ASTM D1557 (Modified Proctor) or equivalent.

In areas where moisture will be detrimental to floor coverings or equipment inside the proposed structure, appropriate vapor barrier and damp-proofing measures should be implemented. Appropriate design professionals should be consulted regarding vapor barrier and damp proofing systems, ventilation, building material selection and mold prevention issues, which are outside GeoPacific’s area of expertise.

Concrete Slabs-on-Grade

Preparation of areas beneath concrete slab-on-grade floors should be performed as recommended in the *Site Preparation and Undocumented Fill Removal* section. Care should be taken during excavation for foundations and floor slabs, to avoid disturbing subgrade soils. If subgrade soils have been adversely impacted by wet weather or otherwise disturbed, the surficial soils should be scarified to a minimum depth of 8 inches, moisture conditioned to within about 3 percent of optimum moisture content and compacted to engineered fill specifications. Alternatively, disturbed soils may be removed and the removal zone backfilled with additional crushed rock.

For evaluation of the concrete slab-on-grade floors using the beam on elastic foundation method, a modulus of subgrade reaction of 150 kcf (87 pci) should be assumed for the medium stiff native silt soils anticipated at subgrade depth. This value assumes the concrete slab system is designed and constructed as recommended herein, with a minimum thickness of crushed rock of 8 inches beneath the slab.

Interior slab-on-grade floors should be provided with an adequate moisture break. The capillary break material should consist of ODOT open graded aggregate per ODOT Standard Specifications 02630-2. The minimum recommended thickness of capillary break materials on re-compacted soil subgrade is 8 inches. The total thickness of crushed aggregate will be dependent on the subgrade conditions at the time of construction, and should be verified visually by proof-rolling. Under-slab aggregate should be compacted to at least 90% of its maximum dry density as determined by ASTM D1557 or equivalent.

In areas where moisture will be detrimental to floor coverings or equipment inside the proposed structure, appropriate vapor barrier and damp-proofing measures should be implemented. A commonly applied vapor barrier system consists of a 10-mil polyethylene vapor barrier placed directly over the capillary break material. Other damp/vapor barrier systems may also be feasible. Appropriate design professionals should be consulted regarding vapor barrier and damp proofing systems, ventilation, building material selection and mold prevention issues, which are outside GeoPacific’s area of expertise.

Permanent Below-Grade Walls

Lateral earth pressures against below-grade retaining walls will depend upon the inclination of any adjacent slopes, type of backfill, degree of wall restraint, method of backfill placement, degree of backfill compaction, drainage provisions, and magnitude and location of any adjacent surcharge loads. At-rest soil pressure is exerted on a retaining wall when it is restrained against rotation. In contrast, active soil pressure will be exerted on a wall if its top is allowed to rotate or yield a distance of roughly 0.001 times its height or greater.

If the subject retaining walls will be free to rotate at the top, they should be designed for an active earth pressure equivalent to that generated by a fluid weighing 35 pcf for level backfill against the wall. For restrained wall, an at-rest equivalent fluid pressure of 55 pcf should be used in design, again assuming level backfill against the wall. These values assume that drainage provisions are incorporated, free draining gravel backfill is used, and hydrostatic pressures are not allowed to develop against the wall.

During a seismic event, lateral earth pressures acting on below-grade structural walls will increase by an incremental amount that corresponds to the earthquake loading. Based on the Mononobe-Okabe equation and peak horizontal accelerations appropriate for the site location, seismic loading should be modeled using the active or at-rest earth pressures recommended above, plus an incremental rectangular-shaped seismic load of magnitude 6.5H, where H is the total height of the wall.

We assume relatively level ground surface below the base of the walls. As such, we recommend passive earth pressure of 320 pcf for use in design, assuming wall footings are cast against competent native soils or engineered fill. If the ground surface slopes down and away from the base of any of the walls, a lower passive earth pressure should be used and GeoPacific should be contacted for additional recommendations.

A coefficient of friction of 0.42 may be assumed along the interface between the base of the wall footing and subgrade soils. The recommended coefficient of friction and passive earth pressure values do not include a safety factor, and an appropriate safety factor should be included in design. The upper 12 inches of soil should be neglected in passive pressure computations unless it is protected by pavement or slabs on grade.

The above recommendations for lateral earth pressures assume that the backfill behind the subsurface walls will consist of properly compacted structural fill, and no adjacent surcharge loading. If the walls will be subjected to the influence of surcharge loading within a horizontal distance equal to or less than the height of the wall, the walls should be designed for the additional horizontal pressure. For uniform surcharge pressures, a uniformly distributed lateral pressure of 0.3 times the surcharge pressure should be added. Traffic surcharges may be estimated using an additional vertical load of 250 psf (2 feet of additional fill), in accordance with local practice.

The recommended equivalent fluid densities assume a free-draining condition behind the walls so that hydrostatic pressures do not build-up. This can be accomplished by placing a 12 to 18-inch wide zone of sand and gravel containing less than 5 percent passing the No. 200 sieve against the walls. A 3-inch minimum diameter perforated, plastic drain pipe should be installed at the base of the walls and connected to a suitable discharge point to remove water in this zone of sand and gravel. The drain pipe should be wrapped in filter fabric (Mirafi 140N or other as approved by the geotechnical engineer) to minimize clogging.

Exhibit A

Wall drains are recommended to prevent detrimental effects of surface water runoff on foundations – not to dewater groundwater. Drains should not be expected to eliminate all potential sources of water entering a basement or beneath a slab-on-grade. An adequate grade to a low point outlet drain in the crawlspace is required by code. Underslab drains are sometimes added beneath the slab when placed over soils of low permeability and shallow, perched groundwater.

Water collected from the wall drains should be directed into the local storm drain system or other suitable outlet. A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. Down spouts and roof drains should not be connected to the wall drains in order to reduce the potential for clogging. The drains should include clean-outs to allow periodic maintenance and inspection. Grades around the proposed structure should be sloped such that surface water drains away from the building.

GeoPacific should be contacted during construction to verify subgrade strength in wall keyway excavations, to verify that backslope soils are in accordance with our assumptions, and to take density tests on the wall backfill materials.

Structures should be located a horizontal distance of at least 1.5H away from the back of the retaining wall, where H is the total height of the wall. GeoPacific should be contacted for additional foundation recommendations where structures are located closer than 1.5H to the top of any wall.

Pavement Design

For design purposes, we used an estimated resilient modulus of 6,000 for compacted native soil or engineered fill. Table 2 presents our recommended minimum pavement section for dry weather construction.

Table 2. Recommended Minimum Dry-Weather Pavement Section

Material Layer	Light Duty Public Streets	Compaction Standard
Asphaltic Concrete (AC)	3 in.	92% of Rice Density AASHTO T-209
Crushed Aggregate Base ¾”-0 (leveling course)	2 in.	95% of Modified Proctor AASHTO T-180
Crushed Aggregate Base 1½”-0	8 in.	95% of Modified Proctor AASHTO T-180
Subgrade	12 in.	90% of Modified Proctor AASHTO T-180 or equivalent

Any pockets of organic debris or loose fill encountered during ripping or tilling should be removed and replaced with engineered fill (see *Site Preparation* Section). In order to verify subgrade strength, we recommend proof-rolling directly on subgrade with a loaded dump truck during dry weather and on top of base course in wet weather. Soft areas that pump, rut, or weave should be stabilized prior to paving. If pavement areas are to be constructed during wet weather, the subgrade and construction plan should be reviewed by the project geotechnical engineer at the time of construction so that condition specific recommendations can be provided. The moisture sensitive subgrade soils make the site a difficult wet weather construction project.

During placement of pavement section materials, density testing should be performed to verify compliance with project specifications. Generally, one subgrade, one base course, and one asphalt compaction test is performed for every 100 to 200 linear feet of paving.

Drains

The outside edge of perimeter walls should be provided with a drainage system consisting of 3-inch diameter, slotted, flexible plastic pipe embedded in a minimum of 1 ft^3 per lineal foot of clean, free-draining gravel or 1 1/2" - 3/4" drain rock. The drain pipe and surrounding drain rock should be wrapped in non-woven geotextile (Mirafi 140N, or approved equivalent) to minimize the potential for clogging and/or ground loss due to piping. Water collected from the footing drains should be directed into the local storm drain system or other suitable outlet. A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. Down spouts and roof drains should not be connected to the foundation drains in order to reduce the potential for clogging. The footing drains should include clean-outs to allow periodic maintenance and inspection. Grades around the proposed structure should be sloped such that surface water drains away from the building.

Footing drains are recommended to prevent detrimental effects of surface water runoff on foundations – not to dewater groundwater. Footing drains should not be expected to eliminate all potential sources of water entering a basement or beneath a slab-on-grade. An adequate grade to a low point outlet drain in the crawlspace is required by code. Underslab drains are sometimes added beneath the slab when placed over soils of low permeability and shallow, perched groundwater.

Seismic Design

The Oregon Department of Geology and Mineral Industries (Dogami), Oregon HazVu: 2020 Statewide GeoHazards Viewer indicates that the site is in an area where *very strong* to *severe* ground shaking is anticipated during an earthquake (Dogami HazVu, 2020). Structures should be designed to resist earthquake loading in accordance with the methodology described in the 2015 International Building Code (IBC) with applicable Oregon Structural Specialty Code (OSSC) revisions (current 2014). We recommend Site Class D be used for design as defined in ASCE 7, Chapter 20, Table 20.3-1. Design values determined for the site using the ATC (Applied Technology Council) *ASCE7-10 Hazards by Location online Tool* website are summarized in Table 3.

Table 3. Recommended Earthquake Ground Motion Parameters (IBC-2015)

Parameter	Value
Location (Lat, Long), degrees	45.361, -122.822
Mapped Spectral Acceleration Values (MCE):	
Peak Ground Acceleration PGA_M	0.449 g
Short Period, S_s	0.940 g
1.0 Sec Period, S_1	0.418 g
Soil Factors for Site Class D:	
F_a	1.124
F_v	1.582
$SD_s = 2/3 \times F_a \times S_s$	0.704 g
$SD_1 = 2/3 \times F_v \times S_1$	0.441 g
Seismic Design Category	D

Soil Liquefaction

Soil liquefaction is a phenomenon wherein saturated soil deposits temporarily lose strength and behave as a liquid in response to earthquake shaking. Soil liquefaction is generally limited to loose, granular soils located below the water table. The Oregon Department of Geology and Mineral Industries (DOGAMI), Oregon HazVu: 2020 Statewide GeoHazards Viewer indicates that the majority of the site is considered to not have a risk for soil liquefaction. A narrow portion of the site along SW Oregon Street is mapped as having a low risk for soil liquefaction during an earthquake and the southwestern portion of the site is mapped as having a high risk for soil liquefaction (Hazvu, 2020). Our explorations in the southwestern portion of the site encountered stiff, fine grained soils underlain by dense to very dense, silty gravel above the water table, underlain by basalt bedrock. It is our opinion that soils underlying the site are not considered susceptible to liquefaction.

Other Potential Seismic Impacts

Other potential seismic impacts include fault rupture potential. However, based on our review of available geologic literature, we are not aware of any mapped active (demonstrating movement in the last 10,000 years) faults on the site. During our field investigation, we did not observe any evidence of surface rupture or recent faulting. Therefore, we conclude that the potential for fault rupture on site is very low.

Exhibit A

UNCERTAINTIES AND LIMITATIONS

We have prepared this report for the owner and their consultants for use in design of this project only. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, GeoPacific should be notified for review of the recommendations of this report, and revision of such if necessary.

Sufficient geotechnical monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations. The checklist attached to this report outlines recommended geotechnical observations and testing for the project. Recommendations for design changes will be provided should conditions revealed during construction differ from those anticipated, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, GeoPacific attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

ELIZABETH K. RAPP
No. E2190
exp 2/1/21

90013PE
MAY 22, 2013
BENJAMIN G. ANDERSON
Expires: 12/31/21

Beth K. Rapp, C.E.G.
Senior Engineering Geologist

Benjamin G. Anderson, P.E.
Associate Engineer

Attachments: References
Figure 1 – Vicinity Map
Figure 2 – Site Plan and Exploration Locations
Test Pit Logs (TP-1 through TP-7)
Hand Auger Log (HA-1 through HA-7)
Results of Laboratory Testing – Organic Content of Soil

Exhibit A

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Exhibit A

Polley Industrial
Project No. 20-5500

CHECKLIST OF RECOMMENDED GEOTECHNICAL TESTING AND OBSERVATION

Item No.	Procedure	Timing	By Whom	Done
1	Preconstruction meeting	Prior to beginning site work	Contractor, Developer, Civil and Geotechnical Engineers	
2	Fill removal from site or sorting and stockpiling	Prior to mass stripping	Soil Technician/ Geotechnical Engineer	
3	Stripping, aeration, and root-picking operations	During stripping	Soil Technician	
4	Compaction testing of engineered fill (95% of Standard Proctor)	During filling, tested every 2 vertical feet	Soil Technician	
5	Compaction testing of trench backfill (95% of Modified Proctor)	During backfilling, tested every 4 vertical feet for every 200 lineal feet	Soil Technician	
6	Pavement Subgrade Compaction (95% of Standard Proctor)	Prior to placing base course	Soil Technician	
7	Base course compaction (95% of Modified Proctor)	Prior to paving, tested every 200 lineal feet	Soil Technician	
8	AC Compaction (92% of Rice)	During paving, tested every 200 lineal feet	Soil Technician	
9	Final Geotechnical Engineer's Report	Completion of project	Geotechnical Engineer	

GeoPacific Engineering, Inc.

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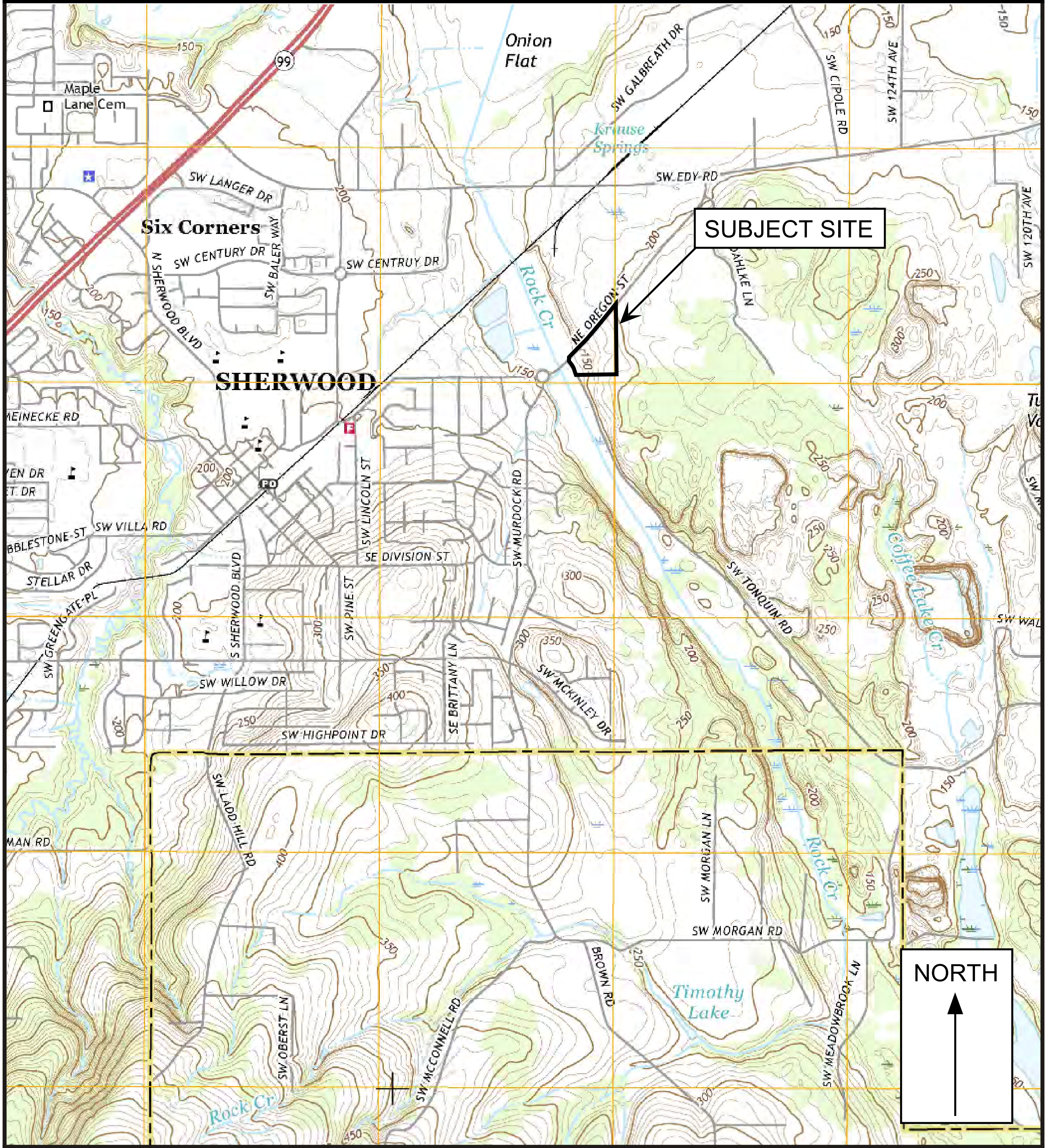
Exhibit A

VICINITY MAP



Legend

Approximate Scale 1 in = 2,000 feet

Date: 6/22/2020
Drawn by: EKR

Base map: U.S. Geological Survey 7.5 minute Topographic Map Series, Sherwood, Oregon Quadrangle, 2017.

Project: Polley Industrial Sherwood, Oregon	Project No. 20-5500	FIGURE 1

Exhibit A

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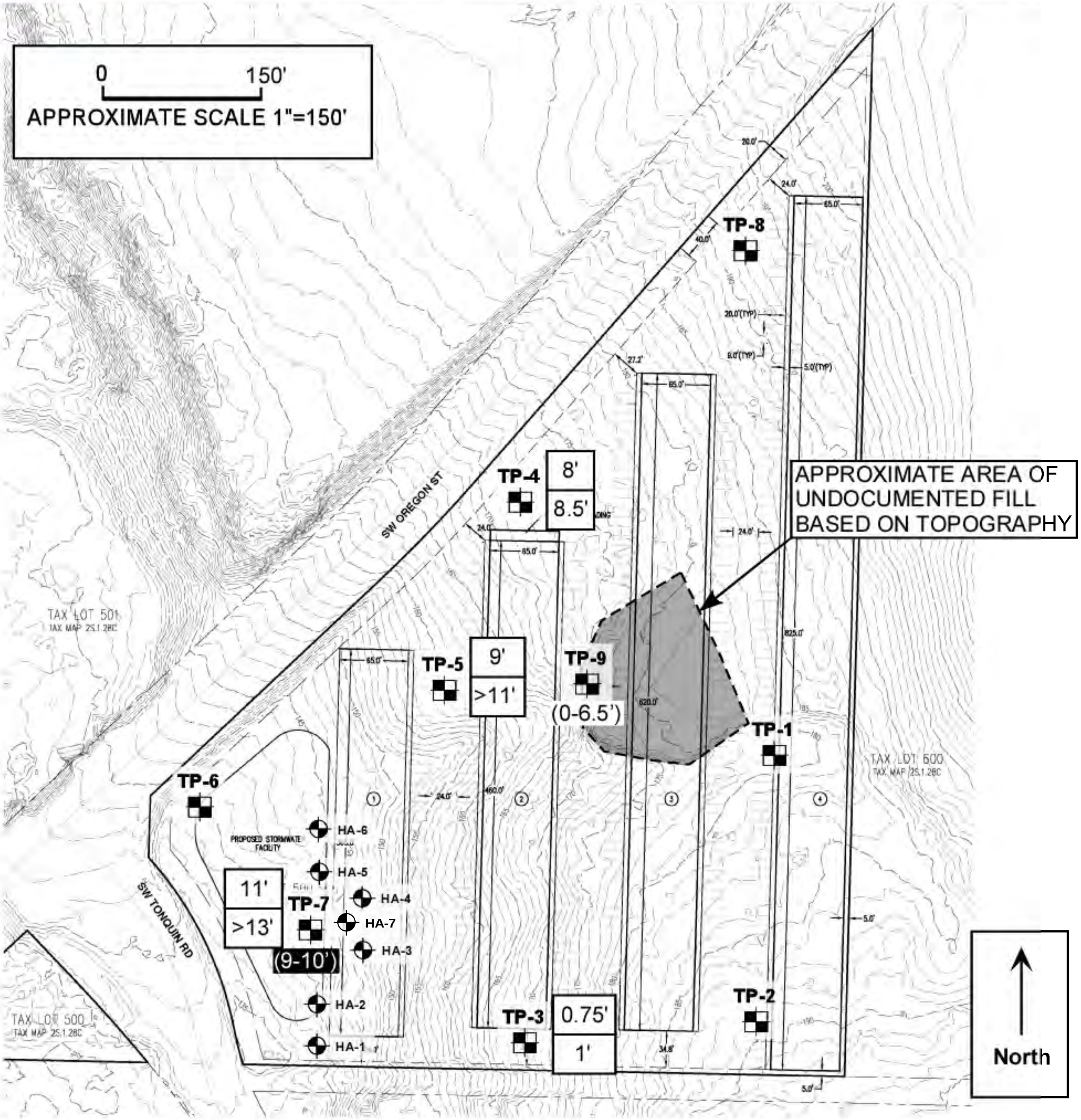
SITE PLAN AND EXPLORATION LOCATIONS



Legend

Date: 6/22/2020
Drawn by: EKR

TP-1 Test Pit Designation and Approximate Location

HA-1 Hand Auger Boring Designation and Approximate Location

8'	8' = Depth at Which Rock is First Encountered
8.5'	8.5' = Depth of Practical Refusal on Rock
	>11'= Depth is Beyond Maximum Exploration Depth

(0-6.5') Depth of Fill Encountered

(9-10') Depth of Peat Soils Encountered

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

FIGURE 2

Exhibit A

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TEST PIT LOG

Project: Polley Industrial Sherwood, Oregon	Project No. 20-5500	Test Pit No. **TP-1**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	**Material Description**
						Moderately organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
1	3.0					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, subtle orange and gray mottling, moist (Fine Grained Catastrophic Flood Deposits)
	3.5					
2						
3						
4						Dense, silty GRAVEL, COBBLES, and BOULDERS (GM), gray to brown, subrounded to subangular, boulders are up to 24 inches in diameter, trace roots to 6 feet, moist (Coarse Grained Catastrophic Flood Deposits)
5						
6						
7						
8						
9						Stiff, SILT (ML), light brown, micaceous, strong orange and gray mottling, moist (Fine Grained Catastrophic Flood Deposits)
10						
11						Test Pit Terminated at 11 Feet. Note: No seepage or groundwater encountered.
12						
13						
14						
15						

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

Exhibit A

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TEST PIT LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

Test Pit No. **TP-2**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	**Material Description**
						Moderately organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
1	2.0					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, subtle orange and gray mottling, trace fine roots, moist (Fine Grained Catastrophic Flood Deposits)
2	3.0					
3	3.5					
4						Dense, silty GRAVEL, COBBLES, and BOULDERS (GM), gray to brown, subrounded to subangular, boulders are up to 30 inches in diameter, moist (Coarse Grained Catastrophic Flood Deposits)
5						
6						
7						
8						
9						
10						Stiff, SILT (ML), light brown, micaceous, strong orange and gray mottling, moist (Fine Grained Catastrophic Flood Deposits)
11						
12						Test Pit Terminated at 12 Feet. Note: No seepage or groundwater encountered.
13						
14						
15						

LEGEND

- 100 to 1,000 g Bag Sample
- 5 Gal. Bucket Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

Exhibit A

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Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

Test Pit No. **TP-3**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	**Material Description**
						Moderately organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
1						Medium hard (R3) to hard (R4) BASALT, gray, trace black staining, fractured, moist (Columbia River Basalt)
2						Practical Refusal on Hard (R4) Basalt at 1 Foot.
3						Note: No seepage or groundwater encountered.
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

Exhibit A

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Portland, Oregon 97224
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TEST PIT LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

Test Pit No. **TP-4**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	Material Description
						Moderately organic SILT (OL-ML), trace gravel fill, light brown, roots throughout, soft, moist (Topsoil Horizon)
1	2.0					
2	2.0					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, strong orange and gray mottling, moist (Fine Grained Catastrophic Flood Deposits)
3	3.0					
4						
5						
6						Dense to very dense, silty GRAVEL, COBBLES, and BOULDERS (GM), gray to brown, subrounded to subangular, boulders are up to 12 inches in diameter, moist (Coarse Grained Catastrophic Flood Deposits)
7					💧	
8						Medium hard (R3) to hard (R4) BASALT, gray, trace black staining, vesicular, moist (Columbia River Basalt)
9						
10						Practical Refusal on Hard (R4) Basalt at 8.5 Feet. Note: Groundwater seepage encountered at 7.5 feet. Discharge visually estimated at <1/4 gallon per minute.
11						
12						
13						
14						
15						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- 💧 Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

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TEST PIT LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

Test Pit No. **TP-5**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	**Material Description**
						Moderately organic SILT (OL-ML), brown, roots throughout, soft, moist (Topsoil Horizon)
1	3.0					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, strong orange and gray mottling, trace large roots to 3.5 feet, moist (Fine Grained Catastrophic Flood Deposits)
2	3.5					
3	2.5					
4	3.5					
5						Dense, silty GRAVEL, COBBLES, and BOULDERS (GM), gray to brown, subrounded to subangular, boulders are up to 12 inches in diameter, moist (Coarse Grained Catastrophic Flood Deposits)
6						
7						
8						
9						Soft (R2) BASALT, gray, fractured, trace black staining, vesicular, trace yellow secondary mineralization, moist (Columbia River Basalt)
10						
11						Test Pit Terminated at 11 Feet. Note: No seepage or groundwater encountered.
12						
13						
14						
15						

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

Exhibit A

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TEST PIT LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

Test Pit No. **TP-6**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	**Material Description**
						Moderately to highly organic SILT (OL-ML), brown, fine roots throughout, soft, moist (Topsoil Horizon)
1	3.5					Stiff to very stiff, SILT (ML), trace clay, light brown to gray, micaceous, strong gray mottling, moist (Fine Grained Catastrophic Flood Deposits)
2	4.5					
3	3.0					
4	3.5					
5						
6						Dense to very dense, silty GRAVEL, COBBLES, and BOULDERS (GM), gray to brown, subrounded to subangular, boulders are up to 30 inches in diameter, trace black staining, moist (Coarse Grained Catastrophic Flood Deposits)
7						
8						
9					💧	
10						Practical Refusal on dense to very dense GRAVEL, COBBLES, and BOULDERS at 10 Feet. Note: Groundwater seepage encountered at 9 feet. Discharge visually estimated at 1/2 gallon per minute.
11						
12						
13						
14						
15						

LEGEND

- 100 to 1,000 g Bag Sample
- 5 Gal. Bucket Bucket Sample
- ▯ Shelby Tube Sample
- 💧 Seepage
- ▨ Water Bearing Zone
- ▽ Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

Exhibit A

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TEST PIT LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

Test Pit No. **TP-7**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	Material Description
						Moderately to highly organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
1	2.0				💧	
2	1.5					
3	2.5					
4	2.0					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, subtle orange and gray mottling, trace fine roots, moist (Fine Grained Catastrophic Flood Deposits)
5						
6						
7						
8						
9						Medium stiff, PEAT (PT), with silt, brown, spongy texture, moist (Peat Deposit) [Organic content = 14.25% - high organic content]
10					💧	Dense, silty GRAVEL, COBBLES, and BOULDERS (GM), gray, boulders are up to 12" in diameter, moist to wet (Coarse Grained Catastrophic Flood Deposits)
11						
12						Very soft (R1) BASALT, gray, fractured, trace black staining, vesicular, trace yellow secondary mineralization, moist (Columbia River Basalt)
13						Test Pit Terminated at 13 Feet.
14						Note: Groundwater seepage encountered at 1.5 and 10 feet. Discharge visually estimated at 1/2 gallon per minute.
15						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- 💧 Seepage
- ▨ Water Bearing Zone
- ▽ Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

Exhibit A

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TEST PIT LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

Test Pit No. **TP-8**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	**Material Description**
						Moderately to highly organic SILT (OL-ML), brown, fine roots throughout, soft, moist (Topsoil Horizon)
1	4.0					
2	2.0					Stiff to very stiff, SILT (ML), trace clay, light brown to gray, micaceous, strong gray mottling, moist (Fine Grained Catastrophic Flood Deposits)
3	3.0					
4	4.5					
5						
6						
7						Dense to very dense, silty GRAVEL, COBBLES, and BOULDERS (GM), gray to brown, subrounded to subangular, boulders are up to 30 inches in diameter, trace black staining, moist (Coarse Grained Catastrophic Flood Deposits)
8						
9						
10						
11						Practical Refusal on dense to very dense GRAVEL, COBBLES, and BOULDERS at 10 Feet. Note: No seepage or groundwater encountered.
12						
13						
14						
15						

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

Exhibit A

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TEST PIT LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

Test Pit No. **TP-9**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Sample Type	In-Situ Dry Density (lb/ft^3)	Moisture Content (%)	Water Bearing Zone	**Material Description**
1 2 3 4 5 6						Loose to medium dense, silty GRAVEL (GM) with abundant inorganic debris consisting of concrete slabs, metal, bricks, and fabric, brown to gray, trace organic debris, significant sidewall caving, moist (Undocumented Fill)
7 8						Stiff to very stiff, clayey SILT (ML), light brown, micaceous, strong orange and gray mottling, moist (Fine Grained Catastrophic Flood Deposits)
9 10 11 12 13 14 15						Test Pit Terminated at 9 Feet. Note: No seepage or groundwater encountered.

LEGEND

100 to 1,000 g	5 Gal. Bucket			▨	
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 5/14/2020
Logged By: B. Rapp
Surface Elevation:

Exhibit A

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Tel: (503) 598-8445 Fax: (503) 941-9281

HAND AUGER LOG

Project: Polley Industrial Sherwood, Oregon	Project No. 20-5500	**HA -1**

Depth (ft)	Sample Type	N-Value	Moisture Content (%)	Water Bearing Zone	**Material Description**
					Moderately to highly organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
1					
					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, subtle orange and gray mottling, trace fine roots, moist (Fine Grained Catastrophic Flood Deposits)
2					
3				💧	
4					Hand auger terminated at ~4' due practical refusal on gravel (Coarse Grained Catastrophic Flood Deposits) Groundwater seepage observed at ~3' bgs.
5					
6					
7					
8					
9					

LEGEND

100 to 1,000 g	▯	▯	💧	▽	▨
Bag Sample	Split-Spoon	Shelby Tube Sample	Seepage	Static Water Table	Water Bearing Zone

Date Drilled: 05/26/20
Logged By: LDG
Surface Elevation: 141 ft

Exhibit A

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HAND AUGER LOG

Project: Polley Industrial Sherwood, Oregon	Project No. 20-5500	**HA - 2**

Depth (ft)	Sample Type	N-Value	Moisture Content (%)	Water Bearing Zone	**Material Description**
					Moderately to highly organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
1					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, subtle orange and gray mottling, trace fine roots, moist (Fine Grained Catastrophic Flood Deposits)
2				💧	
3					
4					
5					Hand auger terminated at ~5' due practical refusal on gravel (Coarse Grained Catastrophic Flood Deposits) Groundwater seepage observed at ~2' bgs.
6					
7					
8					
9					

LEGEND

100 to 1,000 g	▯	▯	💧	∇	▨
Bag Sample	Split-Spoon	Shelby Tube Sample	Seepage	Static Water Table	Water Bearing Zone

Date Drilled: 05/26/20
Logged By: LDG
Surface Elevation: 141 ft

Exhibit A

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HAND AUGER LOG

Project: Polley Industrial Sherwood, Oregon	Project No. 20-5500	**HA - 3**

Depth (ft)	Sample Type	N-Value	Moisture Content (%)	Water Bearing Zone	**Material Description**
					Moderately to highly organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon).
1 2					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, subtle orange and gray mottling, trace fine roots, damp to moist (Fine Grained Catastrophic Flood Deposits).
3 4 5 6 7 8 9					Hand auger terminated at ~2.5' due practical refusal on gravel (Coarse Grained Catastrophic Flood Deposits) No groundwater observed.

LEGEND

- 100 to 1,000 g Bag Sample
- Split-Spoon
- Shelby Tube Sample
- Seepage
- ▽ Static Water Table
- ▨ Water Bearing Zone

Date Drilled: 05/26/20
Logged By: LDG
Surface Elevation: 147 ft

Exhibit A

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HAND AUGER LOG

Project: Polley Industrial Sherwood, Oregon	Project No. 20-5500	**HA - 4**

Depth (ft)	Sample Type	N-Value	Moisture Content (%)	Water Bearing Zone	**Material Description**
					Surface Boulders Observed. Moderately to highly organic SILT (OL-ML), light brown, roots throughout, soft, damp to moist (Topsoil Horizon)
1					Hand auger terminated at ~1.5' due practical refusal on weathered basalt (Columbia River Basalt Formation) No groundwater observed.
2					
3					
4					
5					
6					
7					
8					
9					

LEGEND

100 to 1,000 g	▯	▯	💧	▽	▨
Bag Sample	Split-Spoon	Shelby Tube Sample	Seepage	Static Water Table	Water Bearing Zone

Date Drilled: 05/26/20
Logged By: LDG
Surface Elevation: 147 ft

Exhibit A

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HAND AUGER LOG

Project: Polley Industrial Sherwood, Oregon	Project No. 20-5500	**HA - 5**

Depth (ft)	Sample Type	N-Value	Moisture Content (%)	Water Bearing Zone	**Material Description**
					Surface Boulders Observed. Moderately to highly organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
1					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, subtle orange and gray mottling, trace fine roots, damp to moist (Fine Grained Catastrophic Flood Deposits)
2					Hand auger terminated at ~1.5' due practical refusal on gravel (Coarse Grained Catastrophic Flood Deposits) No groundwater observed.
3					
4					
5					
6					
7					
8					
9					

LEGEND

100 to 1,000 g Bag Sample	Split-Spoon	Shelby Tube Sample	Seepage	▽ Static Water Table	▨ Water Bearing Zone

Date Drilled: 05/26/20
Logged By: LDG
Surface Elevation: 143 ft

Exhibit A

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HAND AUGER LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

HA - 6

Depth (ft)	Sample Type	N-Value	Moisture Content (%)	Water Bearing Zone	**Material Description**
					Moderately to highly organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
1					Hand auger terminated at ~1' due practical refusal on weathered basalt (Columbia River Basalt Formation) No groundwater observed.
2					
3					
4					
5					
6					
7					
8					
9					

LEGEND

100 to 1,000 g	▯	▯	💧	▽	▨
Bag Sample	Split-Spoon	Shelby Tube Sample	Seepage	Static Water Table	Water Bearing Zone

Date Drilled: 05/26/20
Logged By: LDG
Surface Elevation: 143 ft

Exhibit A

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HAND AUGER LOG

Project: Polley Industrial
Sherwood, Oregon

Project No. 20-5500

HA - 7

Depth (ft)	Sample Type	N-Value	Moisture Content (%)	Water Bearing Zone	**Material Description**
					Moderately to highly organic SILT (OL-ML), light brown, roots throughout, soft, moist (Topsoil Horizon)
					Stiff to very stiff, clayey SILT (ML), light brown, micaceous, subtle orange and gray mottling, trace fine roots, moist (Fine Grained Catastrophic Flood Deposits)
1					
2				💧	
3					
4					
5					Hand auger terminated at ~5' due practical refusal on gravel (Coarse Grained Catastrophic Flood Deposits) Groundwater seepage observed at ~2' bgs.
6					
7					
8					
9					

LEGEND

- 100 to 1,000 g — Bag Sample
- ▯ — Split-Spoon
- ▯ — Shelby Tube Sample
- 💧 — Seepage
- ▽ — Static Water Table
- ▨ — Water Bearing Zone

Date Drilled: 05/26/20
Logged By: LDG
Surface Elevation: 145 ft

Exhibit A

GeoPacific Engineering, Inc.

Project Name: Polley Industrial Site
Project No.: 20-5500
Sampled By: EKR
Sample ID: S20-137
Depth: 9'-10'
Sample Date: 5/14/2020
Location: TP-7
Tested By: SJC
Material Type: Peat
Tested Date: 5/18/2020

Moisture

Tare Number:	18
Tare Wt.:	261.7
Tare + Wet Soil:	678.4
Tare + Dry Soil:	456.9
Percent Moisture:	113.5

Organic Content ASTM D 2974 at 440°F

Tare Number:	5	6
Tare Wt.:	25.74	26.21
Tare + Pre-Oven:	48.51	48.95
Tare + Post-Oven:	45.33	45.66
Percent Organic:	14.0	14.5
	Average:	14.25

No. 200 Wash Data

Tare Number	
Tare Wt:	
Tare+Pre-Wash:	
Tare+Post-Wash:	
-#200 From Wash:	
Pre-Wash Mass:	
% Passing No. 200	

Grain Size Data

Sieve Size /(max wt individually retained)	Individual Weight Retained	Individual Weight Retained
3"		
1.5"		
1"		
3/4 / 900		
1/2 / 570		
3/8 / 550		
1/4		
#4 / 325		
#8		
#10 / 180		
#16		
#30		
#40 / 75		
#50		
#100 / 40		
#200 / 20		
Pan		

Atterberg Analysis LI

	Point 1	Point 2	Point 3	Point 4	Point 5
Tare #					
Tare Wt.					
Wet Wt					
Dry Wt					
# of Blows					

Atterberg Analysis PI

	Point 1	Point 2	Point 3
Tare #			
Tare Wt.			
Wet Wt			
Dry Wt			
# of Blows			

Exhibit A

Appendix F:
References and Code

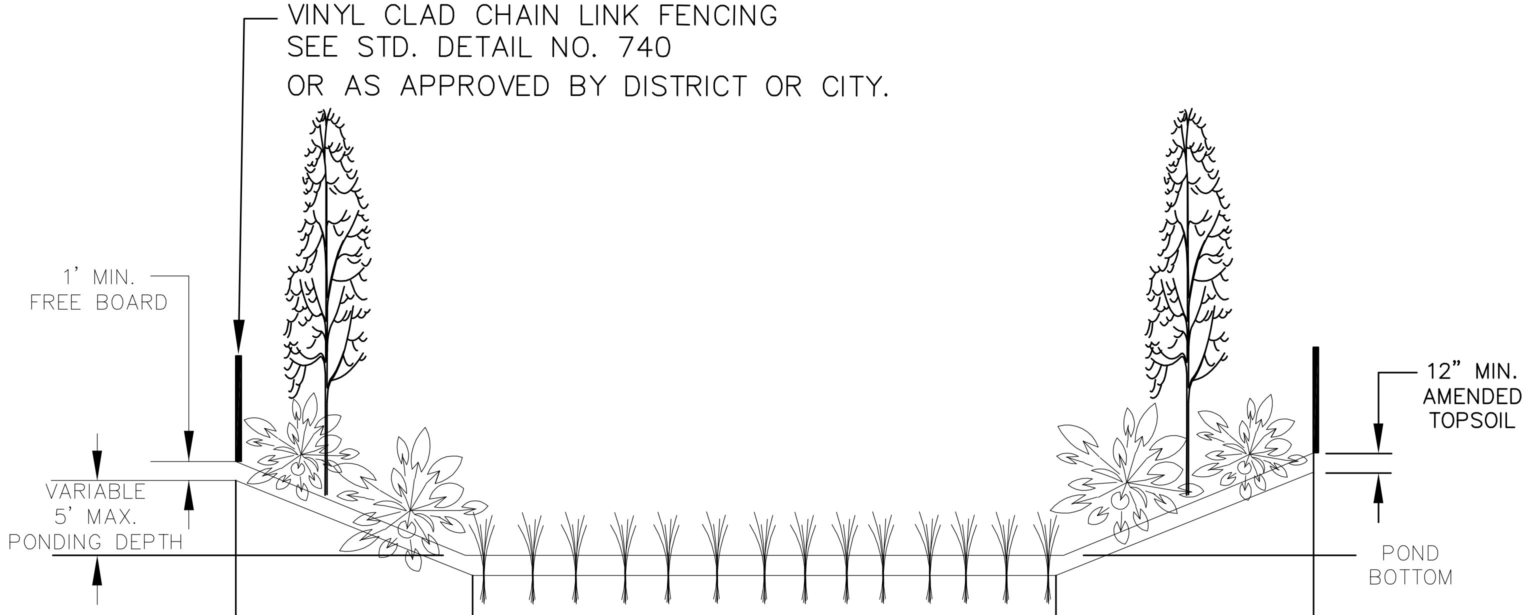
Exhibit A

DRAWING NO. 700

DETENTION POND

REVISED 10-31-19

CleanWater Services



	SIDE SLOPE AREA	DETENTION AREA 6' MINIMUM WIDTH	SIDE SLOPE AREA
EC MATTING	ECONOJUTE*	COCONUT FIBER OR GEOJUTE PLUS*	ECONOJUTE*
SEED MIX	LOW GROW MIX SEE NOTE #5	NONE	LOW GROW MIX SEE NOTE #5
MAX. SLOPE	3H:1V TYP	FLAT BOTTOM	3H:1V TYP

* OR AS APPROVED

NOTES:

1. REFER TO CHAPTER 4, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS.
2. PROVIDE IRRIGATION AS APPROVED BY CWS.
3. JUTE MATTING– GEOJUTE PLUS IN DETENTION AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILIAR FABRICS. COCONUT FIBER IS ALSO ACCEPTABLE.
4. 12 INCHES OF AMENDED TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUANTITY FACILITY.
5. SIDE SLOPE AREA SEED MIX, DWARF TALL FESCUE 40%, DWARF PERENNIAL RYE 30%, CREEPING RED FESCUE 25%, COLONIAL BENT GRASS 5%. APPLY AT A RATE OF 120# / ACRE.

Exhibit A

CONSTRUCTION

1. Detention Pond shall be over-excavated and filled to final grade with 12-inch amended topsoil. Topsoil amendments shall be garden compost, not conventional fertilizer amendments.
2. A biodegradable Erosion Control Matting shall be placed over the topsoil throughout the Detention Pond cross section, fabric shall be held in place in accordance with the manufacturer's installation requirements. Anchor spacing shall be based on 3 fps flow over the fabric.
    a. Pond bottom - high-density jute matting (Geojute Plus or other approved equal)
    b. All other areas - low-density jute matting (Econojute or other approved equal)
3. Plant materials shall be placed in accordance with the plan and plant table as shown on approved plans.
4. The facility shall be deemed acceptable to begin the maintenance period when plant growth and density matches the Engineer's design as shown on the approved plans and all other requirements have been met. The Engineer must certify the facility to be functional, in accordance with the approved plan design to begin the two-year maintenance period..

MAINTENANCE

1. The permittee is responsible for the maintenance of this facility for a minimum of two years following construction and acceptance of this facility per Chapter 2.
2. Irrigation is to be provided per separate irrigation plan as approved.
   Note: Irrigation needs are to be met using a temporary irrigation system with a timer during the dry season. Systems should be winterized during the wet season to assure longevity and guard against damage from freezing temperatures. Water source shall be as shown on the approved plans.
3. Engineer or Owner's Representative is required to perform Monitoring and Maintenance of the Site and provide Documentation as required in Appendix A, 2.5 of the Design and Construction Standards. The Approved Plans shall include a Maintenance Schedule per Appendix A, 2.6.e of the Design and Construction Standards.
4. The Facility shall be re-excavated and planted if siltation greater than 3 inches in depth occurs within the two-year maintenance period.

DETENTION POND
CONSTRUCTION & MAINTENANCE NOTES

DETAIL NO. 701

REVISED 10-31-19

Clean Water Services

Exhibit A

Appendix A

PLANTING REQUIREMENTS

1.0 INTRODUCTION

1.1 General

The District recognizes the importance of Water Quality Sensitive Areas, Vegetated Corridors, and Stormwater Facilities that, along with the Tualatin River, are under its jurisdiction. To improve water quality and preserve aquatic species, and meet the intent of both the federal Clean Water and the Endangered Species Acts, the District developed requirements for planting of Vegetated Corridors, Sensitive Areas, and Stormwater Facilities.

Successful revegetation is critical to the proper function of Sensitive Areas, Vegetated Corridors, and Stormwater Facilities for the benefit of water quality and quantity management, and aquatic species preservation. This Appendix aids professionals, the development community, and field crews in planning, designing and implementing successful revegetation projects in these areas. This document guides design decisions to promote successful planting efforts, while allowing flexibility to address opportunities and constraints at each site.

1.2 Jurisdiction

Most Sensitive Areas are regulated by the Division of State Lands (DSL) and/or the U.S. Army Corps of Engineers (Corps). Where the Corps and/or DSL permit mitigation, planting plans for these areas shall follow DSL and Corps guidelines and approved plans. Vegetated Corridors and Stormwater Facilities are regulated by the District and the plans and management strategies for these areas shall follow the steps outlined in this document. Alternative plans and management strategies may be approved by the District.

1.3 Professional Assistance

Revegetation in Sensitive Areas, Vegetated Corridors and Stormwater Facilities should facilitate succession toward low-maintenance plant communities. Consultation with a professional landscape architect, ecologist, or horticulturist knowledgeable in native plants is highly recommended when preparing plans. Satisfying the landscaping requirements may require the services of a registered landscape architect. See ORS 671.310 through 671.459.

Non-native, invasive plant management and wildlife damage management strategies are provided in Clean Water Services *Integrated Pest Management (IPM) Plan*. Especially challenging management situations may require assistance from a landscape maintenance contractor or a wildlife biologist.

2.0 PLANTING PLAN METHODS

Planting plans shall be required for development projects with Vegetated Corridors or Stormwater Facilities. When a planting plan is required, four major components shall be addressed: hydrology, soils, plant materials, and maintenance. When developing planting plans, the following steps should be used:

2.1 Step 1: Assess Hydrologic and Hydraulic Conditions

a. Determine the frequency and duration of water inundation, including appropriate elevations of the revegetation area. Watershed hydrology and hydraulic models for major streams are available from the District. In some cases, current site conditions (i.e. wetland presence) will suffice. For Stormwater Facilities, the models used to design and size the facility shall be used to determine frequency, duration and surface water elevations within the facility.

b. Assign appropriate hydrologic zones to the revegetation area and apply them to the plan. Most project sites include one or more of the following planting zones with respect to hydrology during the growing season:

   1. Wet - standing or flowing water/nearly constant saturation; anaerobic soils

   2. Moist - periodically saturated; anaerobic and/or aerobic soils

   3. Dry - infrequent inundation/saturation, if any; aerobic soils

2.2 Step 2: Assess Soil Conditions and Assign Appropriate Preparation Specifications to Plans

a. Determine the organic content and non-native, invasive seed bank likely in the soil. For most Stormwater Facilities, the soil is often high in clay, gravel, or minerals devoid of topsoil and organic material, and/or high in non-native, invasive weed content. The conditions in Sensitive Areas and Vegetated Corridors vary greatly.

b. For upland sites with at least one foot of native topsoil, but containing a non-native, invasive seed bank or plants, add notes to the plan to remove the undesirable plants, roots, and seeds (*see IPM Plan*) prior to planting.

c. For upland sites with either disturbed and compacted soils or less than one foot of topsoil and invasive, non-native seed bank or plants that have become established, the following notes shall be added to the plan:

   1. Remove the undesirable plants, roots, and seeds (*see IPM Plan*) prior to adding topsoil.

2. Till the sub-grade in these areas to a depth of at least four inches and add at least 12 inches of clean compost-amended topsoil. The compost-amended topsoil shall have the following characteristics to ensure a good growing medium:
   A) Texture – material passes through one-inch screen
   B) Fertility – 35% organic matter

3. In the event of floodplain grading, over-excavate the sub grade to ensure 12 inches of topsoil can be applied without impacting surface water elevations.

d. For wet areas in Sensitive Areas and Stormwater Facilities, the soil conditions shall be hydric or graded to hold sufficient water to promote hydric soil formation. The addition of organic muck soil will improve plant establishment for some bulbs and tubers.

e. Where appropriate and necessary for erosion control or to enhance organic matter, leaf compost may be placed uniformly on topsoil. (Refer to Chapter 6, Erosion Prevention and Sediment Control). Other amendments, conditioners, and bio-amendments may be added as needed to support the specified plants or adjust the soil pH. Traditional fertilization techniques (applying N-P-K) are not necessary for native plants.

2.3 Step 3: Identify Plants to be Preserved, Select Revegetation Plant Materials, Quantities, Placement, and Assign Planting Zones and Specifications to Plans

a. Preservation: Every effort shall be made to protect a site's existing native vegetation. Native vegetation along Sensitive Areas and Vegetated Corridors shall be retained to the maximum extent practicable.

b. Selection: Plant selection shall be from a native species palette and shall consider site soil types, hydrologic conditions, and shade requirements. Containerized or bare root plants may be used. A list of common native plant community types appropriate for planting Sensitive Areas, Vegetated Corridors and Stormwater Facilities is provided in Table A-1. Upon approval from the District, limited use of non-invasive non-native plants may be permitted in highly urbanized and other unique settings such as regional town centers. Unless approved by District staff, planting restrictions are limited to the following:

1. Deep rooting trees and shrubs (e.g. willow) shall not be planted on top of concrete pipes, or within 10 feet of retaining walls, inlet/outlet structures or other culverts; and

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2. Large trees or shrubs shall not be planted on berms over four feet tall that impound water. Small trees or shrubs with fibrous root systems may be installed on berms that impound water and are less than four feet tall.

c. Quantities:

1. Vegetated Corridors and Sensitive Areas
   Trees and shrubs shall be planted using the following equations to achieve the specified densities on a per acre basis.

   A) Total number of trees per acre = area in square feet x 0.01
   B) Total number of shrubs per acre = area in square feet x 0.05
   C) Groundcover = plant and seed to achieve 100% areal coverage

2. Stormwater Facilities
   A) Stormwater Facilities in tracts or easements less than 30 feet wide shall be planted using the following equations to achieve the specified densities on a per acre basis:
      i. Total number of shrubs per acre = area in square feet x 0.05
      ii. Groundcover = plant and seed to achieve 100% areal coverage
   B) Stormwater Facilities in tracts or easements 30 feet wide or more shall be planted using the following equations to achieve the specified densities on a per acre basis:
      i. Total number of trees per acre = area in square feet x 0.01
      ii. Total number of shrubs per acre = area in square feet x 0.05
      iii. Groundcover = plant and seed to achieve 100% areal coverage

d. Size: Potted plants shall follow size requirements outlined in Table A-1. Bare root plants shall be 12 to 16 inches long.

e. Placement: Plant placement shall be consistent with naturally occurring plant communities. Trees and shrubs shall be placed in singles or clusters of the same species to provide a natural planting scheme. This arrangement may follow curved rows to facilitate maintenance. Distribution and relative abundance shall be dependant on the plant species and on the size of the revegetation area. The Vegetated Corridor revegetation area shall be overseeded with native seed mixes appropriate to the plant community and hydrologic zone of the site (see Table A-1: Plant Communities for Revegetation). Plant placement and seeding shall promote maximum vegetative cover to minimize weed establishment.

2.4 Step 4: Determine Plant Installation Requirements and Assign Specifications to Plans

a. Timing
Containerized stock shall be installed only from February 1 through May 1 and October 1 through November 15. Bare root stock shall be installed only from December 15 through April 15. Plantings outside these times may require additional measures to ensure survival which shall be specified on the plans.

b. Erosion Control
Grading, soil preparation, and seeding shall be performed during optimal weather conditions and at low flow levels to minimize sediment impacts. Site disturbance shall be minimized and desirable vegetation retained, where possible. Slopes shall be graded to support the establishment of vegetation. Where seeding is used for erosion control, an appropriate native grass, Regreen (or its equivalent), or sterile wheat shall be used to stabilize slopes until permanent vegetation is established. Biodegradable fabrics (coir, coconut or approved jute matting (minimum 1/4" square holes) may be used to stabilize slopes and channels. Fabrics such as burlap may be used to secure plant plugs in place and to discourage floating upon inundation. No plastic mesh that can entangle wildlife is permitted. Consult Chapter 6 - Erosion Prevention and Sediment Control for additional information.

c. Mulching
Trees, shrubs, and groundcovers planted in upland areas shall be mulched a minimum of three inches in depth and 18 inches in diameter, to retain moisture and discourage weed growth around newly installed plant material. Appropriate mulches are made from composted bark or leaves that have not been chemically treated. The use of mulch in frequently inundated areas shall be limited, to avoid any possible water quality impacts including the leaching of tannins and nutrients, and the migration of mulch into waterways.

d. Plant Protection from Wildlife
Depending on site conditions, appropriate measures shall be taken to limit wildlife-related damage (*see IPM Plan*).

e. Irrigation
Appropriate plant selection, along with adequate site preparation and maintenance, reduces the need for irrigation. However, unless site hydrology is currently adequate, a District/City approved irrigation system or equivalent (i.e., polymer, plus watering) shall be used during the two-year plant establishment period. Watering shall be at a minimum rate of at least one inch per week from June 15 through October 15. Other irrigation techniques, such as deep watering, may be allowed with prior approval by District staff.

f. Access
Maintenance access for plant maintenance shall be provided for Sensitive Areas and Vegetated Corridors via a five-foot easement or shared boundary with Stormwater Facilities. Stormwater Facilities access requirements are provided in Chapter 4.

2.5 Step 5: Determine Plant Monitoring and Maintenance Requirements

a. Monitoring
Site visits are necessary throughout the growing season to assess the status of the plantings, irrigation, mulching, etc. and ensure successful revegetation.

b. Weed Control
The removal of non-native, invasive weeds shall be necessary throughout the maintenance period, or until a healthy stand of desirable vegetation is established (*see IPM Plan*).

c. Plant Replacement and Preservation
Installed plants that fail to meet the acceptance criteria (see Chapter 2) shall be replaced during the maintenance period. Prior to replacement, the cause of loss (wildlife damage, poor plant stock, etc.) shall be documented with a description of the corrective actions taken.

2.6 Step 6: Prepare Construction Documents and Specifications

The construction documents and specifications shall include:

a. Sensitive Area and Vegetated Corridor boundaries as shown on the Service Provider Letter, including limits of approved, temporary construction encroachment. Orange construction fencing shall be noted at Vegetated Corridor boundaries as well as at encroachment limits during construction. Note permanent type fencing and signage between the development and the Vegetated Corridor for project completion is required.

b. Site Preparation plan and specifications, including limits of clearing, existing plants and trees to be preserved, and methods for removal and control of invasive, non-native species, and location and depth of topsoil and or compost to be added to revegetation area.

c. Planting plan and specifications, including all of the following:
   1. Planting table that documents the common name, scientific name, distribution (zone and spacing), condition and size of plantings
   2. Installation methods for plant materials
   3. Mulching
   4. Plant tagging for identification
   5. Plant protection
   6. Seeding mix, methods, rates, and areas

d. Irrigation plan and specifications, including identification of water source, watering timing and frequency, and maintenance of the system.

e. Maintenance schedule; including responsible party and contact information, dates of inspection (minimum three per growing season and one prior to onset of growing season) and estimated maintenance schedule (as necessary) over the two-year monitoring period.

f. Easement descriptions for all Vegetated Corridor and Sensitive Areas that are required as part of the development.

g. Good rated corridor notes i.e. invasive species removal resulting in cleared areas exceeding 25 square feet shall be replanted with native vegetation.

h. Access points for installation and maintenance including vehicle access if available.

i. Standard drawing details (north arrow, scale bar, property boundaries, project name, drawing date, name of designer and Property Owner).

TABLE A-1
SUGGESTED PLANT COMMUNITIES FOR REVEGETATION

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Riparian Forest (RF)							
Red alder (Alnus rubra)	X	Tree	Moist	Sun	1 gal	3'	Single
Western red cedar (Thuja plicata)	X	Tree	Moist	Shade	2 gal	2'	Single
Red elderberry (Sambucus racemosa)	X	Shrub	Moist	Part	1 gal	1.5'	Single
Black twinberry (Lonicera involcrata)		Shrub	Moist	Part	1 gal	1.5'	Single
Red-osier dogwood (Cornus stoniferia)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Indian plum (Oemleris cerasiformis)	X	Shrub	Moist	Shade	2 gal	2'	Cluster
Swamp rose (Rosa pisocarpa)		Shrub	Moist	Part	1 gal	1.5'	Cluster
Pacific ninebark (Pysocarpus capitatus)		Shrub	Moist	Shade	1 gal	2'	Single
Snowberry (Symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Salmonberry (Rubus spectabilis)	X	Shrub	Moist	Shade	1 gal	1.5'	Cluster
Maidenhair fern (Adiatum aleuticum)		Herb	Moist	Shade	4"	na	Cluster
Lady fern (Athyrium filix-femina)		Herb	Moist	Shade	1 gal	na	Cluster
Skunk cabbage (Lysichiton americanum)		Herb	Wet	Shade	bulbs	na	Cluster
False lily-of-the-valley (Maianthemum dilatatum)		Herb	Moist	Shade	bulbs, 4"	na	Cluster
Candy flower (Claytonia sibirica)		Herb	Moist	Shade	4"	na	Cluster
Miners lettuce (Montia perfoliata)		Herb	Moist	Shade	4"	na	Cluster
Stream violet (Viola glabella)		Herb	Moist	Shade	4"	na	Cluster
Youth-on-age (Tolmiea menziesii)		Herb	Moist	Shade	4"	na	Cluster
Insideout flower (Vancouveria hexandra)		Herb	Moist	Shade	4"	na	Cluster
Dewey's sedge (Carex deweyana)		Herb	Dry	Shade	plugs, 4"	4"	Mass
Hair bentgrass (Agrostis scabra)		Grass	Moist	Part	seed	na	Mass
Spike bentgrass (Agrostis exarata)	X	Grass	Moist	Part	seed	na	Mass
Tall manna-grass (Glyceria elata)	X	Grass	Moist	Part	seed	na	Mass

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Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Upland Forest (UF)							
Red alder (Alnus rubra)	X	Tree	Moist	Sun	1 gal	3'	Single
Big leaf maple (Acer macrophyllum)	X	Tree	Dry	Sun	2gal	3'	Single
Douglas Fir (Pseudotsuga menziesii)	X	Tree	Dry	Sun	2gal	3'	Single
Grand fir (Abies grandis)	X	Tree	Dry	Sun	2 gal	2'	Single
Pacific yew (Taxus brevifolia)		Tree	Moist	Shade	2 gal	2'	Single
Cascara (Rhamnus purshiana)		Tree	Dry	Part	2 gal	2'	Single
Pacific dogwood (Cornus nuttallii)		Tree	Moist	Shade	1 gal	2'	Single
Bitter cherry (Prunus emarginata)		Tree	Moist	Part	2 gal	2'	Single
Vine Maple (Acer circinatum)	X	Tree	Moist	Part	2 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Single
Red elderberry (Sambucus racemosa)	X	Shrub	Moist	Part	1 gal	1.5'	Single
Red flowering currant (Ribes sanguineum)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Cascade Oregon grape (Mahonia nervosa)		Shrub	Moist	Part	1 gal	4"	Cluster
Tall Oregon grape (Mahonia aquifolium)		Shrub	Dry	Sun	1 gal	6"	Single
Red huckleberry (Vaccinium parvifolium)		Shrub	Moist	Shade	1 gal	1.5'	Cluster
Thimbleberry (Rubus pariflorus)		Shrub	Moist	Shade	1 gal	1.5'	Cluster
Snowberry (symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Baldhip Rose (Rosa gymnocarpa)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Serviceberry (Almelanchier alnifolia)		Shrub	Dry	Part	2 gal	2'	Single
Sword fern (Polystichum munitum)		Shrub	Moist	Shade	2 gal	na	Cluster
Deer fern (Blechnum spicant)		Herb	Moist	Shade	1 gal	na	Cluster
Orange honeysuckle (Lonicera ciliosa)		Herb	Moist	Shade	2 gal	na	Single
Salal (Gaultheria shallon)		Herb	Moist	Part	1 gal	4"	Cluster
Wood strawberry (Fragaria vesca)		Herb	Moist	Shade	4"	na	Cluster
Western trillium (Trillium ovatum)		Herb	Moist	Shade	4"	na	Cluster
Five-stemmed mitrewort (Mitella pentandra)		Herb	Moist	Shade	1 gal	na	Cluster
Red columbine (Aquilegia formosa)		Herb	Dry	Part	4"	na	Cluster
False solomon's seal (Smilacina racemosa)		Herb	Moist	Shade	4"	na	Cluster
Native California brome (Bromus carinatus)	X	Grass	Dry	Sun	seed	na	Mass
Blue Wildrye (Elymus glaucus)	X	Grass	Dry	Part	seed	na	Mass

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Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Oak Woodland / Savanna (OW)							
Oregon white oak (Quercus garryana)	X	Tree	Dry	Sun	2 gal	2'	Single
Snowberry (Symphoricarpos albus)	X	Shrub	Dry	Part	1 gal	1.5'	Cluster
Serviceberry (Almelanchier alnifolia)	X	Shrub	Dry	Part	1 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Training blackberry (Rubus ursinus)		Shrub	Dry	Sun	1 gal	1.5'	Cluster
Cascade Oregon grape (Mahonia nervosa)		Herb	Moist	Part	1 gal	4"	Cluster
Blue wild-rye (Elymus glacus)	X	Grass	Dry	Part	seed	na	Mass
Native California brome (Bromus carinatus)	X	Grass	Dry	Sun	seed	na	Mass
Ash Forested Wetland (FW)							
Oregon Ash (Fraxinus latifolia)	X	Tree	Moist	Part	2 gal	3'	Single
Pacific Ninebark (Physocarpus capitatus)	X	Shrub	Moist	Shade	2 gal	2'	Single
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Snowberry (Symphoricarpus albus)	X	Shrub	Dry	Part	1gal	1.5'	Cluster
Slough sedge (Carex obnupta)	X	Herb	Moist	Part	plugs	6"	Mass
Candy flower (Claytonia sibirica)		Herb	Moist	Shade	4"	na	Cluster
Streambank springbeauty (Montia parvifolia)		Herb	Moist	Shade	4"	na	Cluster
Dewey's sedge (Carex deweyana)		Herb	Dry	Shade	plugs	4"	Mass
Small fruited bulrush (Scirpus microcarpus)		Herb	Wet	Sun	plugs	4"	Mass
Tall mannagrass (Glyceria elata)	X	Grass	Moist	Shade	seed	na	Mass

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Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Shrub / Scrub Wetland (SS)							
Pacific willow (Salix lasiandra)	X	Tree	Wet	Sun	1 gal	3'	Single
Sitka willow (Salix sitchensis)		Tree	Moist	Sun	1 gal	3'	Cluster
Douglas hawthorne (Crataegus douglasii)		Tree	Moist	Part	2 gal	2'	Cluster
Pacific Crabapple (Malus fusca)	X	Tree	Moist	Part	2 gal	2'	Cluster
Scouler willow (Salix scouleriana)	X	Shrub	Moist	Sun	1 gal	3'	Cluster
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Clustered rose (Rosa pisocarpa)		Shrub	Wet	Part	1 gal	1.5'	Cluster
Douglas's spiraea (Spiraea douglasii)	X	Shrub	Wet	Sun	1 gal	1.5'	Cluster
Nodding beggartick (Bidens cernua)		Herb	Wet	Sun	1 gal	1.5'	Cluster
Spreading rush (Juncus patens)		Herb	Moist	Part	plugs	6"	Mass
Western manna-grass (Glyceria occidentalis)	X	Grass	Wet	Sun	seed	na	Mass
Emergent Marsh (EM)							
Nodding beggarstick (Bidens cernua)	X	Herb	Moist	Sun	1 gal	1.5'	Cluster
Hardstem bulrush (Scirpus acutus)		Herb	Wet	Sun	plugs	1.5'	Cluster
Small-fruited bulrush (Scirpus microcarpus)	X	Herb	Wet	Sun	plugs	6"	Mass
Creeping spike rush (Eleocharis palustris)	8	Herb	Wet	Sun	seed, plugs	4"	Mass
Wapato (Sagittaria latifolia)		Herb	Wet	Sun	bulbs	na	Cluster
American water plantain (Alisma plantago-aquatica)		Herb	Wet	Sun	bulbs	na	Cluster
Soft stemmed bulrush (Scirpus taberaemontani)		Herb	Wet	Sun	plugs	1.5'	Cluster
American brooklime (Veronica americana)		Herb	Wet	Sun	plugs	na	Cluster
Marsh speedwell (Veronica scutellata)		Herb	Wet	Sun	plugs	na	Cluster
American sloughgrass (Beckmannia syzigachne)	X	Grass	Wet	Sun	seed, plugs	na	Mass
Western manna-grass (Glyceria occidentalis)	X	Grass	Wet	Sun	seed	na	Mass

Exhibit A

Plant Commiunities	Minimum Species Composition	Plant Category	Water Requirements	Light Requirements	Minimum Rooting Size	Minimum Plant Height	Spacing Format
Storm Water Facility (SWF)							
Oregon Ash (Fraxinus latifolia)		Tree	Moist	Part	2 gal	3'	Single
Vine Maple (Acer circinatum)	X	Tree	Moist	Part	2 gal	2'	Single
Cascara (Rhamnus purshiana)		Tree	Moist/Dry	Part	1 gal	2'	Single
Bitter cherry (Prunus emarginata)		Tree	Moist	Part	2 gal	2'	Single
Mock orange (Philadelphus lewisii)		Shrub	Wet/dry	Part	1 gal	2'	Cluster
Red-osier dogwood (Cornus sericea)	X	Shrub	Wet	Part	1 gal	2'	Cluster
Pacific ninebark (Pysocarpus capitatus)		Shrub	Moist	Shade	1 gal	2'	Single
Oceanspray (Holodiscus discolor)	X	Shrub	Dry	Sun	1 gal	1.5'	Single
Serviceberry (Almelanchier alnifolia)	X	Shrub	Dry	Part	1 gal	2'	Single
Clustured rose (Rosa pisocarpa)		Shrub	Moist	Sun	1 gal	1.5'	Cluster
Snowberry (Symphoricarpus albus)	X	Shrub	Dry	Part	1gal	1.5'	Cluster
Douglas's spiraea (Spiraea douglasii)	X	Shrub	Wet	Sun	1 gal	1.5'	Cluster
Red flowering currant (Ribes sanguineum)	X	Shrub	Dry	Sun	1 gal	1.5'	Cluster
Nodding beggartick (Bidens cernua)		Herb	Wet	Sun	1 gal	1.5'	Cluster
Spreading rush (Juncus patens)		Herb	Moist	Part	plugs	6"	Mass
Small-fruited bulrush (Scirpus microcarpus)		Herb	Wet	Sun	plugs	6"	Mass
Slough sedge (Carex obnupta)	X	Herb	Moist	Part	plugs	6"	Mass
Toad rush (Juncus bufonius)*		Herb	Dry	Sun	seed, plugs	4"	Mass
Rossi Sedge (Carex rossi)*		Herb	Moist	Sun	plugs	4"	Mass
NW Native Wildflower mix		Herb	Mix	Sun	seed	na	Mass
Oregon Bentgrass (Agrostis oregonesis)*	X	Grass	Dry	Sun	seed	na	Mass
Idaho bentgrass (Agrostis idahoensis)*		Grass	Dry	Sun	seed	na	Mass
Western manna-grass (Glyceria occidentalis)		Grass	Wet	Sun	seed	na	Mass

* - Grows 5-30 cm tall

Exhibit A

Appendix G:
Operations and Maintenance Plan

Exhibit A

Extended Dry Basin Operation and Maintenance Plan

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Trash and Debris	Visual evidence of trash, debris or dumping	Remove trash and debris from facility. Dispose of properly	SPRING SUMMER FALL WINTER	
Contamination and Pollution	Evidence of oil, gasoline, contaminants, or other pollutants. Look for sheens, odor or signs of contamination	Locate source of contamination and correct. Remove oil using oil-absorbent pads or vactor truck. If low levels of oil persist plant wetland plants that can uptake small concentrations of oil such as Juncus effuses. (soft rush) If high levels of contaminants or pollutants are present, coordinate removal/ cleanup with local jurisdiction	SPRING SUMMER FALL WINTER	
Invasive vegetation as outlined in Appendix A.	Invasive vegetation found in facility. Examples include: Himalayan Blackberry, Reed Canary Grass, Teasel, English Ivy, Nightshade, Clematis, Cattail, Thistle, Scotch Broom	Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible; refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment	SPRING SUMMER FALL	
Obstructed Inlet/Outlet	Material such as vegetation, trash, sediment is blocking more than 10% of inlet/outlet pipe or basin opening	Remove blockages from facility	WINTER SPRING Inspect after major storm (1-inch in 24 hours)	
Poor Vegetation Cover	80% survival of approved vegetation and no bare areas large enough to affect function of facility.	Determine cause of poor growth and correct the condition. Replant with plugs or containerized plants per the approved planting plan and applicable standards at time of construction. Remove excessive weeds and all invasive plants.	SPRING FALL Ideal time to plant is spring and fall seasons	

Exhibit A

Extended Dry Basin Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Vector Control	Evidence of rodents or water piping through facility via rodent holes. Harmful insects present such as wasps and hornets that interfere with maintenance/ inspection activities	Repair facility if damaged. Remove harmful insects, use professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options	As Needed	
Tree/Shrub Growth	Tree/shrub growth shades out wetland/ emergent grass in treatment area. Interferes with access for maintenance/ inspection	Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City	WINTER Ideal time for pruning is winter	
Hazard Trees	Observed dead, dying or diseased trees	Remove hazard trees. A certified Arborist may need to determine health of tree or removal requirements	As Needed	
Excessive Vegetation	Vegetation grows so tall that it competes with approved emergent wetland grass/shrubs, interferes with access or becomes a fire danger	Cut tall grass 4" to 6" and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown.	SPRING Ideal time to prune emergent wetland grass is spring. Cut grass in dry months	
Erosion	Erosion or channelization that impacts or effects the function of the facility or creates a safety concern	Repair eroded areas and stabilize using proper erosion control measures. Establish appropriate vegetation as needed	FALL WINTER SPRING	

Exhibit A

Extended Dry Basin Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Settlement of Pond Dike/ Berm	Look for any part of dike/berm that has settled 4 inches or more lower than the design elevation	Repair dike/berm to approved design specifications. A licensed civil engineer should be consulted to determine the source of the settlement	As Needed	
Blockage of Emergency Overflow/ Spillway	Blockage of overflow/ spillway by trees, vegetation or other material. Blockages may cause the berm to fail due to uncontrolled overtopping	Remove blockage. Small root system (base less than 4 inches) may be left in place; otherwise, roots are removed. A licensed civil engineer should be consulted for proper berm/spillway restoration.	WINTER SPRING Inspect after major storm (1-inch in 24 hours)	
Erosion of Emergency Overflow/Spillway	Native soil is exposed at the spillway, or there is only one layer of rock in an area of 5 square feet or larger	Restore rock and pad depth to appropriate depth. Refer to design specifications	WINTER SPRING Inspect after major storm (1-inch in 24 hours)	
Blockage of Overflow Structure/ Orifice Plate	Excessive standing water or water is not detained for required time.	Inspect and if needed clear orifice plate for proper drainage or re-install to ensure required detention.	WINTER SPRING Inspect after major storm (1-inch in 24 hours)	
Sediment Accumulation in Pond Bottom	Sediment accumulation in pond bottom exceeds 6 inches or affects facility inlet/ outlet or plant growth in treatment area	Remove sediment from pond bottom. Re-establish designed pond shape and depth. Establish appropriate vegetation in treatment area	SUMMER FALL Ideally in the dry season	

Exhibit A

Extended Dry Basin Operation and Maintenance Plan (continued)

Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

Identified Problem	Condition to Check for	Maintenance Activity	Maintenance Timing	✔ Task Complete Comments
Grate Damaged, missing or not in place	Grate is missing or only partially in place, may have missing or broken grate members.	Grate must be in place and meet design standards. Replace or repair any open structure, replace grate if missing	As Needed	
Damage to Outlet Structure	Damage to Frame or Top Slab. Frame not sitting flush on top slab (more than ¾ inch between frame and top slab); frame not securely attached	Ensure frame is firmly attached and sits flush on the riser rings or top slab	As Needed	
Damage to Outlet Structure	Fractures or Cracks in Walls or Bottom. Maintenance person determines the structure is unsound. Soil entering structure through cracks.	Structure replaced or repaired to design standards.	As Needed	
Damage to Outlet Structure	Settlement or Misalignment of Basin. Failure of basin has created a safety, function, or design problem	Structure replaced or repaired to design standards	As Needed	

Appendix H:
SLOPES V Information Form

SLOPES for Stormwater, Transportation and Utilities

Exhibit A

(NMFS# NWR-2013-10411)

Stormwater Information Form

If you are submitting a project that includes a stormwater plan for review under SLOPES for Stormwater, Transportation and Utilities please fill out the following cover sheet **to be included with** stormwater management plan, and any other supporting materials.

Also include a drawing of the stormwater treatment area including drainage areas, direction of flow, BMP locations and types, contributing areas, other drainage features, receiving water/location, etc.

	Project Information		
	Corps of Engineers permit #		
	Name of Project:	Oregon Street Business Park	
	Type of project (i.e., residential, commercial, industrial, or combination)	Industrial	
	Nearest receiving water occupied by ESA-listed species or designated critical habitat	Rock Creek	
	Lat/Long (DDD.dddd) of Project Location:	45.3615 / 122.8233	
	Have you contacted anyone at NMFS regarding this project?	No	
	Applicant/Consultant name:	Oregon Street Business Park, LLC	
	Applicant/Consultant email:		
	Stormwater Designer and/or Engineer Contact Information		
	Name:	John Christiansen, PE	
	Phone:	(503) 563-6151	
	Email:	johnc@aks-eng.com	
	Summary of Design Elements		
1.	24-hour design storm: 1.25 Inches	50%* of 2-yr, 24-hr storm fully treated: Yes No If no, project may not meet the SLOPES programmatic criteria *May be greater than 50% - see PDC 36.e. for geographically based percentage	
2.	2 year, 24 hour storm from NOAA Precipitation Atlas: http://www.nws.noaa.gov/ohd/hdsc/noaaatlas2.htm	2.50	Inches
3.	**Total** contributing impervious area including all contiguous surface (e.g. roads, driveways, parking lots, sidewalks, roofs, and similar surfaces)	7.64	Acres
	Proposed new	7.01	Acres
	Existing	0.63	Acres
	Acres of total impervious area x design storm =		ft^3 to be treated
4.	Peak discharge of design storm:	0.69	cfs
5.	Total stormwater to be treated:	ft^3 0.69	cfs
6.	Stormwater Design Manual Used and Year/Version: (example: City of Portland, Clean Water Services, King County, Western Washington) Clean Water Services Design and Construction Standards (R&O 19-22), December 2019 Describe which elements of your stormwater plan came from this manual: Stormwater water quality treatment standards, hydromodification and stormwater quantity/flow control standards.		

V3.2 Revised March 2016

Exhibit A

<table>
<tr><td>7.</td><td colspan="2">Have you treated all stormwater to the design storm within the contributing impervious area?
Yes No
If no, why not and how will you offset the effects from remaining stormwater?</td></tr>
<tr><td></td><td colspan="2">Water Quality</td></tr>
<tr><td>8.</td><td colspan="2">Low Impact Development methods incorporated? Yes No
(e.g. site layout, vegetation and soil protection, reforestation, integrated management practices such as amended soils, bioretention, permeable pavement, rainwater collection, tree retention)
Please describe:
Stormwater pond covered with growing medium and planted with grasses, shrubs, and trees to promote absorption, filtration, decomposition, and sedimentation.
How much of total stormwater is treated using LID: All contributing impervious area</td></tr>
<tr><td>9.</td><td colspan="2">Treatment train, including pretreatment and bioretention methods used to treat water quality:
Catch basins are used to capture and limit debris, trash, sediment, and pollutant flows into the stormwater facilities (pre-treatment). The stormwater pond will further treat stormwater runoff prior to release into downstream system.
Why this treatment train was chosen for the project site:
The stormwater pond is designed to capture and remove the phosphorous from the stormwater runoff from the impervious area. Grasses, shrubs, and trees will be planted in the water quality pond to provide water quality treatment.
Page in stormwater plan where more details can be found: Section 7</td></tr>
<tr><td></td><td colspan="2">Water Quantity</td></tr>
<tr><td>10.</td><td colspan="2">Does the project discharge directly into a major water body (see PDC 36.c.iii)? Yes No</td></tr>
<tr><td>11.</td><td>Pre-development runoff rate
(i.e., before human-induced changes to the unimproved property)
2-yr, 24-hour storm: 0.24 cfs
10-yr storm: 0.92 cfs</td><td>Post-development runoff rate
(i.e., after proposed developments)
2-yr, 24-hour storm: 0.10 cfs
10-yr storm: 0.31 cfs</td></tr>
<tr><td></td><td colspan="2">Post-development runoff rate must be less than or equal to pre-development runoff rate</td></tr>
<tr><td>12.</td><td colspan="2">Methods used to treat water quantity:
Extended dry detention facilities were designed to detain and limit post-developed discharge rate to match pre-developed discharge rate. The orifices are designed to detain and release stormwater runoff from the stormwater facilities.
Page in stormwater plan where more details can be found: Appendix C</td></tr>
</table>

Exhibit A

	Maintenance and Inspection Plan
13.	Have you included a stormwater maintenance plan with a description of the onsite stormwater system, inspection schedule and process, maintenance activities, legal and financial responsibility, and inspection and maintenance logs? Yes No* *Projects cannot be submitted for review under SLOPES without a maintenance and inspection plan. Page in stormwater plan where plan can be found: Appendix G
14.	Contact information for the party/parties that will be legally responsible for performing the inspections and maintenance or the stormwater facilities: Name: Clean Water Services Phone number: 2550 SW Hillsboro Hwy Email: Hillsboro, OR 97123 Name: Oregon Street Business Park LLC Phone number: PO Box 1489 Email: Sherwood, OR 97140 Name: Phone number: Email: Page in stormwater plan where more details can be found: n/a