Henley Place
Milwaukie, Oregon

Preliminary Stormwater Report

Date: March 3, 2021

Client: Pahlisch Commercial, Inc.
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Preliminary Stormwater Report
HENLEY PLACE
MILWAUKIE, 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 subject site includes Tax Lots 401 and 402 of Clackamas County Assessor's Map 1S 1E 25CC which is located approximately 600-feet north of the intersection of SE Scott Street and SE Main Street and encompasses approximately 1.94 acres.

This project will consist of the removal of an existing commercial structure (and associated parking areas, utilities, etc.), and the construction of a new apartment building with surface parking facilities and private stormwater management systems.

3.0 Regulatory Design Criteria

The subject site is located within the City of Milwaukie and is required to meet the current (2020) City of Portland *Stormwater Management Manual* (SWMM) standards as amended and adopted by Section 2 of the City of Milwaukie *Public Works Standards (March 1, 2021)*.

3.1. Stormwater Quantity

Per City of Milwaukie *Public Works Design Standards*, *Section 2.0013 - Minimum Design Criteria*:

> *Storm detention facilities shall be designed to provide storage up to the 25-year storm event, with the safe overflow conveyance of the 100-year storm event. Calculations of site discharge for both the existing and proposed conditions shall be required using the Unit Hydrograph Method. Storms to be evaluated shall include the 2-, 5-, 10-, 25-, and 100-year storm events. Allowable post-development discharge rate for the 2-, 5-, 10-, and 25-year storm events shall be that of the predevelopment discharge rate. An outfall structure such as a 'V-Notch' weir or a single or multiple orifice structure shall be designed to control the release rate for the above events. No flow control orifice smaller than 1 inch shall be allowed. If the maximum release rate cannot be met with all the site drainage controlled by a single 1-inch orifice, the allowable release rate provided by a 1-inch orifice will be considered adequate as approved by the City Engineer.*

Due to the presence of a seasonally-high groundwater table, stormwater detention requirements will be achieved by using subsurface stormwater detention pipes sized to store the 2-year through 25-year design storm events prior to discharging to the public system. The rate of stormwater runoff leaving the detention pipes will be controlled using flow control manholes that have been designed to limit the post-developed release rates to not exceed their respective pre-developed levels.

The subsurface stormwater detention and flow control system has also been designed with an emergency overflow outlet that can safely convey the 100-year storm event to the public system.

3.2. Stormwater Quality

Per City of Milwaukie *Public Works Design Standards*, *Section 2.0013 - Minimum Design Criteria*:

> *All water quality facilities shall meet the design requirements of the current City of Portland, Stormwater Management Manual, as amended and adopted by the City of Milwaukie.*

Stormwater quality requirements will be achieved by using Manufactured Stormwater Treatment Technologies (MSTTs) that have been approved for use within the City of Portland and designed in accordance with Chapter 6 of the City of Portland SWMM.

4.0 Design Methodology

The Santa Barbara Urban Hydrograph (SBUH) Method was used to analyze stormwater runoff from the site. This method uses the Natural Resource Conservation Service (NRCS) Type 1A 24-hour design storm. HydroCAD computer software aided in the stormwater analysis calculations. Representative pre-developed and post-developed runoff Curve Numbers (CN) were obtained from the City of Portland SWMM and the NRCS *Urban Hydrology for Small Watersheds* (Technical Release 55). See Appendix C for additional information.

5.0 Design Parameters

5.1. Design Storms

Table 5-1 provides a summary of the 24-hour rainfall intensities used as well as the design storms recurrence interval and were obtained from the 2014 City of Milwaukie Stormwater Master Plan –*Table 3-1, Design Storm Depths*:

Table 5-1: Rainfall Intensities

24-hour Design Storm Event	Total Precipitation Depth (Inches)
Water Quality	1.0
2-Year	2.4
5-Year	3.0
10-Year	3.5
25-Year	4.0
100-Year	4.7

5.2. Pre-Developed Site Conditions

5.2.1. Site Topography

The majority of the existing site consists of a paved parking lot with slopes varying from ±1 to ±3 percent. The parking areas are sloped to direct stormwater runoff towards existing area drains where it is captured and conveyed to an existing 36-inch storm main that runs diagonally across Tax Lot 402.

5.2.2. Land Use

The existing site is currently occupied by a commercial building with surface parking facilities and minimal on-site landscaping.

5.3. Soil Type

The on-site soils are classified as Urban Land and Woodburn Silt Loam, according to the Natural Resources Conservation Service (NRCS) Soil Survey for Clackamas County (Appendix D). Table 5-2 provides a summary of the Hydrologic Soil Group rating for each soil type:

Table 5-2: Hydrologic Soil Groupings

NRCS Map Unit Identification	NRCS Soil Classification	Hydrologic Soil Group Rating
82	Urban Land	No/Unclassified
91B	Woodburn Silt Loam	C

5.4. Post-Developed Site Conditions

5.4.1. Site Topography

The on-site topography will be modified with cuts and fills to accommodate the construction of a new multifamily apartment building, surface parking facilities/access, and private stormwater facilities.

5.4.2. Land Use

The post-developed land use will consist of a six-story multifamily apartment building, with associated parking, sidewalks, and underground utilities.

5.4.3. Post-Developed Site Parameters

See the HydroCAD Analysis in the attached appendices.

5.4.4. Description of Off-Site Contributing Basins

The adjacent commercial properties share a common parking area with the project. However, they appear to have independent stormwater management systems and do not direct stormwater runoff towards the subject site.

6.0 Stormwater Analyses

6.1. Proposed Stormwater Conduit Sizing and Inlet Spacing

The proposed on-site area drain inlets will be spaced to provide adequate drainage for the new parking areas and to convey stormwater runoff to the subsurface stormwater detention facilities. The stormwater conveyance pipes will be sized using Manning's equation to accommodate the peak flows from the 25-year storm event.

Stormwater runoff leaving the subject site via the flow control manholes will be routed to a new manhole that will be installed over the existing 36-inch public storm main crossing Tax Lot 402.

6.2. Proposed Stormwater Quality Control Facility

Due to a seasonally-high groundwater table, this project will use City of Portland and City of Milwaukie approved MSTTs (stormwater filter cartridges) to provide water quality treatment for stormwater runoff generated by the new drive aisles and parking areas prior to being conveyed to the detention pipe. Stormwater runoff generated by the new buildings roof area will be routed through a sumped settling manhole prior to being conveyed to the detention pipe.

Due to site topography, a portion of the new buildings' patio and landscaped open space on the south side of the new building will be graded to direct stormwater runoff to sumped landscape drains where it will be captured and conveyed to the existing public storm system.

6.3. Proposed Stormwater Quantity Facility

The subsurface stormwater detention pipes have been sized to detain the 2-year through 25-year design storm events prior to discharging to the public. As designed, the post-developed release rates are less than the pre-developed release rates, thus meeting City requirements.

Table 6-1: Pre-Developed vs Post-Developed Stormwater Runoff Comparison

Design Storm Event	Pre-Developed Runoff (cfs)	Post-Developed Runoff (cfs)
2-Year	0.25	0.18
5-Year	0.43	0.22
10-Year	0.60	0.39
25-Year	0.78	0.64

7.0 Downstream Analysis

Detained stormwater runoff leaving the subject site will be discharged to the public storm system via a new manhole that is to be installed over the existing 36-inch storm main. Stormwater runoff entering the public storm system is then conveyed for approximately 500 feet underground before ultimately discharging to Johnson Creek.

The private stormwater system has been designed to limit the post-developed stormwater runoff release rates to the pre-developed release rates.

There are no known downstream deficiencies and a downstream analysis is not proposed at this time.

8.0 Operation and Maintenance

Operation and maintenance (O&M) of the proposed stormwater management facilities will be the responsibility of the property owner. An O&M procedure, which includes maintenance procedures and inspection frequencies, will be provided with the project's final stormwater report.

Figure 1: Site Vicinity Map with Aerial Overlay

DATE: 03/03/2021

N

NOT TO SCALE

HENLEY PLACE **SITE VICINITY MAP WITH AERIAL OVERLAY**	FIGURE **1**
AKS ENGINEERING & FORESTRY, LLC 12965 SW HERMAN RD, STE 100 TUALATIN, OR 97062 503.563.6151 WWW.AKS-ENG.COM	DRWN: GSH CHKD: JMM AKS JOB: 8145

DWG: 8145 VICINITY MAP | P-02 AERIAL

Appendix A: Pre-Developed Hydrograph

Pre-Developed Site

Pre-Developed Flow Summary

Subcat Reach Pond Link

Routing Diagram for 8145 Pre-Developed
Prepared by AKS Engineering and Forestry, llc, Printed 3/1/2021

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
33,423	81	NRCS 81 - Urban Land (Ex)
50,637	79	NRCS 91B - Woodburn Silt Loam (Ex)
84,060	**80**	**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex: Pre-Developed Site Runoff Area=84,060 sf 0.00% Impervious Runoff Depth=0.82"
Flow Length=100' Slope=0.0500 '/' Tc=17.2 min CN=80 Runoff=0.25 cfs 5,747 cf

Link Pre: Pre-Developed Flow Summary Inflow=0.25 cfs 5,747 cf
Primary=0.25 cfs 5,747 cf

Total Runoff Area = 84,060 sf Runoff Volume = 5,747 cf Average Runoff Depth = 0.82"
100.00% Pervious = 84,060 sf 0.00% Impervious = 0 sf

Summary for Subcatchment Ex: Pre-Developed Site

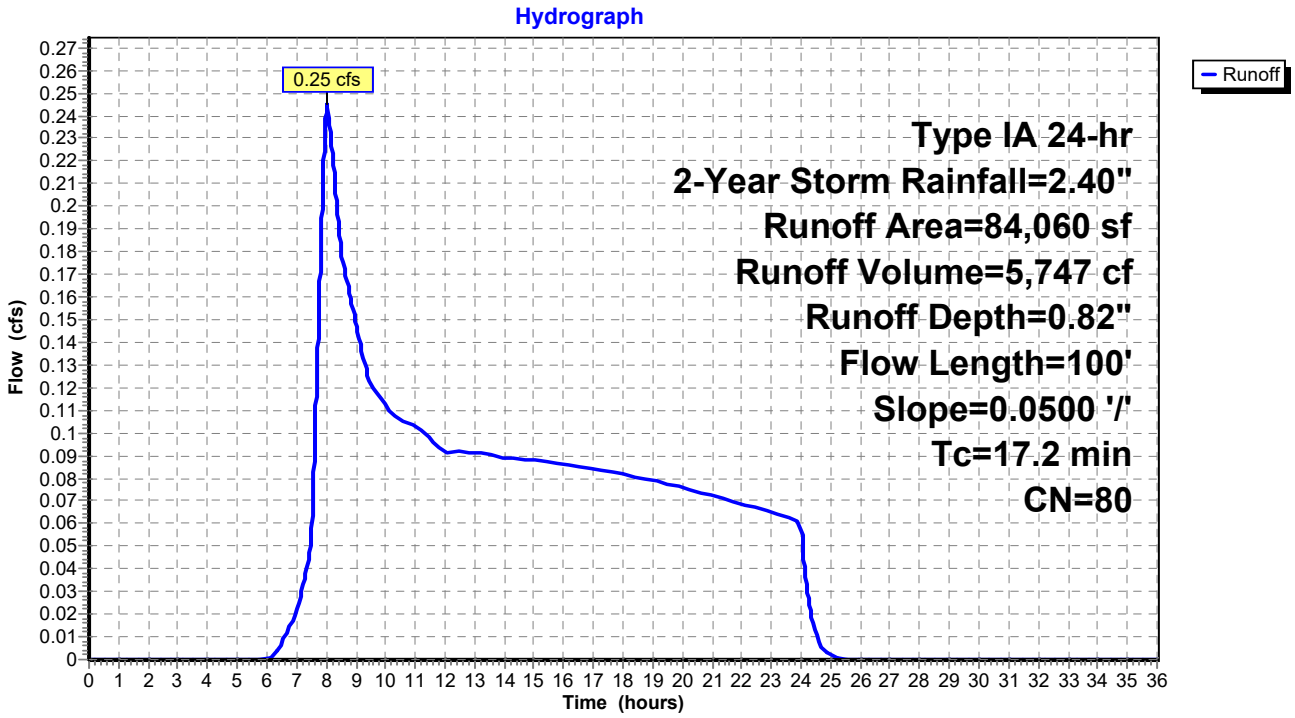
Runoff = 0.25 cfs @ 8.01 hrs, Volume= 5,747 cf, Depth= 0.82"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Storm Rainfall=2.40"

	Area (sf)	CN	Description
*	33,423	81	NRCS 81 - Urban Land
*	50,637	79	NRCS 91B - Woodburn Silt Loam
	84,060	80	Weighted Average
	84,060		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	100	0.0500	0.10		**Sheet Flow, Pre-Developed Sheet Flow** Woods: Light underbrush n= 0.400 P2= 2.40"

Subcatchment Ex: Pre-Developed Site

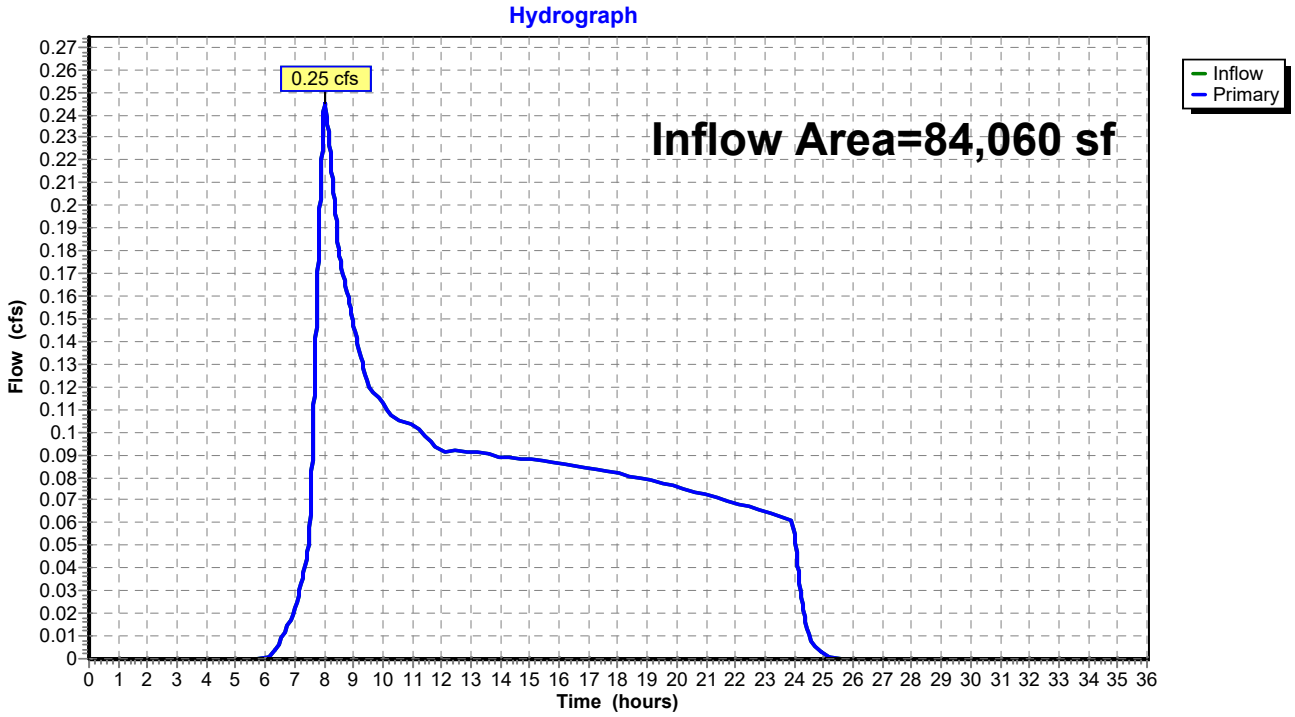


Summary for Link Pre: Pre-Developed Flow Summary

Inflow Area = 84,060 sf, 0.00% Impervious, Inflow Depth = 0.82" for 2-Year Storm event
Inflow = 0.25 cfs @ 8.01 hrs, Volume= 5,747 cf
Primary = 0.25 cfs @ 8.01 hrs, Volume= 5,747 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Pre: Pre-Developed Flow Summary



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex: Pre-Developed Site Runoff Area=84,060 sf 0.00% Impervious Runoff Depth=1.25"
Flow Length=100' Slope=0.0500 '/' Tc=17.2 min CN=80 Runoff=0.43 cfs 8,756 cf

Link Pre: Pre-Developed Flow Summary Inflow=0.43 cfs 8,756 cf
Primary=0.43 cfs 8,756 cf

Total Runoff Area = 84,060 sf Runoff Volume = 8,756 cf Average Runoff Depth = 1.25"
100.00% Pervious = 84,060 sf 0.00% Impervious = 0 sf

Summary for Subcatchment Ex: Pre-Developed Site

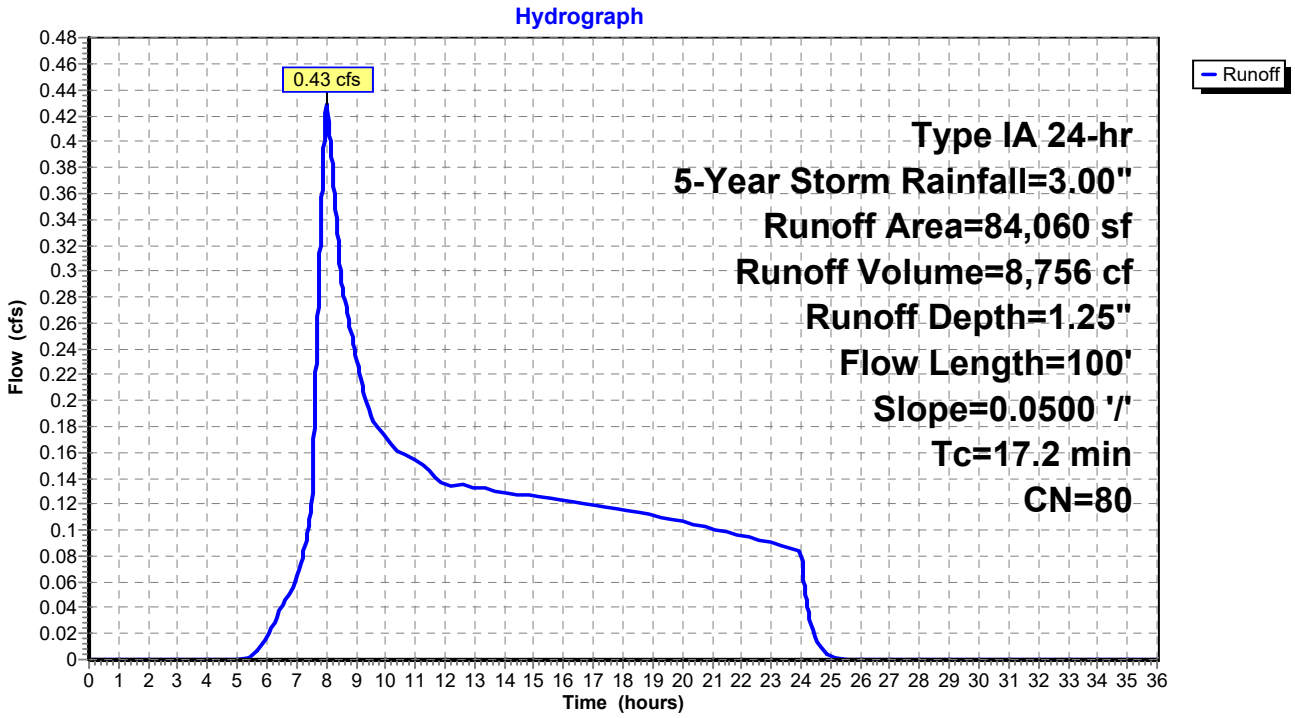
Runoff = 0.43 cfs @ 8.01 hrs, Volume= 8,756 cf, Depth= 1.25"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Storm Rainfall=3.00"

	Area (sf)	CN	Description
*	33,423	81	NRCS 81 - Urban Land
*	50,637	79	NRCS 91B - Woodburn Silt Loam
	84,060	80	Weighted Average
	84,060		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	100	0.0500	0.10		**Sheet Flow, Pre-Developed Sheet Flow** Woods: Light underbrush n= 0.400 P2= 2.40"

Subcatchment Ex: Pre-Developed Site

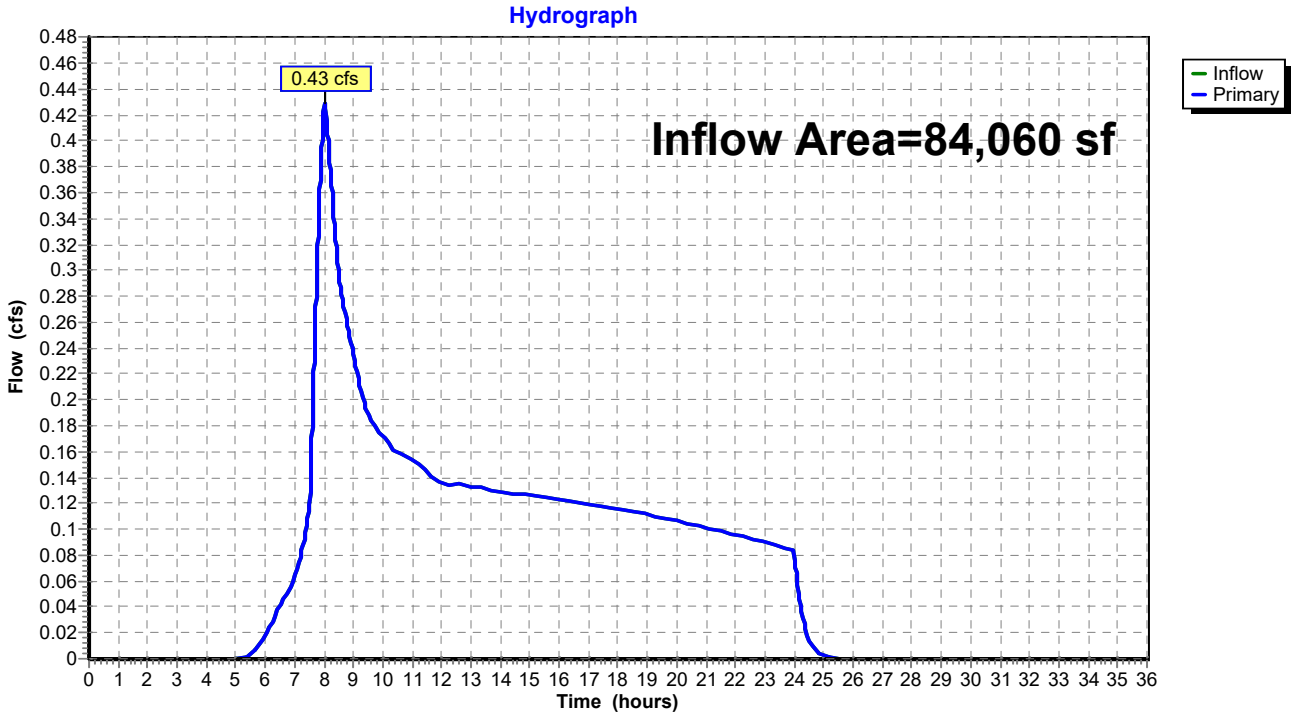


Summary for Link Pre: Pre-Developed Flow Summary

Inflow Area = 84,060 sf, 0.00% Impervious, Inflow Depth = 1.25" for 5-Year Storm event
Inflow = 0.43 cfs @ 8.01 hrs, Volume= 8,756 cf
Primary = 0.43 cfs @ 8.01 hrs, Volume= 8,756 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Pre: Pre-Developed Flow Summary



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex: Pre-Developed Site Runoff Area=84,060 sf 0.00% Impervious Runoff Depth=1.64"
Flow Length=100' Slope=0.0500 '/' Tc=17.2 min CN=80 Runoff=0.60 cfs 11,463 cf

Link Pre: Pre-Developed Flow Summary Inflow=0.60 cfs 11,463 cf
Primary=0.60 cfs 11,463 cf

Total Runoff Area = 84,060 sf Runoff Volume = 11,463 cf Average Runoff Depth = 1.64"
100.00% Pervious = 84,060 sf 0.00% Impervious = 0 sf

Summary for Subcatchment Ex: Pre-Developed Site

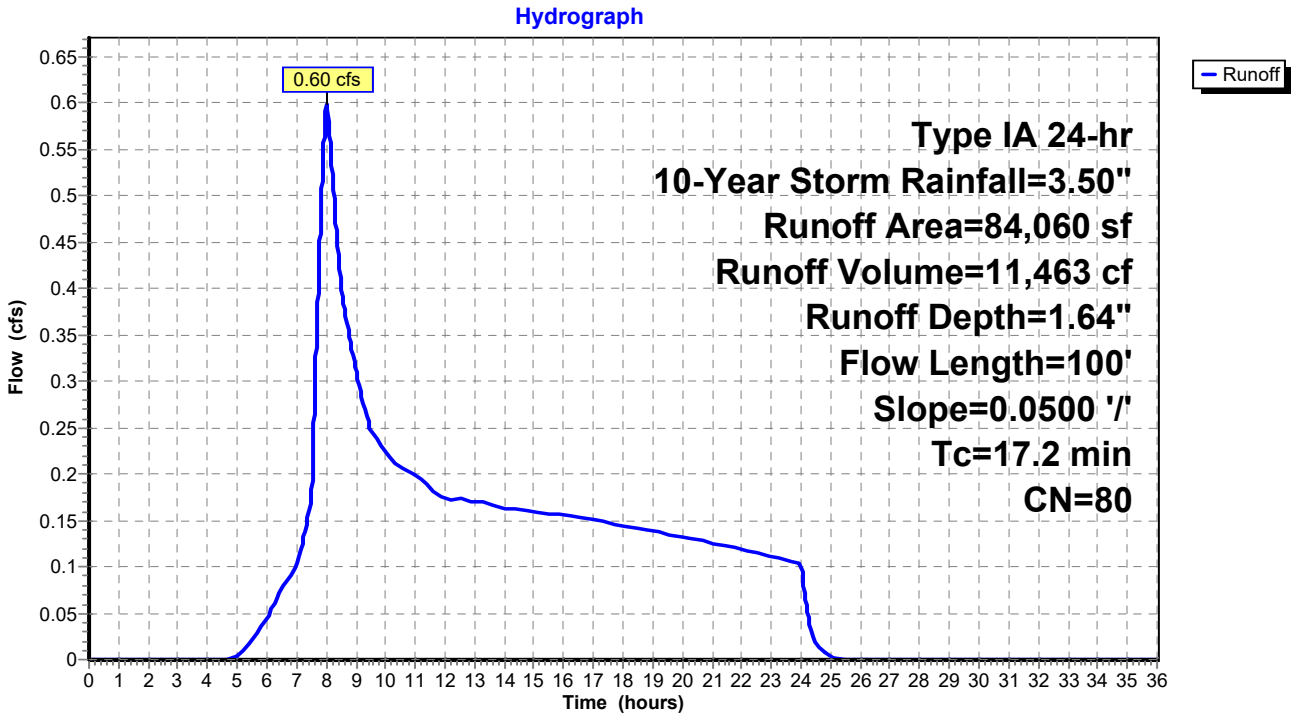
Runoff = 0.60 cfs @ 8.01 hrs, Volume= 11,463 cf, Depth= 1.64"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Storm Rainfall=3.50"

	Area (sf)	CN	Description
*	33,423	81	NRCS 81 - Urban Land
*	50,637	79	NRCS 91B - Woodburn Silt Loam
	84,060	80	Weighted Average
	84,060		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	100	0.0500	0.10		**Sheet Flow, Pre-Developed Sheet Flow** Woods: Light underbrush n= 0.400 P2= 2.40"

Subcatchment Ex: Pre-Developed Site

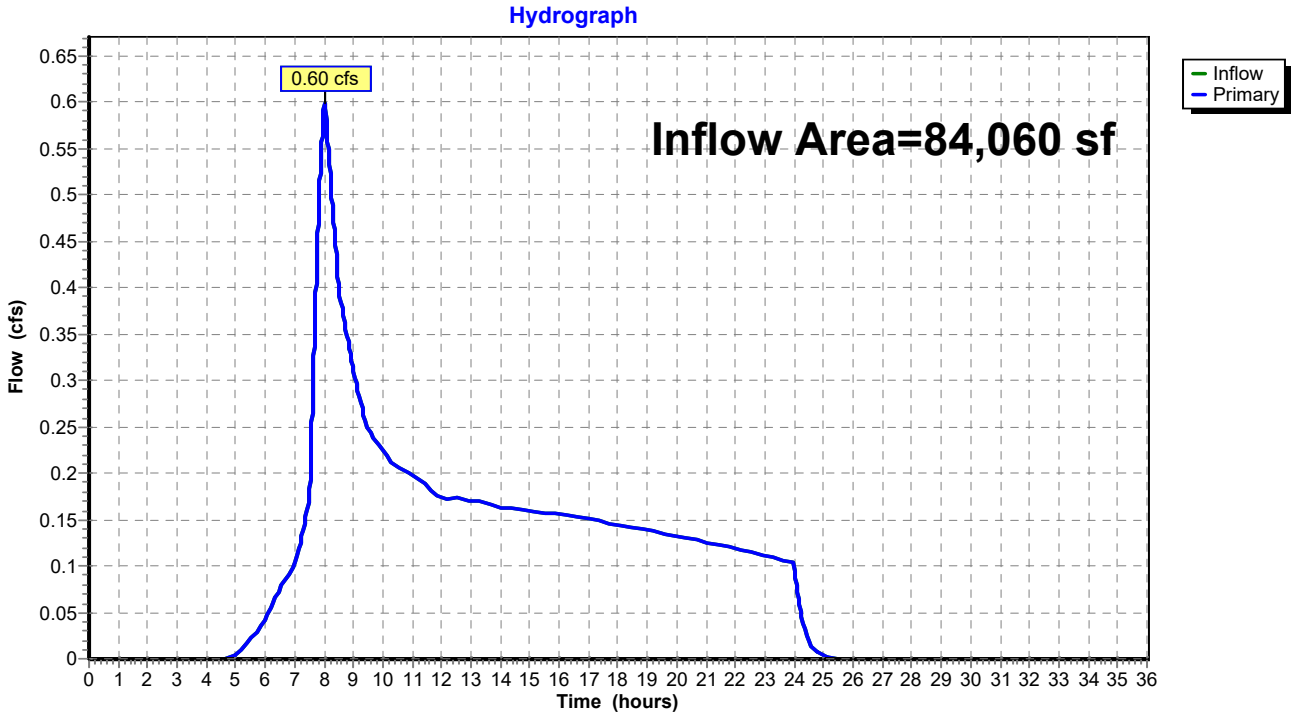


Summary for Link Pre: Pre-Developed Flow Summary

Inflow Area = 84,060 sf, 0.00% Impervious, Inflow Depth = 1.64" for 10-Year Storm event
Inflow = 0.60 cfs @ 8.01 hrs, Volume= 11,463 cf
Primary = 0.60 cfs @ 8.01 hrs, Volume= 11,463 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Pre: Pre-Developed Flow Summary



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Ex: Pre-Developed Site Runoff Area=84,060 sf 0.00% Impervious Runoff Depth=2.04"
Flow Length=100' Slope=0.0500 '/' Tc=17.2 min CN=80 Runoff=0.78 cfs 14,302 cf

Link Pre: Pre-Developed Flow Summary Inflow=0.78 cfs 14,302 cf
Primary=0.78 cfs 14,302 cf

Total Runoff Area = 84,060 sf Runoff Volume = 14,302 cf Average Runoff Depth = 2.04"
100.00% Pervious = 84,060 sf 0.00% Impervious = 0 sf

Summary for Subcatchment Ex: Pre-Developed Site

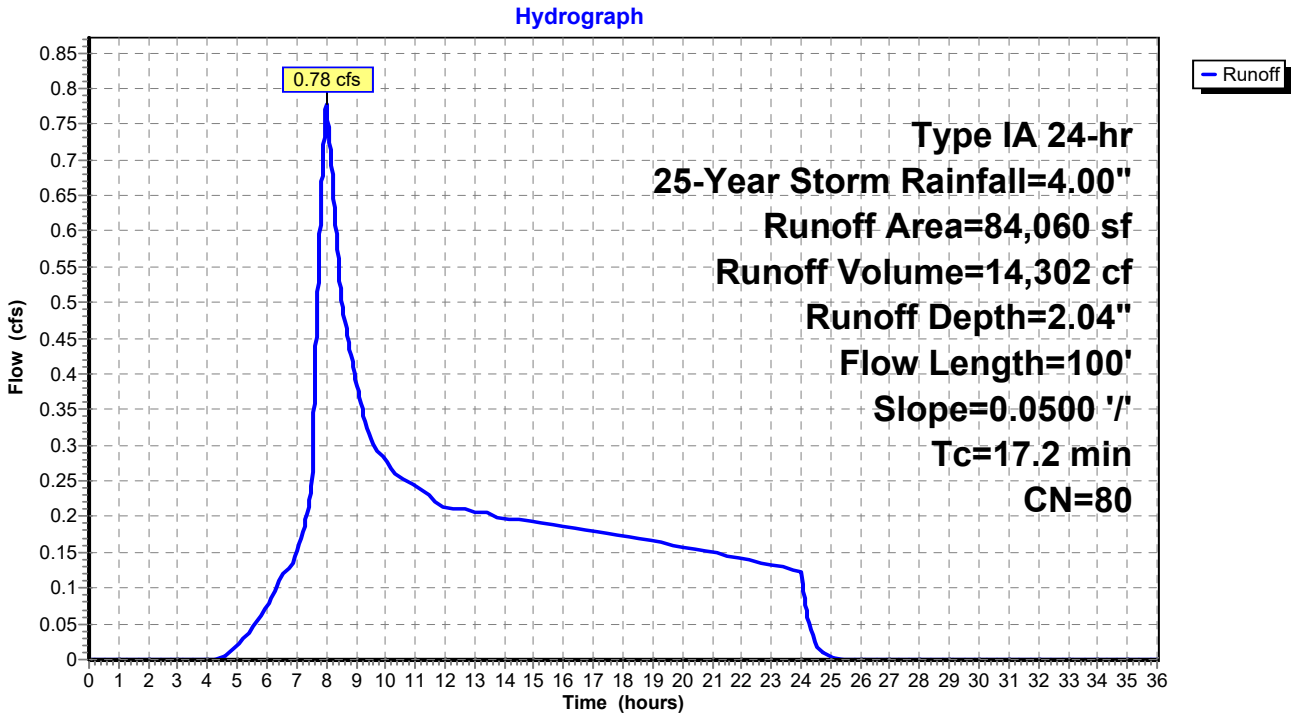
Runoff = 0.78 cfs @ 8.01 hrs, Volume= 14,302 cf, Depth= 2.04"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Storm Rainfall=4.00"

	Area (sf)	CN	Description
*	33,423	81	NRCS 81 - Urban Land
*	50,637	79	NRCS 91B - Woodburn Silt Loam
	84,060	80	Weighted Average
	84,060		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	100	0.0500	0.10		**Sheet Flow, Pre-Developed Sheet Flow** Woods: Light underbrush n= 0.400 P2= 2.40"

Subcatchment Ex: Pre-Developed Site

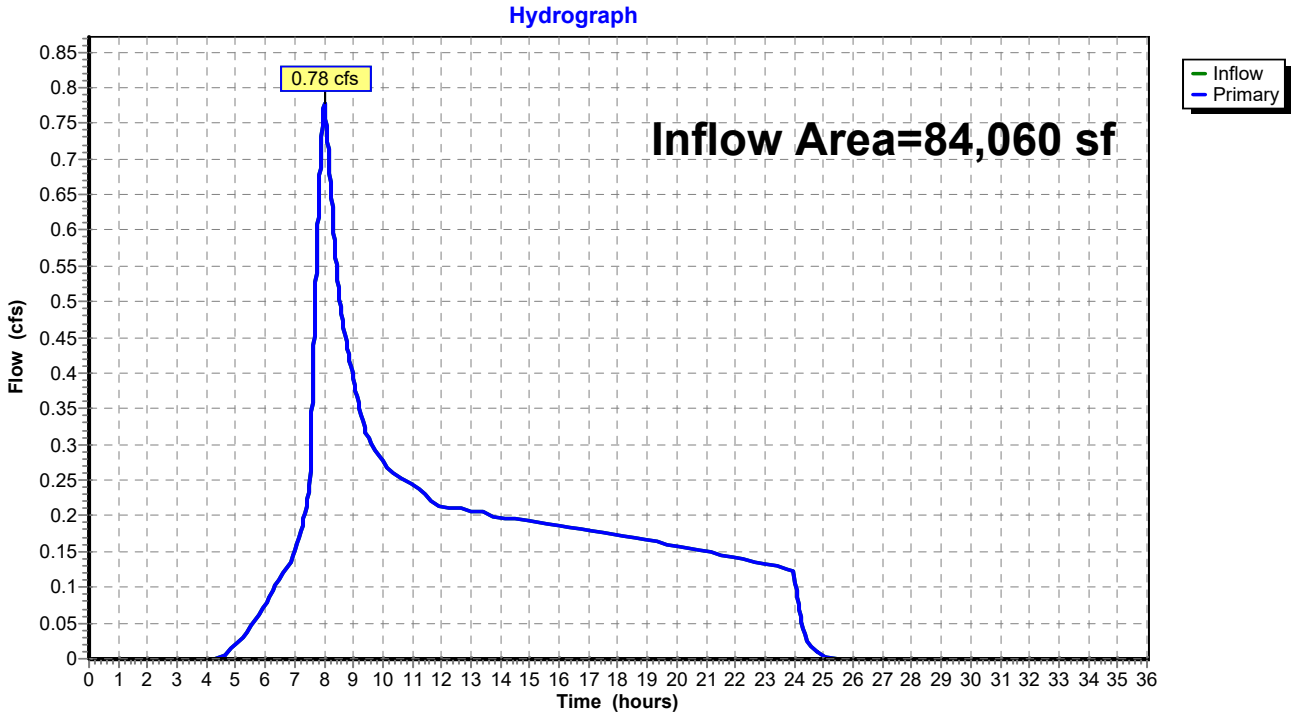


Summary for Link Pre: Pre-Developed Flow Summary

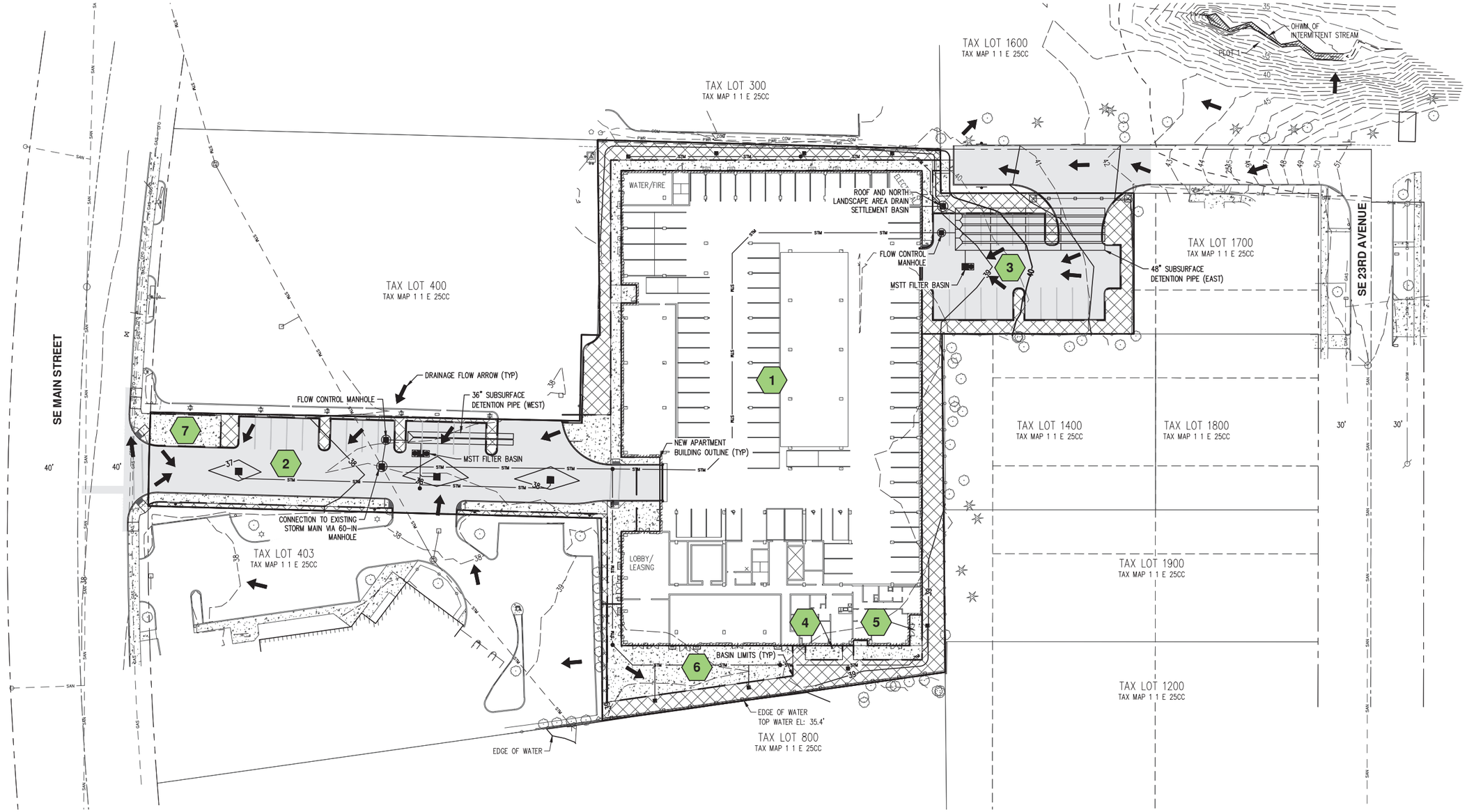
Inflow Area = 84,060 sf, 0.00% Impervious, Inflow Depth = 2.04" for 25-Year Storm event
Inflow = 0.78 cfs @ 8.01 hrs, Volume= 14,302 cf
Primary = 0.78 cfs @ 8.01 hrs, Volume= 14,302 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Pre: Pre-Developed Flow Summary



Appendix B:
Post-Developed Basin Map and Hydrograph



LEGEND

- EXISTING GROUND CONTOUR (1 FT)
- EXISTING GROUND CONTOUR (5 FT) — 350
- FINISHED GRADE CONTOUR (1 FT)
- FINISHED GRADE CONTOUR (5 FT) — 345
- DRAINAGE FLOW DIRECTION
- PLANNED SITE LANDSCAPING AREA
- PLANNED IMPERVIOUS HARDSCAPE AREA

N

SCALE: 1" = 30 FEET

30 0 15 30

ORIGINAL PAGE SIZE: 22" x 34"

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POST-DEVELOPED BASIN MAP
HENLEY PLACE
PAHLISCH COMMERCIAL
MILWAUKIE OREGON

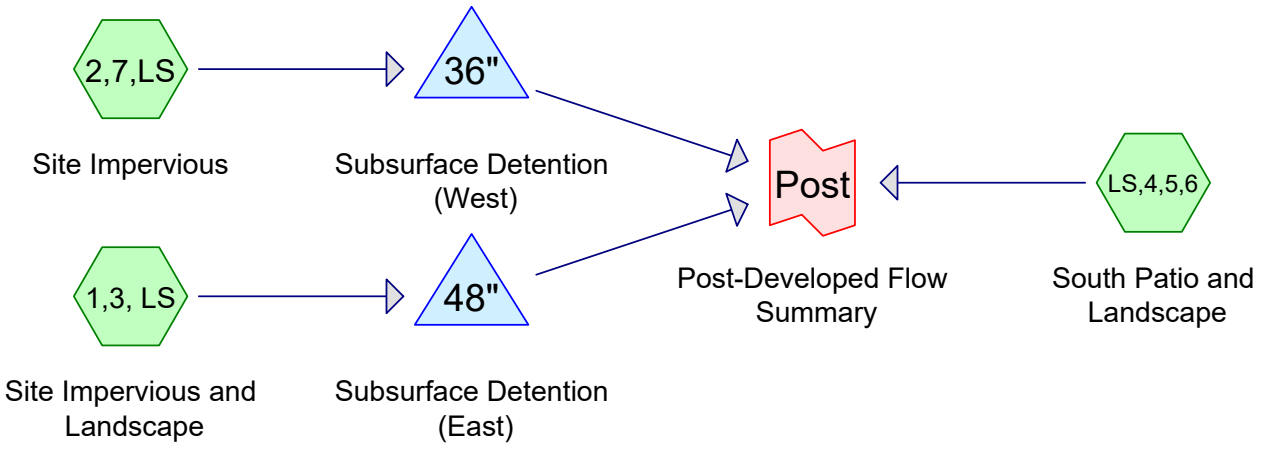
REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 15, 2014
JONATHAN M. MORSE

RENEWAL DATE: 12/31/2022

JOB NUMBER:	8145
DATE:	03/04/2021
DESIGNED BY:	GSH
DRAWN BY:	GSH
CHECKED BY:	JMM

POST

AKS DRAWING FILE: 8145 BASINS.DWG | LAYOUT: POST



Subcat Reach Pond Link

Routing Diagram for 8145 Post-Developed
Prepared by AKS Engineering and Forestry, llc, Printed 3/3/2021

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
12,444	74	>75% Grass cover, Good, HSG C (1,3, LS, 2,7,LS, LS,4,5,6)
3,066	98	Impervious Sidewalk (Basins 4,5,6) (LS,4,5,6)
6,531	98	Paved parking, HSG C (Basin 3) (1,3, LS)
15,621	98	Paved parking/Hardscape, HSG C (Basin 2) (2,7,LS)
725	98	Paved parking/Hardscape, HSG C (Basin 7) (2,7,LS)
45,673	98	Roofs, HSG C (Basin 1) (1,3, LS)
84,060	**94**	**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1,3, LS: Site Impervious Runoff Area=55,172 sf 94.62% Impervious Runoff Depth=2.06"
Flow Length=20' Slope=0.0100 '/' Tc=9.1 min CN=97 Runoff=0.65 cfs 9,494 cf

Subcatchment 2,7,LS: Site Impervious Runoff Area=21,587 sf 75.72% Impervious Runoff Depth=1.60"
Flow Length=20' Slope=0.0050 '/' Tc=10.4 min CN=92 Runoff=0.19 cfs 2,880 cf

Subcatchment LS,4,5,6: South Patio and Runoff Area=7,301 sf 41.99% Impervious Runoff Depth=1.04"
Flow Length=10' Slope=0.0150 '/' Tc=5.2 min CN=84 Runoff=0.04 cfs 632 cf

Pond 36": Subsurface Detention (West) Peak Elev=1.50' Storage=371 cf Inflow=0.19 cfs 2,880 cf
Outflow=0.07 cfs 2,880 cf

Pond 48": Subsurface Detention (East) Peak Elev=2.71' Storage=3,499 cf Inflow=0.65 cfs 9,494 cf
Outflow=0.10 cfs 9,440 cf

Link Post: Post-Developed Flow Summary Inflow=0.18 cfs 12,952 cf
Primary=0.18 cfs 12,952 cf

Total Runoff Area = 84,060 sf Runoff Volume = 13,006 cf Average Runoff Depth = 1.86"
14.80% Pervious = 12,444 sf 85.20% Impervious = 71,616 sf

Summary for Subcatchment 1,3, LS: Site Impervious and Landscape

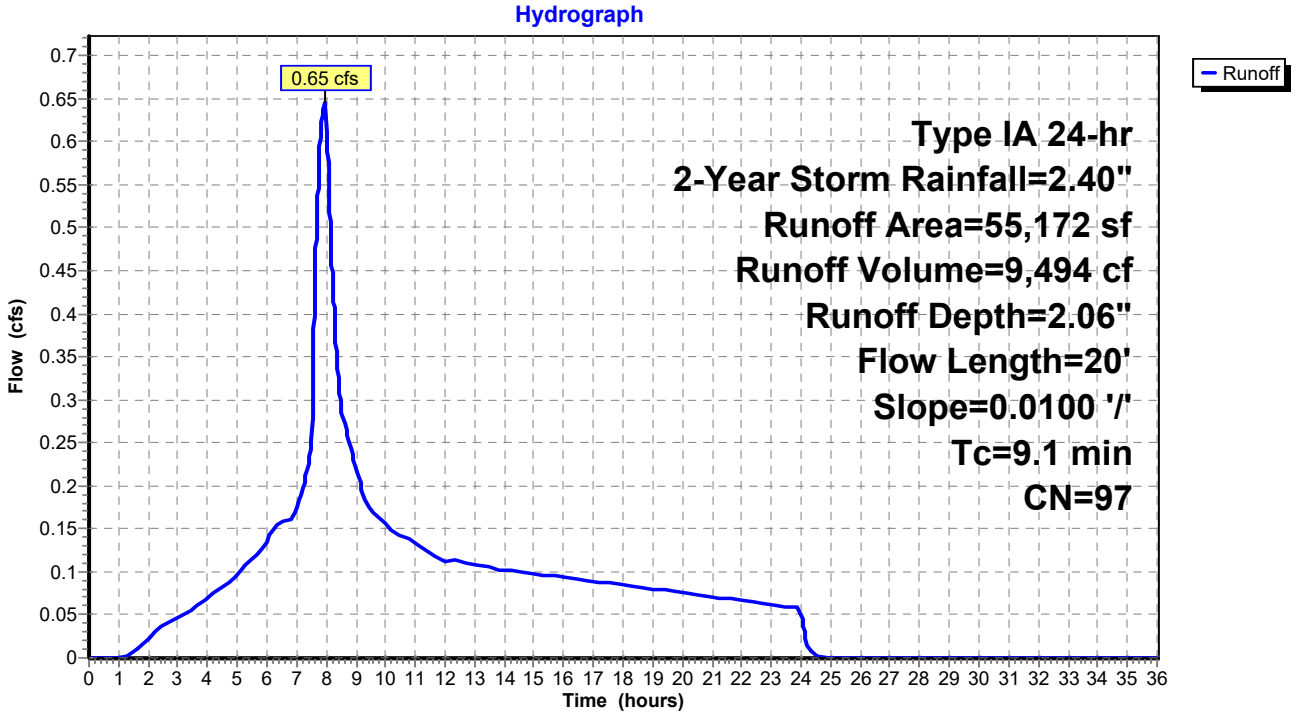
Runoff = 0.65 cfs @ 7.96 hrs, Volume= 9,494 cf, Depth= 2.06"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Storm Rainfall=2.40"

	Area (sf)	CN	Description
*	6,531	98	Paved parking, HSG C (Basin 3)
*	45,673	98	Roofs, HSG C (Basin 1)
	2,968	74	>75% Grass cover, Good, HSG C
	55,172	97	Weighted Average
	2,968		5.38% Pervious Area
	52,204		94.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
4.1	20	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
9.1	20	Total			

Subcatchment 1,3, LS: Site Impervious and Landscape



Summary for Subcatchment 2,7,LS: Site Impervious

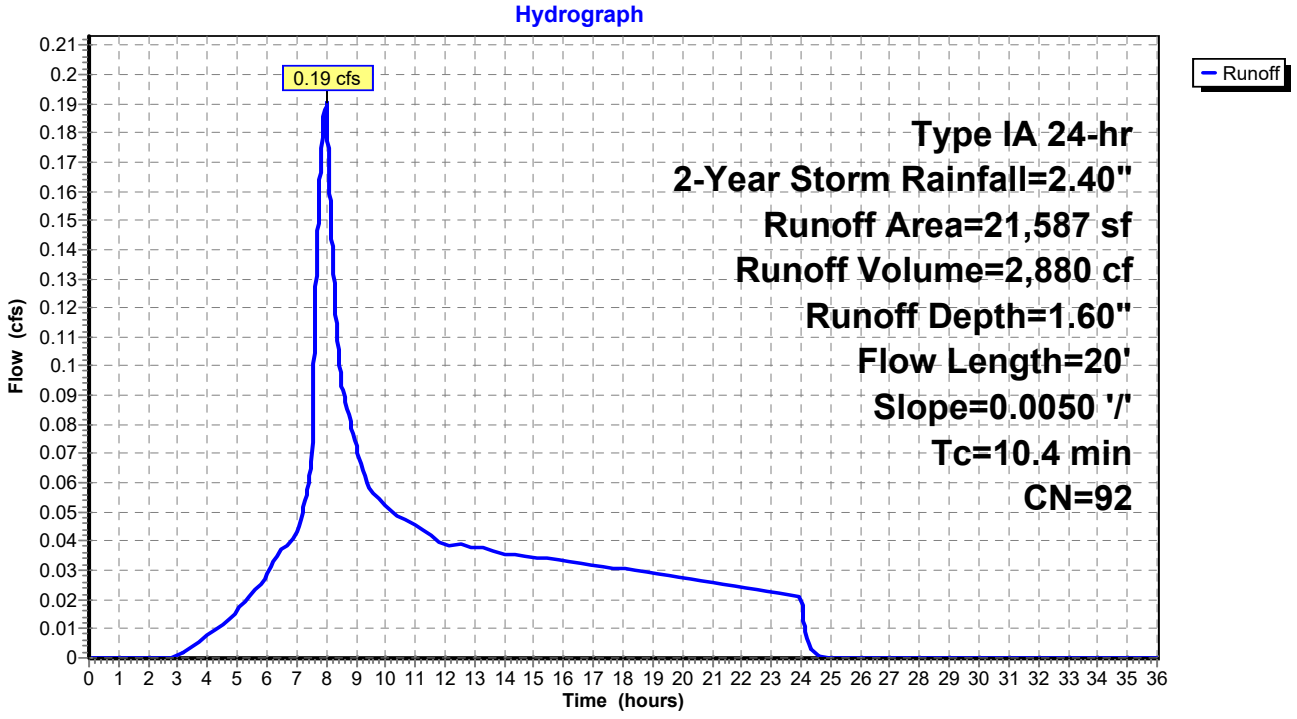
Runoff = 0.19 cfs @ 8.00 hrs, Volume= 2,880 cf, Depth= 1.60"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Storm Rainfall=2.40"

	Area (sf)	CN	Description
*	15,621	98	Paved parking/Hardscape, HSG C (Basin 2)
*	725	98	Paved parking/Hardscape, HSG C (Basin 7)
	5,241	74	>75% Grass cover, Good, HSG C
	21,587	92	Weighted Average
	5,241		24.28% Pervious Area
	16,346		75.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.4	20	0.0050	0.06		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
10.4	20	Total			

Subcatchment 2,7,LS: Site Impervious



Summary for Subcatchment LS,4,5,6: South Patio and Landscape

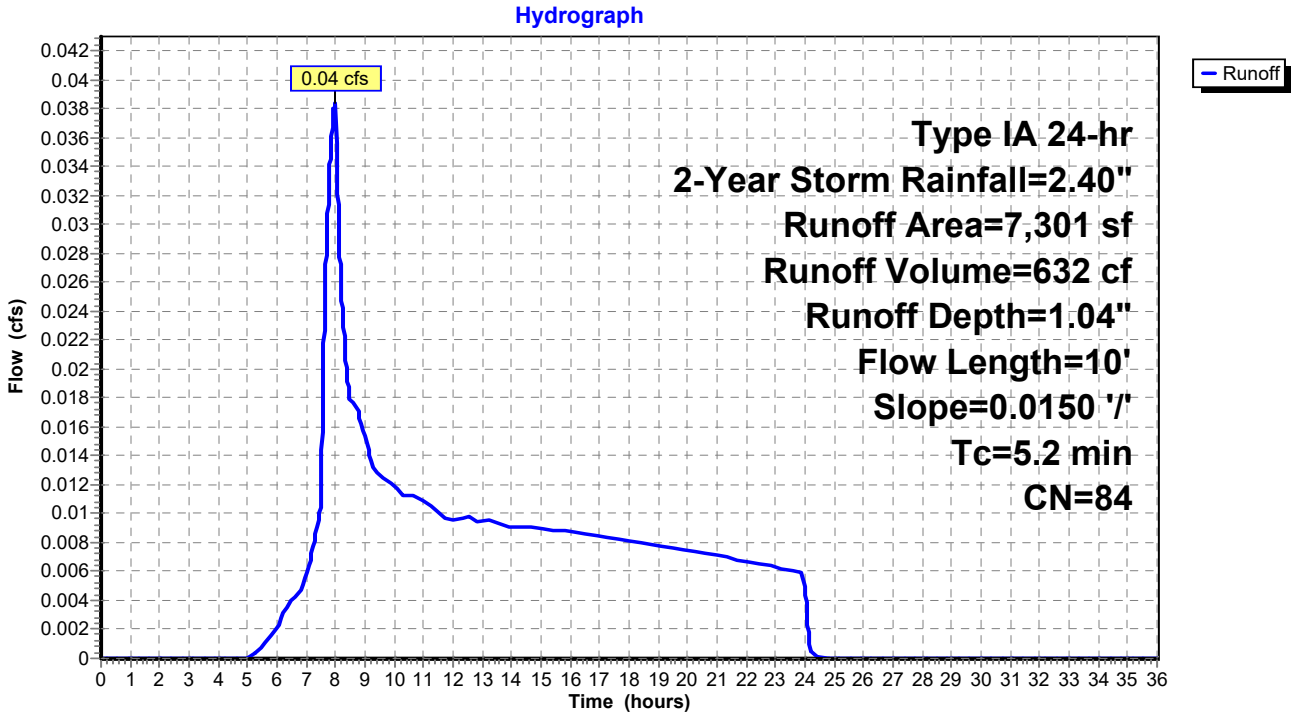
Runoff = 0.04 cfs @ 8.00 hrs, Volume= 632 cf, Depth= 1.04"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Storm Rainfall=2.40"

	Area (sf)	CN	Description
*	3,066	98	Impervious Sidewalk (Basins 4,5,6)
	4,235	74	>75% Grass cover, Good, HSG C
	7,301	84	Weighted Average
	4,235		58.01% Pervious Area
	3,066		41.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0150	0.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.40"
5.0					**Direct Entry, Direct**
5.2	10	Total			

Subcatchment LS,4,5,6: South Patio and Landscape



Summary for Pond 36": Subsurface Detention (West)

Inflow Area = 21,587 sf, 75.72% Impervious, Inflow Depth = 1.60" for 2-Year Storm event
Inflow = 0.19 cfs @ 8.00 hrs, Volume= 2,880 cf
Outflow = 0.07 cfs @ 8.98 hrs, Volume= 2,880 cf, Atten= 62%, Lag= 59.3 min
Primary = 0.07 cfs @ 8.98 hrs, Volume= 2,880 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 1.50' @ 8.98 hrs Surf.Area= 358 sf Storage= 371 cf

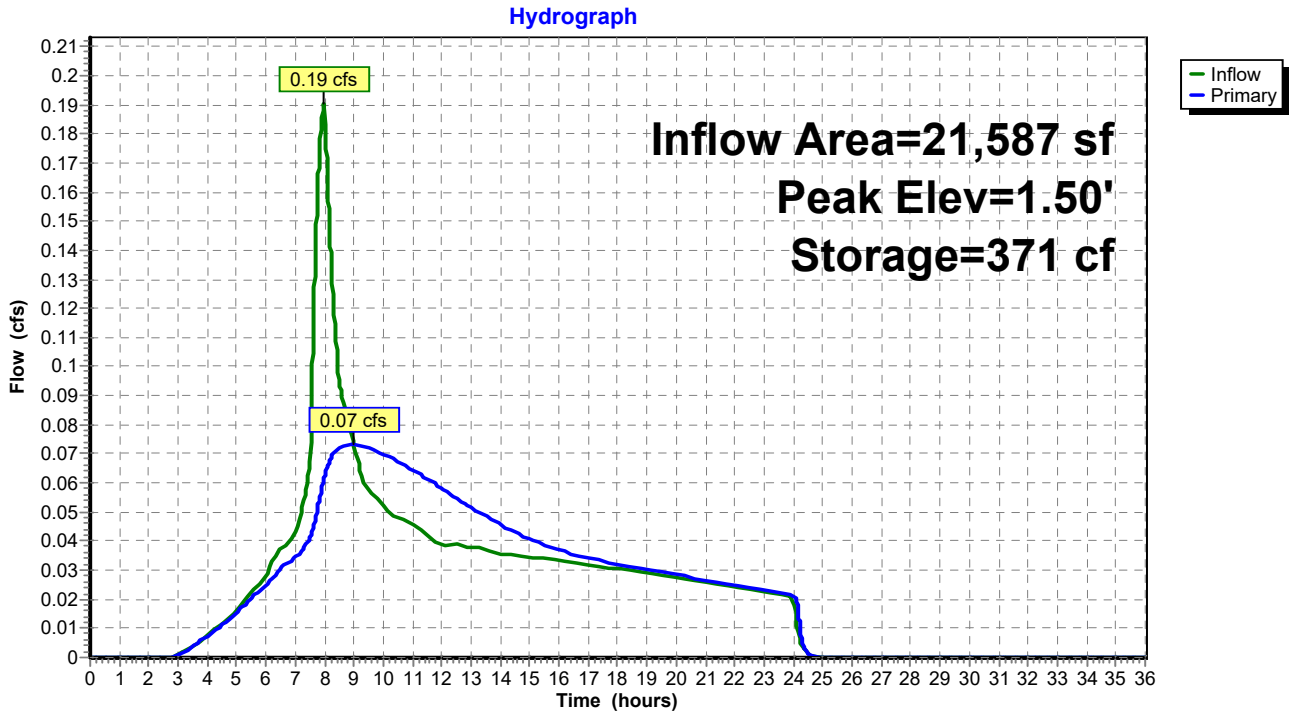
Plug-Flow detention time= 38.3 min calculated for 2,879 cf (100% of inflow)
Center-of-Mass det. time= 38.3 min (793.9 - 755.6)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	848 cf	**36.0" Round Pipe Storage** x 2 L= 60.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	2.50'	**4.0" Vert. Upper Orifice** C= 0.620
#3	Primary	3.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.07 cfs @ 8.98 hrs HW=1.50' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.07 cfs @ 5.97 fps)
- **2=Upper Orifice** (Controls 0.00 cfs)
- **3=100-yr Overflow** (Controls 0.00 cfs)

Pond 36": Subsurface Detention (West)



Summary for Pond 48": Subsurface Detention (East)

Inflow Area = 55,172 sf, 94.62% Impervious, Inflow Depth = 2.06" for 2-Year Storm event
Inflow = 0.65 cfs @ 7.96 hrs, Volume= 9,494 cf
Outflow = 0.10 cfs @ 14.72 hrs, Volume= 9,440 cf, Atten= 85%, Lag= 405.9 min
Primary = 0.10 cfs @ 14.72 hrs, Volume= 9,440 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 2.71' @ 14.72 hrs Surf.Area= 1,644 sf Storage= 3,499 cf

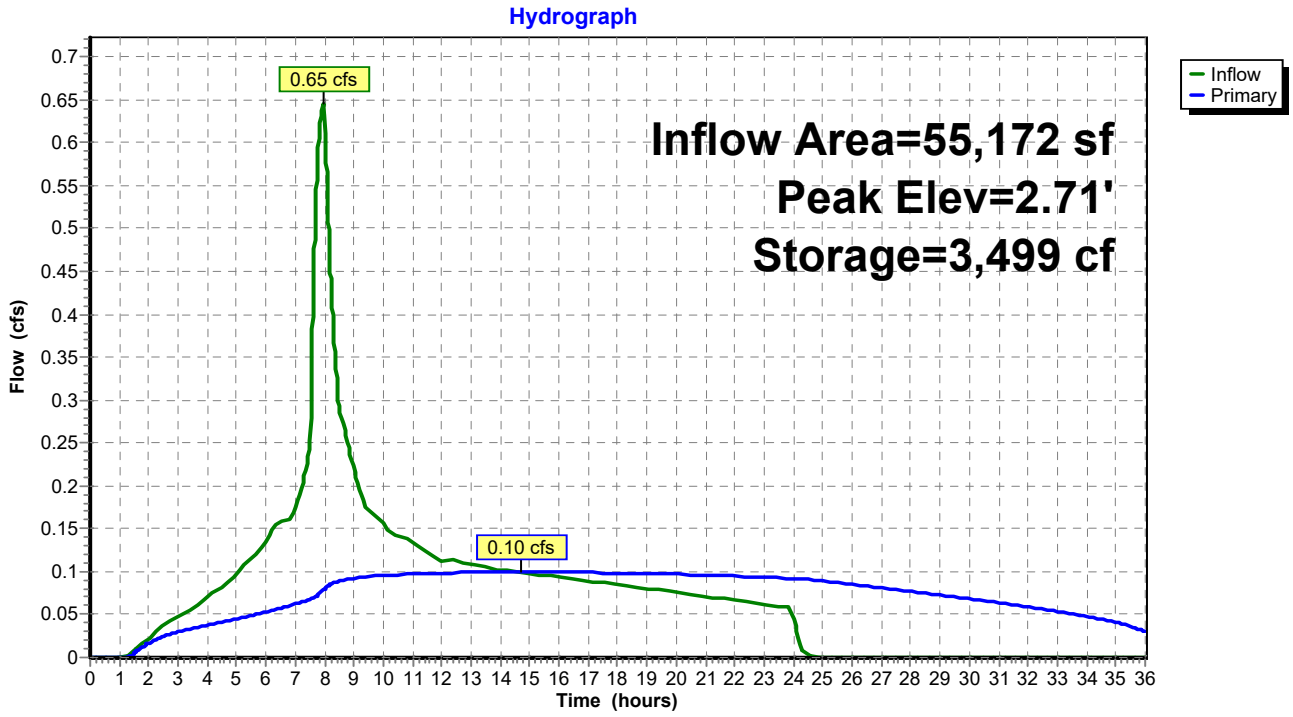
Plug-Flow detention time= 442.4 min calculated for 9,440 cf (99% of inflow)
Center-of-Mass det. time= 438.1 min (1,132.0 - 693.9)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5,341 cf	**48.0" Round CMP_Round 48"** x 5 L= 85.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	3.50'	**4.5" Vert. Upper Orifice** C= 0.620
#3	Primary	4.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.10 cfs @ 14.72 hrs HW=2.71' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.10 cfs @ 8.09 fps)
- **2=Upper Orifice** (Controls 0.00 cfs)
- **3=100-yr Overflow** (Controls 0.00 cfs)

Pond 48": Subsurface Detention (East)

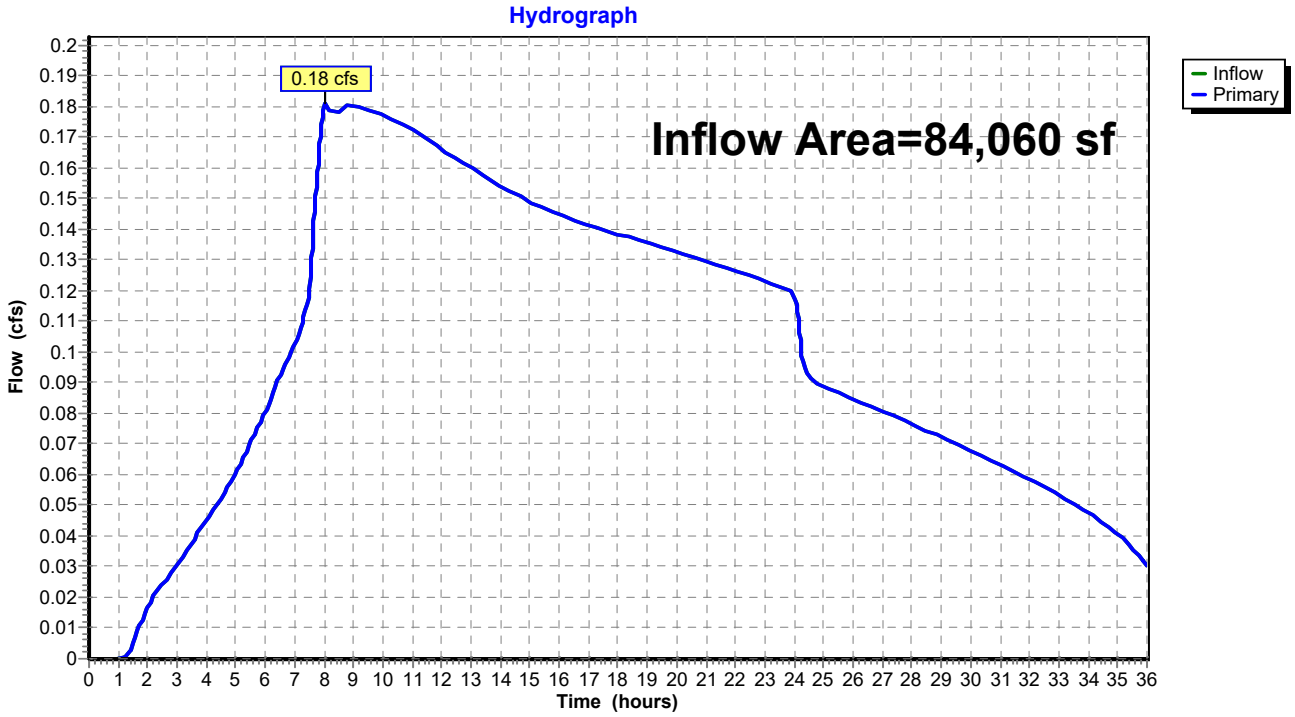


Summary for Link Post: Post-Developed Flow Summary

Inflow Area = 84,060 sf, 85.20% Impervious, Inflow Depth > 1.85" for 2-Year Storm event
Inflow = 0.18 cfs @ 8.01 hrs, Volume= 12,952 cf
Primary = 0.18 cfs @ 8.01 hrs, Volume= 12,952 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Post: Post-Developed Flow Summary



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1,3, LS: Site Impervious Runoff Area=55,172 sf 94.62% Impervious Runoff Depth=2.66"
Flow Length=20' Slope=0.0100 '/' Tc=9.1 min CN=97 Runoff=0.83 cfs 12,222 cf

Subcatchment 2,7,LS: Site Impervious Runoff Area=21,587 sf 75.72% Impervious Runoff Depth=2.16"
Flow Length=20' Slope=0.0050 '/' Tc=10.4 min CN=92 Runoff=0.26 cfs 3,888 cf

Subcatchment LS,4,5,6: South Patio and Runoff Area=7,301 sf 41.99% Impervious Runoff Depth=1.52"
Flow Length=10' Slope=0.0150 '/' Tc=5.2 min CN=84 Runoff=0.06 cfs 923 cf

Pond 36": Subsurface Detention (West) Peak Elev=2.19' Storage=613 cf Inflow=0.26 cfs 3,888 cf
Outflow=0.09 cfs 3,888 cf

Pond 48": Subsurface Detention (East) Peak Elev=3.59' Storage=4,806 cf Inflow=0.83 cfs 12,222 cf
Outflow=0.14 cfs 11,545 cf

Link Post: Post-Developed Flow Summary Inflow=0.22 cfs 16,355 cf
Primary=0.22 cfs 16,355 cf

Total Runoff Area = 84,060 sf Runoff Volume = 17,032 cf Average Runoff Depth = 2.43"
14.80% Pervious = 12,444 sf 85.20% Impervious = 71,616 sf

Summary for Subcatchment 1,3, LS: Site Impervious and Landscape

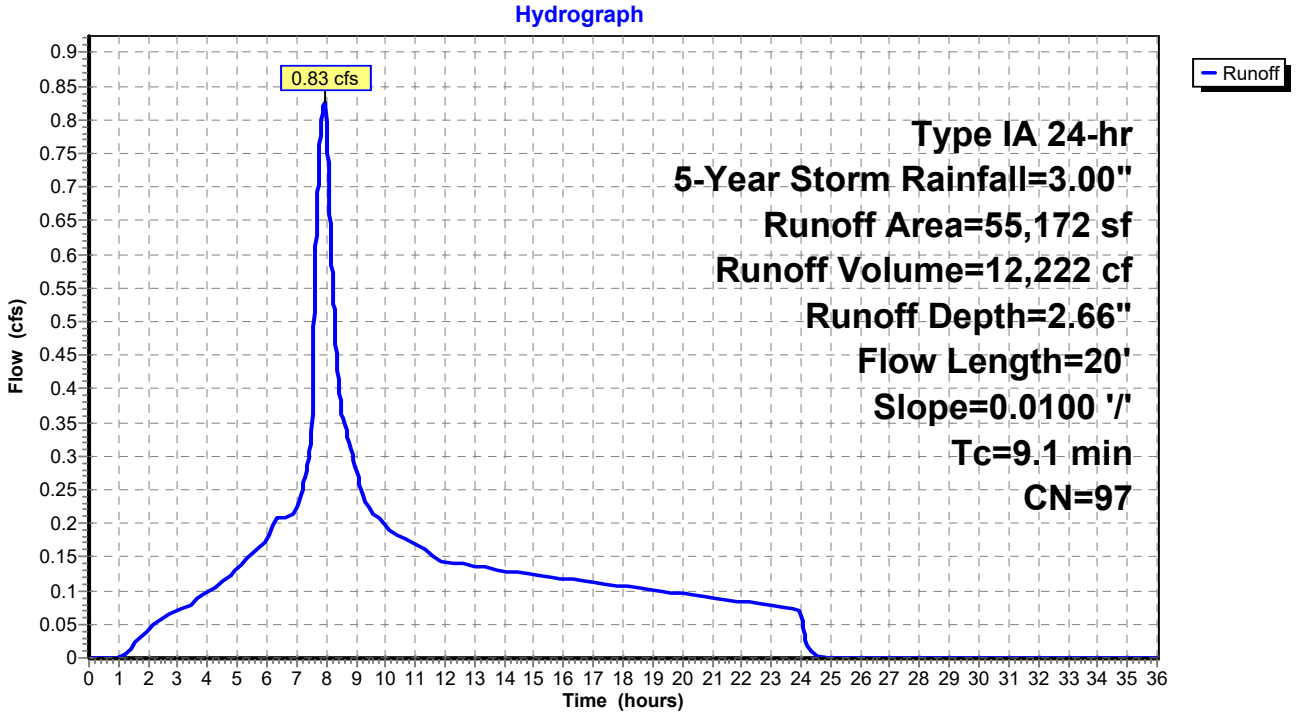
Runoff = 0.83 cfs @ 7.95 hrs, Volume= 12,222 cf, Depth= 2.66"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Storm Rainfall=3.00"

	Area (sf)	CN	Description
*	6,531	98	Paved parking, HSG C (Basin 3)
*	45,673	98	Roofs, HSG C (Basin 1)
	2,968	74	>75% Grass cover, Good, HSG C
	55,172	97	Weighted Average
	2,968		5.38% Pervious Area
	52,204		94.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
4.1	20	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
9.1	20	Total			

Subcatchment 1,3, LS: Site Impervious and Landscape



Summary for Subcatchment 2,7,LS: Site Impervious

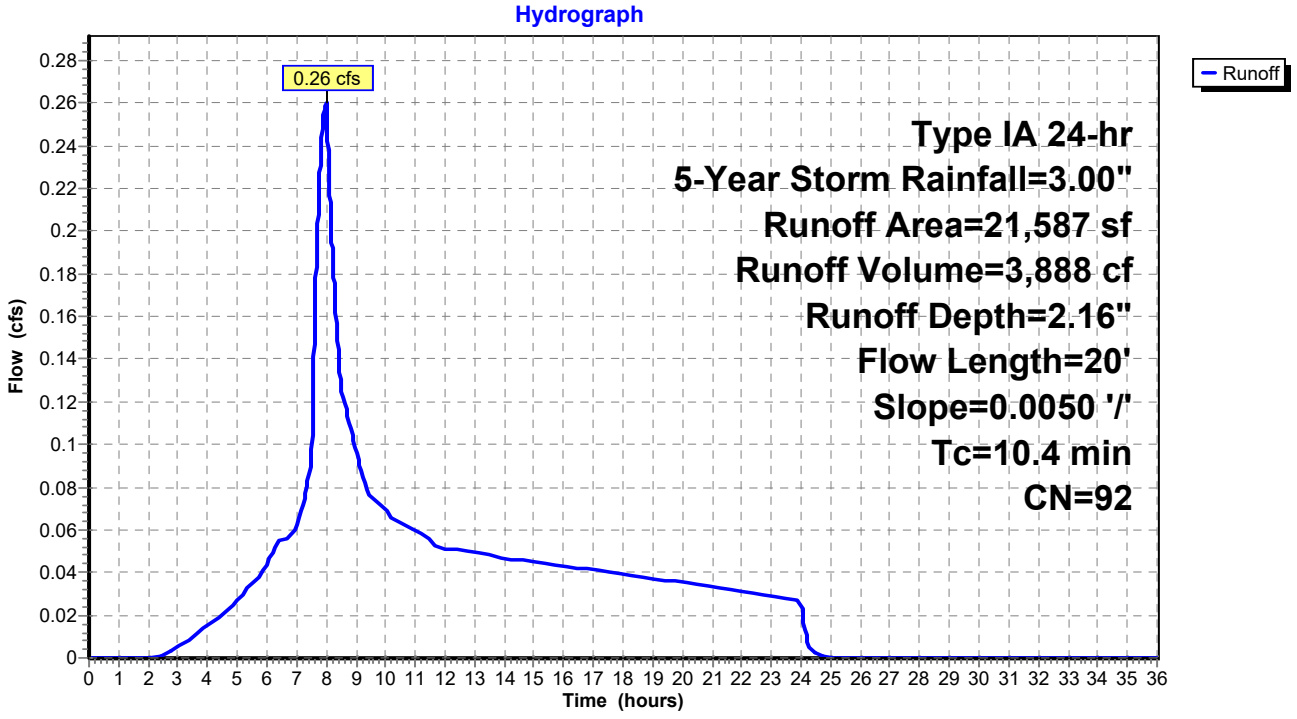
Runoff = 0.26 cfs @ 8.00 hrs, Volume= 3,888 cf, Depth= 2.16"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Storm Rainfall=3.00"

	Area (sf)	CN	Description
*	15,621	98	Paved parking/Hardscape, HSG C (Basin 2)
*	725	98	Paved parking/Hardscape, HSG C (Basin 7)
	5,241	74	>75% Grass cover, Good, HSG C
	21,587	92	Weighted Average
	5,241		24.28% Pervious Area
	16,346		75.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.4	20	0.0050	0.06		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
10.4	20	Total			

Subcatchment 2,7,LS: Site Impervious



Summary for Subcatchment LS,4,5,6: South Patio and Landscape

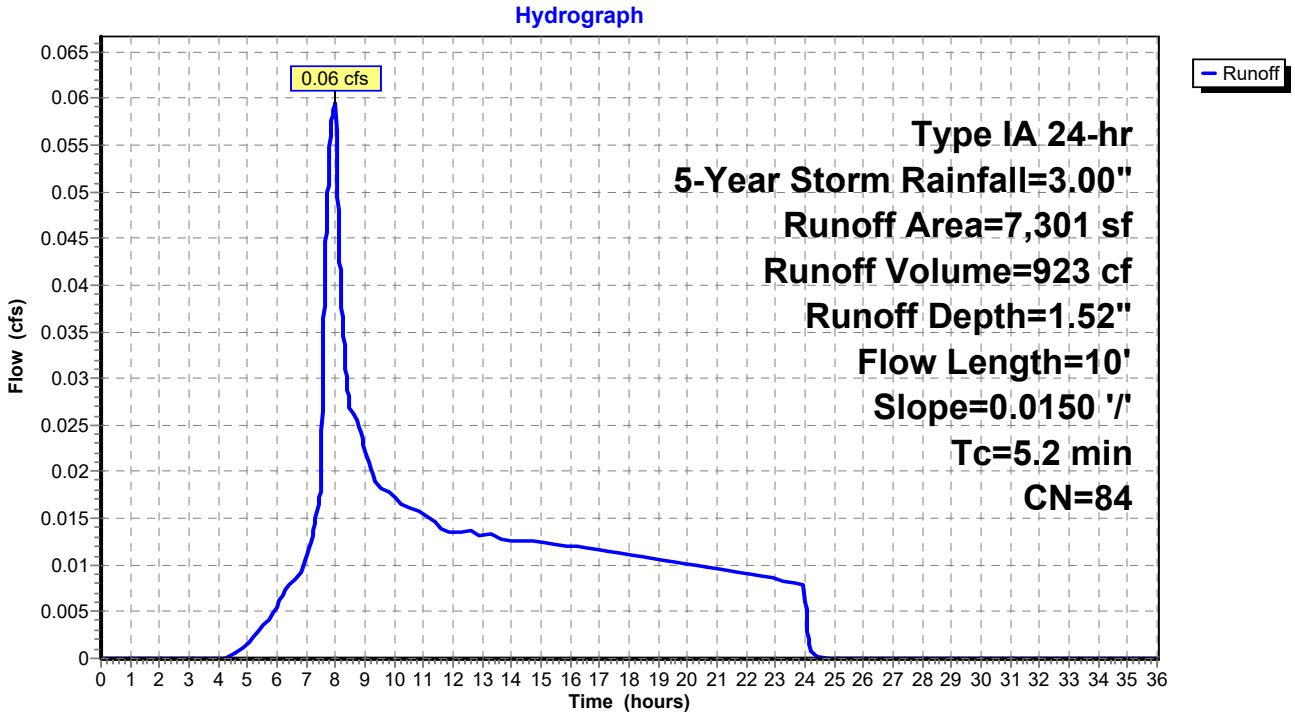
Runoff = 0.06 cfs @ 7.97 hrs, Volume= 923 cf, Depth= 1.52"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-Year Storm Rainfall=3.00"

	Area (sf)	CN	Description
*	3,066	98	Impervious Sidewalk (Basins 4,5,6)
	4,235	74	>75% Grass cover, Good, HSG C
	7,301	84	Weighted Average
	4,235		58.01% Pervious Area
	3,066		41.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0150	0.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.40"
5.0					**Direct Entry, Direct**
5.2	10	Total			

Subcatchment LS,4,5,6: South Patio and Landscape



Summary for Pond 36": Subsurface Detention (West)

Inflow Area = 21,587 sf, 75.72% Impervious, Inflow Depth = 2.16" for 5-Year Storm event
Inflow = 0.26 cfs @ 8.00 hrs, Volume= 3,888 cf
Outflow = 0.09 cfs @ 9.14 hrs, Volume= 3,888 cf, Atten= 66%, Lag= 68.6 min
Primary = 0.09 cfs @ 9.14 hrs, Volume= 3,888 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 2.19' @ 9.14 hrs Surf.Area= 335 sf Storage= 613 cf

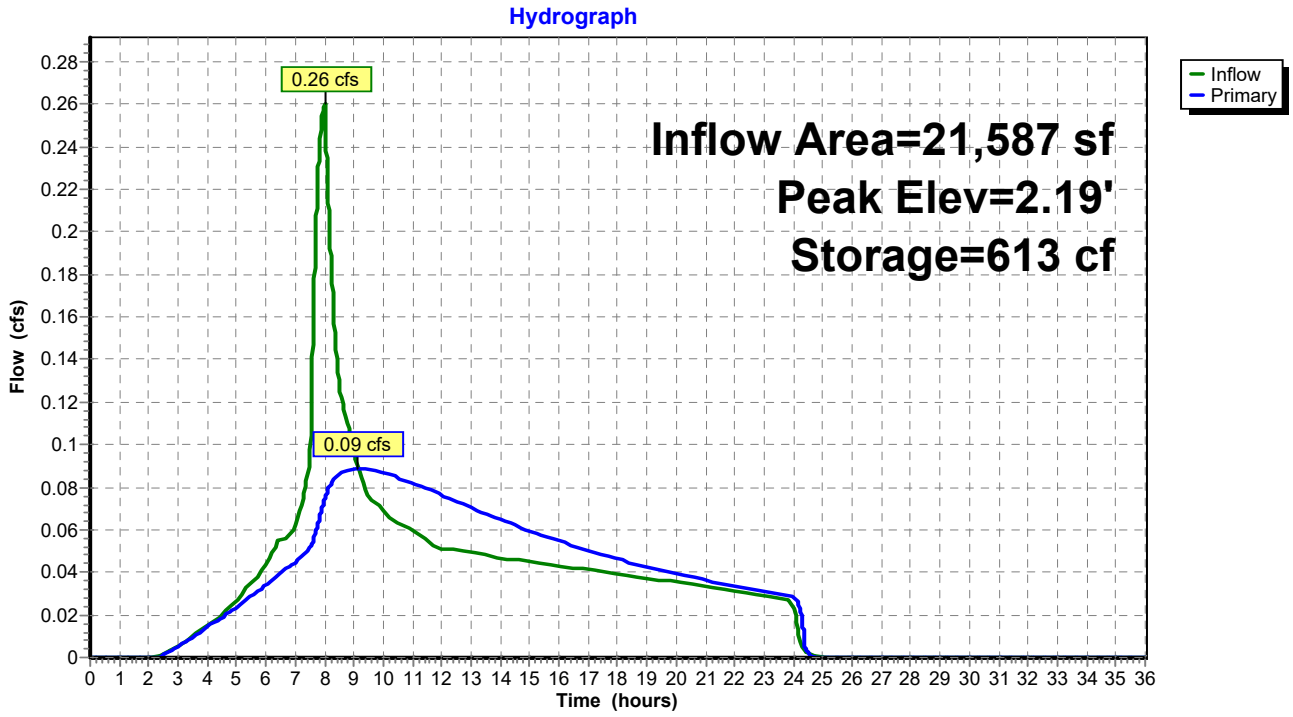
Plug-Flow detention time= 61.3 min calculated for 3,887 cf (100% of inflow)
Center-of-Mass det. time= 61.2 min (801.0 - 739.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	848 cf	**36.0" Round Pipe Storage** x 2 L= 60.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	2.50'	**4.0" Vert. Upper Orifice** C= 0.620
#3	Primary	3.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 9.14 hrs HW=2.19' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.09 cfs @ 7.25 fps)
- **2=Upper Orifice** (Controls 0.00 cfs)
- **3=100-yr Overflow** (Controls 0.00 cfs)

Pond 36": Subsurface Detention (West)



Summary for Pond 48": Subsurface Detention (East)

Inflow Area = 55,172 sf, 94.62% Impervious, Inflow Depth = 2.66" for 5-Year Storm event
Inflow = 0.83 cfs @ 7.95 hrs, Volume= 12,222 cf
Outflow = 0.14 cfs @ 12.80 hrs, Volume= 11,545 cf, Atten= 83%, Lag= 290.7 min
Primary = 0.14 cfs @ 12.80 hrs, Volume= 11,545 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 3.59' @ 12.80 hrs Surf.Area= 1,223 sf Storage= 4,806 cf

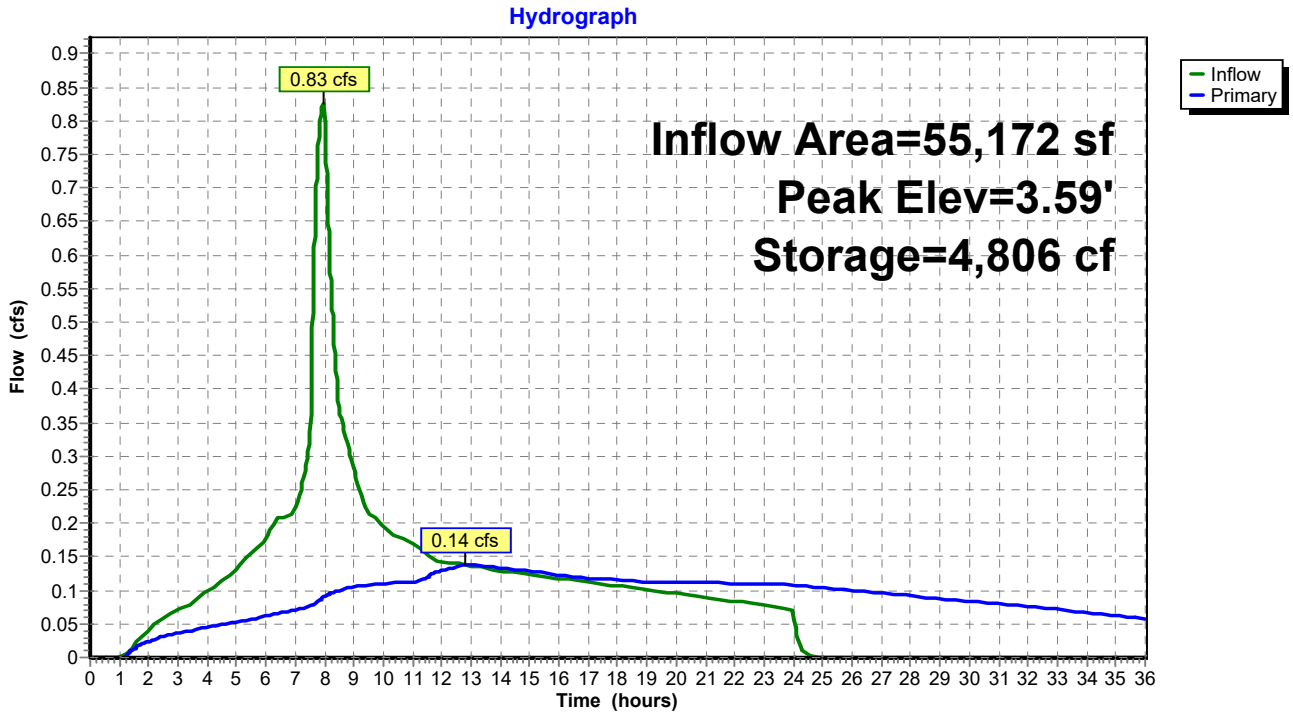
Plug-Flow detention time= 498.2 min calculated for 11,541 cf (94% of inflow)
Center-of-Mass det. time= 457.8 min (1,142.7 - 684.9)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5,341 cf	**48.0" Round CMP_Round 48"** x 5 L= 85.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	3.50'	**4.5" Vert. Upper Orifice** C= 0.620
#3	Primary	4.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.14 cfs @ 12.80 hrs HW=3.59' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.11 cfs @ 9.35 fps)
- **2=Upper Orifice** (Orifice Controls 0.02 cfs @ 1.06 fps)
- **3=100-yr Overflow** (Controls 0.00 cfs)

Pond 48": Subsurface Detention (East)

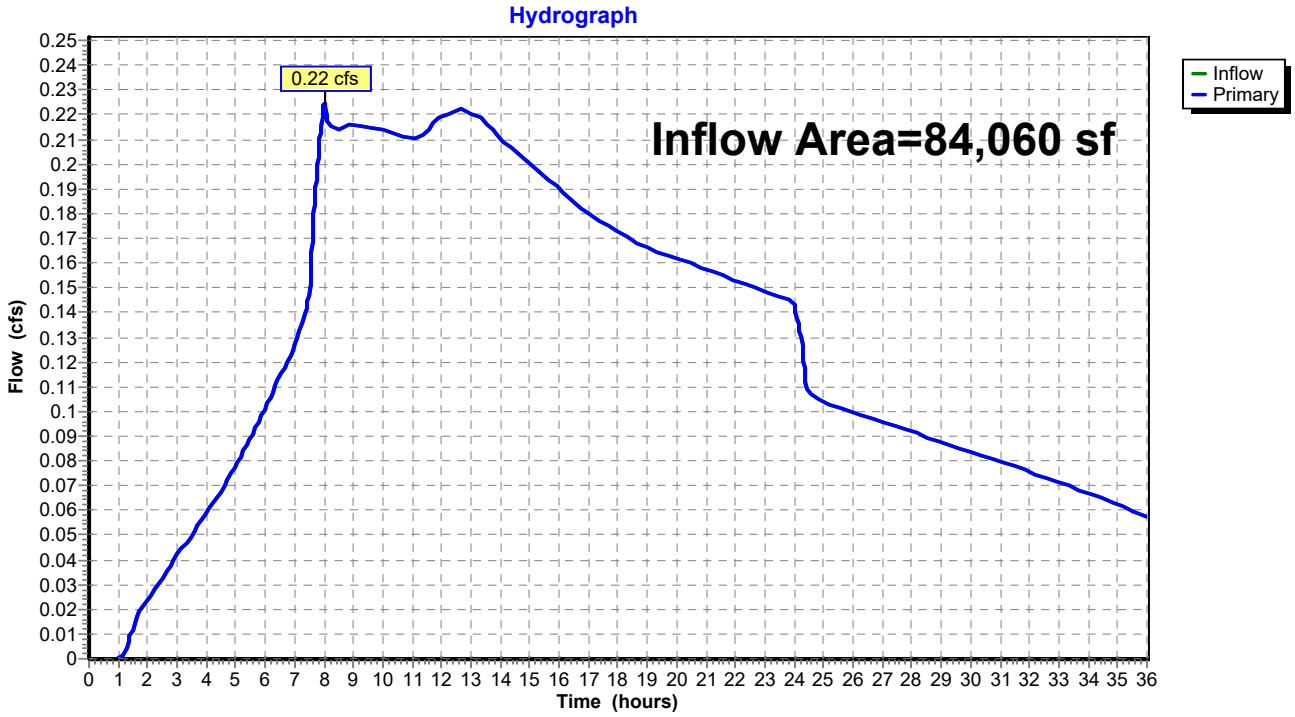


Summary for Link Post: Post-Developed Flow Summary

Inflow Area = 84,060 sf, 85.20% Impervious, Inflow Depth > 2.33" for 5-Year Storm event
Inflow = 0.22 cfs @ 8.00 hrs, Volume= 16,355 cf
Primary = 0.22 cfs @ 8.00 hrs, Volume= 16,355 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Post: Post-Developed Flow Summary



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1,3, LS: Site Impervious Runoff Area=55,172 sf 94.62% Impervious Runoff Depth=3.15"
Flow Length=20' Slope=0.0100 '/' Tc=9.1 min CN=97 Runoff=0.97 cfs 14,503 cf

Subcatchment 2,7,LS: Site Impervious Runoff Area=21,587 sf 75.72% Impervious Runoff Depth=2.64"
Flow Length=20' Slope=0.0050 '/' Tc=10.4 min CN=92 Runoff=0.32 cfs 4,743 cf

Subcatchment LS,4,5,6: South Patio and Runoff Area=7,301 sf 41.99% Impervious Runoff Depth=1.94"
Flow Length=10' Slope=0.0150 '/' Tc=5.2 min CN=84 Runoff=0.08 cfs 1,178 cf

Pond 36": Subsurface Detention (West) Peak Elev=2.64' Storage=753 cf Inflow=0.32 cfs 4,743 cf
Outflow=0.15 cfs 4,743 cf

Pond 48": Subsurface Detention (East) Peak Elev=3.75' Storage=4,993 cf Inflow=0.97 cfs 14,503 cf
Outflow=0.26 cfs 13,674 cf

Link Post: Post-Developed Flow Summary Inflow=0.39 cfs 19,595 cf
Primary=0.39 cfs 19,595 cf

Total Runoff Area = 84,060 sf Runoff Volume = 20,424 cf Average Runoff Depth = 2.92"
14.80% Pervious = 12,444 sf 85.20% Impervious = 71,616 sf

Summary for Subcatchment 1,3, LS: Site Impervious and Landscape

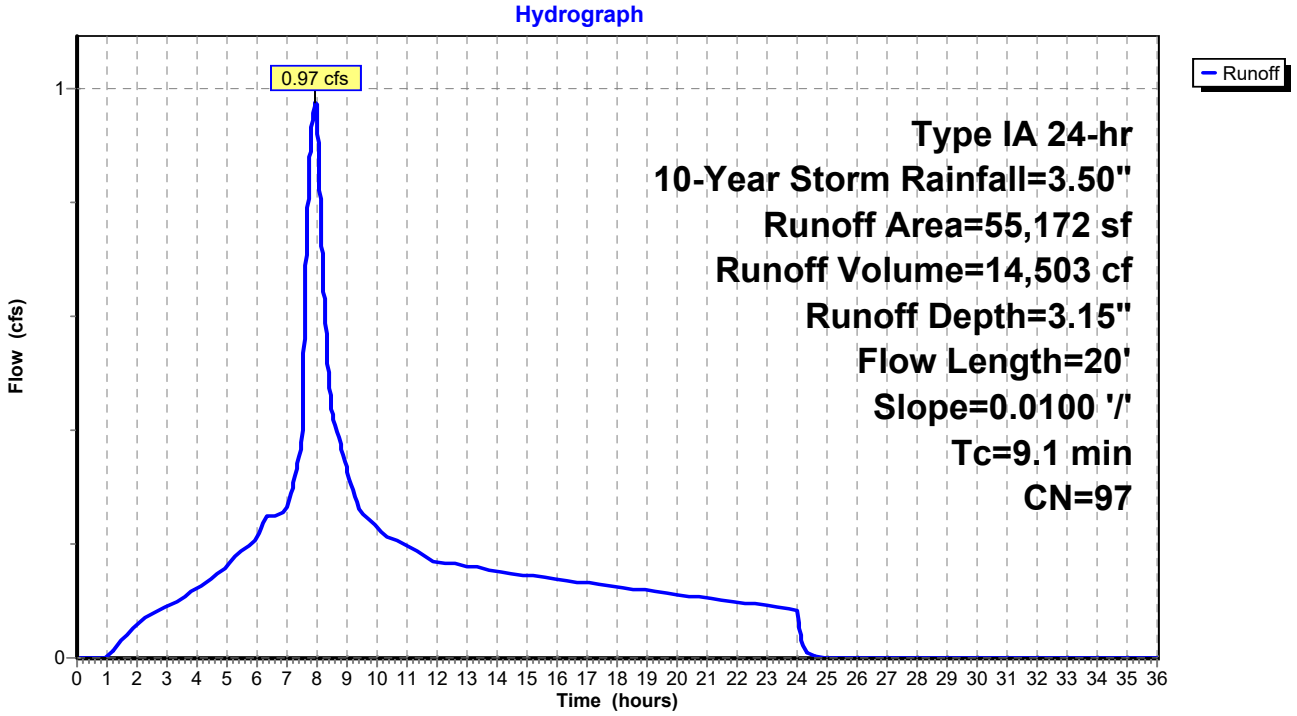
Runoff = 0.97 cfs @ 7.95 hrs, Volume= 14,503 cf, Depth= 3.15"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Storm Rainfall=3.50"

	Area (sf)	CN	Description
*	6,531	98	Paved parking, HSG C (Basin 3)
*	45,673	98	Roofs, HSG C (Basin 1)
	2,968	74	>75% Grass cover, Good, HSG C
	55,172	97	Weighted Average
	2,968		5.38% Pervious Area
	52,204		94.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
4.1	20	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
9.1	20	Total			

Subcatchment 1,3, LS: Site Impervious and Landscape



Summary for Subcatchment 2,7,LS: Site Impervious

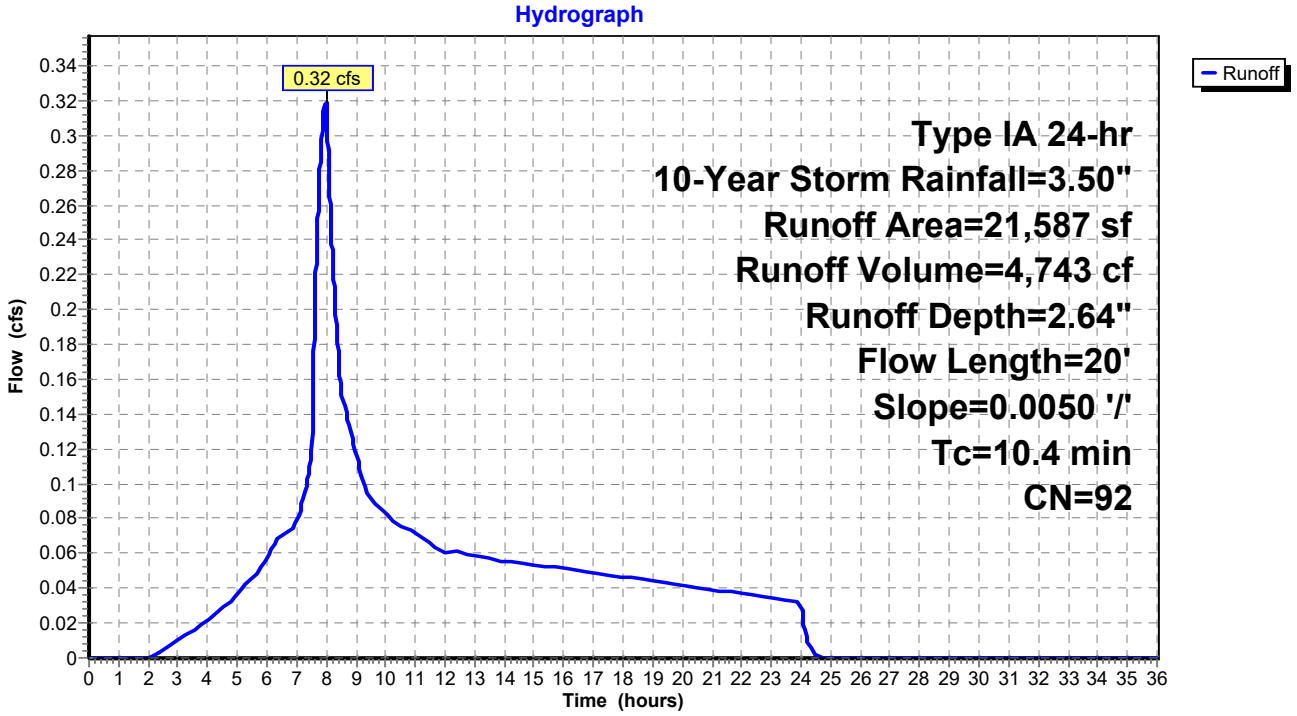
Runoff = 0.32 cfs @ 7.99 hrs, Volume= 4,743 cf, Depth= 2.64"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Storm Rainfall=3.50"

	Area (sf)	CN	Description
*	15,621	98	Paved parking/Hardscape, HSG C (Basin 2)
*	725	98	Paved parking/Hardscape, HSG C (Basin 7)
	5,241	74	>75% Grass cover, Good, HSG C
	21,587	92	Weighted Average
	5,241		24.28% Pervious Area
	16,346		75.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.4	20	0.0050	0.06		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
10.4	20	Total			

Subcatchment 2,7,LS: Site Impervious



Summary for Subcatchment LS,4,5,6: South Patio and Landscape

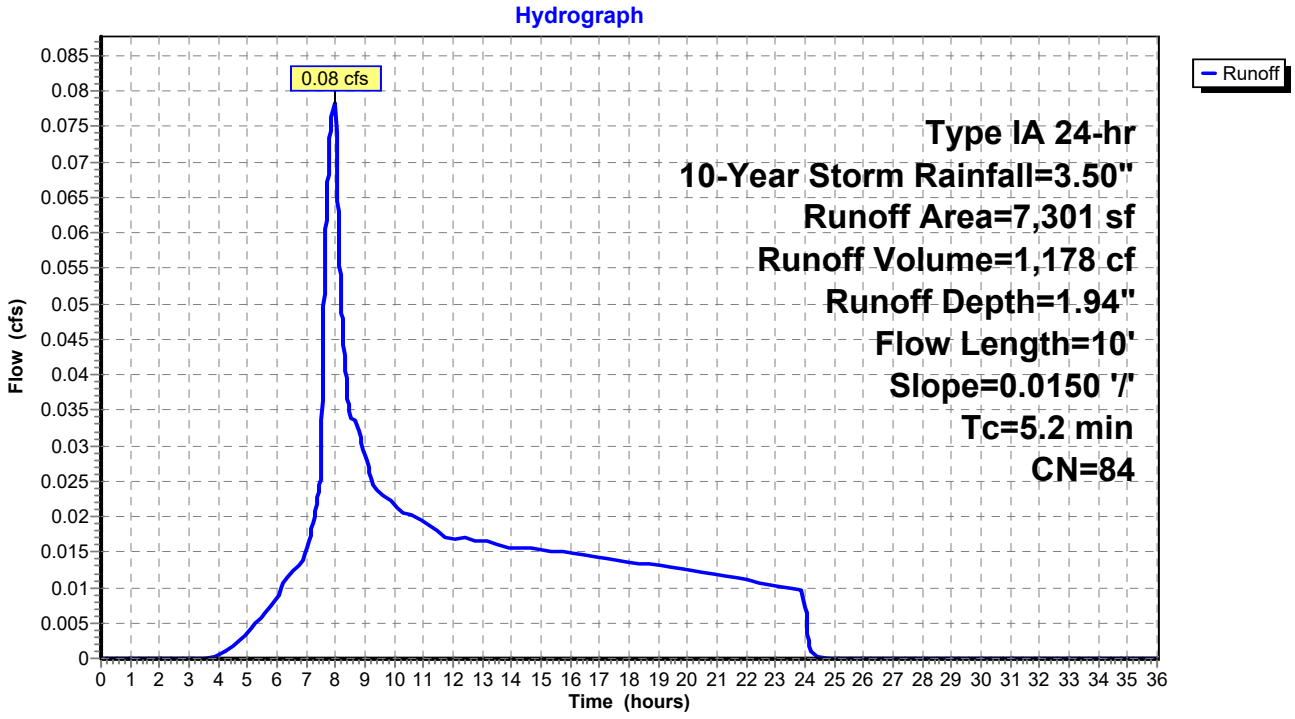
Runoff = 0.08 cfs @ 7.96 hrs, Volume= 1,178 cf, Depth= 1.94"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Storm Rainfall=3.50"

	Area (sf)	CN	Description
*	3,066	98	Impervious Sidewalk (Basins 4,5,6)
	4,235	74	>75% Grass cover, Good, HSG C
	7,301	84	Weighted Average
	4,235		58.01% Pervious Area
	3,066		41.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0150	0.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.40"
5.0					**Direct Entry, Direct**
5.2	10	Total			

Subcatchment LS,4,5,6: South Patio and Landscape



Summary for Pond 36": Subsurface Detention (West)

Inflow Area = 21,587 sf, 75.72% Impervious, Inflow Depth = 2.64" for 10-Year Storm event
Inflow = 0.32 cfs @ 7.99 hrs, Volume= 4,743 cf
Outflow = 0.15 cfs @ 8.59 hrs, Volume= 4,743 cf, Atten= 54%, Lag= 35.8 min
Primary = 0.15 cfs @ 8.59 hrs, Volume= 4,743 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 2.64' @ 8.59 hrs Surf.Area= 268 sf Storage= 753 cf

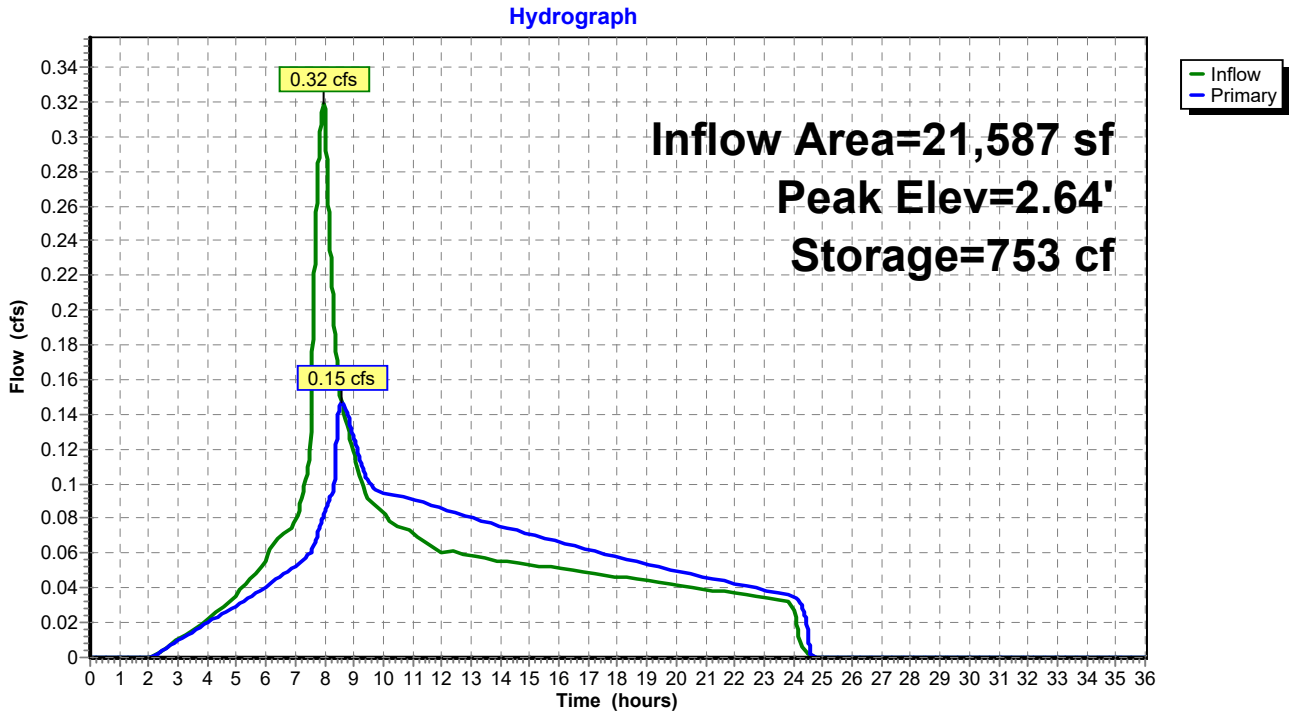
Plug-Flow detention time= 73.5 min calculated for 4,742 cf (100% of inflow)
Center-of-Mass det. time= 73.5 min (803.2 - 729.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	848 cf	**36.0" Round Pipe Storage** x 2 L= 60.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	2.50'	**4.0" Vert. Upper Orifice** C= 0.620
#3	Primary	3.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.59 hrs HW=2.64' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.10 cfs @ 7.99 fps)
- **2=Upper Orifice** (Orifice Controls 0.05 cfs @ 1.34 fps)
- **3=100-yr Overflow** (Controls 0.00 cfs)

Pond 36": Subsurface Detention (West)



Summary for Pond 48": Subsurface Detention (East)

Inflow Area = 55,172 sf, 94.62% Impervious, Inflow Depth = 3.15" for 10-Year Storm event
Inflow = 0.97 cfs @ 7.95 hrs, Volume= 14,503 cf
Outflow = 0.26 cfs @ 9.45 hrs, Volume= 13,674 cf, Atten= 73%, Lag= 89.6 min
Primary = 0.26 cfs @ 9.45 hrs, Volume= 13,674 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 3.75' @ 9.45 hrs Surf.Area= 1,070 sf Storage= 4,993 cf

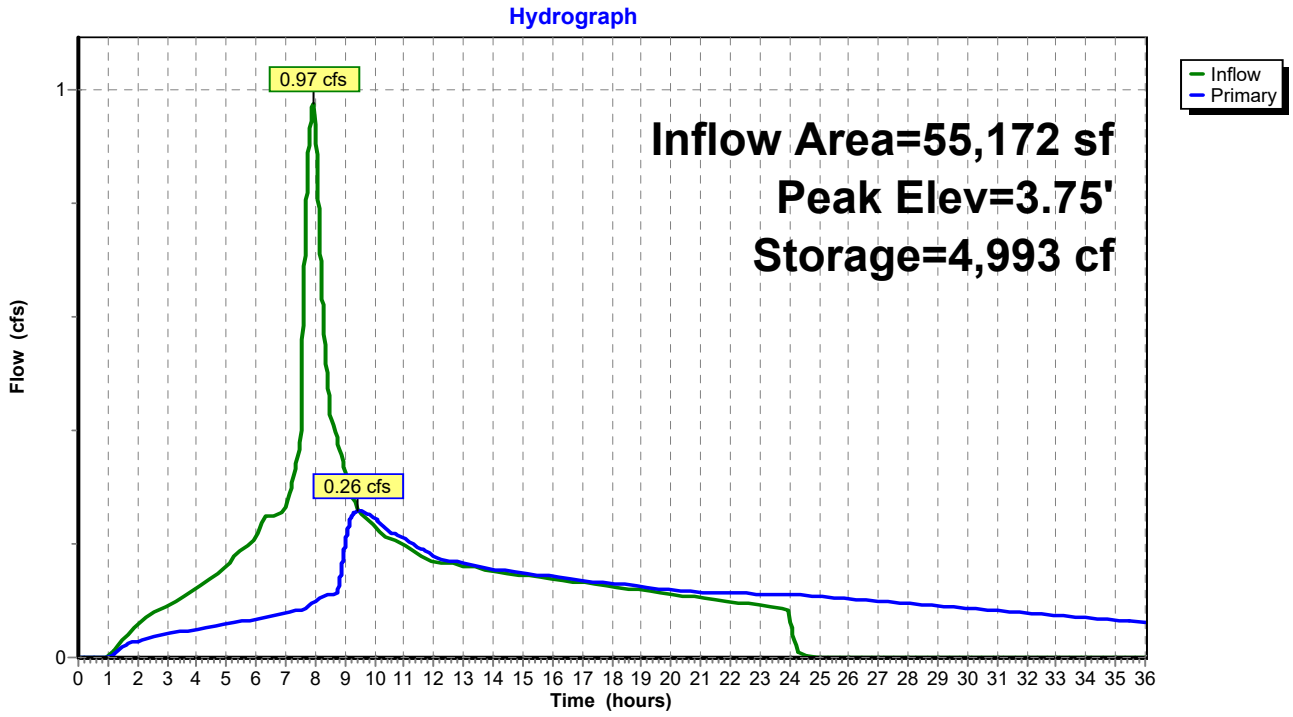
Plug-Flow detention time= 445.1 min calculated for 13,670 cf (94% of inflow)
Center-of-Mass det. time= 403.3 min (1,082.6 - 679.4)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5,341 cf	**48.0" Round CMP_Round 48"** x 5 L= 85.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	3.50'	**4.5" Vert. Upper Orifice** C= 0.620
#3	Primary	4.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.26 cfs @ 9.45 hrs HW=3.75' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.12 cfs @ 9.56 fps)
- **2=Upper Orifice** (Orifice Controls 0.14 cfs @ 1.77 fps)
- **3=100-yr Overflow** (Controls 0.00 cfs)

Pond 48": Subsurface Detention (East)

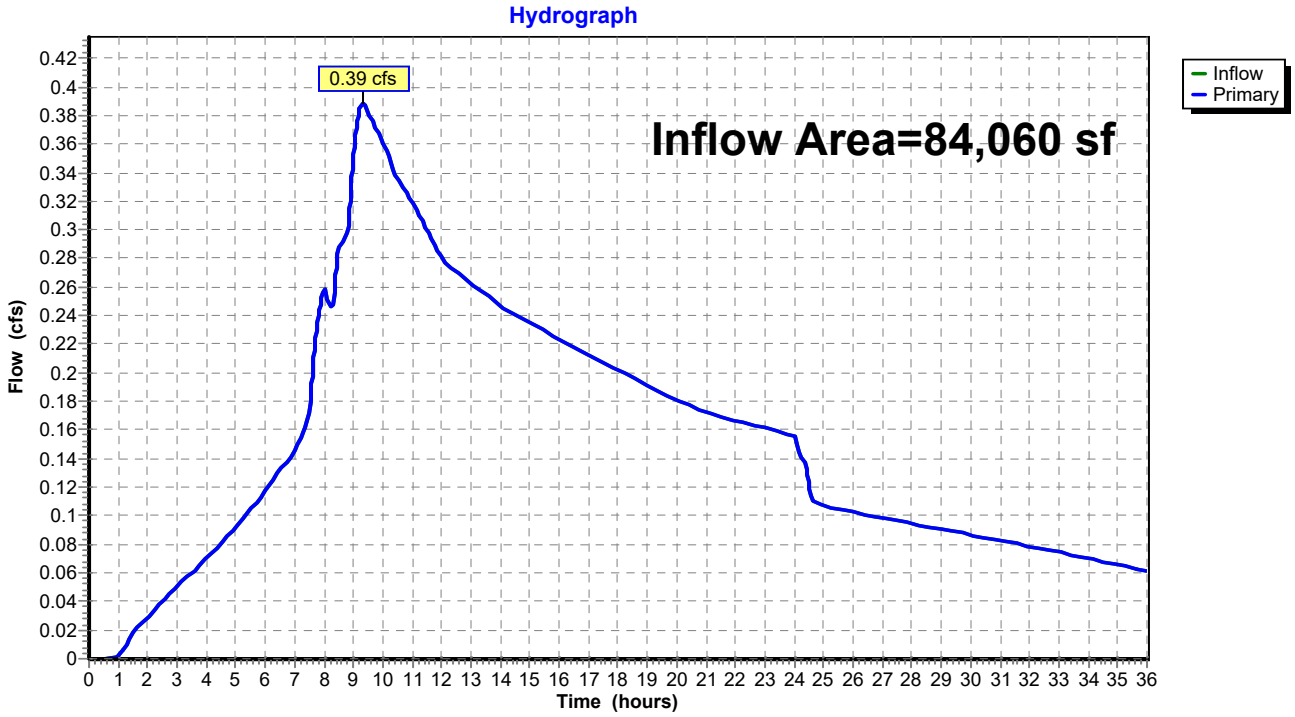


Summary for Link Post: Post-Developed Flow Summary

Inflow Area = 84,060 sf, 85.20% Impervious, Inflow Depth > 2.80" for 10-Year Storm event
Inflow = 0.39 cfs @ 9.33 hrs, Volume= 19,595 cf
Primary = 0.39 cfs @ 9.33 hrs, Volume= 19,595 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Post: Post-Developed Flow Summary



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1,3, LS: Site Impervious Runoff Area=55,172 sf 94.62% Impervious Runoff Depth=3.65"
Flow Length=20' Slope=0.0100 '/' Tc=9.1 min CN=97 Runoff=1.12 cfs 16,788 cf

Subcatchment 2,7,LS: Site Impervious Runoff Area=21,587 sf 75.72% Impervious Runoff Depth=3.12"
Flow Length=20' Slope=0.0050 '/' Tc=10.4 min CN=92 Runoff=0.38 cfs 5,608 cf

Subcatchment LS,4,5,6: South Patio and Runoff Area=7,301 sf 41.99% Impervious Runoff Depth=2.37"
Flow Length=10' Slope=0.0150 '/' Tc=5.2 min CN=84 Runoff=0.10 cfs 1,443 cf

Pond 36": Subsurface Detention (West) Peak Elev=2.81' Storage=794 cf Inflow=0.38 cfs 5,608 cf
Outflow=0.27 cfs 5,608 cf

Pond 48": Subsurface Detention (East) Peak Elev=4.00' Storage=5,215 cf Inflow=1.12 cfs 16,788 cf
Outflow=0.43 cfs 15,872 cf

Link Post: Post-Developed Flow Summary Inflow=0.64 cfs 22,923 cf
Primary=0.64 cfs 22,923 cf

Total Runoff Area = 84,060 sf Runoff Volume = 23,839 cf Average Runoff Depth = 3.40"
14.80% Pervious = 12,444 sf 85.20% Impervious = 71,616 sf

Summary for Subcatchment 1,3, LS: Site Impervious and Landscape

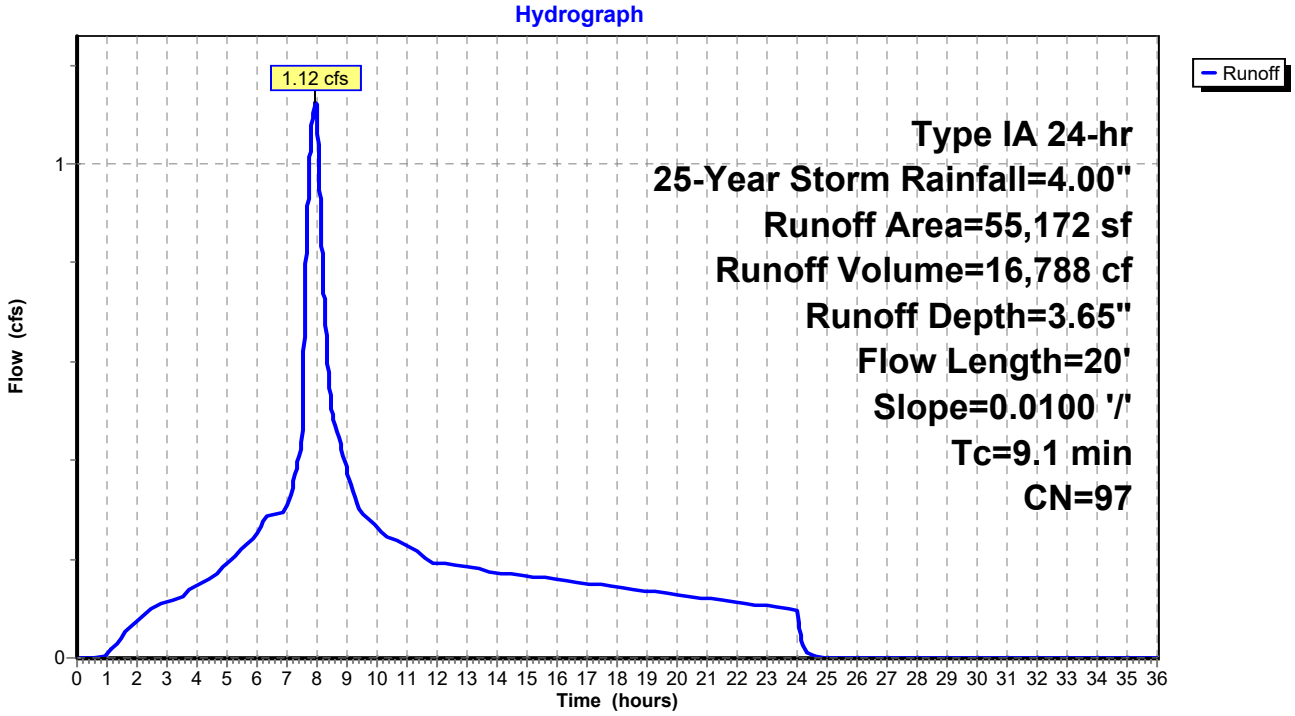
Runoff = 1.12 cfs @ 7.95 hrs, Volume= 16,788 cf, Depth= 3.65"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Storm Rainfall=4.00"

	Area (sf)	CN	Description
*	6,531	98	Paved parking, HSG C (Basin 3)
*	45,673	98	Roofs, HSG C (Basin 1)
	2,968	74	>75% Grass cover, Good, HSG C
	55,172	97	Weighted Average
	2,968		5.38% Pervious Area
	52,204		94.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
4.1	20	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
9.1	20	Total			

Subcatchment 1,3, LS: Site Impervious and Landscape



Summary for Subcatchment 2,7,LS: Site Impervious

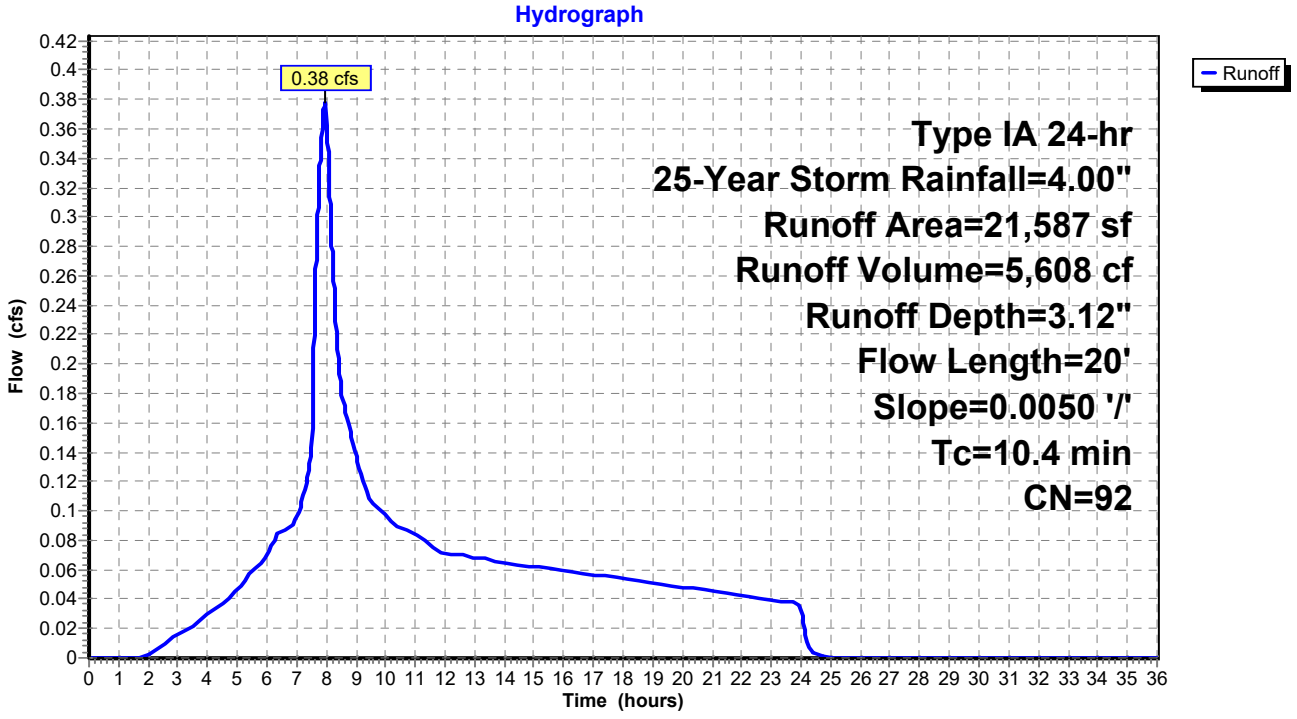
Runoff = 0.38 cfs @ 7.99 hrs, Volume= 5,608 cf, Depth= 3.12"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Storm Rainfall=4.00"

	Area (sf)	CN	Description
*	15,621	98	Paved parking/Hardscape, HSG C (Basin 2)
*	725	98	Paved parking/Hardscape, HSG C (Basin 7)
	5,241	74	>75% Grass cover, Good, HSG C
	21,587	92	Weighted Average
	5,241		24.28% Pervious Area
	16,346		75.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.4	20	0.0050	0.06		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
10.4	20	Total			

Subcatchment 2,7,LS: Site Impervious



Summary for Subcatchment LS,4,5,6: South Patio and Landscape

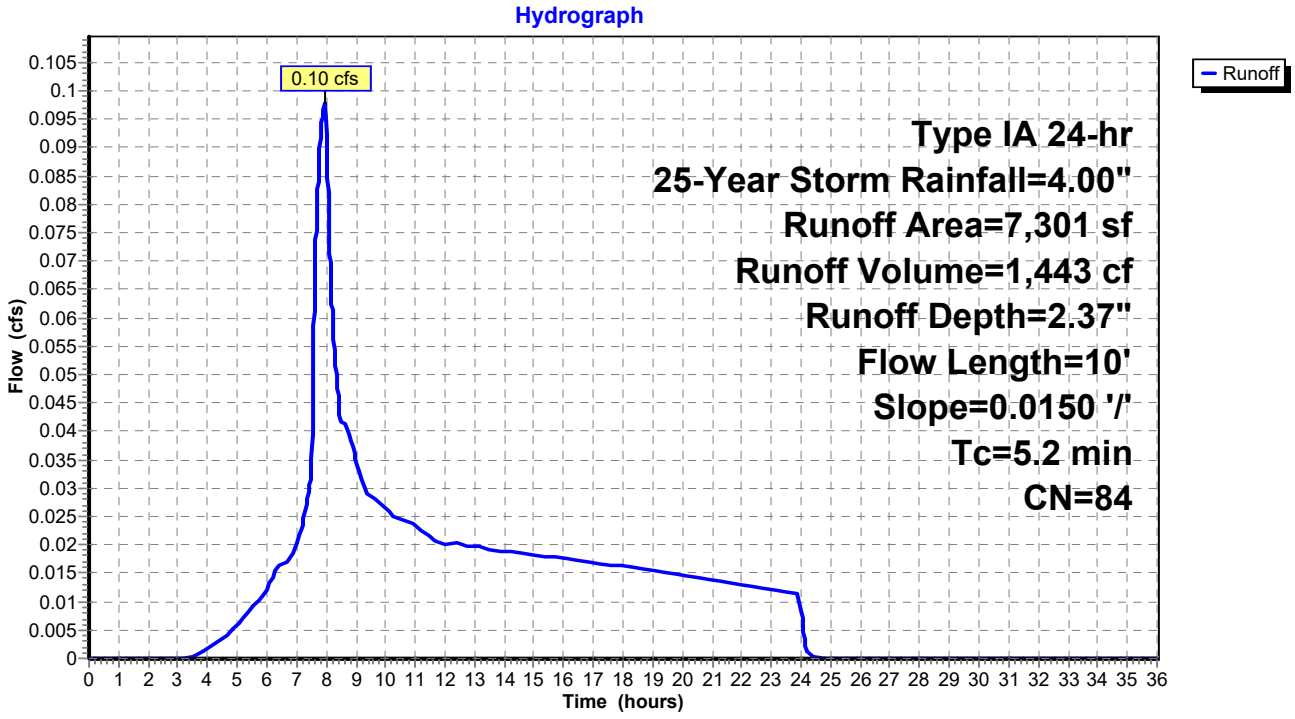
Runoff = 0.10 cfs @ 7.95 hrs, Volume= 1,443 cf, Depth= 2.37"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Storm Rainfall=4.00"

	Area (sf)	CN	Description
*	3,066	98	Impervious Sidewalk (Basins 4,5,6)
	4,235	74	>75% Grass cover, Good, HSG C
	7,301	84	Weighted Average
	4,235		58.01% Pervious Area
	3,066		41.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0150	0.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.40"
5.0					**Direct Entry, Direct**
5.2	10	Total			

Subcatchment LS,4,5,6: South Patio and Landscape



Summary for Pond 36": Subsurface Detention (West)

Inflow Area = 21,587 sf, 75.72% Impervious, Inflow Depth = 3.12" for 25-Year Storm event
Inflow = 0.38 cfs @ 7.99 hrs, Volume= 5,608 cf
Outflow = 0.27 cfs @ 8.22 hrs, Volume= 5,608 cf, Atten= 30%, Lag= 14.1 min
Primary = 0.27 cfs @ 8.22 hrs, Volume= 5,608 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 2.81' @ 8.22 hrs Surf.Area= 226 sf Storage= 794 cf

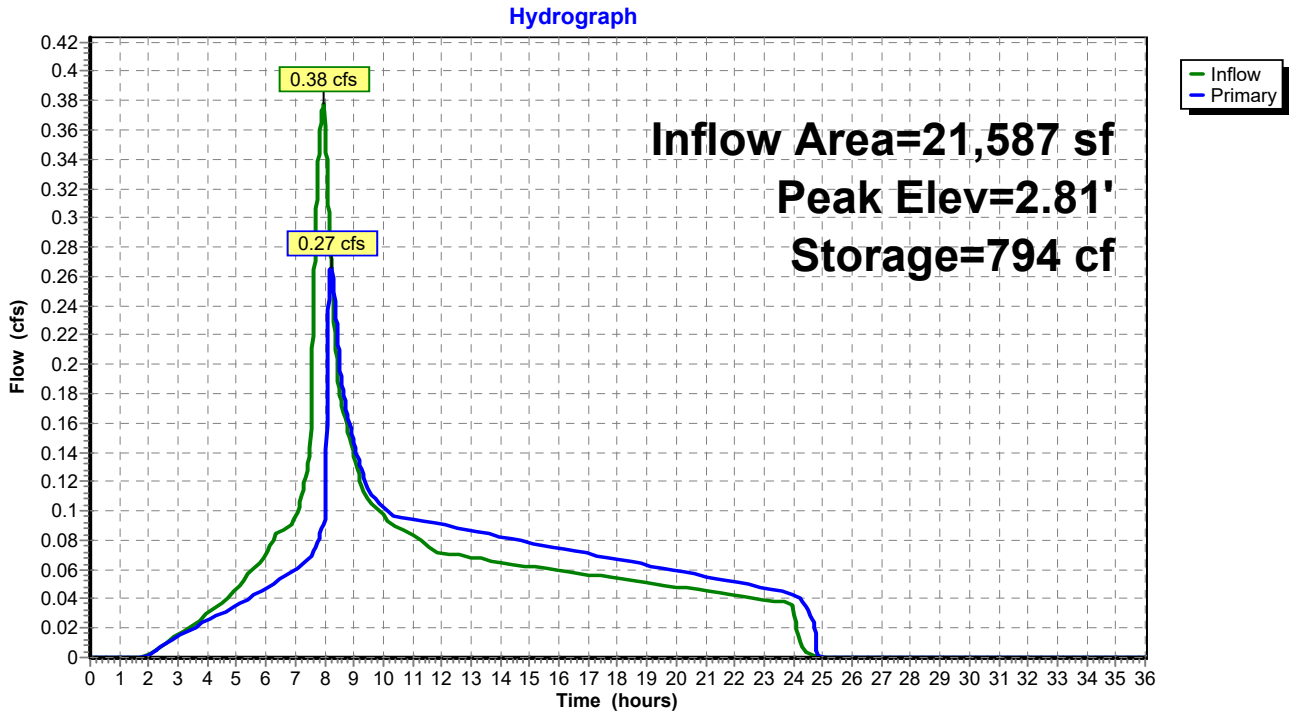
Plug-Flow detention time= 77.4 min calculated for 5,607 cf (100% of inflow)
Center-of-Mass det. time= 77.4 min (799.0 - 721.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	848 cf	**36.0" Round Pipe Storage** x 2 L= 60.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	2.50'	**4.0" Vert. Upper Orifice** C= 0.620
#3	Primary	3.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.27 cfs @ 8.22 hrs HW=2.81' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.10 cfs @ 8.25 fps)
- **2=Upper Orifice** (Orifice Controls 0.17 cfs @ 1.96 fps)
- **3=100-yr Overflow** (Controls 0.00 cfs)

Pond 36": Subsurface Detention (West)



Summary for Pond 48": Subsurface Detention (East)

Inflow Area = 55,172 sf, 94.62% Impervious, Inflow Depth = 3.65" for 25-Year Storm event
Inflow = 1.12 cfs @ 7.95 hrs, Volume= 16,788 cf
Outflow = 0.43 cfs @ 8.80 hrs, Volume= 15,872 cf, Atten= 62%, Lag= 50.7 min
Primary = 0.43 cfs @ 8.80 hrs, Volume= 15,872 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 4.00' @ 8.80 hrs Surf.Area= 725 sf Storage= 5,215 cf

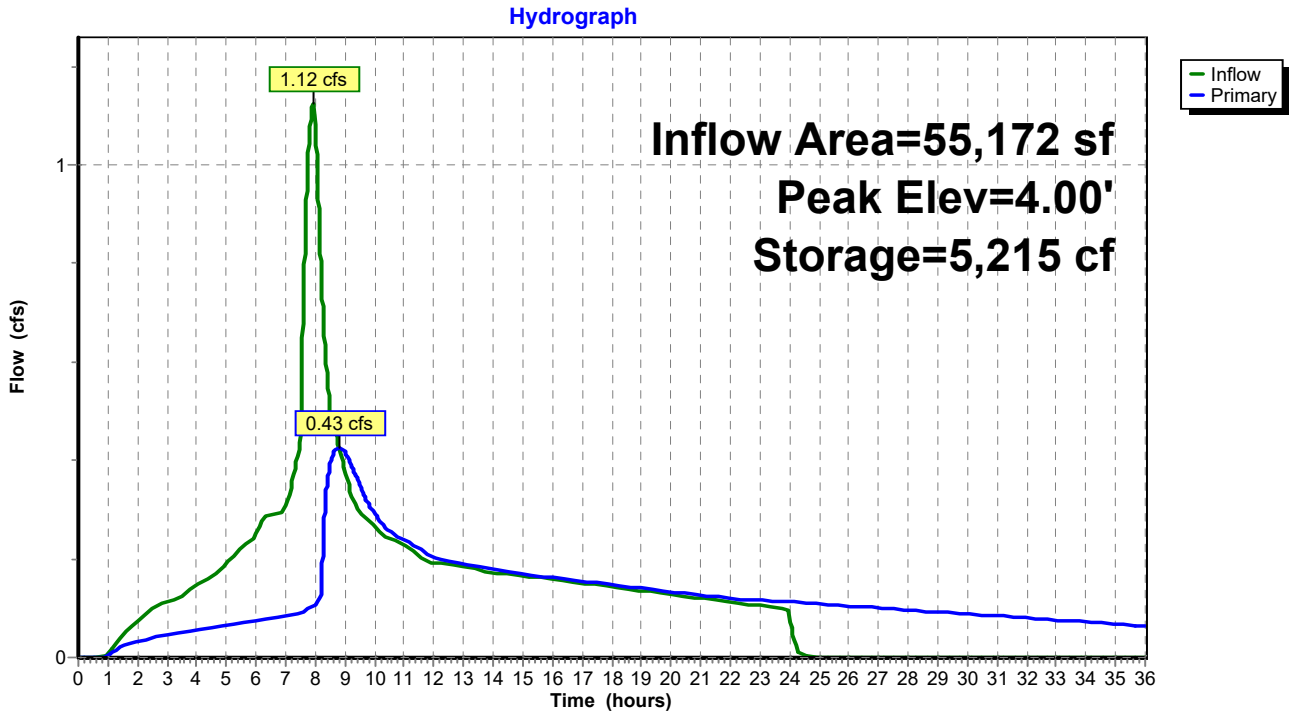
Plug-Flow detention time= 396.8 min calculated for 15,872 cf (95% of inflow)
Center-of-Mass det. time= 356.4 min (1,031.4 - 675.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5,341 cf	**48.0" Round CMP_Round 48"** x 5 L= 85.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	3.50'	**4.5" Vert. Upper Orifice** C= 0.620
#3	Primary	4.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.43 cfs @ 8.80 hrs HW=4.00' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.12 cfs @ 9.87 fps)
- **2=Upper Orifice** (Orifice Controls 0.31 cfs @ 2.76 fps)
- **3=100-yr Overflow** (Controls 0.00 cfs)

Pond 48": Subsurface Detention (East)

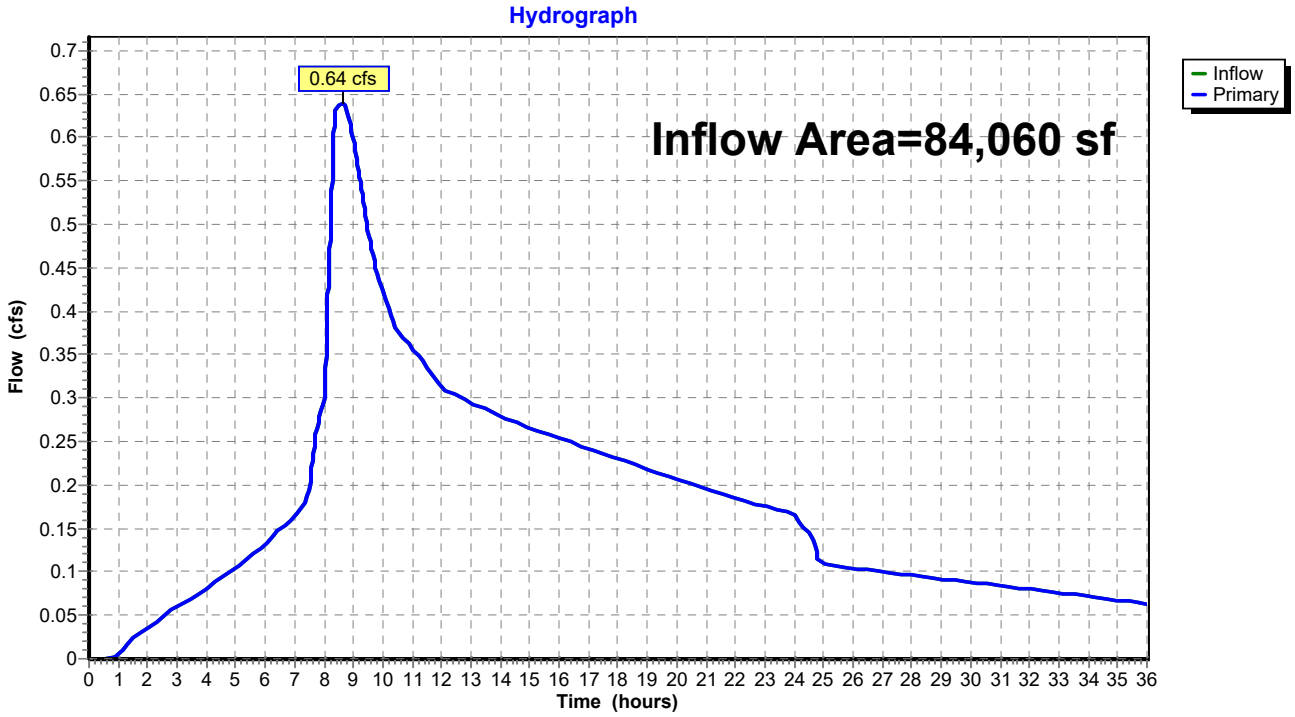


Summary for Link Post: Post-Developed Flow Summary

Inflow Area = 84,060 sf, 85.20% Impervious, Inflow Depth > 3.27" for 25-Year Storm event
Inflow = 0.64 cfs @ 8.62 hrs, Volume= 22,923 cf
Primary = 0.64 cfs @ 8.62 hrs, Volume= 22,923 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Post: Post-Developed Flow Summary



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1,3, LS: Site Impervious Runoff Area=55,172 sf 94.62% Impervious Runoff Depth=4.35"
Flow Length=20' Slope=0.0100 '/' Tc=9.1 min CN=97 Runoff=1.33 cfs 19,992 cf

Subcatchment 2,7,LS: Site Impervious Runoff Area=21,587 sf 75.72% Impervious Runoff Depth=3.80"
Flow Length=20' Slope=0.0050 '/' Tc=10.4 min CN=92 Runoff=0.46 cfs 6,830 cf

Subcatchment LS,4,5,6: South Patio and Runoff Area=7,301 sf 41.99% Impervious Runoff Depth=3.00"
Flow Length=10' Slope=0.0150 '/' Tc=5.2 min CN=84 Runoff=0.13 cfs 1,824 cf

Pond 36": Subsurface Detention (West) Peak Elev=3.04' Storage=836 cf Inflow=0.46 cfs 6,830 cf
Outflow=0.46 cfs 6,830 cf

Pond 48": Subsurface Detention (East) Peak Elev=4.16' Storage=5,303 cf Inflow=1.33 cfs 19,992 cf
Outflow=1.17 cfs 19,023 cf

Link Post: Post-Developed Flow Summary Inflow=1.70 cfs 27,676 cf
Primary=1.70 cfs 27,676 cf

Total Runoff Area = 84,060 sf Runoff Volume = 28,645 cf Average Runoff Depth = 4.09"
14.80% Pervious = 12,444 sf 85.20% Impervious = 71,616 sf

Summary for Subcatchment 1,3, LS: Site Impervious and Landscape

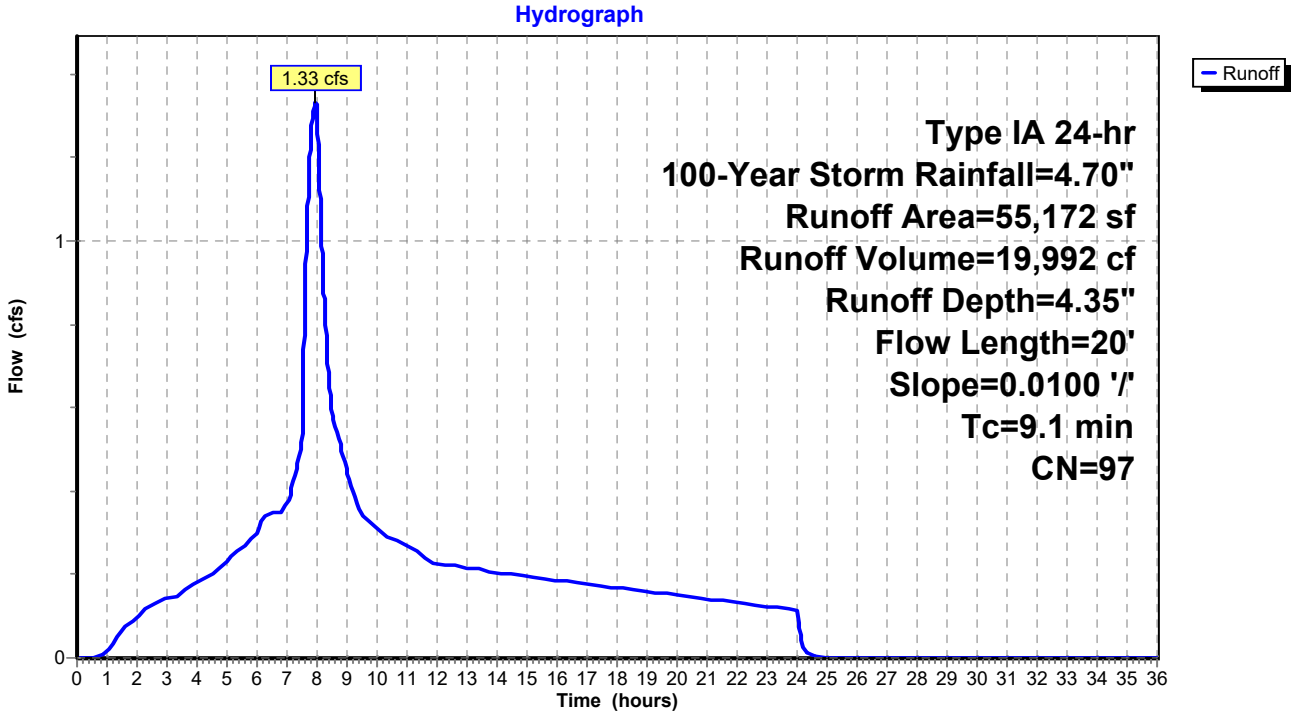
Runoff = 1.33 cfs @ 7.95 hrs, Volume= 19,992 cf, Depth= 4.35"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Year Storm Rainfall=4.70"

	Area (sf)	CN	Description
*	6,531	98	Paved parking, HSG C (Basin 3)
*	45,673	98	Roofs, HSG C (Basin 1)
	2,968	74	>75% Grass cover, Good, HSG C
	55,172	97	Weighted Average
	2,968		5.38% Pervious Area
	52,204		94.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
4.1	20	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
9.1	20	Total			

Subcatchment 1,3, LS: Site Impervious and Landscape



Summary for Subcatchment 2,7,LS: Site Impervious

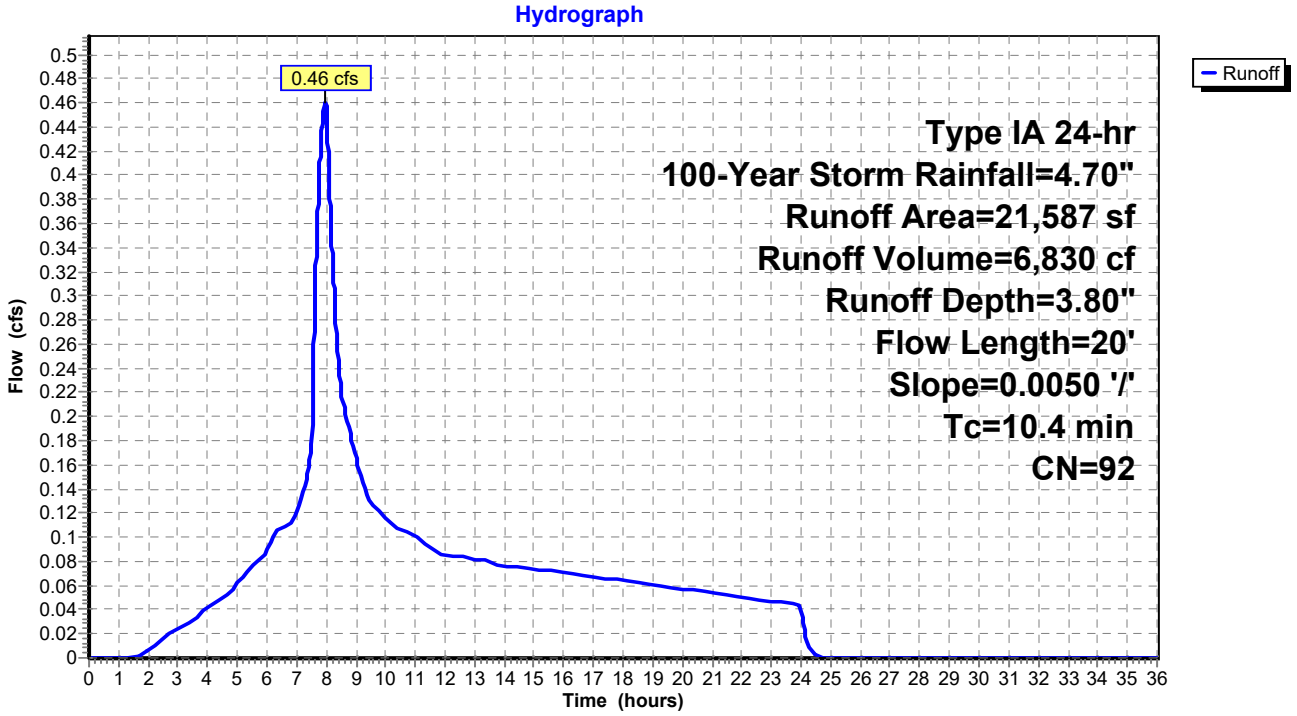
Runoff = 0.46 cfs @ 7.98 hrs, Volume= 6,830 cf, Depth= 3.80"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Year Storm Rainfall=4.70"

	Area (sf)	CN	Description
*	15,621	98	Paved parking/Hardscape, HSG C (Basin 2)
*	725	98	Paved parking/Hardscape, HSG C (Basin 7)
	5,241	74	>75% Grass cover, Good, HSG C
	21,587	92	Weighted Average
	5,241		24.28% Pervious Area
	16,346		75.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.4	20	0.0050	0.06		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.40"
10.4	20	Total			

Subcatchment 2,7,LS: Site Impervious



Summary for Subcatchment LS,4,5,6: South Patio and Landscape

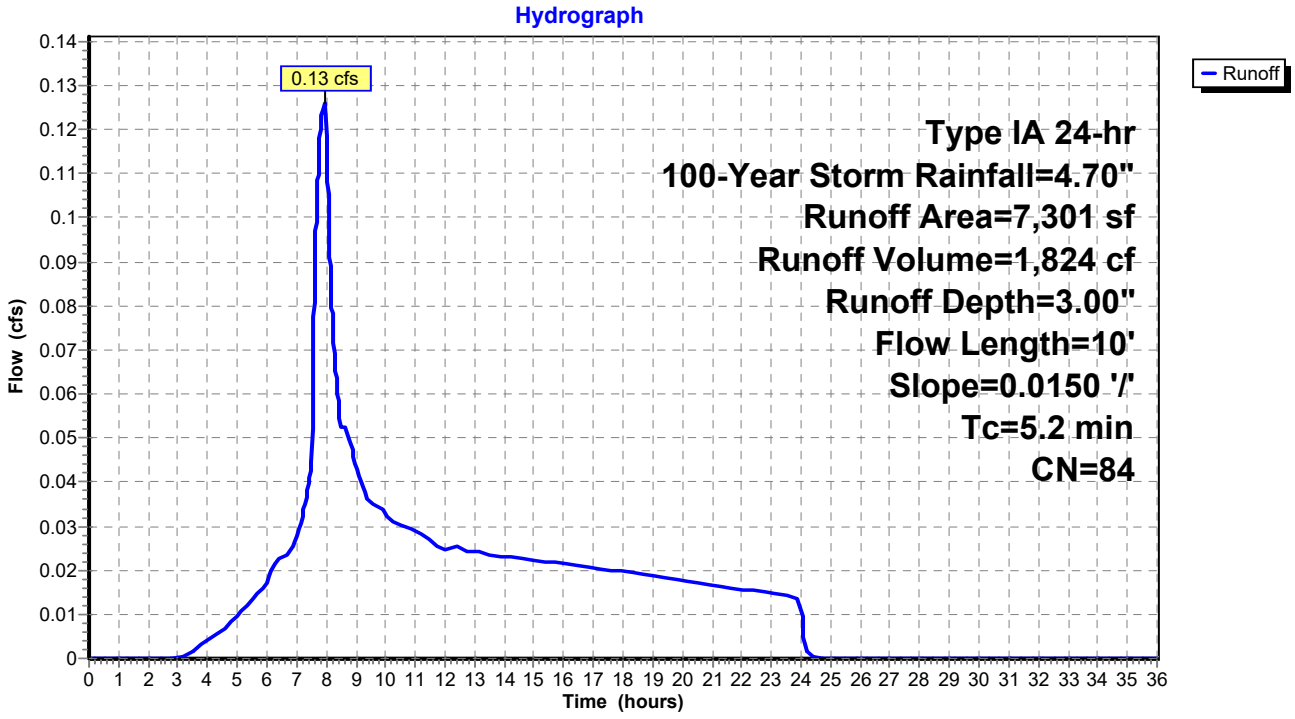
Runoff = 0.13 cfs @ 7.94 hrs, Volume= 1,824 cf, Depth= 3.00"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Year Storm Rainfall=4.70"

	Area (sf)	CN	Description
*	3,066	98	Impervious Sidewalk (Basins 4,5,6)
	4,235	74	>75% Grass cover, Good, HSG C
	7,301	84	Weighted Average
	4,235		58.01% Pervious Area
	3,066		41.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0150	0.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.40"
5.0					**Direct Entry, Direct**
5.2	10	Total			

Subcatchment LS,4,5,6: South Patio and Landscape



Summary for Pond 36": Subsurface Detention (West)

Inflow Area = 21,587 sf, 75.72% Impervious, Inflow Depth = 3.80" for 100-Year Storm event
Inflow = 0.46 cfs @ 7.98 hrs, Volume= 6,830 cf
Outflow = 0.46 cfs @ 8.01 hrs, Volume= 6,830 cf, Atten= 1%, Lag= 1.7 min
Primary = 0.46 cfs @ 8.01 hrs, Volume= 6,830 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 3.04' @ 8.01 hrs Surf.Area= 119 sf Storage= 836 cf

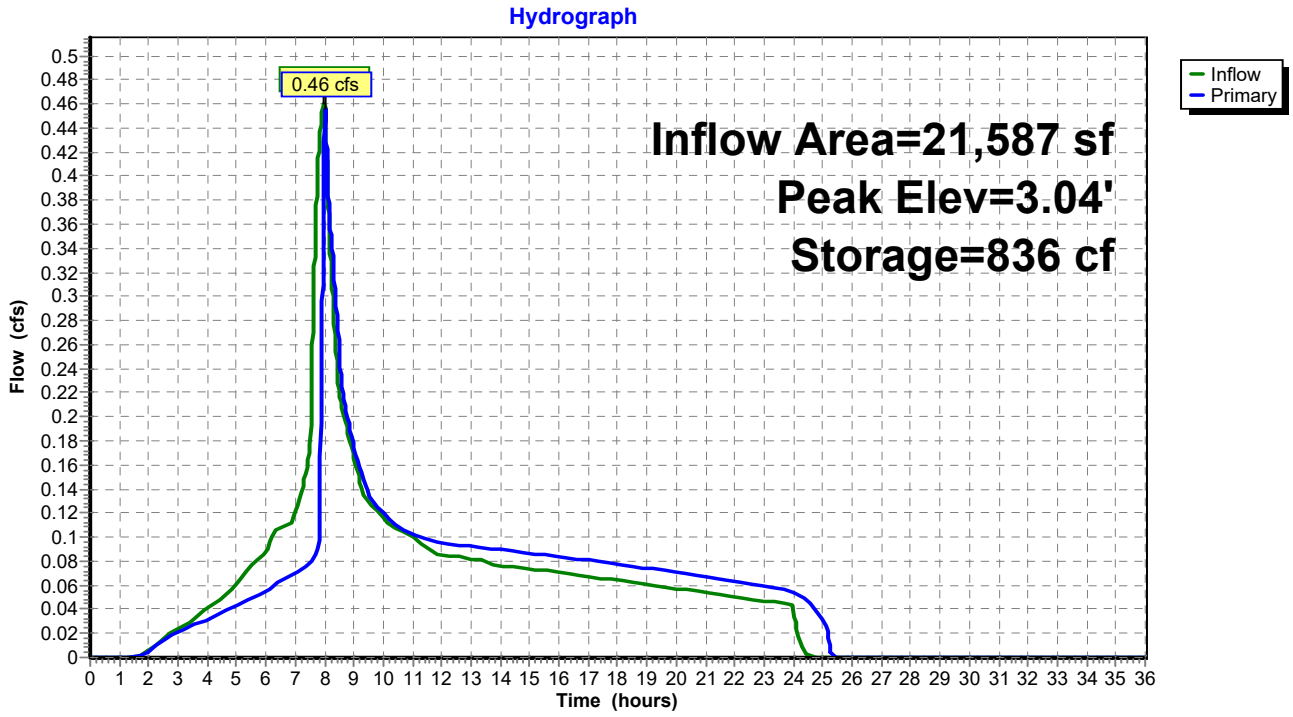
Plug-Flow detention time= 80.8 min calculated for 6,828 cf (100% of inflow)
Center-of-Mass det. time= 80.8 min (793.5 - 712.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	848 cf	**36.0" Round Pipe Storage** x 2 L= 60.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	2.50'	**4.0" Vert. Upper Orifice** C= 0.620
#3	Primary	3.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=0.45 cfs @ 8.01 hrs HW=3.04' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.11 cfs @ 8.59 fps)
- **2=Upper Orifice** (Orifice Controls 0.27 cfs @ 3.04 fps)
- **3=100-yr Overflow** (Weir Controls 0.08 cfs @ 0.65 fps)

Pond 36": Subsurface Detention (West)



Summary for Pond 48": Subsurface Detention (East)

Inflow Area = 55,172 sf, 94.62% Impervious, Inflow Depth = 4.35" for 100-Year Storm event
Inflow = 1.33 cfs @ 7.95 hrs, Volume= 19,992 cf
Outflow = 1.17 cfs @ 8.07 hrs, Volume= 19,023 cf, Atten= 12%, Lag= 7.2 min
Primary = 1.17 cfs @ 8.07 hrs, Volume= 19,023 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 4.16' @ 8.07 hrs Surf.Area= 354 sf Storage= 5,303 cf

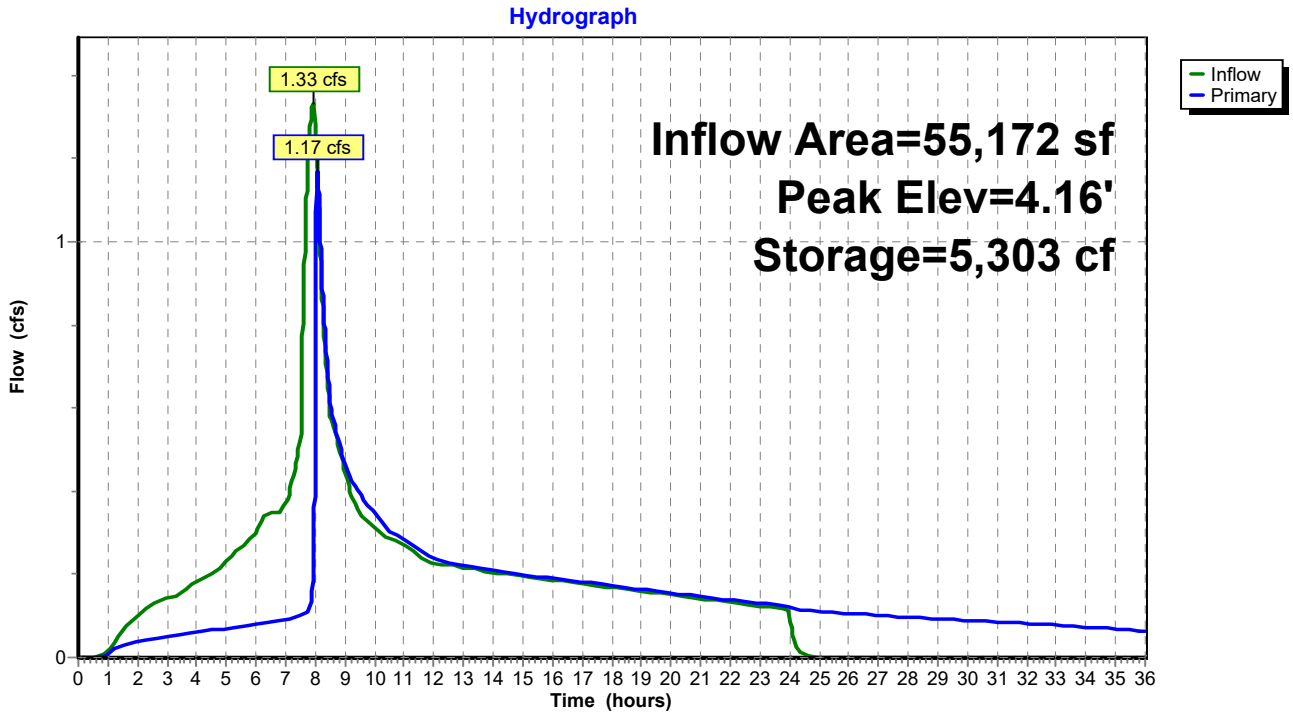
Plug-Flow detention time= 342.6 min calculated for 19,018 cf (95% of inflow)
Center-of-Mass det. time= 306.5 min (976.7 - 670.2)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5,341 cf	**48.0" Round CMP_Round 48"** x 5 L= 85.0' S= 0.0050 '/'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.5" Vert. Lower Orifice** C= 0.620
#2	Primary	3.50'	**4.5" Vert. Upper Orifice** C= 0.620
#3	Primary	4.00'	**12.0" Horiz. 100-yr Overflow** C= 0.620 Limited to weir flow at low heads

Primary OutFlow Max=1.17 cfs @ 8.07 hrs HW=4.16' (Free Discharge)
- **1=Lower Orifice** (Orifice Controls 0.12 cfs @ 10.07 fps)
- **2=Upper Orifice** (Orifice Controls 0.38 cfs @ 3.42 fps)
- **3=100-yr Overflow** (Weir Controls 0.66 cfs @ 1.31 fps)

Pond 48": Subsurface Detention (East)

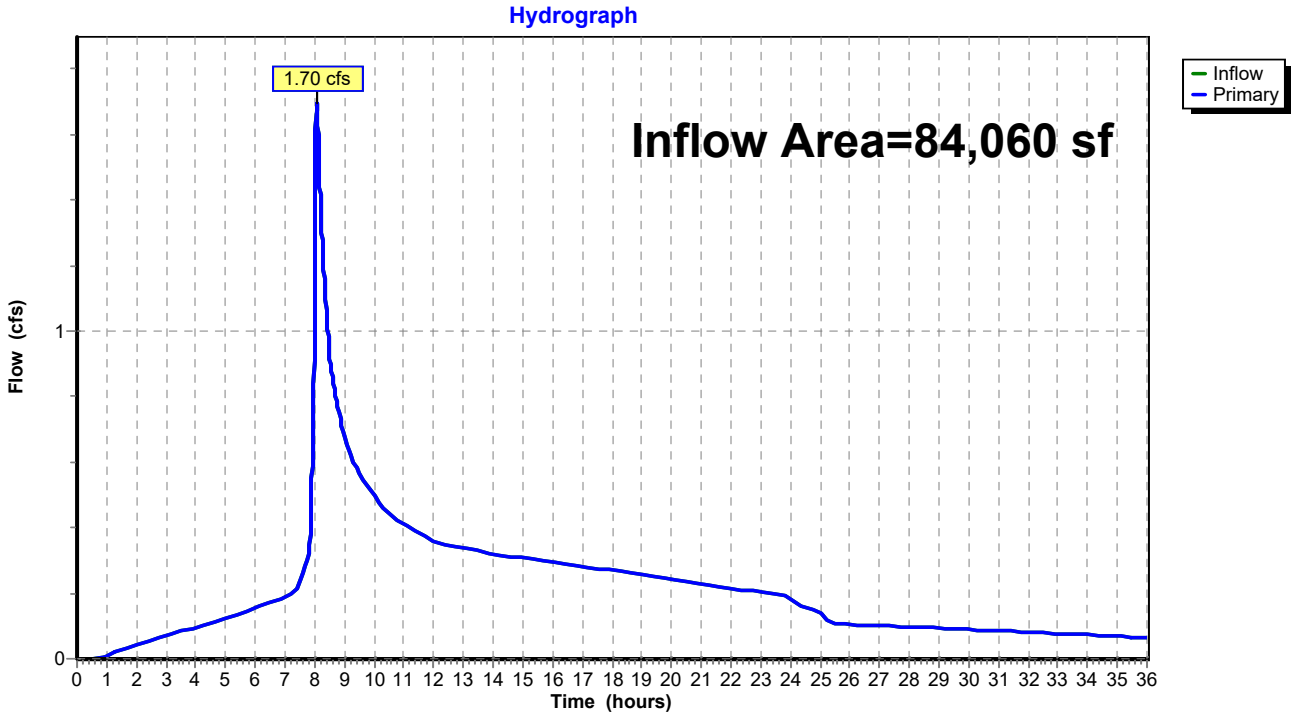


Summary for Link Post: Post-Developed Flow Summary

Inflow Area = 84,060 sf, 85.20% Impervious, Inflow Depth > 3.95" for 100-Year Storm event
Inflow = 1.70 cfs @ 8.06 hrs, Volume= 27,676 cf
Primary = 1.70 cfs @ 8.06 hrs, Volume= 27,676 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link Post: Post-Developed Flow Summary



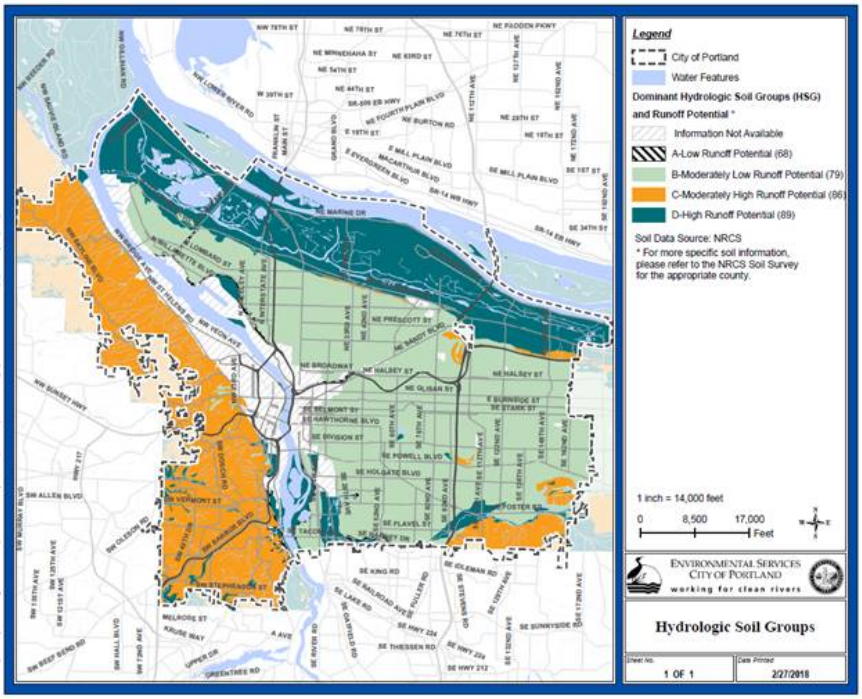
Appendix C:
Typical Details and Supporting Information

Curve Numbers

Use the pre-development curve numbers in Table 2-11 based on the site's soil type. These curve numbers are based on undeveloped, not existing, site conditions. Use post-development curve numbers of 98 for impervious surfaces and 61 for ecoroofs. The design professional may use a different curve number if adequate justification is provided. The Sewer and Drainage Facilities Design Manual provides post-development curve numbers for other surfaces.

Figure 2-7 shows soil types in the City and is for reference only; it is not for site design. For site design, enter an address into Portland Maps and check utilities →environment → stormwater management to find the soil type.

Figure 2-7. Soil Types in the City[1]



1 For reference only; not for site design

Table 2-11 Pre-Development Curve Numbers Based on Soil Type

Soil Type	Curve Number
A	65
B	72
C	79
D	81
Unidentified	81

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.

CITY OF PORTLAND
ENVIRONMENTAL SERVICES
1120 SW Fifth Avenue, Room 1000, Portland, Oregon 97204 ▪ Nick Fish, Commissioner ▪ Michael Jordan, Director

February 2019

Stormwater Management Manual
Approved Manufactured Stormwater Treatment Technology

Contech Stormwater Management StormFilter™ with PhosphoSorb® Filter Media

City of Portland Decision:

The Contech Stormwater Management StormFilter with PhosphoSorb Filter Media meets Portland's pollution reduction requirements, per the requirements of the 2016 Stormwater Management Manual, and is approved for use in the City of Portland with the following conditions.

Background:

As part of the application process, Contech Engineered Solutions submitted the Washington State Department of Ecology (DOE) Technology Assessment Protocol (TAPE) Technology Evaluation Report, including all appendices and performance monitoring data, to demonstrate that the StormFilter with PhosphoSorb meets the City of Portland's pollution reduction requirements.

Contech gave a technical presentation to City staff the public on June 27, 2018. The presentation was followed by a technical interview with the City of Portland review committee to discuss water quality performance, maintenance, and overall use in the public right-of-way.

Additional information is available online for this system, including:

- Contech StormFilter Website Page
- WA TAPE Approval for TSS and Phosphorus Treatment General Use Designation for Basic (TSS) and Phosphorus Treatment at 1.67 gpm/sq ft of media surface.

Conditions of Use:

1. All configuration options for the Contech StormFilter with PhosphoSorb are approved for TSS removal. Selection of a specific configuration is the responsibility of the project designer.

2. Use of a Contech StormFilter with PhosphoSorb does not exempt a project or site from required flow control requirements, operations and maintenance requirements, or other applicable requirements of the SWMM.

3. For use in the public right-of-way, the following conditions must be met:
   - Units must meet City of Portland street design requirements, including but not limited to H-20 vehicle load rating, non-slip surface, and American with Disabilities Act tolerances specific to surface grates or vault lids.

   - The O&M Plan must call for an assessment during the two-year warranty period of project-specific maintenance requirements and frequencies.

4. Contech-certified providers should be utilized for activation, inspection and maintenance of the system, unless otherwise trained and certified by the manufacturer.

Project Designer Responsibilities:

1. Ensuring that the Conditions of Use are met.

2. Ensuring that the project meets all applicable requirements of the Portland SWMM, including the Stormwater Infiltration and Discharge Hierarchy.

3. Ensuring that the design and installation of the units are appropriate for the project goals, site conditions, long-term maintenance requirements, and any other site-specific design requirements on private property or for use in the public right-of-way.

4. Sizing units to meet the current Portland SWMM presumptive design approach and pollution reduction requirements. The pollution reduction capacity is flow-based and assumes a treatment flow intensity of 0.19 inches per hour, 5 minute time of concentration, and a 0.90 runoff coefficient using the Rational Method with treatment rates based upon WA GULD approved flow rates, in lieu of the manufacturer's standard flow rate. The treatment capacities for Contech StormFilter units with Phosposorb, based on those assumptions, are provided in Table 1. For sites with different times of concentration, different rainfall intensities may be appropriate. See SWMM Chapter 1.3.4, page 1-40 for additional information.

Table 1. Contech StormFilter with PhosphoSorb Sizing to Meet City of Portland Pollution Reduction Requirements

Cartridge Size/Stack Configuration	Cartridge Design Flow Rate (gpm/ cartridge stack)	Maximum Drainage Area (acres/ cartridge stack)	Maximum Drainage Area (square feet/ cartridge stack
12	8.35	0.109	4739
18	12.53	0.163	7112
27	18.79	0.245	10665

5. Each site plan must undergo Contech review before the City of Portland can approve the unit(s) for site installation. A letter certifying the project has been designed to the manufacturer's specification must be submitted to BES prior to the appropriate design milestone. For public improvements, including public works permits, the letter must be submitted to BES prior to 60% plan review. For installation on private property, the letter must be submitted prior to building permit plan approval. The project designer is highly encouraged to work with Contech prior to the appropriate review milestone to maximize placement and performance of the unit(s).

6. If the project designer wishes to vary from these conditions of approval, the project designer must use the Performance Design Approach required by the SWMM.

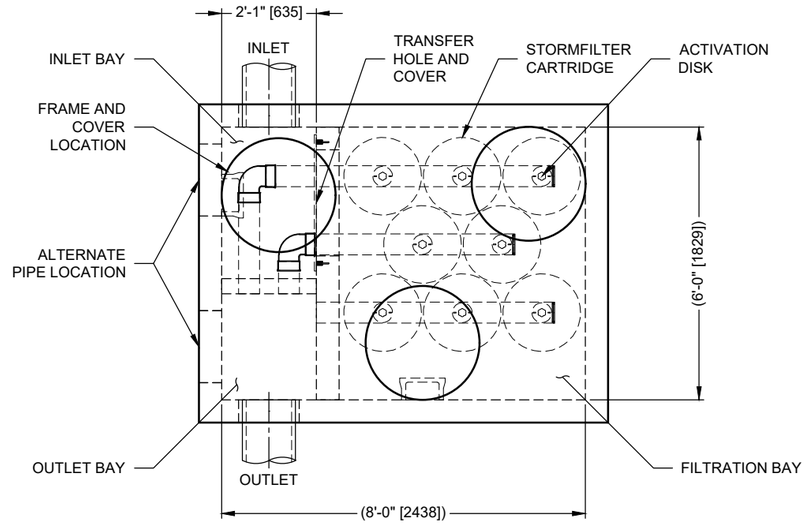
General Conditions:

1. BES may at any time suspend or revoke approval if the performance of the technology does not meet performance criteria, if there are changes to the TAPE certification, or the performance criteria change due to local, state, or federal pollution reduction standards.

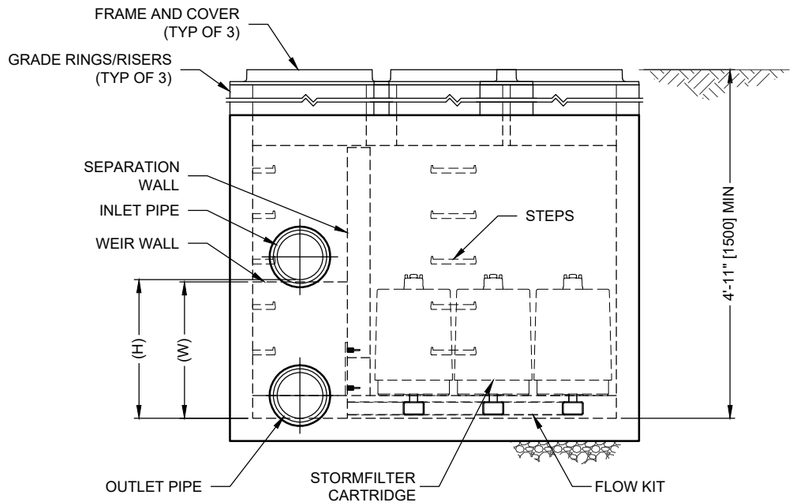
2. If any changes, updates, or revisions have occurred to the StormFilter with PhosphoSorb, the applicant must obtain WA DOE TAPE GULD certification and re-apply following submission guidelines in effect at the time of application.

Document Updates:

Date	Action
August 2018	The device was approved for use in the City of Portland.
February 2019	Removed "Cartridges per Impervious Acre" from Table 1 due to the potential for associated sizing errors.



PLAN



ELEVATION

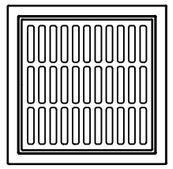
The Stormwater Management StormFilter®

STORMFILTER DESIGN NOTES

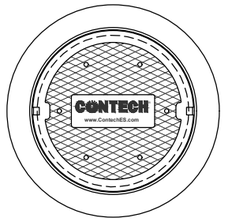
- STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD
- A 6' x 8' [1829 x 2438] PEAK DIVERSION STYLE STORMFILTER IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (8) AND IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR A RIGHT INLET CONFIGURATION
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS NOTED OTHERWISE

CARTRIDGE SIZE (in. [mm])	27 [686]			18 [457]			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H) (ft. [mm])	3.05 [930]			2.3 [701]			1.8 [549]		
HEIGHT OF WEIR (W) (ft. [mm])	3.00 [914]			2.25 [686]			1.75 [533]		
SPECIFIC FLOW RATE (gpm/sf [L/s/m^2])	2 [1.36]	1.67* [1.13]*	1 [0.68]	2 [1.36]	1.67* [1.13]*	1 [0.68]	2 [1.36]	1.67* [1.13]*	1 [0.68]
CARTRIDGE FLOW RATE (gpm [L/s])	22.5 [1.42]	18.79 [1.19]	11.25 [0.71]	15 [0.95]	12.53 [0.79]	7.5 [0.47]	10 [0.63]	8.35 [0.53]	5 [0.32]

* 1.67 gpm/sf [1.13 L/s/m^2] SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY



FRAME AND GRATE
(24" SQUARE)
(NOT TO SCALE)



FRAME AND COVER
(30" ROUND)
(NOT TO SCALE)

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (cfs [L/s])	
PEAK FLOW RATE (cfs [L/s])	
RETURN PERIOD OF PEAK FLOW (yrs)	
CARTRIDGE FLOW RATE	
CARTRIDGE SIZE (27, 18, LOW DROP (LD))	
MEDIA TYPE (PERLITE, ZPG, PSORB)	
NUMBER OF CARTRIDGES REQUIRED	
INLET BAY RIM ELEVATION	
FILTER BAY RIM ELEVATION	

PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			

NOTES/SPECIAL REQUIREMENTS:

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7" [178].** FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **37 SECONDS**. SPECIFIC FLOW RATE SHALL BE **2 GPM/SF [1.36 L/s/m^2] (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF [13.39 L/s/m^3] OF MEDIA (MAXIMUM).**

GENERAL NOTES

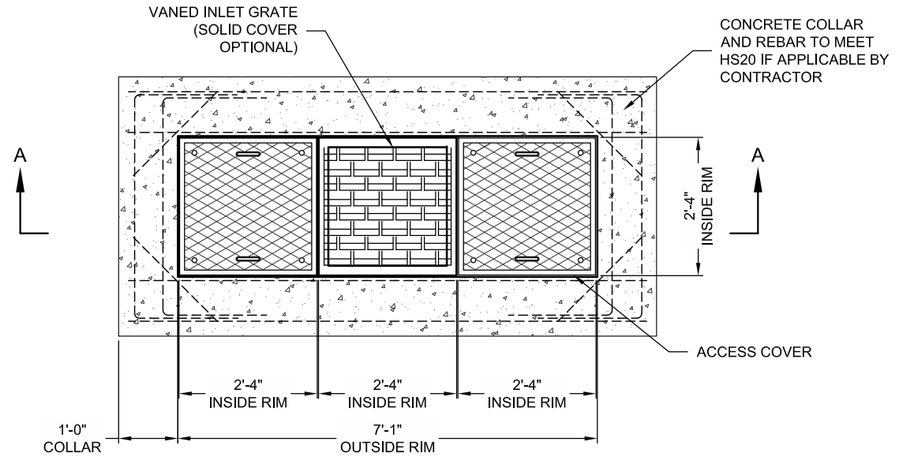
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. ALTERNATE DIMENSIONS ARE IN MILLIMETERS [mm] UNLESS NOTED OTHERWISE.
4. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
5. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
6. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 10' [3048] AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

INSTALLATION NOTES

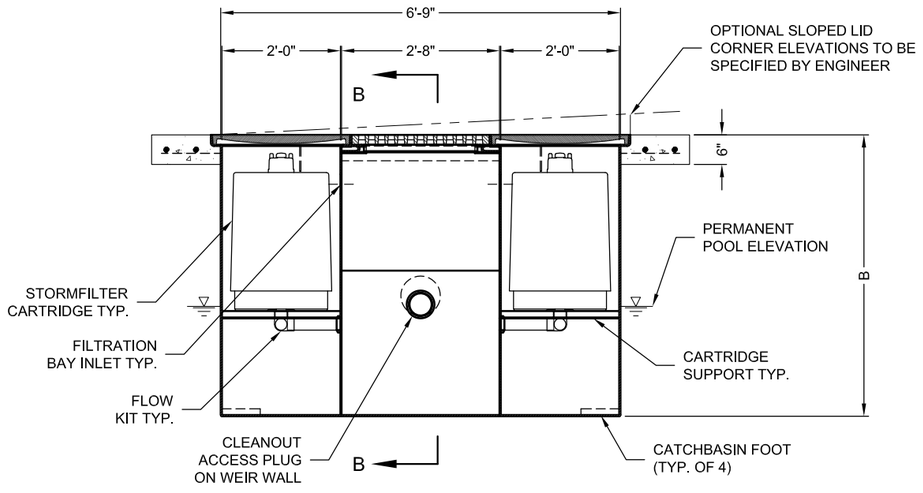
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER OPENING COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

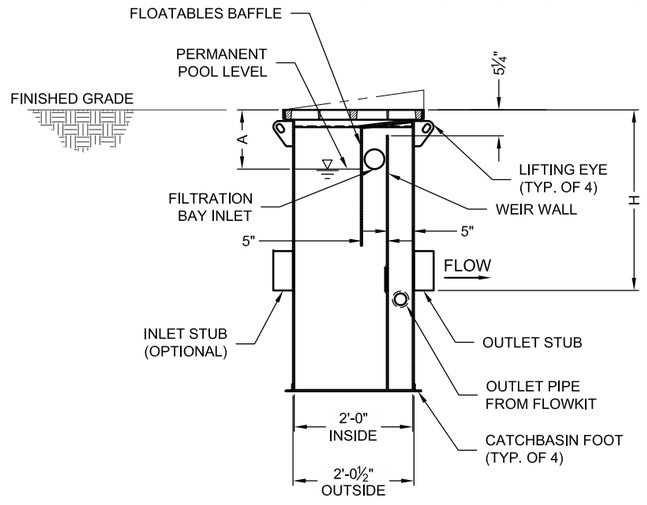
SFPD0608 (6' x 8')
PEAK DIVERSION STORMFILTER
STANDARD DETAIL



PLAN VIEW



SECTION A-A



SECTION B-B

STORMFILTER STEEL CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 2 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF TWO CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			18" DEEP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			3.3'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	15	12.53	7.5
PEAK HYDRAULIC CAPACITY	1.0			1.0			1.8		
INLET PERMANENT POOL LEVEL (A)	1'-0"			1'-0"			2'-0"		
OVERALL STRUCTURE HEIGHT (B)	4'-9"			3'-9"			4'-9"		

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. WWW.CONTECHES.COM
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. MANUFACTURER TO APPLY A SURFACE BEAD WELD IN THE SHAPE OF THE LETTER "O" ABOVE THE OUTLET PIPE STUB ON THE EXTERIOR SURFACE OF THE STEEL SFCB.
6. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
7. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
8. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
9. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

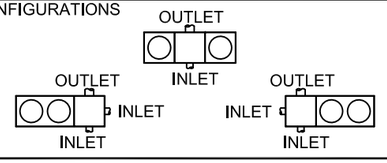
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

2-CARTRIDGE DEEP CATCHBASIN STORMFILTER DATA

STRUCTURE ID	XXX
WATER QUALITY FLOW RATE (cfs)	X.XX
PEAK FLOW RATE (<1.8 cfs)	X.XX
RETURN PERIOD OF PEAK FLOW (yrs)	XXX
CARTRIDGE FLOW RATE (gpm)	XX
MEDIA TYPE (PERLITE, ZPG, PSORB)	XXXXX
RIM ELEVATION	XXX.XX'

PIPE DATA:	I.E.	DIAMETER
INLET STUB	XXX.XX'	XX"
OUTLET STUB	XXX.XX'	XX"

CONFIGURATIONS



SLOPED LID	YES\NO
SOLID COVER	YES\NO

NOTES/SPECIAL REQUIREMENTS:

The Stormwater Management StormFilter®
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,324,070; 5,707,527; 5,865,157; 6,027,639; 6,649,048; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-526-3999 513-645-7000 513-645-7993 FAX

2 CARTRIDGE CATCHBASIN STORMFILTER STANDARD DETAIL

Appendix D:
Soil Information from the NRCS Soil Survey of Clackamas County, Oregon

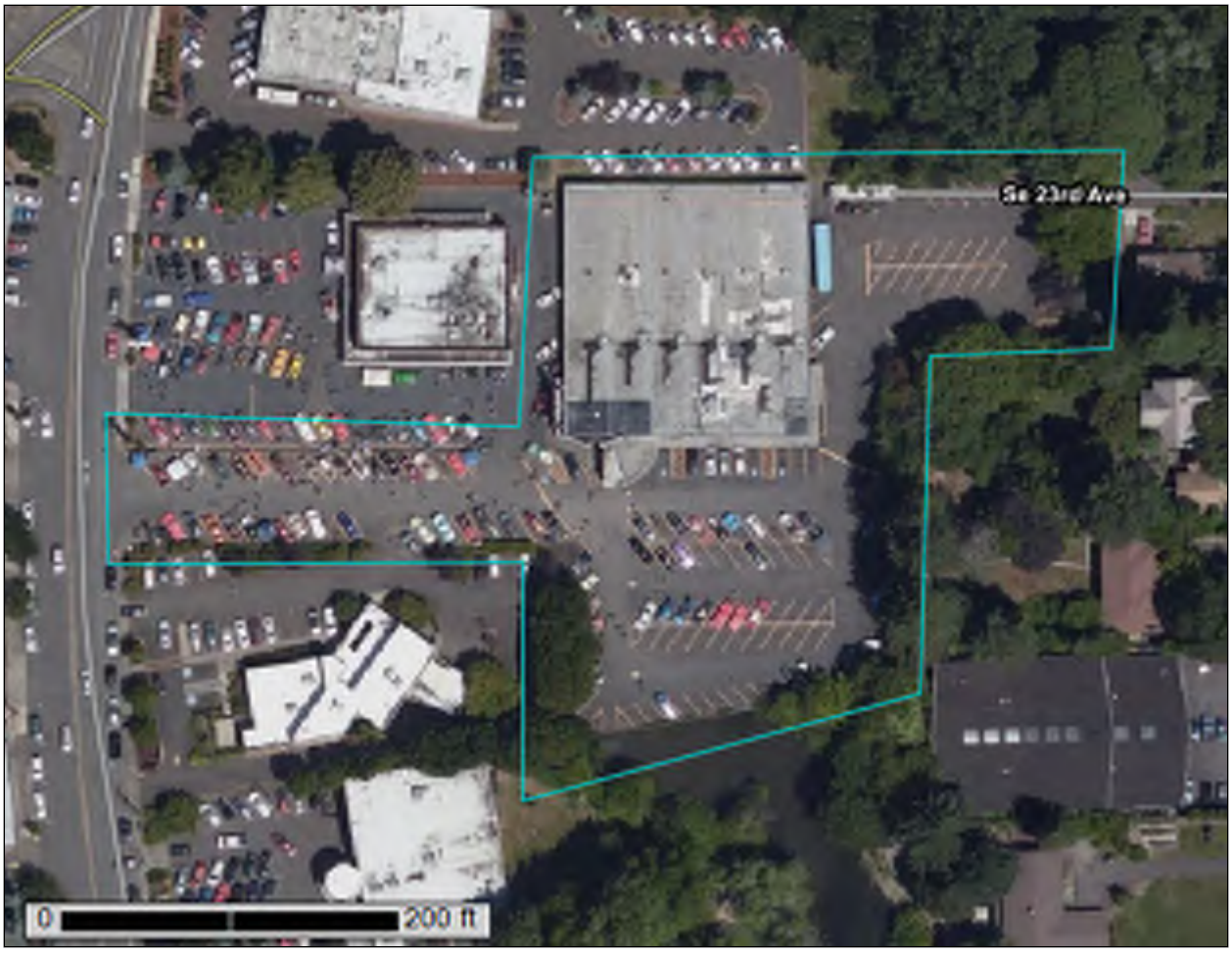
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Clackamas County Area, Oregon



February 10, 2021

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

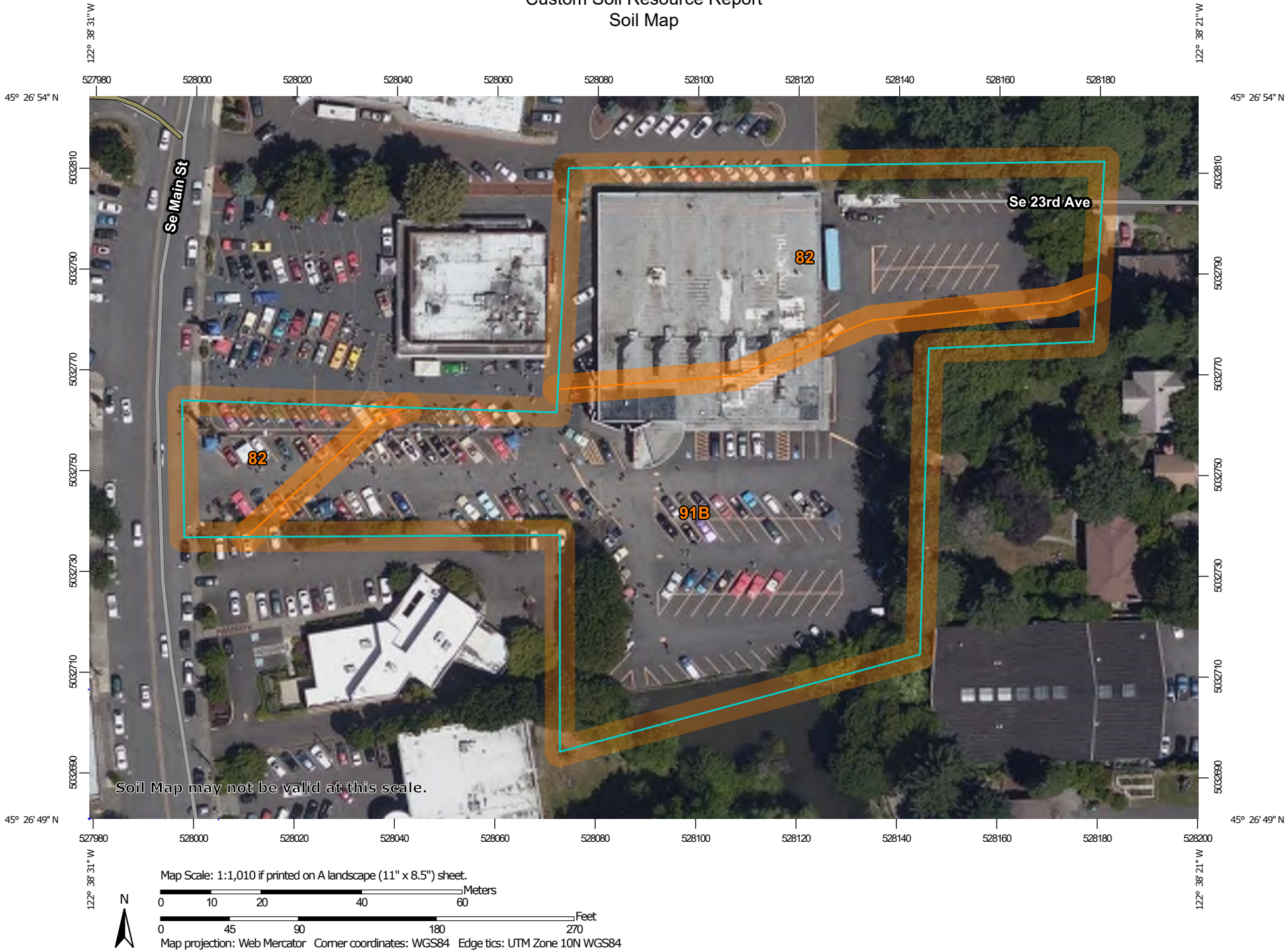
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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

Soil Map

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

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,010 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 45 90 180 270

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 16, 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: Jun 13, 2019—Jul 25, 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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
82	Urban land	1.1	41.2%
91B	Woodburn silt loam, 3 to 8 percent slopes	1.6	58.8%
Totals for Area of Interest		**2.7**	**100.0%**

Map Unit Descriptions

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

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

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

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

onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Clackamas County Area, Oregon

82—Urban land

Map Unit Setting

National map unit symbol: 227g
Elevation: 50 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

91B—Woodburn silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 227z
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodburn and similar soils: 90 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodburn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 38 inches: silty clay loam
H3 - 38 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Aquolls

Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

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Appendix E:
Geotechnical Engineer and Infiltration Report

GEO CONSULTANTS NORTHWEST

March 9, 2021

Pahlisch Commercial
210 SW Wilson Avenue, Suite 100
Bend, Oregon 97702

Attention: Kathryn Joseph

Subject: Geotechnical Evaluation
Kellogg Bowl, Milwaukie
GCN Project 1526

This report presents our Preliminary Geotechnical Evaluation of the proposed multi-family housing development located at 10306 SE Main Street in Milwaukie, Oregon. The report summarizes the work accomplished and provides our conclusions and recommendations for site development. It has been prepared in accordance with our proposal dated May 14, 2020.

PROJECT INFORMATION

The project is located on an approximate 1.62-acre property that is currently developed with the Kellogg Bowl and parking lot. The site location relative to surrounding features is shown in Figure 1.

We understand design drawings have not been completed at this point. You provided us with the preliminary access exhibits and site layout prepared by AKS Engineering and Forestry in October 2020 and January 2021.

The project is expected to include a six-story, multi-family residential structure with 178 units. The project will include undercover parking, paved parking, and underground utilities. The project may include a half-height basement vault for auto-stacker equipment. The preliminary site layout is shown in Figure 2.

Site grades, available from MetroMap, show the site to be nearly flat with elevations ranging from about 38 to 40 feet above mean sea level (MSL). The site slopes slightly downward to the north.

SCOPE OF WORK

The purpose of our services was to explore the site to fulfill the requirements of land use planning, to determine the need for additional site explorations, and to provide preliminary design and construction recommendations. The following describes our scope of services outline presented in our initial proposal with additional comments on additional scope items:

- Coordinate and manage the field investigation, including utility locates, authorization for site access, access preparation, exploration waste, and scheduling of contractors and GCN staff.

- Observe drilling of seven soil borings to depths up to 30 feet below the ground surface using mud-rotary and hollow-stem-auger (HSA) methods. The mud rotary borings were drilled on October 27, 2020 and three additional HSA borings were drilled on January 11, 2021.
- Conduct falling head infiltration tests in two borings to evaluate near surface infiltration rate of the on-site soil. The infiltration tests were conducted in general conformance with procedures referenced in the City of Portland's Stormwater Management Manual standards.
- Maintain a log of soil, rock, and groundwater conditions encountered in the borings and return samples to our laboratory for additional evaluation and testing. We classify the soil in general accordance with the Unified Soil classification System (USCS).
- Determine the moisture content of all samples, the content of material finer than the U.S. Standard 200 Sieve, and dry unit weight of selected samples in general accordance with guidelines presented in ASTM D 2216, ASTM D1140, and ASTM D 2937, respectively.
- Provide a written report that summarizes our explorations, geotechnical analysis, and preliminary conclusions.

SITE CONDITIONS

The site is in an area of commercial development situated about 1 block east of SE Main Street at the northern end of downtown Milwaukie. The following paragraphs describe the site geology, surface, and subsurface features.

SITE GEOLOGY

Multiple catastrophic floods inundated the Columbia River channel from Idaho to the Pacific Ocean from a period covering about 21,000 to 12,000 years ago. The floodwaters reached an elevation of about 400 feet above sea level in Portland area. The floodwater carried soil, gravel, and boulders that buried much of the area in multiple layers while scouring other areas to the bedrock surface.

The floods deposited silt, sand and gravel in the site vicinity. Bedrock underlying the area is basalt of the Columbia River Basalt flows that was deposited 15 to 16 million years ago.[1] All of these geologic units were found in the exploratory borings.

SURFACE CONDITIONS

The project site is the located on the east side of SE Main Street in downtown Milwaukie. Based on historic aerial photos, the site was used for residential and agricultural purposes through the 1950's. The site was redeveloped in 1962 with the existing single-story retail building, the Kellogg Bowl. Asphalt pavement covers all of the site except for the building footprint.

The existing building and pavement will be demolished during the redevelopment.

[1] Beeson, M.H. et al, "Geologic Map of the Lake Oswego Quadrangle, Clackamas, Multnomah, and Washington Counties, Oregon",1:24,000, State of Oregon Department of Geology and Mineral Industries, GMS-59, 1989.

SUBSURFACE CONDITIONS

We explored subsurface conditions at the site by observing the drilling of seven soil borings (B-1 through B-7) at the locations shown in Figure 2. Four of the borings (B-1 to B-4) were extended to the depth of dense gravel that underlies the site. Three borings (B-5 to B-7) were primarily intended for infiltration testing.

Soil samples obtained from the borings were returned to our laboratory for additional evaluation and testing. Select samples tested to determine the natural moisture content, fines content, and dry unit weight. Descriptions of field and laboratory procedures and the exploration logs are included in Attachment A.

We encountered asphalt pavement at the ground surface that varied from 2 to 4 inches thick. Base rock beneath the pavement varied from 6 to 18 inches thick.

Beneath the pavement we encountered a near surface layer of medium stiff to stiff silt that was generally 7 to 10 feet thick. The silt was underlain layers of very loose to loose silty sand that was generally about 10 feet thick. The silt was very soft in boring B-2 from about 5 to 10 feet. The silty sand layer was absent in boring B-1. We encountered loose to medium dense gravel fill in boring B-4 that extended to 7 feet bgs.

The silt and sand units were underlain by very dense gravel that varied from 10 to 25 feet below the ground surface. In boring B-3 we encountered decomposed basalt bedrock at 31 feet bgs.

GROUNDWATER AND INFILTRATION

The USGS Oregon Water Science Center estimates groundwater levels within the vicinity to vary between 5 and 7 feet[2]. Water levels on site were inferred in October at 15 feet. Water levels in January were inferred at 5 to 11 feet.

A summary of the water infiltration tests are shown in Table 1 below. The infiltration rate is plotted on Figures 3 and 4 where we have provided several rates with varying amounts of head. Both tests were started with water level at the existing ground surface.

TABLE 1 – INFILTRATION TESTING RESULTS

BORING	WELL SCREEN DEPTH	GROUNDWATER DEPTH (FEET)	INFILTRATION RATE IN/HR
B-6	7.5-12.5	7.0	37
B-7	4.5-14.5	8.5	48

The borings were finished with casing and monitoring well covers in accordance with State of Oregon Water Resources Division (OWRD) requirements. The wells can be used for monitoring seasonal groundwater levels in the future. Copies of the monitoring well reports, submitted to the, follow the logs of borings in Attachment B.

[2] Daniel T. Snyder, "Estimated Depth to Groundwater in the Portland, Oregon Area", USGS Scientific Investigations Report 2008-5059, December 31, 2008.

SEISMIC SETTING

The Portland area is subject to seismic events stemming from three possible sources: the Cascadia Subduction Zone (CSZ), intraslab faults within the Juan de Fuca Plate, and crustal faults in the North American Plate.

The site is surrounded in all directions by Quaternary crustal faults that are mapped or inferred. The faults within 10 miles of the site are the Portland Hills fault about 0.5 miles northeast, the Oatfield Fault about 1.7 miles southwest, Bolton fault about 3.3 miles southwest, the Damascus-Tickle Creek fault zone 4.3 miles to the east, the East Bank fault about 4.9 miles north, the Canby-Molalla fault about 6 miles southwest, and the Beaverton Fault 8.2 miles west. The USGS considers the faults to be greater than 10,000 years old and are considered inactive.

The contribution of potential earthquake-induced ground motion from all known sources, including the faults described above, are included in probabilistic ground motion maps developed by the USGS. We will provide seismic design parameters after liquefaction analysis and selection of the foundation system.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our field explorations and our engineering analysis, it is our opinion that the site can be developed as proposed.

Explorations conducted on the site confirm that mapped groundwater on the site is very shallow, in the range of 5 to 7 feet below the ground surface in the winter months. The condition will not allow stormwater disposal by infiltration. Stormwater will need to be disposed of in the municipal system.

Near surface soil on the site includes soft and loose layers of variable in depth and thickness. Layers of loose silty sand are likely liquefiable during a design level seismic event and there would likely be manifestation at the ground surface resulting in differential settlement. These conditions will likely require the building be supported on deep foundations that derive support from the underlying dense gravel. The conditions are suitable for rammed aggregate piers or deep soil mixing as alternatives to driven piles or concrete piers.

We recommend two cone penetrometer tests be conducted to provide better understanding of the soft and loose layers and to gain information for detailed evaluation of the liquefaction potential of these units.

Two shallow wells were installed for of infiltration testing and future groundwater level measurement. The wells will need to be abandoned during construction by an Oregon-licensed well driller in accordance with OWRD guidance.

LIMITATIONS

This report was prepared for the exclusive use of Pahlisch Commercial and members of the design team for this specific project. It should be made available to prospective contractors for information on the factual data only, and not as a warranty of subsurface conditions, such as those interpreted from the explorations and discussed in this report.

The recommendations contained in this report are preliminary, and are based on information derived through site reconnaissance, subsurface testing, and knowledge of the site area. Variation of conditions within the area and the presence of unsuitable materials are possible and cannot be determined until exposed during construction. Accordingly, GCN's recommendations can be finalized only through GCN's observation of the project's earthwork construction. GCN accepts no responsibility or liability for any party's reliance on GCN's preliminary recommendations.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by exploratory methods. Such unexpected conditions frequently require that additional expenditures be made to attain properly constructed projects. Therefore, a contingency fund is recommended to accommodate the potential for extra costs.

Within the limitations of the scope of work, schedule, and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice in this area at the time this report was prepared. We make no warranty, either express or implied.

♦ ♦ ♦

We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,
GEO Consultants Northwest, Inc.

EXPIRES 05/01/2022
David K. Rankin, CEG
Principal

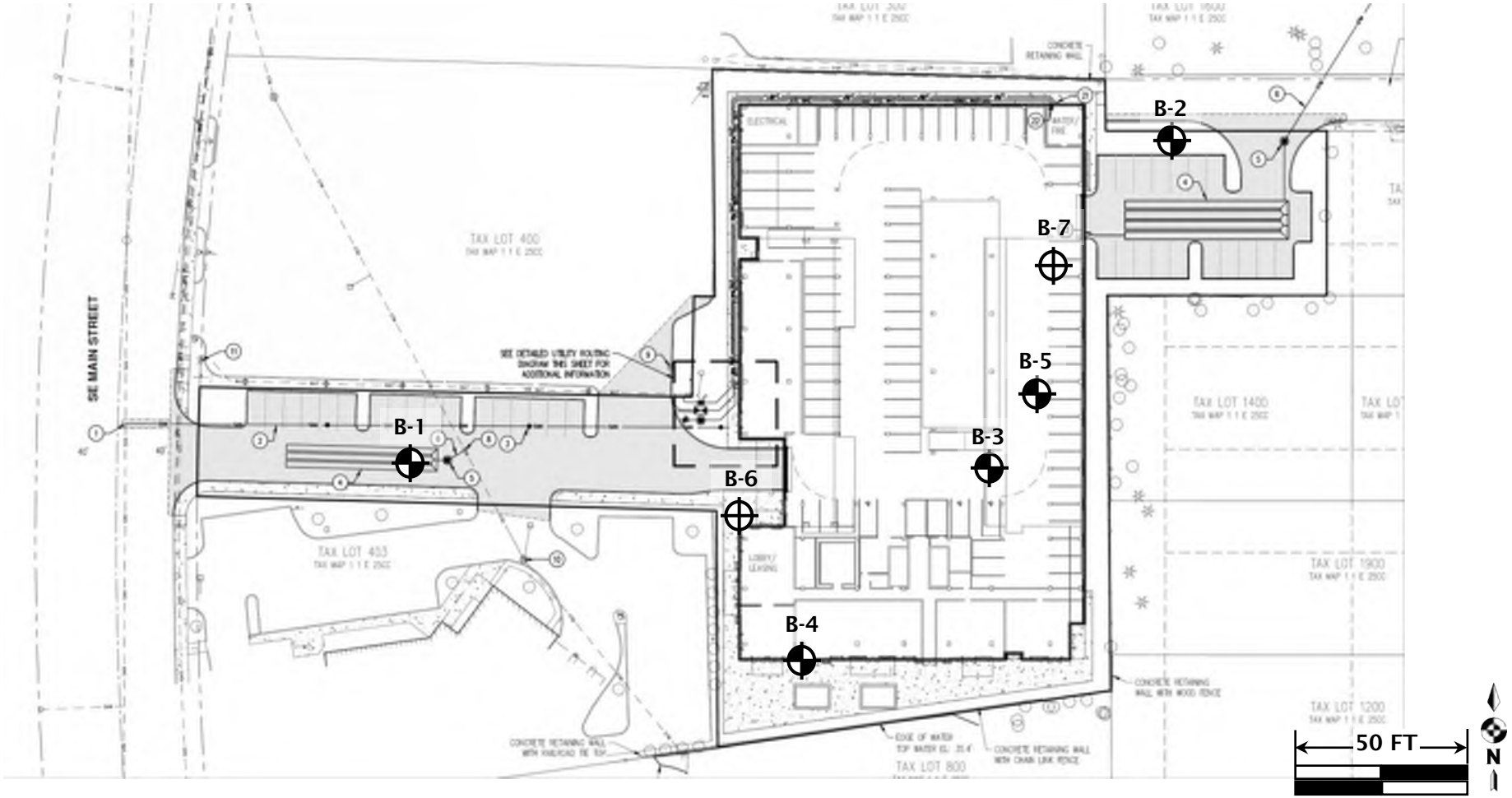
EXPIRES 08/30/2022
Randall S. Goode, PE, GE
Principal Engineer

Figures: Figure 1 - Site Vicinity
Figure 2 - Site Layout and Explorations
Figure 3 – Infiltration Results B-6
Figure 4 – Infiltration Results B-7

Attachments: Attachment A – Field Exploration and Laboratory Testing
Attachment B – Monitoring Well Log Reports

IMAGE FROM METROMAPS
10306 SE MAIN STREET, MILWAUKIE, OR 97222
LAT 45.448 N, LON 122.641 W; T1S, R1E, SEC36

GEO CONSULTANTS NORTHWEST	PROJECT 1526	PAHLISCH COMMERCIAL KELLOGG BOWL	
2839 SE Milwaukie Portland, OR 97202	FEB 2021 Drawn By: tac	SITE VICINITY	FIGURE 1

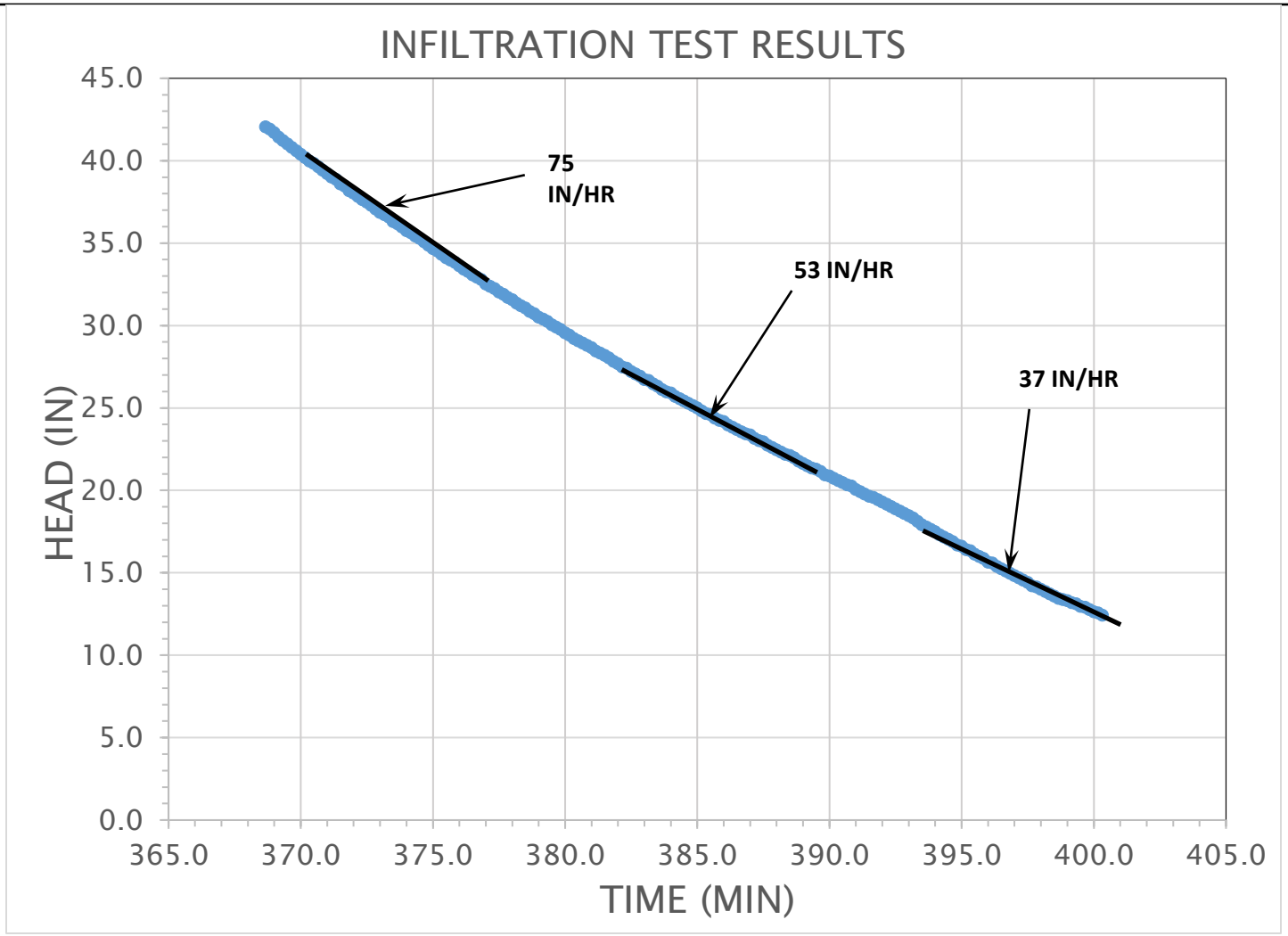


B-1 BORINGS (B-1 THROUGH B-4) DRILLED OCTOBER 27, 2021; BORINGS B-5 THROUGH B-7 DRILLED JANUARY 11, 2021. LOCATIONS APPROXIMATE.

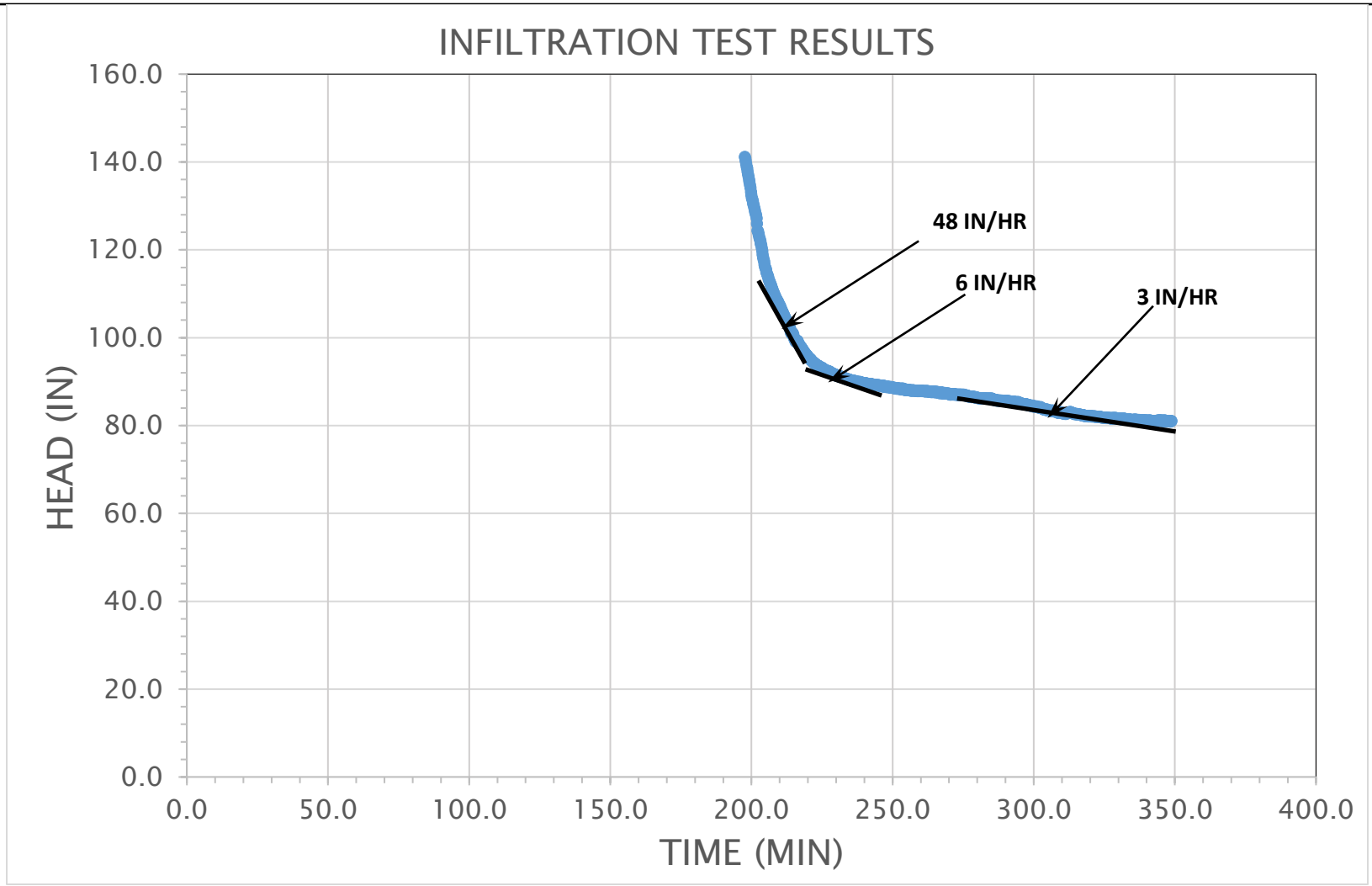
B-6 INFILTRATION TEST LOCATIONS CONDUCTED JANUARY 11-13, 2021

BASE DRAWING "SITE LAYOUT" PREPARED BY AKS ENGINEERED, JANUARY 2021

GEO CONSULTANTS NORTHWEST	PROJECT 1526	**PAHLISCH COMMERCIAL KELLOGG BOWL**	
2839 SE Milwaukie Avenue Portland, OR 97202	FEB 2021	**SITE LAYOUT & EXPLORATIONS**	**FIGURE 2**
	Drawn By:TAC		



GEO CONSULTANTS NORTHWEST	PROJECT 1526	**PAHLISCH COMMERCIAL KELLOGG BOWL**	
2839 SE Milwaukie Avenue Portland, OR 97202	FEB 2021	**INFILTRATION RESULTS – B-6**	**FIGURE 3**
	Drawn By: TAC		



GEO CONSULTANTS NORTHWEST	PROJECT 1526	**PAHLISCH COMMERCIAL KELLOGG BOWL**
2839 SE Milwaukie Avenue Portland, OR 97202	FEB 2021 Drawn By: TAC	**INFILTRATION RESULTS – B-7** / **FIGURE 4**

ATTACHMENT A

FIELD EXPLORATION PROCEDURES

LABORATORY TESTING PROCEDURES

KEY TO BORING AND TEST PIT LOGS

BORING LOGS

FIELD EXPLORATION PROCEDURES

GENERAL

We explored subsurface conditions at the site by drilling four soil borings (B-1 through B-4) to depths of 20 to 31 feet below ground surface (bgs) on October 27, 2020. In addition, we drilled an additional three soils borings (B-5 through B-7) on January 11, 2021 and conducted several infiltration tests within B-6 and B-7 at the approximate locations shown in Figure 2.

The borings drilled on October 27, 2020 using mud rotary methods by Western States out of Hubbard, Oregon. On January 11, 2021 soil borings were conducted using hollow-stem auger methods by Western States as well.

SOIL SAMPLING

A member of GCN's geotechnical staff observed subsurface explorations to record the soil, rock, and groundwater conditions encountered. Samples obtained in the exploration were sealed in airtight plastic bags to retain moisture and returned to our laboratory for additional examination and testing.

FIELD CLASSIFICATION

Soil samples were initially classified visually in the field. Consistency, color, relative moisture, degree of plasticity, peculiar odors, and other distinguishing characteristics of the soil samples were noted. The terminology used is described in the key and glossary that follow.

SUMMARY EXPLORATION LOGS

Results from the borings are shown in the summary exploration logs. The left-hand portion of a log provides our interpretation of the soil encountered, sample depths, and groundwater information. The right-hand, graphic portion of a log shows the results of pocket penetrometer and laboratory testing. Soil descriptions and interfaces between soil types shown in summary logs are interpretive, and actual transitions may be gradual.

LABORATORY TESTING PROCEDURES

Soil samples obtained during field explorations are examined in our laboratory, and representative samples may be selected for further testing. The testing program included visual-manual classification and natural moisture content.

VISUAL-MANUAL CLASSIFICATION

Soil samples are classified in general accordance with guidelines presented in ASTM D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. The physical characteristics of the samples are noted, and the field classifications are modified, where necessary, in accordance with ASTM terminology, though certain terminology that incorporates current local engineering practice may be used. The term which best described the major portion of the sample is used to describe the soil type.

NATURAL MOISTURE CONTENT

Natural moisture content is determined in general accordance with guidelines presented in ASTM D2216, *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*. The natural moisture content is the ratio, expressed as a percentage, of the weight of water to the weight of soil particles.

FINES CONTENT

Fines content testing is performed in general accordance with guidelines presented in ASTM D1140, *Standard Test Methods for Determining the Amount of Material Finer than 75-μm (No. 200) Sieve in Soils by Washing.* The fines content is the fraction of soil that passes the U.S. Standard Number 200 Sieve. This sieve differentiates fines (silt and clay) from fine sand. Soil material that remains on the 200 sieve is sand. Material that passes the sieve is fines. The test is used to refine soil type.

DRY UNIT WEIGHT (IN-PLACE DRY DENSITY)

Dry unit weight (in-place dry density) testing is performed in general accordance with guidelines presented in ASTM D2937, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method. The dry unit weight is defined as the ratio of the dry weight of the soil sample to the volume of that sample. The dry unit weight typically is expressed in pounds per cubic foot.

BORING AND TEST PIT LOGS

DISTINCTION BETWEEN FIELD LOGS AND FINAL LOGS

A field log is prepared for exploration by our field representative. The log contains information concerning soil and groundwater encountered, sampling depths, sampler types used and identification of samples selected for laboratory analysis. The final logs presented in this report represent our interpretation of subsurface conditions based on the contents of the field logs, observations made during explorations, and the results of laboratory testing. Our recommendations are based on the contents of the final logs and the information contained therein, and not on the field logs.

SOIL CLASSIFICATION SYSTEM

Soil samples are classified in the field in general accordance with the United Soil Classification System (USCS) presented in ASTM D2488 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)." Final logs reflect field soil classifications and laboratory testing results. A summary of the USCS is provided on page 3. Classifications and sampling intervals are shown in the logs.

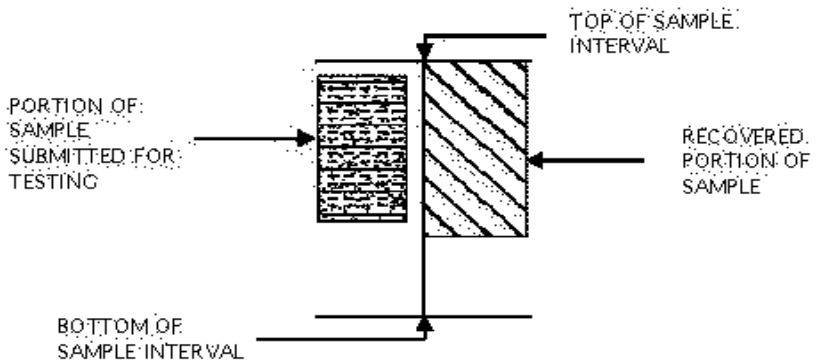
VARIATION OF SOIL BETWEEN EXPLORATIONS

The final logs and related information depict subsurface conditions only at the specific location and on the date(s) indicated. Those using the information contained herein should be aware that soil conditions at other locations or on other dates may differ.

TRANSITION BETWEEN SOIL AND ROCK CLASSIFICATIONS

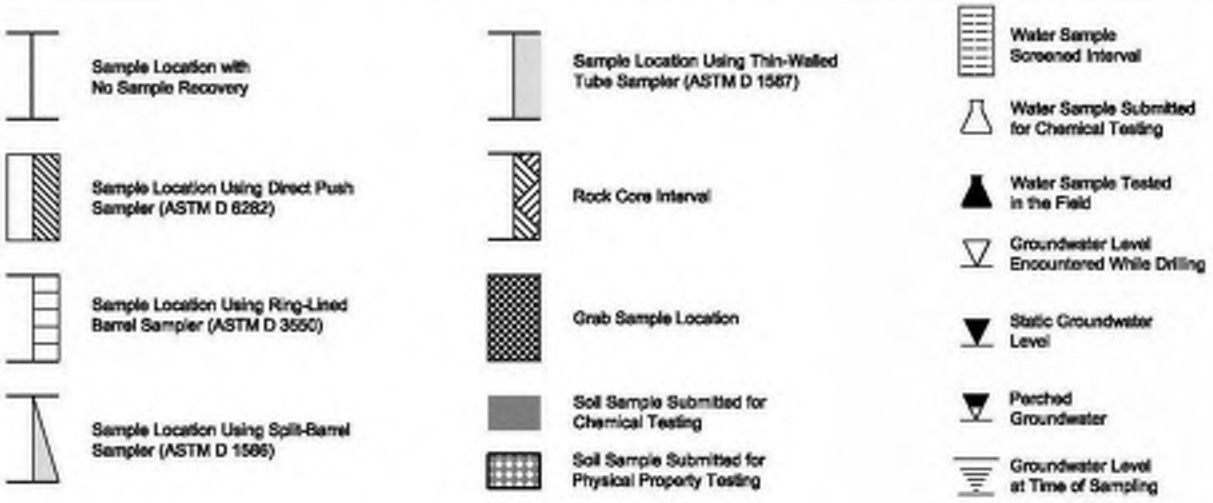
The lines designating the interface between soil, fill, or rock on the final logs and on the subsurface profiles presented in the report are determined by interpolation and are, therefore, approximate. The transition between the materials may be abrupt or gradual. Only at specific exploration locations should profiles be considered as reasonably accurate and then only to the degree implied by the notes.

BORING LOG SAMPLES



GEO CONSULTANTS NORTHWEST	2019	KEY TO BORING AND TEST PIT LOGS	
2839 SE Milwaukie Avenue Portland, OR 97202	Drawn By: GCN	GENERAL INFORMATION	1/5

EXPLORATION LOG SYMBOLS



SOIL CHARACTER

Granular Soil		Cohesive Soil		
Density	Standard Penetration Test *	Consistency	Standard Penetration Test*	Unconfined Compressive Strength (tsf)
Very Loose	0 - 4	Very Soft	Less Than 2	Less Than 0.25
Loose	4 - 10	Soft	2 - 4	0.25 - 0.5
Medium Dense	10 - 30	Medium Stiff	4 - 8	0.50 - 1.0
Dense	30 - 50	Stiff	8 - 16	1.0 - 2.0
Very Dense	Greater Than 50	Very Stiff	16 - 32	2.0 - 4.0
Blows Required to Drive a Split-Barrel Sampler 12 inches		Hard	Greater Than 32	Greater Than 4.0

DEFINITIONS AND ABBREVIATIONS

AT	ATTERBERG LIMITS TEST	ND	NON DETECT	PPB	PARTS PER BILLION
BGS	BELOW GROUND SURFACE	NEG	NEGATIVE RESULT	PPM	PARTS PER MILLION
CO	CONSOLIDATION TEST	NS	NO VISIBLE SHEEN	PSF	POUNDS PER SQUARE FOOT
DS	DIRECT SHEAR TEST	OC	ORGANIC CONTENT	RS	SOIL RESISTIVITY TEST
DW	DRY UNIT WEIGHT	P	PUSHED SAMPLE	S4	SUDAN IV SOIL TEST
GS	MECHANICAL GRAIN SIZE TEST	P200	P200 FINES CONTENT TEST	SG	SPECIFIC GRAVITY TEST
HS	HEAVY SHEEN	PCF	POUNDS PER CUBIC FOOT	SPT	STD. PENETRATION TEST
HYD	HYDROMETER TEST	PH	SOIL pH	SS	SLIGHT SHEEN
MC	MOISTURE CONTENT	PID	PHOTOIONIZATION DETECTOR	TO	TOREVANE
MG/KG	MILLIGRAMS PER KILOGRAM	POS	POSITIVE RESULT	TSF	TONS PER SQUARE FOOT
MS	MODERATE SHEEN	PP	POCKET PENETROMETER	UV	ULTRAVIOLET LIGHT TEST

GRAIN SIZE DEFINITIONS			MINOR FRACTIONS IN FINE GRAINED SOIL		GROUNDWATER SEEPAGE	
SAND	FINE	No. 200 to No. 40	No Mention (CLAY, SILT)	< 15 percent	Slow	< 1 gpm
	MEDIUM	No. 40 to No. 10	With Sand, With Gravel	15 to 30 percent	Moderate	1-3 gpm
	COARSE	No. 10 to No. 4	Sandy, Gravelly	30 to 49 percent	Rapid	> 3 gpm
GRAVEL	FINE	No. 4 to 3/4-inch	FIELD MOISTURE OBSERVATION		CAVING	
	COARSE	3/4- to 3-inch	Dry	Absence of moisture, dusty, dry to touch	Minor	
COBBLE		3-inches to 12-inches	Moist	Damp but no visible water.	Moderate	
BOULDER		> 12-inches	Wet	Saturated, below groundwater	Severe	

GEO CONSULTANTS NORTHWEST	2019	KEY TO BORING AND TEST PIT LOGS	
2839 SE Milwaukie Avenue Portland, OR 97202	Drawn By: GCN	SYMBOLS AND ABBREVIATIONS	2/5

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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ROCK CLASSIFICATION GUIDELINES

HARDNESS		DESCRIPTION
Very soft	(RH-0)	For plastic material only
Soft	(RH-1)	Carved or gouged with a knife
Moderate	(RH-2)	Scratched with a knife
Hard	(RH-3)	Difficult to scratch with a knife
Very hard	(RH-4)	Rock scratches metal; rock cannot be scratched with a knife

STRENGTH	DESCRIPTION
Plastic	Easily deformable with finger pressure
Friable	Crumbles by rubbing with fingers
Weak	Crumbles only under light hammer blows
Moderately Strong	Few heavy hammer blows before breaking
Strong	Withstands few heavy hammer blows and yields large fragments
Very Strong	Withstands many heavy hammer blows, yields dust and small fragments

WEATHERING	DESCRIPTION
Severe	Rock decomposed; thorough discoloration; all fractures extensively coated with clay, oxides, or carbonates.
Moderate	Intense localized discoloration of rock; fracture surfaces coated with weathering minerals.
Little	Slight and intermittent discoloration of rock; few stains on fracture surfaces.
Fresh	Rock unaffected by weathering

FRACTURING	FRACTURE SPACING
Crushed	Less than 5/8 inch to contains clay
Highly Fractured	5/8 inch to 2 inches
Closely Fractured	2 inches to 6 inches
Moderately fractured	6 inches to 1 foot
Little Fractured	1 foot to 4 feet
Massive	Greater than 4 feet

JOINT SPACING	DESCRIPTION
Papery	Less than 1/8 inch
Shaley or Platey	1/8 inch to 5/8 inch
Very Close	5/8 inch to 3 inches
Close	3 inches to 2 feet
Blocky	2 to 4 feet
Massive	Greater than 4 feet

GLOSSARY

Alluvial – Made up of or found in the materials that are left by the water of rivers, streams, floods, etc.

Bearing pressure – The total stress transferred from the structure to the foundation, then to the soil below the foundation.

Bulk density (Soil density) – The total mass of water and soil particles contained in a unit volume of soil: lb/ft^3.

Coefficient of active earth pressure – The ratio of the minimum horizontal effective stress of a soil to the vertical effective stress at a single point in a soil mass retained by a retaining wall as the wall moves away from the soil.

Cohesive soil – Clay type soil with angles of internal friction close to zero. Cohesion is the force that holds together molecules or like-particles within a substance.

Colluvium – A loose accumulation of soil and rock fragments deposited through the action of gravity, such as erosion and soil creep.

Differential settlement – The vertical displacement due to settlement of one point in a foundation with respect to another point of the foundation.

Engineered fill – Soil used as fill, such as retaining wall backfill, foundation support, dams, slopes, etc., that are to be placed in accordance with engineered specifications. These specifications may delineate soil grain-size, plasticity, moisture, compaction, angularity, and many other index properties depending on the application.

Excess pore pressure – That increment of pore water pressures greater than hydro-static values, produced by consolidation stresses in compressible materials or by shear strain; excess pore pressure is dissipated during consolidation.

Factor of safety – The ratio of a limiting value of a quantity to the design value of that quantity.

Fines – Material by weight passing the U.S. Standard No. 200 Sieve by washed analysis.

Fluvial – Produced by the action of rivers or streams.

Homogenous soil – A mass of soil where the soil is of one characteristic having the same engineering and index properties.

In situ – Undisturbed, existing field conditions.

Lacustrine – Of a lake, e.g., the depositional environment of a lake.

Liquefaction – The sudden, large decrease of shear strength of cohesionless soil caused by collapse of the soil structure, produced by small shear strains associated with sudden but temporary increase of pore water pressure. Usually a problem in submerged, poorly graded sands within the upper 50 feet of subgrade in earthquake-prone environments.

Maximum dry density – A soil property obtained in the laboratory from a Proctor test. Density of soil at 100% compaction.

Overbank deposit – Sediment that has been deposited on the floodplain of a river or stream by flood waters that have broken through or overtopped the banks.

Permeability – A measure of continuous voids in a soil. The property which allows the flow of water through a soil. See also coefficient of permeability.

Porosity (Pore space) – The ratio of the volume of voids to the total volume: unitless or expressed as a percentage.

Residual soil – Soil that has been formed in place by rock decay.

Shear strength – The maximum shear stress which a soil can sustain under a given set of conditions. For clay, shear strength = cohesion. For sand, shear strength = the product of effective stress and the tangent of the angle of internal friction.

Surcharge – An additional force applied at the exposed upper surface of a restrained soil.

Tuff – An igneous rock (from molten material) that forms from the debris ejected by an explosive volcanic eruption.

Unit weight – The ratio of the total weight of soil to the total volume of a unit of soil: lb/ft^3.

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	MOISTURE CONTENT (%)	GROUNDWATER	FIELD TESTING	TESTING AND LABORATORY DATA
0		ACC GW	ASPHALT - 4 inches thick BASE COURSE (3/4-MINUS) - 6 inches thick						
		ML	Stiff, brown SILT with trace fine sand; moist.	1	3-4-7	33			
5		ML	Stiff, brown mottled gray SILT with trace subangular gravel and fine to medium sand; moist.	2	1-3-2	27			
				3	2-3-7	36			
10		GW	Very dense, black-dark gray, subangular GRAVEL with cobbles, fine to coarse sand and silt; moist to wet.	4	6-42-50/ 5"	27			
15				5	50/5"	24			
20			End at 20 feet in very dense gravel. Could not determine groundwater levels due to drilling methods.	6	50/3"	20			
25									
30									
35									
40									

BORING METHOD: Mud Rotary
BOREHOLE DIAMETER: 4 7/8"
DRILL RIG: CME-75
CONTRACTOR: Western States
LOGGED BY: Tima Carlson

ELEVATION REFERENCE:
GROUND SURFACE ELEVATION:
CASING ELEVTATION:
LOCATION: See Figure 2
DRILLING DATES: 10/27/20 10/27/20

START CARD/TAG ID:

Pahlisch - Kellogg Bowl

1526

GEO Consultants Northwest
2839 SE Milwaukie Avenue
Portland OR 97202
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GEO CONSULTANTS NORTHWEST

LOG OF BORING
B-1

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	MOISTURE CONTENT (%)	GROUNDWATER	FIELD TESTING	TESTING AND LABORATORY DATA
0		ACC GW	ASPHALT - 2 inches thick						
			BASE COURSE (3/4-MINUS) - 10 inches thick						
			Medium stiff, brown mottled gray SILT with trace sand; moist.	1	2-3-5	36			
5		ML		2	1-2-3	45			
				3	SH	33			DW = 102
10				4	3-4-7	32			
			Grades stiff at 10 feet.						
			Medium dense, reddish-brown SAND with some silt and trace fine gravel; moist.	5	4-4-8	28			
				6	3-5-4	32			
15		SM	Becomes loose at 15 feet.	7	1-1-0	49	▼		
			Very soft, brown-gray SILT with trace fine sand; wet.	8	0-0-0	48			
20		ML		9	1-0-0	101			
25		GW	Medium dense, black-dark gray, subangular GRAVEL with cobbles, coarse sand and trace silt; wet.	10	14-12-15	10			
			Very dense, light brown-red, clayey GRAVEL (DECOMPOSED WEATHERED BASALT); moist.	11	22-50/5"	33			
30		RK	End at 31 feet in hard bedrock.						
			Groundwater inferred at 15 feet bgs. Note - drilling methods were mud rotary.						
35									
40									

BORING METHOD: Mud Rotary	**ELEVATION REFERENCE:**	**START CARD/TAG ID:**
BOREHOLE DIAMETER: 4 7/8"	**GROUND SURFACE ELEVATION:**	
DRILL RIG: CME-75	**CASING ELEVTATION:**	
CONTRACTOR: Western States	**LOCATION:** See Figure 2	
LOGGED BY: Tima Carlson	**DRILLING DATES:** 10/27/20 10/27/20	

Pahlisch - Kellogg Bowl 1526	GEO Consultants Northwest 2839 SE Milwaukie Avenue Portland OR 97202 Tel 503-616-9425 Fax 1-866-293-9037 GEO CONSULTANTS NORTHWEST	LOG OF BORING B-2 **Page 1 of 1**

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	MOISTURE CONTENT (%)	GROUNDWATER	FIELD TESTING	TESTING AND LABORATORY DATA
0		ACC	ASPHALT - 4 inches thick						
		GW	BASE COURSE (3/4-MINUS) - 10 inches thick						
			Medium stiff, brown mottled gray SILT with trace fine sand; moist.	1	7-6-4				
5		ML		2	1-2-3	54			
			Becomes very soft at 7-1/2 feet.	3	1-2-1	50			
10				4	SH	16			DW = 90 pcf
		SM	Very loose, brown mottled gray SAND with silt; wet.	5	1-2-2	69			
15			Becomes dark gray at 15 feet.	6	2-0-1	51	▼		
		SW	Very dense, black-dark gray, medium to coarse SAND with gravel, cobbles and trace silt; wet.	7	50/6"	18			
25		GW	Very dense, black-dark gray, subangular GRAVEL with cobbles, medium to coarse sand and and trace silt; wet.	8	23-32-48	13			
30			End at 26-1/2 feet in very dense gravel. Groundwater inferred at 15 feet bgs. Note - drilling methods were mud rotary.						
35									
40									

BORING METHOD: Mud Rotary
BOREHOLE DIAMETER: 4 7/8"
DRILL RIG: CME-75
CONTRACTOR: Western States
LOGGED BY: Tima Carlson

ELEVATION REFERENCE:
GROUND SURFACE ELEVATION:
CASING ELEVTATION:
LOCATION: See Figure 2
DRILLING DATES: 10/27/20 10/27/20

START CARD/TAG ID:

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LOG OF BORING
B-3

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	MOISTURE CONTENT (%)	GROUNDWATER	FIELD TESTING	TESTING AND LABORATORY DATA
0		ACC	ASPHALT - 4 inches thick						
		GW	BASE COURSE (3/4-MINUS) - 18 inches thick						
		Fill	Dense, gray-black, subangular GRAVEL FILL with trace silt and coarse sand; moist.	1	13-16-13	16			
5				2	1-2-3	90			
		ML	Medium stiff, brown mottled gray SILT with trace fine sand; moist.	3	3-3-4	42			
10				4	1-2-3	42			
		SM	Very loose, brown, fine to medium SAND with silt; wet.	5	2-1-1	54			
15				6	SH	68	▼		DW = 74 pcf
		SW-SM	Medium dense, black-dark gray, fine to medium SAND with trace silt; wet.	7	2-0-10	31			
		GW	Hard, black, subangular GRAVEL with cobbles, coarse sand and silt/clay (decomposed rock); wet.	8	50/3"	11			
20									
25				9	50/2"				
30				10	50/1"				
			End at 30 feet in hard gravel. Groundwater inferred at 15 feet bgs. Note - drilling methods were mud rotary.						
35									
40									

BORING METHOD: Mud Rotary	**ELEVATION REFERENCE:**	**START CARD/TAG ID:**
BOREHOLE DIAMETER: 4 7/8"	**GROUND SURFACE ELEVATION:**	
DRILL RIG: CME-75	**CASING ELEVTATION:**	
CONTRACTOR: Western States	**LOCATION:** See Figure 2	
LOGGED BY: Tima Carlson	**DRILLING DATES:** 10/28/20 10/28/20	

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LOG OF BORING
B-4

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	MOISTURE CONTENT (%)	GROUNDWATER	FIELD TESTING	TESTING AND LABORATORY DATA
0		AC/C GW	ASPHALT - 3 1/2 - inches thick BASE COURSE (3/4-MINUS) - 4 1/2-inches thick						
5		ML	Light brown mottled orange SILT with trace fine sand; moist.	1		46	▼		
10				2		41			
15		SM	Brown, fine SAND with silt; wet.	3		40			
20			End at 16 1/2 - feet in very loose sand. Groundwater encountered at 5 feet during site exploration.						
25									
30									
35									
40									

BORING METHOD: Hollow Stem Auger
BOREHOLE DIAMETER: 4 7/8"
DRILL RIG: CME-75
CONTRACTOR: Western States
LOGGED BY: Paul Rabay

ELEVATION REFERENCE:
GROUND SURFACE ELEVATION:
CASING ELEVTATION:
LOCATION: See Figure 2
DRILLING DATES: 1/11/21 1/11/21

START CARD/TAG ID:

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GEO CONSULTANTS NORTHWEST

LOG OF BORING
B-5

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	WELL CONSTRUCTION	SAMPLE	BLOW COUNT SPT N VALUE	MOISTURE CONTENT (%)	GROUNDWATER	FIELD TESTING	TESTING AND LABORATORY DATA
0		GW	ASPHALT - 3 1/2 - inches thick							
			BASE COURSE (3/4-MINUS) - 4 1/2- inches thick							
5		ML	Light brown mottled orange SILT with trace fine sand; moist.		1		43	▼		
10					2		55			FC = 83 %
15		SM	Brown, fine, silty SAND; wet.		3		56			
		GW	Gray, subrounded GRAVEL; wet.							
20			End at 17 feet in dense gravel. Groundwater inferred at 7 feet (?) during site exploration.							
25			Well Description 0-4.5 Bentonite 4.5-7.5 Sand 7.5-12.5 Screen 12.5-16 Bentonite							
30										
35										
40										

BORING METHOD:	Hollow Stem Auger	**ELEVATION REFERECE:**	
BOREHOLE DIAMETER:	4 7/8"	**GROUND SURFACE ELEVATION:**	112
DRILL RIG:	CME-75	**CASING ELEVTATION:**	
CONTRACTOR:	Western States	**LOCATION:**	See Figure 2
LOGGED BY:	Paul Rabay	**DRILLING DATES:**	1/11/21 1/11/21

START CARD/TAG ID:

REMARKS:

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LOG OF BORING
B-6

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	WELL CONSTRUCTION	SAMPLE	BLOW COUNT SPT N VALUE	MOISTURE CONTENT (%)	GROUNDWATER	FIELD TESTING	TESTING AND LABORATORY DATA
0		GW	ASPHALT - 3 1/2 - inches thick							
			BASE COURSE (3/4-MINUS) - 4 1/2- inches thick							
5		ML	Light brown mottled orange SILT with trace fine sand; moist.		1		41			
10		SM	Gray-brown, fine, silty SAND; moist..		2		29			FC = 18%
15		ML	Gray SILT with fine sand; wet.		3		54			FC = 96%
20					4		38			
			End at 21 1/2 - feet.							
25			Groundwater inferred at 8.5 feet (?) during site exploration.							
30			Well Description 0-4.5 Bentonite 4.5-14.5 Sand 4.5-14.5 Screen 14.5-21 Bentonite							
35										
40										

BORING METHOD: Hollow Stem Auger
BOREHOLE DIAMETER: 4 7/8"
DRILL RIG: CME-75
CONTRACTOR: Western States
LOGGED BY: Paul Rabay

ELEVATION REFERECE:
GROUND SURFACE ELEVATION: 112
CASING ELEVTATION:
LOCATION: See Figure 2
DRILLING DATES: 1/11/21 1/11/21

START CARD/TAG ID:
REMARKS:

Pahlisch - Kellogg Bowl

1526

GEO Consultants Northwest
2839 SE Milwaukie Avenue
Portland OR 97202
Tel 503-616-9425
Fax 1-866-293-9037

GEO CONSULTANTS NORTHWEST

LOG OF BORING
B-7

ATTACHMENT B

MONITORING WELL LOG REPORT

CLAC 76283 Amended

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

2/17/2021

WELL I.D. LABEL# L 139123

START CARD # 1050442

(1) LAND OWNER

Owner Well I.D. B1

First Name _____ Last Name _____

Company GEO CONSULTANTS NORTHWEST, INC. - OWNERS REP

Address 1021 SE 33RD AVE.

City PORTLAND State OR Zip 97202

(2) TYPE OF WORK

☒ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☐ Abandonment

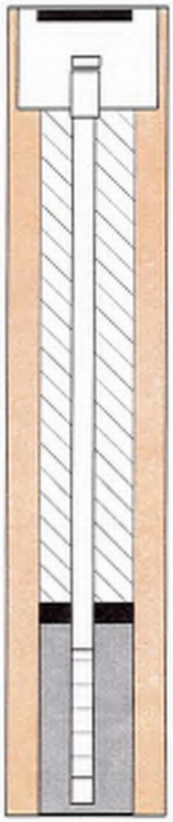
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☒ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other _____

(4) CONSTRUCTION

Piezometer Well ☒

Depth of Completed Well 15.00 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 8 From 0 To 15

CASING
Dia. 2 From ☐ 0 To 5
Gauge S80 Wld ☐ Thrd ☒
Material ◯ Steel ◉ Plastic

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld ☐ Thrd ☐
Material ◯ Steel ◯ Plastic

SEAL
From 0 To 1
Material Concrete
Amount 2 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC
Diameter 2 From 5 To 15
Slot Size 0.010

FILTER
From 4 To 15 Material SILICA SAND Size of pack 10/20

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 197 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County CLACKAMAS Twp 1.00 S N/S Range 1.00 E E/W WM
Sec 25 SW 1/4 of the SW 1/4 Tax Lot 401
Tax Map Number _____ Lot _____
Lat ° ' " or ~~45.44767778~~ 45.447644 DMS or DD
Long ° ' " or ~~-122.6403261~~ -122.640814 DMS or DD

◯ Street address of well ◉ Nearest address

10306 SE MAIN ST, MILWAUKIE

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+ SWL(ft)
Existing Well / Predeepening			
Completed Well			

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+ SWL(ft)

(8) WELL LOG

Ground Elevation _____

Material	From	To
Asphalt	0	0.3
Clay, Silt, Sand	0.3	15

Date Started 1/11/2021 Completed 1/11/2021

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number _____ Date _____
Password : (if filing electronically) _____
Signed _____

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10690 Date 2/17/2021
Password : (if filing electronically) _____
Signed SHARON STIGALL (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

2/17/2021

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Chips	1	4	1	S	

CASING/LINER

Casing Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 76283

2/17/2021

Map of Hole

Corrected Lat & Long for B1

45.447644

-122.640814

Correct Location for B1

CLAC 76284

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

2/17/2021

WELL I.D. LABEL# L 139119

START CARD # 1050443

(1) LAND OWNER

Owner Well I.D. B2

First Name _____ Last Name _____

Company GEO CONSULTANTS NORTHWEST, INC. - OWNERS REP

Address 1021 SE 33RD AVE.

City PORTLAND State OR Zip 97202

(2) TYPE OF WORK

☒ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☐ Abandonment

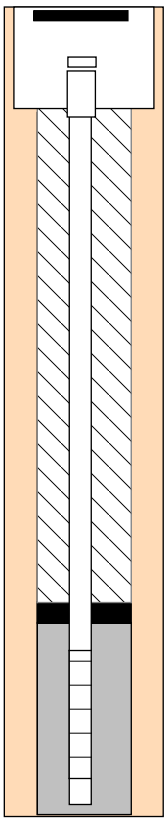
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☒ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☐ Other _____

(4) CONSTRUCTION

Piezometer Well ☒

Depth of Completed Well 20.00 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 8 From 0 To 20

CASING
Dia. 2 From ☐ 0 To 5
Gauge S80 Wld ☐ Thrd ☒
Material ◯ Steel ◉ Plastic

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld ☐ Thrd ☐
Material ◯ Steel ◯ Plastic

SEAL
From 0 To 1
Material Concrete
Amount 2 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC
Diameter 2 From 5 To 15
Slot Size 0.010

FILTER
From 4 To 15 Material SILICA SAND Size of pack 10/20

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 197 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County CLACKAMAS Twp 1.00 S N/S Range 1.00 E E/W WM
Sec 25 SW 1/4 of the SW 1/4 Tax Lot 401
Tax Map Number _____ Lot _____
Lat ° ' " or 45.44792778 DMS or DD
Long ° ' " or -122.64030000 DMS or DD
◯ Street address of well ◉ Nearest address
10306 SE MAIN ST, MILWAUKIE

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation _____

Material	From	To
Asphalt	0	0.3
Clay, Silt, Sand	0.3	20

Date Started 1/11/2021 Completed 1/11/2021

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number _____ Date _____
Password : (if filing electronically) _____
Signed _____

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10690 Date 2/17/2021
Password : (if filing electronically) _____
Signed SHARON STIGALL (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

CLAC 76284

WELL I.D. LABEL# L 139119

START CARD # 1050443

2/17/2021

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Chips	1	4	1	S	
Bentonite Chips	15	20	2	S	

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

CLAC 76284

2/17/2021

Map of Hole